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# Information-communication
# TECHNOLOGY

**MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN**

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# INFORMATION-COMMUNICATION TECHNOLOGY

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This book outlines the materials to obtain fundamental knowledge and concepts of the basics of modern directions of information and communication technologies. The main objectives of the book are the formation of concepts of computer science as a fundamental science and a universal language of the natural-scientific, general technical and professional disciplines, as well as the acquisition of abilities and skills of application of means and methods of Informatics and Information Technology for applied professional tasks with personal computers, local area and global computer networks. The offered textbook is an inestimable teacher assistant in planning and conducting studies on themes and the perfect guide for classroom and extracurricular work of students.

The manual is drawn up in accordance with the model program of discipline and intended for students of all specialties.

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# INTRODUCTION

The modern development of human civilization is characterized by the next stage of the technological revolution, the introduction in all aspects of information and communication technologies (here in after – ICT) are changing the way people's lives. Moreover it is the foundation and the material basis for the transition to an information society, a society with a high socio-economic, political and cultural development.

All over the world there are such trends as:

1. Transformation of all public institutions and spheres of human activity under the impact of ICT;

2. Progress in all areas of development, production and introduction of modern technologies;

3. The commitment to the formation of advanced information environment adequate to the tasks of socio-economic development of the country;

4. The ensuring of equitable guaranteed public access to information resources;

5. Training of citizens, public institutions, businesses and public authorities at all levels of life in the information society.

In most advanced countries, such as Canada, Korea, Malaysia, Singapore, the United States strategies are developed and implemented as far as programs of information development of society, which are integrated as a whole and the individual areas of activity.

The States of the former Soviet Union is not the exception. For example, long-term strategic goal of the state information policy of the Russian Federation and the state policy of the Republic of Belarus in the sphere of informatization is to move to a new stage of development like building the information society and entry into the global information community.

Analysis of the above strategies and programs shows that the leading role in the formation of a national strategy for information development in the consolidation of all sectors of society is to achieve the goals of the information and innovation development, business coordination, all public institutions and citizens given to the state to implement the national strategy.

In our country, the main accent was placed only on one of the components of the information society, on the formation and development of e-government, which has been successfully implemented, as evidenced by high international ratings. However, the challenge of the information society is certainly broader than the development of e-government and the telecommunications industry. Therefore, to create all the necessary conditions that will facilitate the transition to an information society and in pursuance of orders of the Head of State, this article «Social modernization of Kazakhstan: Twenty Steps to

the Universal Society of Labor», dated 10 July 2012 to develop state program «Information Kazakhstan – 2020» (here in after – the Program).

The basic provisions of the Okinawa Charter on global information society (Okinawa, Japan, 2000), the Declaration of Principles Building the Information Society (Geneva, Switzerland, 2003), the Plan of Action of the Tunis Commitment (Tunis, Tunisia, 2005) and other international instruments were considered by the development of program, as well as the Strategic plan of development of Kazakhstan till 2020, approved by Presidential Decree of February 1, 2010 № 922.

Based on international experience of building the information society and the provisions of the above documents, the Program is identified by four key areas:

• Ensuring the effectiveness of the public administration system;
• Ensuring the availability of information and communication infrastructure;
• Creation of an information environment for socio-economic and cultural development of society;
• Development of the national information space.

Within these areas the problem for good governance, the creation of an open and mobile government, development of access to the information infrastructure will be solved through the widespread adoption of ICT. The development of the information society must be accompanied by the development of human resources, and will include provisions for the creation of opportunities for citizens to learn and acquire the skills, work with information techno-logy through e-learning, lifelong learning and training, work remotely, receive services accessible e-health. Also, in order to build a more open, accessible and competitive economy of our country, the program provides the maximum implementation of intelligent systems in the basic sectors of the economy.

The effectiveness of the transition to an information society policy depends on the consolidation of efforts of business and government ICT wide application and provision of electronic services.

It is expected that the final stage of implementation of Kazakhstan's transition to an information society will be the state program «Information Kazakhstan – 2030».

I would like to thank the many collegues (A. Pyrkova, K. Aidarov, N. Baymuldina, A. Kavokin and A. Kuatbayeva) that helped me understand things I was unclear about during the writing of this text and the reviewers that took the time to read the chapters and offer their opinions on how each could be improved. Without your help I would have been lost in many places.

# CHAPTER 1. THE ROLE OF ICTs IN KEY SECTORS OF SOCIETY. STANDARDS OF ICT

## 1.1 ICT subject and its purpose

Material, tools, energy and other resources, including information are need for the development of human society. Nowadays it is characterized by an unprecedented increase in the volume of information flows. This is applied to almost any area of human activity. The greatest part of information growth is observed in industry, commerce, financial, banking and educational fields. For example, particullarly in the industry growth is due to the increase in production volume, the increasing complexity of products, materials, technological equipment, expansion of internal and external economic relations of objects as a result of the concentration and specialization of production.

Information is one of the main decisive factors that determine the development of technologies and resources in general. In this regard, it is important to understand not only the relationship of the information industry, computerization, information technology of informatization process, but also to determine the level and degree of influence on the process of information management and human intellectual activity.

Problems of information management in general and how the information is given to the process of attention due to the following objective processes:

• humanity is experiencing an information explosion. The growth of circulating and stored in the information society come into conflict with individual human capabilities for its assimilation;

• the development of mass – communication processes;

• the need to develop a common information theory;

• development of cybernetics as the science of management;

• the penetration of information technologies in the sphere of social life;

• research in the natural sciences confirm the role of information in the processes of self-organization of living and inanimate nature;

• actualization of the problem of sustainable development, the emergence of the information economy, the main driving force of which is the potential of information and information resources;

• problem prospects of development of humanity, the necessary integrity of the question about the criteria for progress in modern conditions.

The processes of modern society informatization and all forms of educational activities are characterized by the improvement processes and mass distribution of modern information and communication technologies (ICT). The word «technology» is derived from Greek and translates the science, a set of techniques and methods of processing or recycling of raw materials, semi-finished products and transform them into commodities. The

modern understanding of this word includes the application of scientific and engineering knowledge to solve practical problems. In this case technologies, which are aimed at the processing and transformation of information and telecommunication technologies can be considered.

**Information and communication technologies (ICT)** is "a wide range of digital technologies used to create, transfer and dissemination of information and services (computer hardware, software, telephone lines, cellular communications, e-mail, wireless and satellite technologies, network and wireless cable communications, multimedia, and the Internet)"

**Aims and objectives of discipline:**

• formation of ideas about computer science as the fundamental science and the universal language of the natural sciences, general technical and professional disciplines;

• the acquisition of skills and the use of technical means of computer techniques and information technology solutions for the application of professional tasks with personal computers, local and global computer networks.

Information and communication technologies (ICTs) are one of the most important tools of professionals' and managers' modern activities. So the development of modern data processing and the storage techniques, document management system and records management, data analysis and decision-making are based on this. Therefore, possession of a confident professional modern ICT depends largely on the efficiency and the quality of professional activity.

All ICT tools used in the education system can be divided into two types:

• hardware;
• software.

The main direction of the impact of information and communication technologies (ICTs) on society is the impact on the structure of the economy, state policy, culture, science and education. As a consequence, new communications economy in which the main resource development is knowledge and information. In this connection it is fair to characterize the appropriate communicative economy of a new type of society as an information society.

Forming the basis of the "new economy", "the knowledge economy" communication and economy, ICTs have a major influence on the development of the national economy, and this influence has common features and significant features in comparison with the impact of conventional technologies on the structure and growth of the economy.

Impact of ICT on the development of the national economy goes through the same stages as the core technology. First, the contribution of new technology to economic growth is determined by a qualitative improvement in

the means of production, changes in traditional technologies, which leads to an increase in the organic composition of capital, increased productivity and the formation of the effects of the reorganization and improvement of production processes. The next stage begins to show the result of their influence on the financial markets. In the third stage there are the factors contributing to the rapid spread of new technologies, which occur under the influence of active changes in all sectors of the economy. At this stage, the growth efficiency of the use of new technologies due primarily significant costs savings.

At the same time, ICT compared to previous conventional technologies differ a number of features, due to which their effect on economic growth and development of the national economy is qualitatively different. First of all, it is the global nature of the ICT distribution, they are used in almost all industries where there may be productivity and efficiency increase, including in the field of management. High speed development of ICT is associated with extremely low marginal cost of distribution and use, resulting in a significant reduction in the production of the ICT industry prices. Due to the cumulative effect of new technologies usage in the economy can be obtained much faster and to a greater extent than any other traditional technologies. ICT provides a special economic impact as they are related to the processing and exchange of information, which plays a pivotal role in the modern economy.

Thus, the consequences of the widespread diffusion of ICT are both economic general, social specific personal character. They are intertwined problems of business, labor, family, society. These problems become more complex, as the communication speed of change is increasing, as a result of the spread of new communications capabilities often exceed their perceptions. ICTs radically change in the processing area of human capabilities, storage, transmission and consumption of information, but at the same time and require new skills and new ways of thinking. It has a wider range of information resources and communication tools than ever before, resulting in the fact that the possession of information has become an important strategic advantage. However, the realization of these benefits can be developed within the framework of the communication economy, formation and development of which should be directed to the benefit of society and the individual.

**1.2 The role of ICTs in key sectors of the society development**

In the Strategic Plan of Kazakhstan Development till 2020 it was noted that the rapid development and adaptation of ICT are important factors in the modernization of society, impacting not only on economic performance, but also on people's lifestyle that characterizes the importance of ICT for the economy and the lives of citizens of modern Kazakhstan.

In recent years, there are significant achievements of Kazakhstan in the ICT sector.

In the ranking of the United Nations E-Government Survey-2012 «E-government for the people», published at the beginning of March 2012, Kazakhstan took the 38th place, up to 8 positions compared to 2010. According to the index of e-participation of Kazakhstan along with Singapore shared the 2nd place. The Global Competitiveness Report 2012-2013, World Economic Forum, Kazakhstan's competitiveness ranking rose 21 places to reach 51 seats.

In the ranking of the International Telecommunication Union Kazakhstan in the last year rose from 72 th place to 68 ICT Development Index.

In the field of postal services market, the main supplier of joint-stock company «Kazpost» is the national operator. Provision of services is carried out more than 3,000 industrial facilities, covering the whole territory of the country. Besides postal, courier services also provide LLP «DHL International Kazakhstan», LLP «Jantzen Express» and others.

The main trends of the telecommunications industry are the development of infrastructure based on high-speed optical and wireless technologies, the provision of multimedia services to the population and organizations, the implementation and development of digital broadcasting technologies, as well as increase the level of digitalization of local telephony.

The development of communications networks is to provide access to the Internet as a faster pace. The Internet users are 53.5% of Kazakhstan's population (according to operative data of the Statistics Agency of the Republic of Kazakhstan for the 2nd quarter 2012).

Currently, 4G technology is embedded in the Republic of Kazakhstan, the development of broadband access networks (hereinafter – BBA) to the Internet by using technologies such as: ADSL, CDMA / EVDO, 3G, FTTH.

**ADSL technology**

ADSL technology (Asymmetric Digital Subscriber Line) – Asymmetric Digital Subscriber Line has been designed to provide high-speed access to interactive video services (video on demand, video games, etc.) and not less than fast data transfer (Internet access, dial-up lines a high-voltage connection and other networks).

ADSL technology is the most popular and cheapest way of providing broadband services to subscribers by not placing high demands on the speed of the Internet access. Network with ADSL broadband technology can be deployed on virtually any part of a communications network that uses the copper access network.

The data transfer speed in the direction of the subscriber is up to 7 Mbit/s (up to 24 Mbit / s ADSL2 +), and the subscriber – up to 1 Mbit / s. Speed of access may depend on the condition of copper cable distribution network, the distance from the PBX to the subscriber, the number of subscribers in a cable, etc.

To date, the number of subscribers using ADSL technology is - 1017486 people.

**FTTH Technology**

FTTH (Fiber To The Home) - fiber optic cable in the house (meaning the individual / private house, flat).

The construction of universal fiber-optic FTTH access networks (Fiber to the Home) was started in 2011 in order to meet the growing demand for high-speed broadband services and expanding the range of services provided. The project provides 100% coverage of apartment buildings and cottage developments in the cities of Astana, Almaty and all regional centers of the Republic of Kazakhstan.

As a result of the implementation of the 1st phase of the project in 2011, was built a network of fiber-optic subscriber access at 146 sites in the cities of Astana, Almaty, Semey, Zhanaozen and regional centers covering 3718 blocks of flats, 2755 cottage developments. Completed installation put into operation a gigabit passive optical network (GPON) in Astana, Almaty, Aktau, Aktobe, Atyrau, Karaganda, Kokshetau, Kostanay, Kyzylorda, Pavlodar, Petropavlovsk, Taldykorgan, Taraz, Uralsk, Ust-Kamenogorsk, Shymkent, calculated to 170 962 subscriber ports.

**CDMA / EVDO technology**

CDMA / EVDO (Evolution Data Optimized) – high speed data transmission technology is used in the CDMA mobile communications networks.

To date, it is forward-looking and it could provide electricity to rural settlements with telephone 100% by the individual and / – or multiple access.

Since 2011, rural communication standard CDMA 450, thanks to retrofitting EVDO cards CDMA450 technology is developed using EVDO technology, which allows us to provide the rural population of the Republic of Kazakhstan broadband access services to the Internet.

450 CDMA / EVDO technology provides subscribers access to a high-speed packet data transmission regardless of their location within the network coverage as well as in motion.

In rural areas, high speed data transfer technology CDMA 450 / EVDO is achieved through the application of new algorithms for compression of digital data, which allows for high-speed Internet access anywhere in the coverage area of the network of CDMA-450.

Currently, residents of rural settlements in Almaty, Aktobe, Zhambyl, Kostanay, South Kazakhstan, Pavlodar regions are able to receive wireless broadband access to the Internet.

To date, the number of subscribers using CDMA / EVDO technology is – 7737.

**3G technology** is the third generation mobile communication technology.

It is main advantage - high speed data transmission, access to the Internet. 3G third-generation networks allows to organize video telephony, looking at mobile phone video streaming, etc. In 2011, the mobile operators are in operation of 3G network in the cities of Astana, Almaty and all regional centers of the Republic of Kazakhstan.

**4G technology (LTE)** (Long Term Evolution) – mobile data communication protocol providing the possibility of establishing high-speed mobile communication systems are optimized for packet data at speeds up to 300 Mbit/s (from the base station to the user) and up to 75 Mbit / s ( from a user to the base station). 4G technology allows us to develop the penetration of services of the Internet access, including the expanding the range of associated services (mobile TV, video on demand, etc.). Moreover, it improves quality and reduces tariffs. From 2012 the project for the construction of the fourth-generation network implementation (4G standard) began on telecommunication networks.

### Digital Broadcasting

Nowadays the modernization of the entire national broadcasting network by switching to digital technology is an urgent challenge facing the Republic of Kazakhstan.

Currently various projects are carried out on the introduction and development of digital broadcasting in the Republic of Kazakhstan pursuant to the State program for accelerated industrial-innovative development of Kazakhstan for 2010-2014 years, and to develop programs of information and communication technologies in the Republic of Kazakhstan for 2010-2014.

In accordance with the above programs by 2015, it is necessary to provide 95% coverage of terrestrial digital TV.

Currently the following works were performed on the introduction of digital broadcasting in the Republic of Kazakhstan:

• approved frequency-territorial plan;
• accepted broadcast standards DVB T2;
• digital terrestrial television broadcasting network was put into operation in a test mode in the cities of Astana, Almaty, Karaganda, Zhezkazgan, Zhanaozen on July 3, 2012.

In addition, for the development of the Kazakhstani segment of the Internet is required the willingness of telecommunications networks for the provision of broadband services, the establishment of data centers, increasing the number of electronic public services provided through the portal of «electronic government», the development of state bodies portals, creation of socially important Internet resources and an increase in the number of e-commerce projects.

Improvements in the quality of services provided to citizens and busi-

nesses have been done in public service centers (hereinafter – CHS). More-over, the necessary legal framework, simplified procedures for maintenance of the population and business were not forgotten too. Also there is a positive trend of reducing corruption.

Mechanisms for dialogue and feedback with the population of the state and business by state authorities of the Internet resources, virtual reception, internet conferences were implemented.

Through the infrastructure of "electronic government" has successfully solved the problem of providing information and services to citizens, busi-nesses and public authorities.

It holds an annual assessment of the activities of state bodies on the ap-plication of information technology and e-government services.

Create favorable conditions for intensive development of science, tech-nology transfer, increasing the volume of investment in research and develop-ment, cooperation between business and universities are implemented in the high-tech ICT industry.

"International University of Information Technology" conducted close cooperation with the US Carnegie Mellon University for the development of education in the field of info-communications.

In 2011, two research were established and development laboratories, in areas of "free software (open-source)" and "information technology".

Industry Research Institute ICT was also established.

On the territory of "Information Technology Park", located in the city of Almaty, a project to create the ICT Cluster, comprising the construction of educational and research complex, business center, data center, the seed fund business incubation functions and other necessary for the functioning of the ICT cluster development institutions is initiated.

There is constantly a work to improve the processes in the field of mass media (hereinafter - the media) and development of the domestic manufactur-ing industry, entertainment and information content.

Thus, the current situation analysis indicates readiness of Kazakhstan to the implementation of large-scale and comprehensive public information stra-tegy development and formation of an effective public administration system.

**1.2.1 Optimization of the system of public administration through computerization**

Currently measures were implemented to improve the licensing system and regulatory activities of state bodies. Furthermore, the process of issuing permits, legislated rules on the simplification of licensing procedures were au-tomated, and also a mechanism to establish the frequency of inspections based on the risk management system was implemented.

All these measures are directed on achievement of indicators:
• decrease time and costs of business;
• reducing administrative barriers;
• arrangement of control activity of state body;
• increase of efficiency in the provision of public services.

A number of measures aimed at automation and optimization of business processes of rendering public services were also implemented. One of the key ways of creation effective system of public administration is defined information technology, which should be considered as a catalyst and tool of administrative reforms. Application at all levels of government information technology will ensure orderliness in matters of control, eliminate the duplication of business processes and data, which ultimately reduce the expenditure of budgetary funds and increase the quality of public services.

### 1.2.2 Openness of state bodies

Currently, the mechanisms for dialogue and feedback of the state with a population and business are established. All state agencies created the Internet-resources containing information for citizens and business.

Legislated requirements for providing access to the Internet resources of state bodies are disabled.

Assesses completeness and quality of information on the Internet resources of state bodies.

The service «Virtual reception» is provided on the portal of «electronic government» where citizens directly apply to the state authorities.

In addition, there are blogs of the first heads of state bodies and the Government of the Republic of Kazakhstan, where anyone can post comments and ask questions.

A special section «The Presidential protection of business» is created on the official web-site of the President of the Republic of Kazakhstan.

Also, the Internet-conference with participation of Government members and representatives of the authorities is regularly held on the portal of «electronic government». During these conferences, the citizens receive answers to their questions online.

### 1.2.3 Development of "electronic government"

For the period since 2008, "electronic government" of Kazakhstan has risen in the UN rating by 43 positions. In the ranking of UN E-Government Survey 2012, published in early March 2012, Kazakhstan took 38th place. The online services index grew by 10 positions. Index of e-participation Kazakhstan together with Singapore shared 2nd place.

In the task of providing information and services to citizens and orga-

nizations successfully implemented the basic components and create the infrastructure of «electronic government» and projects such as: the issuance of electronic licenses, CHS, e-payment of taxes and penalties, electronic notary, e-customs, e-government services, Call-center «electronic government».

Projects such as electronic document management, electronic public procurement, the government implemented the project e-health, covering all medical institutions and all the management medicine of Kazakhstan were implemented in order to improve the efficiency of the Government of the Republic of Kazakhstan.

The implementation of the project «e-Ministry of Finance» and «e-Statistics» was completed.

Public institutions through the infrastructure of «electronic government» to the population and business are 236 interactive and transactional services, 108 of which are represented on the portal «e-licensing» and 128 on the portal of «electronic government».

To receive e-government services to citizens and businesses more than 1.1 million digital signatures are issued.

Information system «e-licensing» was introduced in all state bodies licensors, 79 territorial licensors, 8 of the 16 local Executive bodies.

Transfer of the Central state bodies to electronic document without duplication of paper documents, documents with a shelf life of up to 5 years were secured.

In the development of electronic administrations the project «Regional gateway «e-akimat» with the possibility of automation of 20 public services is implemented.

### 1.2.4 Introduction of a new model of Informatization of state authorities

One of the mechanisms to improve the application of information technologies in state authorities is the introduction of a new model of information support based on the transition to cloud computing, ICT outsourcing and consolidation of orders.

Currently, the world practice widely used model for server virtualization and cloud computing-based data centers.

The result of the implementation of this technology is the consolidation and budget savings, efficiency of business processes of state bodies.

Today the implementation of technologies of virtualization and cloud computing in the public sector started in Kazakhstan.

In 2010 the Server center government was launched, which in 2011 collocation services (rental of rack space for server equipment) provided, deployed, consolidated computing platform with the use of virtualization technology for the centralized provision of computing resources.

Implementation of the project "unified mail system of state bodies of the Republic of Kazakhstan" began on the basis of "cloud" computing.

### 1.2.5 ICT for law enforcement, public safety, decrease risks of industrial accidents and natural disasters

The main task in the field of public safety is a high willingness of law enforcement and emergency services for rapid interaction to prevent and take necessary measures to ensure security of life of every citizen of the Republic of Kazakhstan in emergency situations and disasters natural and manmade.

The interaction of law enforcement and emergency services in the first place, including information exchange and coordinated work of all their structures in circumstances dangerous to life and health of the population. In such situations, it is necessary to note the special role of ICTs that allows to quickly communicate and act as a tool for timely informing and alerting the public about impending dangers and threats.

Law enforcement bodies take all necessary measures to improve the protection of public order and security of citizens on the streets and in other public places.

Navigation system GPS was implemented in order to promptly respond to crimes and working on the patrol cars. It is also allows real-time map of the area to track the location of a particular outfit and guide on the scene, next the police, the issue of equipping the system on a Hiking patrol.

Currently, in all regions of the centers of operational management (hereinafter – COM), which allow to increase responsiveness to crime, and also cover video surveillance which is the most criminogenic areas of regional centers. Commissioned Situational center of the Ministry of internal Affairs of the Republic of Kazakhstan, which brings together regional centers of operational management into a single system, allows to monitor the operational situation in the regions and carry with them the conference video calls.

Today, the whole country use CCTV installations connected to COM, which contributes to the timely identification of thousands of violations.

### 1.2.6 Increasing the level of computer literacy and education professionals in ICT

The introduction of ICTs largely determines today the development of science, education, economic and social spheres, promotes the growth of labor productivity and quality of goods, services, increase of effectiveness of work of state authorities and their interaction with society. However, without high-level knowledge workers of the various areas used in their work of software, resources, new technologies will not allow to properly and effectively using the implementation ICT and, consequently, improve the quality of their ser-

vices and functions. Therefore, building the information society, the key issue becomes not only an increase in the level of General computer literacy of the population, but also increase the level of computer literacy in core areas of workers in all sectors of the economy, public and civil servants, representatives of small and medium-sized businesses.

In 2006 the State programm on reduction of information inequity was adopted for 2007-2009. This program, as well as a high level of ICT and the Internet penetration in the economy, governance, daily life and professional activities of nationals, have borne results and the level of computer literacy increased from 18.7 % in 2008 to 47.4 % in 2011. However, there is a problem with highly specialized computer skills, doctors do not know enough used in medicine technology, and without the qualification to move to telemedicine, many teachers need special training to start using the e-learning system, etc.

Negative factors of training professionals are lagging behind the level of ICT development methodology and principles of selection of educational content for their training. Insufficiently developed system of adaptation and development of professional standards, relevant international standards, improvement of qualification requirements for modern it professionals that fails to achieve the adequacy of the content of the training needs of the industry [1].

For the development of remote forms of employment in 2012 amendments to the labor legislation are in the part of legislative consolidation of remote forms of employment. However, the real conditions for wide application of this form of work have not yet been established, and meanwhile, remote employment affects many of the indicators, such as reducing traffic congestion, reducing damage to the environment, the social side of the question (e.g., employment of persons with disabilities or women with small children), welfare, etc.

### 1.2.7 ICT in education and science

The development of modern ICT dictates the pace and direction of development of education methods should be flexible, tasks close to industrial practice and teachers are required to be not only highly professional, but also to continuously improve their skills, both methodological and production. Otherwise the impact of ICTs on human capital formation is negative.

The future of education is blended education, that is, the symbiosis of internal and network forms of learning with different degrees of inclusion in the educational process. Currently blended learning (traditional and e-learning) is practiced in the world. According to international studies (Watson, John, 2008) in the future combined form of training will become dominant in secondary education [2].

Records of all new tendencies of ICT development in education and their

application in the educational process will help to bring the country's education to a new level.

For global implementation of ICT in secondary education in 2011 the project of implementation of information system of electronic learning (e-Learning) in schools, technical and vocational education (further – TPE) was launched. However, this project requires the solution of a large number of related tasks such as standardization of digital educational content, providing free or subsidized broadband education institutions, the provision of preferential treatment for the Internet students and teachers.

During the implemented activities of the Reduction Program Information inequality in the Republic of Kazakhstan for 2007-2009 approved by the Government of the Republic of Kazakhstan dated October 13, 2006 No 995, as well as the State Program "Information Kazakhstan 2020" approved by the Decree of the President of the Republic of Kazakhstan dated January 8, 2013 No 414 the following indicators were achieved:

– to the Statistics Committee of the Ministry of National Economy of the RK, the level of computer. The literacy rate of the population in 2015 was 74.2%, an increase of 11% compared to 2013 (63.2% in 2013 and 64.1% in 2014);
– Every year on the specialties of ICT are produced on average 30 thousand people. (Submitted to the Committee on Statistics of the Ministry of National Economy of the RK of the Republic of Karelia: university – 13 thousand people, Technical and vocational education – 17 thousand people; On the international scholarship «Bolashak» – 200 people).

### 1.2.8 Development of e-health

The introduction of ICT into the health system will bring a new level of quality medical care. ICT will play a vital role in the provision and delivery of health care. E-health technologies allow us to monitor patients at a distance, to better disseminate information to patients, improve access to health care, especially in remote areas for disabled and elderly.

Today in the field of Informatization of health, a number of projects have already been implemented. In 2011, in the framework of creation, the Unified information system of health of the Republic of Kazakhstan (hereinafter – UHMIS) has been completed of a pilot zone. For the purposes the implementation of the UHMIS is operating the portal «Hospitalization Bureau», «register of the attached population», «Formation accounts registries» («Electronic register of patients»), «Incentive component to health care».

However, it remains the problem of excessive bureaucratization, which in turn affects the quality of patient care. From year to year there is an increase queues in the medical clinics, patients have little alternatives when choosing a doctor, and can quickly plan a visit to him. Data problems in health care may

be overcome by a wide introduction of ICT, the transition to «e-health», which will improve the accessibility of health services for the population, to ensure the timeliness and accuracy of diagnosis and treatment of patients, reduce the time for paperwork and, therefore, use it directly for patient care.

### 1.2.9 Development of e-Commerce

E - Commerce is fairly new, but already well developed in the West and South-East Asia segment of the economy which includes all financial and trading transactions carried out by means of computer networks and business processes associated with conducting such transactions. The most dynamic e-Commerce market began to develop in our country in the past two years, due to rapid growth in the number of the Internet users, the increasing influence of social networking, the removal of the monopoly in the field of electronic payments, and a transition leading web services technology platform from Web 1.0 to Web 2.0.

Currently, Kazakhstan lags behind industrial countries in the development of electronic Commerce (e-Commerce in 2011 amounted to $ 260 million, or 0.4% of the total market of goods and services, which is 10 times less than Russia in 10 times, they have 4 %). This is partly due to the later appearance in the Kazakhstan segment of the Internet critical mass of users. As world practice shows, e-Commerce is becoming the industry with the number of the Internet users from the total population exceeds 20% and they are for at least 2-3 years (time enough for removing barrier of fear to pay online).

The second part of the problem – lack of culture of payment by payment cards and the critically high failure rate if you pay with payment cards in e-Commerce. Currently, only 21% of all transactions is non-cash payments using payment cards, everything else is the withdrawal from the payment card via ATM (for example, according to the National Bank of the Republic of Kazakhstan in August 2012 in a country of 11 million payment cards accounted for 12.5 million transactions for cash withdrawals and only 3.4 million payment transactions of cashless payments using payment cards). If to talk about payment online via credit card, the situation is exacerbated by the large number of failures (the failure rate if you pay with payment cards of different players in the market ranges from 37 to 48%). This is a consequence of the closure of many Kazakhstan banks of the second level of payment cards for the Internet transactions and the establishment of special procedures for the Internet transactions, which are essentially artificial barriers.

### 1.2.10 ICT in industry

Information technology is known to increase production flexibility and speed of decision-making also create the basis for global markets and for the

competitiveness of enterprises. However, with all the demand for them, still a relatively low level of Informatization of the domestic industry shows a steady and strong growth. The economic base of enterprises in the mass is not yet adequately prepared to intensive consumption of ICT. And those industries where high technologies are not involved in the formation of profit, prefer to spend money on this article time which is not too large.

In today's information and high-tech century, the domestic industrial enterprises to ensure their competitiveness should reconsider their opinions and attitudes on ICT use in manufacturing and administrative activities and pay due attention to automation of all internal processes.

To ensure the competitiveness of industrial enterprises continuous improvement of production processes through introduction of ICT and training industrial workers with special knowledge in the field of ICT are required. Therefore, businesses are very important to pay attention to this aspect and encourage the development of innovative activities among the production personnel.

### 1.2.11 ICT in the transport system

The basic tool to solve the problem of increasing the efficiency and attractiveness of transport industry in Kazakhstan should be the introduction of intelligent transport system (hereinafter – ETS) is a complex of interrelated automated systems. It is solving the problem of traffic management, monitoring and control of all types of transport (individual, public, cargo), informing citizens and enterprises about the organization of transport services on the territory of the region of the country. It is aimed at three main objectives: safety, mobility, and environmental protection.

An important element in the creation of it is a global navigation satellite system (hereinafter – the NCC). Solutions based on this system increase the efficiency of not only land transport but also actively used in aviation, Navy, railway sector are used for synchronization of transmission lines and transportation, used in connection to synchronize data transfer, etc.

The formation and implementation of its will increase the efficiency of transportation management, reduce non-production costs of transporting goods, passengers accelerate the development of transportation and communication structure, provide a favorable climate for implementation of services based on existing satellite navigation systems [3].

World trade is developing rapidly over the past two decades. Annual trade turnover between Europe and Asia making at this stage about $ 400 billion by 2015 could reach $ 1 trillion. In this regard, the favorable geographical location of Kazakhstan is expedient to use for the passage of traffic between Europe and Asia, that promotes the increase of revenues in the budgets of the

transport companies and the state budget of Kazakhstan. In 2015, the Ministry of transport and communications of Kazakhstan plans to increase cargo transit to 25 million tons, and the total revenue from transit will be 1.5 billion dollars.

Among the main disadvantages of transport in Kazakhstan possible to note the unsatisfactory organization of transport used in transportation of obsolete technologies and low level of service of transport services. Logistics providing in the developed countries, the majority of the benefits from the rationalization of traffic flows, their optimal interaction in Kazakhstan is at an early stage of development. In this situation, Kazakhstan is necessary to form a modern transport infrastructure providing for the transit of goods between East and West, as well as passenger traffic, both international and domestic, corresponding to the level participating in the transport integration of the developed States.

Integrated information system «Smart stop» will be implemented that takes into account the needs of persons with disabilities and aims to ensure that:

1. informing passengers about the arrival time of the passenger transport at a stop in real time;

2. informing passengers about the numbers of routes and modes of public transport plying on this line;

3. passenger information about public transport:

• changes in schedules;

• changes of traffic routes;

• change of tariffs for journey payment;

• emergence of criminal and emergency situations;

• will be introduced system of video surveillance on public transport and at stops, with the possibility of the call to the operator of the situational center and emergency response services using the panic button;

• implemented a fare collection system, ticket booking via mobile devices (tickets will be equipped with bar codes and bar-codes, which gives the opportunity to show your ticket electronically on your mobile phone, and the inspectors or conductors check tickets special readers).

### 1.2.12 ICT in agriculture

The agro-industrial complex (further – AIC) is an integral part of the economy of Kazakhstan, which vital for companies and products has enormous economic potential.

The experience of leading countries with developed agriculture shows that they have been a kind of «technological revolution». Classic extensive agriculture is displaced accurate (precision). GIS technologies, multioperational energy-saving agricultural machines, selection of high-yielding varieties of plants and breeding of highly productive breeds of animals are used widely.

ICT play a critical role in supplying agricultural producers such useful information as weather forecasts and prices of agricultural products, and educate them regarding new technologies.

To build an efficient and competitive agriculture, it is necessary to spend trust funds for implementation of non-traditional cost, innovative and sustainable ICT increase efficiency of the economy, reduction of production costs.

The most serious problem of agriculture is a general technical and technological backwardness, weak implementation of ICT in the industry, while the international experience of agricultural work is already directly linked to ICT.

Currently in agriculture information system there is: a unified automated control system for branches of agro-industrial complex «E-Agriculture», the electronic trading System in the agricultural sector, the System of electronic that grain receipts are operated. This year is automation of 12 licensing services and the issuance of 4 licenses.

Through the portal of «electronic government» there are two e-government services in the field of agriculture. The average in the industry issued annually about 700 thousand permits in 2011 issued more than 6 million documents.

However, a unified system of monitoring and identification in agriculture is not developed. In addition, most public services related to spatial information (maps, plans, diagrams) are not automated. Spatial information is created repeatedly in the same area in different precision in different ways, with different reference and coordinate system. Spatial records are maintained by various departments of the state and local level. Account work carried out by various bodies for the same types of data that negatively affects the timing and quality of public services.

### 1.3 Standardization in ICT

Standardization – the establishment of rules and characteristics for the purpose of their voluntary multiple use, aimed at achievement of orderliness in the spheres of production, circulation of products and increase the competitiveness of products, works or services.

**System ICT standards** – a complex of normative-technical and normative-methodological documents including a set of interrelated standards and other documents in the field of standardization (in accordance with the Federal Law FZ 184) related to ICT, documents, defining the methodology for their elaboration, coordination, approval, modification, implementation, use and replacement, including the method of evaluating sites for compliance with specified standards and other documents in the field of standardization.

**The branch standard** (OST) is a standard relating to processes, products and other aspects of a particular field of activity (whether commercial or not

aimed at profit). In this paper, the industry standard refers to a standard or other document standardization, designed for the use of ICT. The procedure for the development and use of OST is set by the industry on public administration.

**Standard** – document standardization, in accordance with the principles of standardization and other provisions of the Federal law 184, covers such categories as the standard organization, standard non-profit associations, industry-specific standard or set of rules (sectoral), national and international standard.

**International standard** – a standard adopted by an international organization. IOS (International Organization for Standardization) and IEC (International Electrotechnical Commission) form the specialized system for worldwide standardization. State agencies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization for standardization individual areas of technical activities. Technical committees of ISO and IEC cooperate in areas of mutual interests. Other international organizations, governmental and non-governmental, in cooperation with ISO and IEC also participate in this work. In the field of information technology, ISO and IEC organized a joint technical Committee, ISO/IEC JTC 1. The main task of the joint technical Committee is to prepare International Standards. Draft International Standards adopted by the joint technical Committee are transmitted to state bodies for voting. Publication as an International Standard requires approval by at least 75 percent of the voters of the state authorities.

The proposed Family of International Standards on Information Security Management 27000 is developed by ISO/IEC JTC 1/SC 27. This family includes International standards that define requirements for information security and risk management, metrics and measurement.

| ISO27000 | ISO/IEC 27000:2009<br>Information technology – Security – Information security management systems – Overview and vocabulary |
|---|---|
| ISO27001 | ISO/IEC 27001:2013<br>Information technology – Security techniques – Information security management systems – Requirements. Second edition 2013–10–01 |
| ISO27002 | ISO/IEC 27002:2013<br>Information technology – Security techniques – Code of practice for information security management. Second edition 2013–10–01 |

| ISO27003 | ISO/IEC 27003:2010 Information technology – Security Techniques – Information Security Management Systems Implementation Guidance |
|---|---|
| ISO27004 | ISO/IEC 27004:2009 Information technology – Security techniques – Information security management – Measurement |
| ISO27005 | ISO/IEC 27005:2011 Information technology – Security techniques – Information security risk management. Second edition, 2011 |
| ISO27006 | ISO/IEC 27006:2007 Information technology – Security techniques – Requirements for bodies providing audit and certification of information security management systems |
| ISO27007 | ISO/IEC 27007:2011 Information technology – Security techniques – Guidelines for Information Security Management Systems auditing |
| ISO27008 | ISO/IEC TR 27008:2011 Information technology – Security techniques – Guidance for auditors on ISMS controls |
| ISO27010 | ISO/IEC 27010:2012 Information technology – Security techniques – Information security management for inter–sector communications The standard provides guidance on sharing information on risks of information security, controls, issues and/or incidents that are beyond the boundaries of individual sectors and States, especially regarding «critical infrastructures». |
| ISO27011 | ISO/IEC 27011:2008 Information technology – Security techniques – Information security management guidelines for telecommunications organizations based on ISO/IEC 27002 |
| ISO27013 | ISO/IEC 27013:2012 Information technology – Security techniques – Guideline on the integrated implementation of ISO/IEC 20000–1 and ISO/IEC 27001 |
| ISO27014 | ISO/IEC 27014:2013 Information technology – Security techniques – Information security governance framework |
| ISO27015 | ISO/IEC TR 27015:2012 Information technology – Security techniques – Information security management systems guidelines for financial and insurance sectors |

| ISO27018 | ISO/IEC 27018:2014 |
| --- | --- |
| | Information technology – Security techniques – Code of practice for protection of personally identifiable information (PII) in public clouds acting as PII processors. First edition, August 2014. |
| ISO27031 | ISO/IEC 27031:2011 |
| | Information technology – Security techniques – Guidelines for information and communications technology readiness for business continuity |
| ISO27032 | ISO/IEC 27032:2012 |
| | Information technology – Security techniques – Guidelines for cybersecurity |
| ISO27033 | ISO/IEC 27033–1:2009 |
| | Information technology – Security techniques – Network security – Overview and concept |
| | ISO/IEC 27033–2:2012 |
| | Information technology – Security techniques – Network security – Guidelines for design and implementation of network security |
| | ISO/IEC 27033–3:2010 |
| | Information technology – Security techniques – Network security – Reference networking scenarios – threats, design techniques and control issues |
| | ISO/IEC 27033–4:2014 |
| | Information technology – Security techniques – Network security – Securing communications between networks using security gateways – threats, design techniques and control issues |
| | ISO/IEC 27033–5 |
| | Information technology – Security techniques – Network security – Securing Virtual Private Networks – threats, design techniques and control issues |
| | ISO/IEC 27033–6 |
| | Information technology – Security techniques – Network security – IP convergence |
| | ISO/IEC 27033–7 |
| | Information technology – Security techniques – Network security – Guidelines for securing wireless networking – Risks, design techniques and control issues |
| | ISO 27033 replaces known international standard of network security ISO 18028, consisting of five parts. |

| ISO27034 | ISO/IEC 27034–1:2011<br>Information technology – Security techniques – Application security overview and concepts<br>ISO/IEC 27034–2<br>Information technology – Security techniques – Application security – Organization Normative Framework (draft)<br>ISO/IEC 27034–3<br>Information technology – Security techniques – Application Security Management Process (pre–draft)<br>ISO/IEC 27034–4<br>Information technology – Security techniques – Application security validation (pre–draft)<br>ISO/IEC 27034–5<br>Information technology – Security techniques – Protocols and application security control data structure (pre–draft)<br>ISO/IEC 27034–6<br>Information technology – Security techniques – Security guidance for specific applications (pre–draft) |
|---|---|
| ISO27035 | ISO/IEC 27035:2011<br>Information technology – Security techniques – Security incident management |
| ISO27036 | ISO/IEC 27036–1:2014<br>Information technology – Security techniques – Guidelines for security of outsourcing – Part 1: Overview and concepts<br>ISO/IEC 27036–2:2014<br>Information technology – Security techniques – Information security for supplier relationships – Part 2: Requirements<br>ISO/IEC 27036–3:2013<br>Information technology – Security techniques – Guidelines for security of outsourcing |
| ISO27037 | ISO/IEC 27037:2012<br>Information technology – Security techniques – Guidelines for identification, collection and/or acquisition and preservation of digital evidence. It was based on British standard BS 10008:2008 Evidential weight and legal admissibility of electronic information. Evidential weight and legal admissibility of electronic information. Specification |
| ISO27040 | ISO/IEC 27040:2015<br>Information technology – Security techniques – Storage security |

| ISO27041 | ISO/IEC 27041:2015<br>Information technology – Security techniques – Guidance on assuring suitability and adequacy of incident investigative method |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| ISO27042 | ISO/IEC 27042:2015<br>Information technology – Security techniques – Guidelines for the analysis and interpretation of digital evidence |
| ISO27799 | ISO 27799:2008<br>Health informatics – Information security management in health using ISO/IEC 27002 |

**1.4 ICT and programme of the United Nations on sustainable development goals in the Millennium Declaration**

It is a world where opportunities for millions of people through new technologies, expansion of access to important information and knowledge that can greatly improve the lives of people and contribute to poverty reduction. But this is possible only if the growing interdependence is accompanied by an exchange of values, commitment and solidarity for inclusive and sustainable development, where progress for all peoples. In connection with the development of information and communication technologies (ICT) in recent years, the Asia-Pacific region was "a region of superlatives". According to the International telecommunication Union, the region is home to over 2 billion fixed-line subscribers and 1.4 billion mobile subscribers. The Asia-Pacific region accounts for 40 percent of the world's Internet users and the world's largest market of broadband access to the Internet with a share of 39 percent of the global total.

In 2015, the United Nations was a landmark year for the completion of the process associated with the Millennium development goals (MDGs), and the approval of the new development programme for the period after 2015, entitled «transforming our world: an Agenda for sustainable development for the period till 2030», which was adopted at the summit of the United Nations on sustainable development, held from 25 September 2015. The Declaration emphasized the important role of ICT as a catalyst for development and it was noted that with the spread of information and communication technologies, and global interoperability networks offer tremendous opportunities for accelerating human progress, the digital divide and the formation of societies based on knowledge and on the development of scientific-technical and innovative activities in such diverse areas as medicine and energy.

The formation of modern information culture of future specialists, appropriate to the level of ICT development, relevant international indicators of competitiveness are important social and pedagogical task, the degree of

implementation which further depends on their willingness to learn new technologies and the development of new trajectories of economic development of the state.

**Control questions:**

1. Give the definition of the discipline "information and communication technologies".

2. What are the intended subject of ICT and its purpose?

3. In which else speheras do you see the development of ICT.

4. Give the definition of standardization.

5. Name the main world standards of ICT.

6. What is the United Nations Programme of Sustainable Development Goals and ICT?

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# CHAPTER 2. COMPUTER SYSTEMS

## 2.1 The history of the development of computer systems

The computer system is a combination of various components, consisting of hardware and software used for the joint collection, storage, processing, data transformation.

It is possible to consider the history of computer systems from the simple account to modern computers.

People always wanted to make their job easier, this also applies to mental work. History dates back to the III century BC, then in Asia people began to use a knuckle on the bars for calculations, called Abacus. In 1630 the slide rule is appeared, based on the rules of logarithm of Nepera, by the way, this line was used until 1970. Slide rule had a cylindrical shape and a spiral shape. In 1592-1635 years William Shickard invented the first working machine. For the addition, in the years 1623-1662 Blaise Pascal opened the car and subtraction in two›s complement notation, representing a variety of gears. Gottfried Leibniz continued the idea inventing a Mechanical calculator that performs arithmetic operations. In the XIX century the Loom Jakarta appeared in 1801, which has been called the first industrial computer for the first time in metal cards and used still. In 1822 there was already a huge calculator, the difference engine inventor Charles Babbage. He also offered an analytical machine in 1833. It was a steam engine, which could store numbers with precision to the sixth decimal place, the calculator "mill" used punched metal to enter. In 1886 Dorr felt invented the adding machine. In 1930, Vannevar Bush developed the Differential solvers for the solution of differential equations $dz = ydx$ later electric version. In 1936 the Relay computers appeared, Konrad Zuse invented a Mechanical calculator, the Z1, which included a control system and memory. In 1939, the Atanasoff – berry was the First electric digital computer that used vacuum tubes to store information, it is called the first computer with a binary system.

It is conditionally possible to divide the computer system into generation, depending on the components and release time.



**The first generation (1941 – 1954).** First generation computers used vacuum tubes that did not contain air and relays. The size of these computers required an entire building. In 1945, scientists at Harvard University, under the leadership of grace Hopper, tested computer MACG II Aka Relay Calculator, found a moth stuck between the contacts of Electromechanical relays, and called it "debugging" of the computer, so there was the First Bug 1945, which used the relay Switches which is the part of the computers. The first fully electronic digital computer created at

the University of Pennsylvania (USA) was called UNIVAC – 1951, weighed 30 tons, contained 18,000 vacuum tubes, worth about $487,000. The performance of these machines was only 5,000 operations per second.

**The second generation (1955 – 1965).** Computers of second generation used transistors. The size of these computers demanded half of the room. In 1948 silicon was used and designed switch op off, the first transistor. A transistor is a semiconductor element, usually with three leads, one of them, the collector served a strong current, and on the other, the base is weak, the control current. At a certain strength of the control current, the valve like "open" and the current collector begins to flow to the emitter, the third output transistor. The second generation computers had more speed.
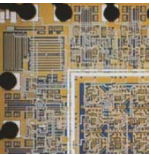
**The third generation (1965 – 1980).** The third generation computers used Integrated circuits (chips). The size of these computers required a few tables. Integrated circuits – transistors, resistors and capacitors fabricated in a single technological cycle on a single semiconductor substrate, the silicon "chip". Operating system had appeared. The first Microprocessor 4004 Intel appeared in 1971, consisted of 2250 transistors, 4-bit, 108 Khz which had a «Microchip». The sizes have become smaller and more compact.

**The fourth generation (1980 – to current time).** The fourth generation computers use microprocessors and integrated circuits (LSI). ENCORE is a chip that combines in one housing hundreds of thousands and millions of elements. This generation can be attributed to personal computers. In 1976 Apple II, released by Apple, and in 1983 the IBM PC at IBM. Now the computer is able not only to «calculate», it is a universal machine to work with different types of information. Along with versatility, affordable price, performance, appeared the possibility of combining computers in the network, which led to entire computer systems.

The supercomputers are multiprocessor systems with huge processing power, very powerful computers that are servers, global networks, a variety of personal computers: desktop, mobile, handheld, invented microprocessor-based controllers, which are used as control systems in different technical systems.

### 2.2 Architecture and components of computer systems
There are the following components of computer systems, such as:
• Internal hardware, which includes a set of equipment and production technology;

• Software, including operating system, file system and system commands;

• External hardware consists of peripheral devices, networks.

• The main elements of a personal computer are:

• The system unit

• Monitor (Display)

• Keyboard

• Mouse

*The principle of open architecture*

A personal computer (PC) is a computer-centric to one user. Personal computers are based on the principle of open architecture.

The principle of open architecture means:

• Standartisied and regulated by only its configureuration and the description of the principle of operation of the computer. Under the configureuration refers to a set of hardware (Hardware) and their compounds. There is a possibility to assemble a computer from individual parts and components which are developed and produced various independent producers.

• There is the option to upgrade and expand the computer due to the presence of designated inside the expansion sockets for the insertion of various devices, i.e., the user changes the configureuration of the own computer of their choice.

Only if all the different devices share the same interface, they can be connected them to each other.

Interface (eng. Interface: inter - between and face - to- face) is a way to connect (pair) two devices, in which logical and physical parameters fit together. A standard interface is generally accepted at international level interface.

*The structure of a modern PC*

1) the motherboard (Motherboard) – main (Mainboard) or the motherboard;

2) SRI (Central Processing Unit) – in the Central processor; FPU (Floating Point Processing Unit) – in the translation of the coprocessor;

3) HDD (Hard Disc Drive) – in the drive on a hard magnetic disk, another name for Winchester;

4) FDD (Floppy Disk Drive) – in the drive for flexible magnetic disks;

5) RAM (Random Access Mamoru) – in random access memory (RAM);

6) ROM (Read Only Mamoru) – in a persistent storage device (ROM);

7) graphics controller – device designed to perform graphics operations and processing videomining; speed up processing of video images there is a processor called an accelerator;

8) flat cables, the bridging contact elements of the electrical connections of the units, blocks and the mounting wires;

9) Case – translated as housing is designed to protect PC components (PC) from external influences, it contains the power supply;

10) UPS (Uninterruptible Power Supply) – translated as uninterruptible power supply;

11) input devices – keyboard, mouse, joystick, trackball, scanner, digitizer;

12) the device output information – monitor, plotter, printer;

13) multimedia CD-ROM (Compact Diss – Read Only Mamoru), sound card, DVD ROM (Digital Video Diss – Read Only Mamoru), card input-output;

14) the device for communications – network card, modem.

In the core architecture of modern computers personal puts backbone-modular principle, i.e. the organization of the computer is modular and the exchange of information between the devices on the highway (tires).
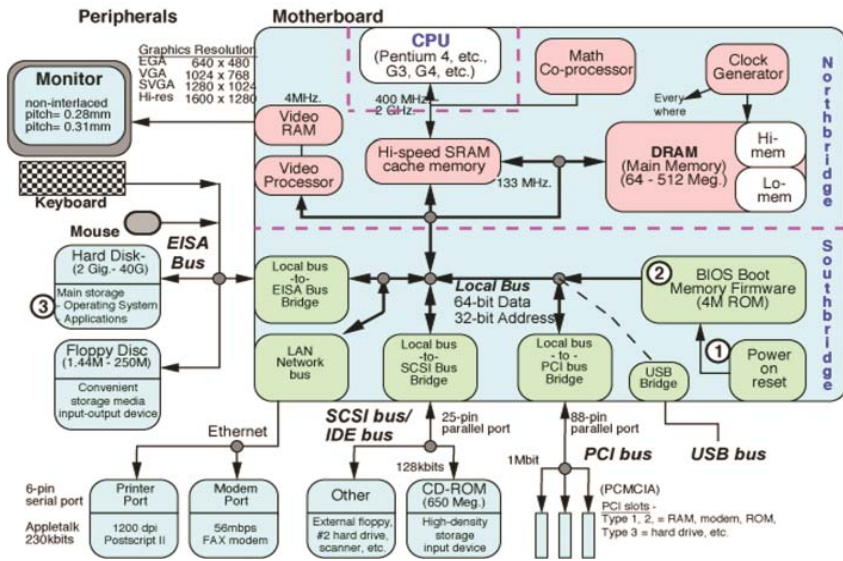


**Figure 2.1.** *Diagram of computer*

### *The internal hardware. The system unit*
*Motherboard (Motherboard)*

The biggest payoff and connects all the other boards from the system unit called the motherboard, which is the heart of your computer. It ensures transmission of signals between devices that are within it, binds all.

For installation (connection) of the devices on the surface of the motherboard has the following connectors: sockets (sockets) – sockets for processors-

slots (slots), slots for expansion cards and memory; the controllers (controller) ports input/ output.

*Processor (CPU)*

The brain of the computer is the CPU. Basic parameters of CPU:

• clock frequency, which determines the number of clock operations (cycles) performed by the processor per unit time [Hz, MHz, GHz];

• the bit, which shows how many bits of data it can accept and process in its registers in one clock cycle;

• the coefficient of internal multiplying clock frequency by which to multiply the clock speed of the motherboard to achieve the frequency of the processor;

• working voltage;

• the size of the CACHE memory, the CACHE high-speed memory to store frequently accessed data or commands.

The processor also has a memory called internal memory of the processor. In turn, there are registers of the processor memory. In operation, the processor uses the registers as a draft, i.e. for temporary storage. This can be an internal information processor such as executed commands, memory addresses, data processing and other.

Each register performs its function:

• IP (Instruction Pointer) – the program counter, the processor places the address of the memory cell, which stores the next executable command;

• CS (Code Segment) – the command register, is placed the team at the time of its execution;

• DI SI BP (Destination Index, Source Index, Base Pointer) – index registers, pointers, shifts in the segments;

• AX BX (Accumulator, Base Register) – General purpose registers;

• SS (Stack Segment) – stack register (Stack area for temporary storage of data. The stack is contained in a separate segment);

• DS (Data Segment) – additional register.

Processor performance = the bit width × Frequency × Number of commands per clock.

Present generation processors firms Intel: 8088, 286, 386, 486, Pentium, Pentium II, Pentium III, IV Pentium, Celeron, Cheap, Sore.

Cooler fan for CPU cooling.

*The system bus (backbone)*

Line (on the harness) includes three multi-bit bus, which is a stranded line:

• the data bus (bus for transmitting data between different devices),

• bus (bus to select the device or memory where sent or from which data is read via data bus),

• the control bus (bus for transmitting signals defining the nature of the exchange of information on highway).

Bus bandwidth = bus Frequency x bus width.

*Memory (RAM / RAM)*

RAM is a volatile fast memory (chipset), when processing information, the processor writes, reads and stores necessary program and data processed by them.

*The memory cell* – several consecutive bytes of internal memory, containing information intended for processing of a separate command processor.

The contents of the memory cell is a word.

Bytes of internal memory are numbered. The numbering starts with 0.

The sequence number byte is called the address byte.

The principle of addressability memory is that any information recorded in the memory and extracted from it the addresses, i.e. take the information from the memory cell, or put it there, you must specify the address of this cell.

The address of the memory cell equals the address of the low byte within the cell. Cells are multiple of the number of bytes in a machine word.

Dynamic memory DRAM (Dynamic random will assess Mamoru) and static memory SRAM (Static random will assess Mamoru) are distinguished according to the physical principle of action.

Memory bandwidth = data bus width × Frequency.

*Permanent memory (ROM/ROM)*

*Permanent memory* (ROM) – non-volatile memory is loaded at the time of turning on the PC and forms VO (Was Input Output System – basic input / output system). The main purpose of these programs is to check the composition and capacity of the system and to provide interaction with the keyboard, monitor, rigid and flexible magnetic media [1].

*HDD*

*Drives on hard magnetic disks* (HDD) – the main device for long-term storage of large amounts of data (called also hard drive or hard drive). Here are the parameters that affect the performance of the hard disk (HDD):

• velocity drives (from 4.5 to 12000 rotations / min.);

• capacity cache memory (from 64 KB to 128 MB). To accelerate the exchange

of data on disk drives have Cache buffers, large capacity Cache memory means to store the necessary information that does not need to be read from disk. Hard disk capacity is up to 6000 GB;

• average access time (≈10-13 MS) – the time during which the unit heads are shifted from one cylinder to another;

• delay time – time from when the positioning block on the right cylinder to the positioning of a particular head on a particular sector (the search time of a new sector);

• exchange rate (30-216 MB / sec) defines the amount of data that can be transferred from storage to the microprocessor and in the opposite direction for a certain period of time. The maximum value of this parameter is the bandwidth of the disk interface and depends on which mode is used.

*The disk drive (floppy disk)*

Floppy disk drive (FDD), which is integrated in the system unit, for recording on a floppy drive (floppy disk).

*Drive CD-ROM*

CD-ROM drive – permanent storage device based on the CD. The operating principle: the laser beam reads the digital data being reflected from the disk surface. The carrier of information is a CD-ROM (capacity 650 – 700 MB). Burn to CD disc of magnetic and has a high density.

CD-R (Record) – "gold" (high reliability) for the write-once disc. CD-RW – drive to rewritable (approximately 1000 times).

*A DVD-ROM*

DVD – digital versatile disc (video films, audio, games, encyclopedia, etc.).

| Designation | | Sides | Layers | Capacity, GB, decimal. |
|---|---|---|---|---|
| DVD-5 | SS SL | 1 | 1 | 4,7 |
| DVD-9 | SS DL | 1 | 2 | 8,5 |
| DVD-10 | DS SL | 2 | 1 | 9,4 |
| DVD-18 | DS DL | 2 | 2 | 17,0 |

Decipher record: SS (single-sided) – unilateral, DS (double-sided) – double-sided, SL (single-layer) – a single-layer, DL (dual-layer) – two-ply.

*Flash -Memory*

Flash memory (Flash-short frame, flash, flicker) – a special type of rewritable nonvolatile semiconductor memory.

*Rewritable* – makes it possible to change (overwrite) the data.

*Non-volatile* – does not require additional energy storage (energy is needed only for writing).

*Semiconductor* – built on the basis of integrated circuits, has no mechanical moving parts (such as hard drives, CD).

Flash memory is derived from the ROM, and functions as a RAM. But unlike RAM, nonvolatile, i.e. data when power is removed from it does not disappear. Flash memory cell consists of one transistor singular architecture that stores multiple bits of information, which does not contain capacitors.

*The graphics controller (graphics card / graphics card / video card)*

*The controller* (from the English Controller – Regulator controller).

The graphics controller has its own RAM (128 Mb – 24 (12x2) Gb).

The card is capable to place a certain number of points of the screen that make up the image, it has a certain resolution. The more points located on the screen, the better the image will be, the more is graphical information on the screen.

*The audio adapter (sound card / sound card / charge)*

Adapter (the Adapter from the English, Latin Adarto -.. Adaptive) - a device, the device or part for connecting compatible devices only in this way:

• ISA Slots (8MHz / 16bit) obsolete;

• Slots RSI (33MHz / 32bit) today.

**Table 2.1.** *Graph modes*

| Mode | Resolution (Horizon. The X vertic.) |
|------|-------------------------------------|
| VGA  | 640x480                             |
| SVGA | 800x600                             |
| XGA  | 1024x768                            |
| SXGA | 1280x1024                           |
| UXGA | 1600x1200                           |
| QXGA | 2048 × 1536                         |

*Bit audio recording and dynamic range* – the range between the softest and loudest sounds.

Here are the types of architectures:

1. Bit interfaces and machine words: 8-bit, 16-bit, 32-bit, 64-bit, 128-bit;

2. According to the features set of registers, instructions and data format: SISS (Somrlete Instruction Set Computer)), RISC (Reduse Instruction Set Computer), VLIW (Veru Long Instruction Word);

3. According to the number of CPUs: a single-processor, superscalar, multiprocessor; multi-divided according to the principle of interaction with memory: SMR (Symmetric Multiprocessing), MRR (Massive Parallel processing), distributed.

Most multiprocessor systems today are used by a symmetric multiprocessing architecture (SMR).

**External hardware. Peripherals**

*Input Devices*

Mouse (mouse), digitizer (digitizer / graphic tablet / pen tablet), keyboard, scanner, digital camera and others.

*Output Devices*

The monitor (cathode ray tube, liquid crystal, plasma), the monitor runs a

special card, which is called the video card, printers (dot matrix, inkjet, laser), plotters (plotters), a modem (modulator-demodulator), and others [2].

## 2.3 The use of computer systems

### 2.3.1 The use of computer systems in everyday life
Computer systems are widely used in everyday life, in education, commerce and business, economics, medicine, banking, and other spheres of the economy.

There are two main ways of using home computers.

**a) Ensuring the normal life of the home:**
• burglar, fire and gas analyzer automation;
• lighting control, power consumption, heating system, climate control;
• cookers, refrigerators, washing machines with built-in microprocessors.

**b) Provide the information needs of people in the home:**
• the Internet;
• ordering goods and services;
• learning processes;
• communicating with databases and knowledge;
• collecting data on the health status of the population;
• providing leisure and entertainment;
• providing background information;
• E-mail, teleconferences.

### 2.3.2 Computer Systems in Education
The process of preparation of the qualified experts is long and complicated. Education in high school and then in high school occupies nearly a third of the length of human life. In addition, knowledge of aging is very quickly in today's information society. To perform a professional activity, specialist must continually replenish their education.

The main objective of secondary and higher education is not to inform the greatest possible amount of knowledge, but rather teach this knowledge and produce independently and creatively used to produce new knowledge. This is possible only with the introduction in the educational process by means of new information technologies (MNIT)[1] aimed at achieving the goals of education and upbringing.

Main applications MNIT in education are:

**1. Automated Training System (ATS)** - Program-technical and educa-

_____

[1] *Means of new information technology – a software and hardware and devices that operate on the basis of computer technology, as well as the latest tools and information exchange systems to ensure operation for the collection, creation, accumulation, storage, processing and transmission of information.*

tional tools that provide an active learning activities. EPA not only provides training specific knowledge, but also test the responses of students, the opportunity to tips, interesting material under study and others.

**2. Expert Training Systems (ELS).** Implement training functions and provide knowledge of a certain rather narrow subject area. EOS have the capacity explaining the strategy and tactics of solving the problem of the study subject area and provide control of the level of knowledge and skills with the diagnosis based on the results of training errors.

**3. Training database (LPP) and educational-methodical complexes (EMCD), focused on a certain subject area.** EMCD let you create data sets for a given discipline and exercise selection, sorting, analysis and processing contained in these sets of information. In EMCD, as a rule, contain a description of the basic concepts of the subject area, the strategy and tactics of problem solving; set of proposed exercises, examples and domain tasks, and a list of possible errors and information for the student to correct them; a database containing a list of instructional techniques and organizational forms of training.

**4. Multimedia Systems.** Allow to implement intensive methods and forms of training, increase the motivation of learning through the use of modern means of handling the media, raise the level of emotional perception of the information, form skills to implement various forms of self-information processing activities.

Multimedia systems are widely used to study the processes of different nature based on their simulation. You can make a visual eye invisible usual life of a microcosm of elementary particles in the study of physics, figuratively and clear talk about abstract and n-dimensional worlds, lucidly explain how a particular algorithm, etc. Possibility in color and with sound to simulate real process of training raises to a new level.

**5. Systems "Virtual Reality".** They are used in the solution of structural and graphics, art, and other tasks where you need to develop the ability, create a mental spatial structure of an object on the graphical representation; in the study of solid geometry and drawing; in computerized simulators of technological processes of nuclear facilities, aircraft, marine and land transportation, where there are no such devices which are fundamentally impossible to fulfill the human interaction skills with modern super complex and dangerous mechanisms and phenomena.

**6. Educational computer telecommunication networks.** Allows distance learning (DL) – distance learning where the teacher and the student are separated by space and (or) in time, and the learning process is carried out by means of telecommunications, mainly based on the Internet resources. Many people have an opportunity to improve education at home (for example, adults,

burdened with business and family cares, youth living in rural areas or small towns). The man at any period of his life acquires the ability to remotely get a new profession, improve their skills and broaden their horizons, and in almost any scientific or academic center of the world.

In educational practice all the main types of computer telecommunications are used: e-mail, electronic bulletin boards, newsgroups and other features of the Internet. To provide and use a standalone course, recorded on DVDs, CDs, etc.

Computer Telecommunications provide:

• access to various sources of information via the Internet system and work with this information;

• the possibility of immediate feedback during the dialogue with the teacher or with other participants of the training course;

• the possibility of organizing joint telecommunications projects, including international ones, teleconferences, the opportunity to exchange views with any member of this course, teacher advisors, the possibility of requesting information on any topic of interest through a teleconference.

• the possibility of implementing remote creative techniques, such as participation in remote conferences, benchmarking information in the WWW, business games, workshops, virtual tours, etc..

Teamwork encourages students to become acquainted with different points of view, study the problem, find additional information on the assessment of the results obtained by their own.

### 2.3.3 Knowledge bases and expert systems

**Knowledge Base** – a body of knowledge related to a certain subject area and formally presented so that the reasoning could be carried out on their basis.

Knowledge bases are most often used in the context of expert systems, which represented with their help skills and experience of experts engaged in practical activities in the field (such as medicine or mathematics). Typically, the knowledge base is a set of inference rules.

**Expert System** – a set of computer software that helps a person to make informed decisions. Expert systems use information obtained in advance from the experts, people who in any field are the best experts.

Expert systems should:

• store of knowledge about a particular subject area (facts, descriptions of events and patterns);

• be able to communicate with the user on the limited natural language (i.e., ask questions and understand the answers);

• have a logical set of tools to develop new knowledge, identify patterns, detect inconsistencies;

• put the task on demand, to clarify her statement and find solutions;

• explain to the user how to obtain a solution.

It is also desirable that the expert system could:

• report such information, which increases user confidence in the expert system;

• «talk» about themselves, about their own structure.

Expert systems can be used in various fields – medical diagnostics, troubleshooting, mineral exploration, choice of computer system architecture, etc.

### 2.3.4 Use of computer systems in medicine

Doctors use computers for many important applications. Let us name some of them.

Computer equipment is widely used in the diagnosis, screening and check-ups. Examples of computer devices and methods for treatment and diagnosis:

• computer tomography and nuclear medical diagnostics – provide accurate images of internal organs layered structures;

• ultrasound diagnostics and sensing – using the effects of the interaction of the incident and reflected ultrasound waves, opens countless opportunities to produce images of internal organs and the study of their condition;

• X-ray microcomputer technology research – stored in digital X-ray images can be quickly and accurately processed, reproduced and recorded in the file for comparison with later images of the patient;

• dial (driver) heart rate;

• breathing apparatus and anesthesia;

• radiation therapy with microprocessor control – enables the use of more reliable and sparing irradiation methods;

• diagnostic devices and localization of kidney and gallstones, as well as control the process of their destruction by means of external shock waves (lithotripsy);

• dental treatment and prosthetics with the help of a computer;

• a microcomputer control system for intensive medical patient monitoring.

Computer networks are used to transmit messages of donor organs needed by patients awaiting transplant surgery.

Medical data banks allow doctors to keep abreast of the latest scientific and practical achievements.

Computers allow us to establish how air pollution affects the morbidity of the population of the area. Furthermore, they can be used to study the impact blows to various parts of the body, in particular, the consequences of impact with an automobile accident for the skull and a human spine.

### 2.3.5 Computer systems in administration

Major applications in the administration of computer systems are follows:

**Electronic Office.** This automation system of the institution, based on the use of computer technology. It typically includes components such as:
• text editors;
• Integrated software packages;
• spreadsheets;
• database management system;
• image editing and image library (for charts, diagrams, graphs, and others.);
• electronic notebooks;
• electronic calendars to schedule business meetings, meetings, etc .;
• Electronic filing, providing cataloging and retrieval of documents (letters, reports, etc.) With the help of a computer;
• automatic phone directories, which you can scroll on the screen, set the cursor to the desired number and connect [3].

**Workflow using special electronic devices:**

**Adapter** (Latin adaptare – adapt.). Due to a peripheral device having access to a telephone line;

**Scanner** (scan English – Field of view) for computer input documents – texts, drawings, graphs, drawings, photographs.

**Email.** This messaging system between users of computer systems, in which the computer takes over all the functions of storing and forwarding a message. To implement such a transfer sender and receiver there is not a need at the same time displays, necessarily have to be connected to a single computer.

**The control system** of orders and execution of orders.

**Teleconferencing System**. It is based on the use of computer technology system that allows users, in spite of their mutual distance in space, but sometimes, and in time, to participate in joint activities, such as organization and management of complex projects.

### 2.3.6 The use of computer systems in trade, banking

In the organization of computer services trade enterprises widespread received a so-called bar code (bar code). It is series of wide and narrow lines, which encrypted number of trade items.

This number is written on the product label twice, in the form of two five-digit numbers in the form of wide and narrow lines. The first five digits indicate the supplier firms, and the other five – the product number in the nomenclature of goods produced by this company.

Print barcodes use special prefixes in conventional printers. These codes are read by a scanner, converted into electrical impulses that are translated into binary code and transmitted to the computer's memory.

Information about each available in a store or warehouse product is listed in the database. Upon request, the computer analyzes:

• the number of remaining goods;

• its tax rules;

• legal restrictions on its sale and others.

Together with the submission of information about the goods sold to the display of the cash register computer produces a corresponding correction (update) commodity list.

Typically, software is arranged so that a summary of the available goods store manager issued by the end of the working day. However, the manager has the ability to update data on price changes and new consignments.

**The use of electronic money**

One of the most important components of information becomes a transition monetary and financial sphere to electronic money.

The main directions of the use of electronic money are:

• Trading without cash.

• Payment is made with credit cards.

• Having a credit card instead of cash, the buyer with any purchase pays no cash, and automatically withdraw from your account at the bank the required amount of money and sends it to the store's account.

The system of trade without cash POS (English Points of Sale System –POS machine system) performs the following functions:

• verification of credit cards (i.e. a certificate of authenticity);

• withdrawal from the buyer's account;

• transfer them to the seller.

POS – the most massive and exponential branch system of electronic money. It can also detect the slightest theft of cash and goods. Information on the credit card is applied by magnetic recording method. Each credit card is inserted into the magnetic card – media. In the magnetic card the following data is pre-recorded:

• the number of personal accounts;

• name of the bank;

• a country;

• category of customer solvency;

• the amount of credit granted, etc.

It is believed that on their own credit cards save 10% on payments for goods spending.

Change machines. They are set by banks only to its customers, which previously issued credit cards. The customer inserts the automatic credit card and personal identification number, and dials the amount he wants to have cash. The machine according to the banking network checks the correctness of the

code, removes the said amount from the customer's account and gives cash. Several banks together create a common network change machines.

Banking transactions at home. For a small monthly fee if PC and modem at home, the investor can communicate via the telephone network to computerized banking organizations and receive from them a rich set of services.

Counter offsets. All over the world are actively introduced the electronic system of consumer credit and mutual settlements between the banks on the general result. Such systems are implemented as automated clearing (English clearing – Cleaning) ACH (Automated Clearing House) networks. According to the network are not only the bank documents and information important to make responsible financial decisions.

Electronic money is an inevitable consequence of technological progress in the monetary sphere [4].

### 2.4 Representation of data in computer system

### 2.4.1 Representation of numbers
In memory of the CS any information (such as numeric and non-numeric) is represented by a binary code, it uses a different method of encoding.

The memory is divided into elementary cells, each of which has a length of 8 bits (1 byte). Each cell has its own number (address). Machine word is called the maximum sequence of bits that COP processes as a whole. What is the capacity of the processor, and the length of the machine word, e.g. 16, 32 bits, etc.

There are cases when the use decimal and binary, i.e., numeral mixed system in this case for storing, the decimal sign bit 4 is used, and for storing the number of decimal digits (0 - 9 to 0000 - 1001) in the remaining bits of the binary system. For example, the integers with 18 significant digits are stored in packed decimal format, take up 10 bytes in memory (MSB sign).

The CS represent numbers the following two forms are used:
• Natural form is called the form of fixed-point FL (FT period);
• The normal form is called the form of a floating-point PP (PT point).

For example, consider a record number 58500 in the natural form: 58500 – integer 0.000585 – proper fraction, 5.8250 – improper fraction.

Consider a record of the same number 18340 in normal form, depending on the constraints imposed by: $18340 = 1,834 \cdot 104 \cdot 105 = .1834 = 1834000 \cdot 10\text{-}2$, etc.

The CS in representation of numbers in its natural form is set fixed and word length, and for fractional and integer part is also fixed. Hence the name of the form of fixed-point.

But the presentation of the form in the normal position of the decimal point changes, hence the name of the form of floating point.

Universal CS work with numbers in the form of a floating-point, dedicated CS – with numbers of fixed-point, but the majority of the CS work with numbers in both formats.

Thus, to represent numbers in the CS bit sets are used (the sequence of 0 and 1) of fixed length, this method is technically easier organization. Discharge is a position in a fixed set of bits.

*Representation of integers*

Representation of integers in CM is stored in fixed-point format. For example integers – 75 and 74, discharge grid is divided into two parts, a fixed part of the sign portion for digits 0 and 1 in binary recording of these numbers, and the remaining bits are filled with zeros free (Figure 2.2, a).

The need for coding numbers is the fact that the Constitutional Court can not enter a number in the form in which they are represented by a man on paper.

There are several agreements on a common presentation format of both positive and negative numbers.

For the algebraic representation of numbers, i.e. E. To represent numbers, taking into account their marks are used in computers codes:

• direct code number;
• reverse code;
• additional code.

All three methods use the left-most (most significant) bit of the length set to encode the sign: «plus» sign is coded zero, and «minus» - unit. The remaining bits (called a digital part) are used to represent the absolute value of the number.

The disadvantage of such form is often unacceptable in the calculation, since it has a small range of representation of numbers. Positive and negative numbers are represented in the COP in a single format, there are certain agreements. To represent numbers with regard to their sign, i.e. algebraic representation in the Constitutional Court, the following code numbers:

• Direct code (DC);
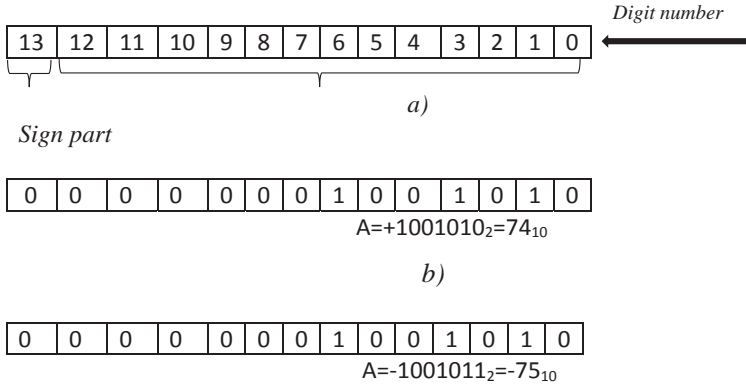• Return code (RC);
• Additional code (AC).

| 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----|----|----|----|---|---|---|---|---|---|---|---|---|---|

*Digit number*

*a)*

*Sign part*

| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

$A=+1001010_2=74_{10}$

*b)*

| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

$A=-1001011_2=-75_{10}$

**Figure 2.2.** *Recording a fixed point number in the discharge grid*

In these codes to encode the "+" sign in the most significant (left most) digit figure recorded zero, and for the "–" – the number one. In other places (in digital part) is written in the absolute value of binary redundant system.

Denote direct code of number $K_{dir}(X)$.

Example: Get the code for the direct number +74 and –75

+ 74 = 1001010

$K_{dir}(X) = 0'1001010$ 2 (Figure 2.2, b)

-75 = -1001011

$K_{dir}(X) = 1'1001011$ 2 (in Figure 2.2, c)

Before apostrophe numbers are reserved to indicate the number of characters which are written in the high sign bit.

Denote the return code to the mod $K_{ret}(X)$. Reverse code number is written as follows:

$$K_{ret}(X) = \begin{cases} 0'K_{dir}(X) & x \ge 0 \\ 1'\overline{K_{dir}(X)} & x \le 0 \end{cases}$$

So, for a positive number reverse code coincides with the straight.

A negative number, reverse code in the high sign bit for the "-" is 1, and all digits 1 are replaced by 0, and the number 0 to 1. In the formula, this operation is indicated by a horizontal line above the expression called the inversion number.

Example: Get the return code number -34

$K_{dir}(X) = 1'010001_2$

$K_{ret}(X) = 1'101110_2$

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Optional additional code $K_{add}(X)$ is recorded by the formula:

$$K_{add}(X) = \begin{cases} 0'K_{dir}(X) & x \geq 0 \\ 1'K_{dir}(X)+1, & x \leq 0 \end{cases}$$

It coincides with the direct source for positive numbers DK.

For negative numbers, DK is the summation of the return code of the last number 1 LSB.

Example: Get additional code to the number -18:

$K_{dir}(X) = 1'0010010_2$

$K_{ret}(X) = 1'1101101_2$

$K_{add}(X) = 1'1101110_2$

Example: Let the bit grid consists of 8 bits. The number is written in it - 21.

A number is represent in the direct code, etc. $K_{dir}(X) = 1'10101_2$

| Numbers of positions | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| Content of positions | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |

Higher position, at number 7 - the sign, to write the number 1, since a negative number had been given. The starting numbers are written in the ranks with the numbers 0 - 4. The remaining digits are at number 5 and 6 fill additional zeros.

With a negative number in the additional code such a scheme work number is not correct.

When extending the discharge grid, i.e. when bits are available on the sign and number of digits, the additional code conversion is performed as follows: if the number was positive, then all the extra bits are recorded zeros, and if negative - units. Such an operation is called an extension of the sign.

Example: Suppose there is 8 bit grid. Add to it the number of -18 in the additional code.

To begin and transform the number of direct, inverse and additional codes:

$K_{dir}(X) = 1'10010_2$

$K_{ret}(X) = 1'01101_2$

$K_{add}(X) = 1'01110_2$

| Numbers of positions | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| Content of positions | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 |

*Representation of real numbers*

To represent real numbers (fractional) in CS use a form of floating point.

In the form of a floating point (point) number is divided into two groups of numbers:

M – the mantissa;

r – order;

p – base.

The order number shows how many bits and in which direction is shifted by replacing the comma notation numbers.

The absolute value of the mantissa is less than 1 and the order of an integer.

For example, the number 0.017 can have several (multiple) representations in the form of a floating-point: $0.17*10^{-1}$, $0.0017*10^1$, $0.00017*10^2$, and so on.

From the above example, it is obvious that the point moves on the mantissa, by changing the order. If the order is positive, the point is shifted to the left in the mantissa, and if negative moves to the right.

But in the CS all floating-point numbers stored in a normalized form.

Normalized numeric is a number, the MSB of the mantissa is strictly greater than zero, i.e., it cannot be zero.

$-45,8= -0,458*10^2$

$+12,7= +0,7*10^2$

$+0,00043= +0,43*10^{-3}$

$+500= +0,5*10^3$

$-10806,102=-0,108\ 06102*10^5$

$+4823=+0,4823*10^4$

$+121,933=+0,121933*10^3$

$+0,00654=+0,654*10^{-2}$

$+30=+0,3*10^2$

$+0,00011=+0,11*10^{-3}$

Example: Write the number $+0,0000110011$ and $-11100,01$ in the form of a floating-point number.

First of all, the record numbers in normalized form:

$+0,0000110011=+0,110011*2^{-4}$

$-11100,01=-0,1110001*2^5$

Translate the order into a binary number system:

$4_{10}=100_2$

$5_{10}=101_2$

Code the mantissa signs and order:

"+" Is coded 00

"–" Coded 11

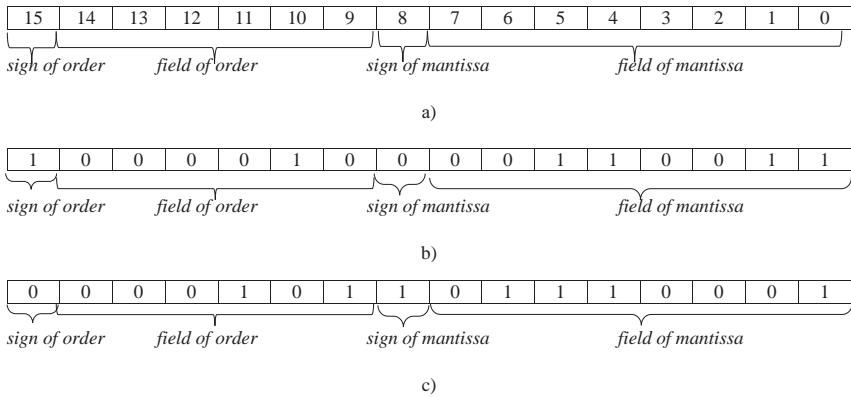As a result, all the write bit grid 16 thus look at Figure 2.3 (b, c)

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----|----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|

sign of order    field of order    sign of mantissa    field of mantissa

a)

| 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

sign of order    field of order    sign of mantissa    field of mantissa

b)

| 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

sign of order    field of order    sign of mantissa    field of mantissa

c)

**Figure 2.3.** *Record floating point numbers in the discharge grid*

### 2.4.2 Presentation of characters

In presenting the character data to the Constitutional Court by one character assigned 1 byte. Each of the 256 characters can be represented in decimal code 0 to 255. There are several ways of coding standards rather codes allocated for each character (code tables). Consider the code tables ASSII, KOI-7, KOI-8, Unicode, MAC.

American Standard Code for Information Interchange (American Standard Code for Information Interchange – Table 2.2) is an eight-bit code table, which is coded 256 characters [5].

**Table 2.2.** *ASCII encoding*

| sp 32 | ! 33 | " 34 | # 35 | $ 36 | % 37 | & 38 | ' 39 | ( 40 | ) 41 | * 42 | + 43 | , 44 | - 45 | . 46 | / 47 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 48 | 1 49 | 2 50 | 3 51 | 4 52 | 5 53 | 6 54 | 7 55 | 8 56 | 9 57 | : 58 | ; 59 | < 60 | = 61 | > 62 | ? 63 |
| @ 64 | A 65 | B 66 | C 67 | D 68 | E 69 | F 70 | G 71 | H 72 | I 73 | J 74 | K 75 | L 76 | M 77 | N 78 | O 79 |
| P 80 | Q 81 | R 82 | S 83 | T 84 | U 85 | V 86 | W 87 | X 88 | Y 89 | Z 90 | [ 91 | \ 92 | ] 93 | ^ 94 | _ 95 |
| ` 96 | a 97 | b 98 | c 99 | d 100 | e 101 | f 102 | g 103 | h 104 | i 105 | j 106 | k 107 | l 108 | m 109 | n 110 | o 111 |
| p 112 | q 113 | r 114 | s 115 | t 116 | u 117 | v 118 | w 119 | x 120 | y 121 | z 122 | { 123 | \| 124 | } 125 | ~ 126 | |

Codes: 0-32 function keys; 127-characters of the English alphabet, numbers, special characters; 128-255 national standard, the alphabet, scientific symbols, pseudographic characters. On the personal computer IBM PC character set is an extension ASSII.

Code 32 – space.

The code table KOI-7, KOI-8 (Table 2.3):
display code using seven – eight – bit encryption and are designed to encode the Russian characters and letters.

Code 154 – non-breaking space.

Unicode code table:

Unicode – standard, which uses two bytes can represent each character and designed to encode mathematical, chemical, musical symbols, Russian, English, Greek, Chinese and other characters, and even extinct characters, artificial alphabets. In general 65,536 different characters are coded.

**Table 2.3**. *KOI-7, KOI-8*

| — 128 | │ 129 | ┌ 130 | ┐ 131 | └ 132 | ┘ 133 | ├ 134 | ┤ 135 | ┬ 136 | ┴ 137 | ┼ 138 | ■ 139 | ■ 140 | ■ 141 | ▐ 142 | ▌ 143 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ░ 144 | ▒ 145 | ▓ 146 | ⌠ 147 | ■ 148 | ● 149 | √ 150 | » 151 | J 152 | i 153 | **nbsp** 154 | ⌡ 155 | ▫ 156 | 2 157 | ● 158 | ё 159 |
| = 160 | ‖ 161 | F 162 | ё 163 | ╓ 164 | ╔ 165 | ╕ 166 | ╖ 167 | ╗ 168 | ╘ 169 | ╙ 170 | ╚ 171 | ╛ 172 | ╜ 173 | ╝ 174 | ╞ 175 |
| ╟ 176 | ╠ 177 | ╡ 178 | Ё 179 | ╢ 180 | ╣ 181 | ╤ 182 | ╥ 183 | ╦ 184 | ╧ 185 | ╨ 186 | ╩ 187 | ╪ 188 | ╫ 189 | ╬ 190 | У 191 |
| ю 192 | а 193 | б 194 | ц 195 | д 196 | е 197 | ф 198 | г 199 | ч 200 | и 201 | й 202 | к 203 | л 204 | м 205 | н 206 | о 207 |
| п 208 | я 209 | р 210 | с 210 | т 212 | у 213 | ж 214 | в 215 | ь 216 | ы 217 | з 218 | ш 219 | э 220 | щ 221 | ч 222 | ъ 223 |
| Ю 224 | А 225 | Б 226 | Ц 227 | Д 228 | Е 229 | Ф 230 | Г 231 | Ч 232 | И 233 | Й 234 | К 235 | Л 236 | М 237 | Н 238 | О 239 |
| П 240 | Я 241 | Р 242 | С 243 | Т 244 | У 245 | Ж 246 | В 247 | Ь 248 | Ы 249 | З 250 | Ш 251 | Э 252 | Щ 253 | Ч 254 | Ъ 255 |

Code table SR1251 (Table 2.4):
Sode PAGE (code page) is a common encoding of Microsoft Windows.

**Table 2.4**. *Encoding CP1251*

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Á 128 | à 129 | , 130 | È 131 | " 132 | ... 133 | † 134 | ‡ 135 | € 136 | ‰ 137 | É 138 | < 139 | Й 140 | Й 141 | Ó 142 | Ý 143 |
| á 144 | ` 145 | ' 146 | " 147 | " 148 | · 149 | – 150 | s 151 | ĕ 152 | ™ 153 | É 154 | > 155 | Ò 156 | Й 157 | ó 158 | ý 159 |
| nbsp 160 | ў 161 | Ў 162 | э 163 | и 164 | Ы 165 | ¦ 166 | § 167 | Ё 168 | © 169 | Ю 170 | « 171 | ¬ 172 | Shy 173 | ® 174 | Я 175 |
| ■ 176 | ± 177 | Ы 178 | э 179 | ` 180 | μ 181 | ¶ 182 | ч 183 | Ё 184 | № 185 | Ю 186 | » 187 | э 188 | ю 189 | я 190 | я 191 |
| А 192 | Б 193 | В 194 | Г 195 | Д 196 | Е 197 | Ж 198 | З 199 | И 200 | Й 201 | К 202 | Л 203 | М 204 | Н 205 | О 206 | П 207 |
| Р 208 | С 209 | Т 210 | У 211 | Ф 212 | Х 213 | Ц 214 | Ч 215 | Ш 216 | Щ 217 | Ъ 218 | Ы 219 | Ь 220 | Э 221 | Ю 222 | Я 223 |
| а 224 | б 225 | в 226 | г 227 | д 228 | е 229 | ж 230 | з 231 | и 232 | й 233 | к 234 | л 235 | м 236 | н 237 | о 238 | п 239 |
| р 240 | с 241 | т 242 | у 243 | ф 244 | х 245 | ц 246 | ч 247 | ш 248 | щ 249 | ъ 250 | ы 251 | ь 252 | э 253 | ю 254 | я 255 |

Code 160 – non-breaking space, the code 173 – hyphens.

There is also a code table SR866 under MS DOS.

The MAC code table (Table 2.5) – is designed for character encoding on computers Arrle firms that use Mac 0S operating system.

**Table 2.5.** *Encoding MAC*

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| А 128 | Б 129 | В 130 | Г 131 | Д 132 | Е 133 | Ж 134 | З 135 | И 136 | Й 137 | К 138 | Л 139 | М 140 | Н 141 | О 142 | П 143 |
| Р 144 | С 145 | Т 146 | У 147 | Ф 148 | Х 149 | Ц 150 | Ч 151 | Ш 152 | Щ 153 | Ъ 154 | Ы 155 | Ь 156 | Э 157 | Ю 158 | Я 159 |
| † 160 | ■ 161 | Ы 162 | ξ 163 | § 164 | · 165 | ¶ 166 | Ы 167 | ® 168 | © 169 | ™ 170 | Á 171 | á 172 | è 173 | À 174 | è 175 |
| Ё 176 | ± 177 | ≤ 178 | ≥ 179 | э 180 | μ 181 | r 182 | Э 183 | Ю 184 | ю 185 | Я 186 | я 187 | É 188 | é 189 | й 190 | ò 191 |
| э 192 | Ю 193 | ¬ 194 | √ 195 | f 196 | ≈ 197 | Δ 198 | « 199 | » 200 | ... 201 | nbsp 202 | Ó 203 | ó 204 | Й 205 | Й 206 | я 207 |

| – 208 | s 209 | " 210 | " 211 | ' 212 | ' 213 | ё 214 | „ 215 | ÿ 216 | Ӹ 217 | Ý 218 | ý 219 | № 220 | Ё 221 | ё 222 | я 223 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| а 224 | б 225 | в 226 | г 227 | д 228 | е 229 | ж 230 | з 231 | и 232 | й 233 | к 234 | л 235 | м 236 | н 237 | о 238 | п 239 |
| р 240 | с 241 | т 242 | у 243 | ф 244 | х 245 | ц 246 | ч 247 | ш 248 | щ 249 | ъ 250 | ы 251 | ь 252 | э 253 | ю 254 | □ 255 |

Code 202 – non-breaking space

Code table ISO 8859-5.

ISO, International Standards Organization (ISO) has approved another encoding standard for the Russian language. In this coding method codes 128 by 159 are used.

**Table 2.6.** *ISO 8859-5 encoding*

| nbsp 160 | Ё 161 | Ђ 162 | Ѓ 163 | € 164 | Ѕ 165 | І 166 | Ї 167 | Ј 168 | ® 169 | ® 170 | Њ 171 | Ќ 172 | shy 173 | Ў 174 | Ũ 175 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| А 176 | Б 177 | В 178 | Г 179 | Д 180 | Е 181 | Ж 182 | З 183 | И 184 | Й 185 | К 186 | Л 187 | М 188 | Н 189 | О 190 | П 191 |
| Р 192 | С 193 | Т 194 | У 195 | Ф 196 | Х 197 | Ц 198 | Ч 199 | Ш 200 | Щ 201 | Ъ 202 | Ы 203 | Ь 204 | Э 205 | Ю 206 | Я 207 |
| а 208 | б 209 | в 210 | г 211 | д 212 | е 213 | ж 214 | з 215 | и 216 | й 217 | к 218 | л 219 | м 220 | н 221 | о 222 | п 223 |
| р 224 | с 225 | т 226 | у 227 | ф 228 | х 229 | ц 230 | ч 231 | ш 232 | щ 233 | ъ 234 | ы 235 | ь 236 | э 237 | ю 238 | я 239 |
| № 240 | ё 241 | ® 242 | ѓ 243 | є 244 | s 245 | i 246 | ї 247 | j 248 | љ 249 | њ 250 | ħ 251 | ќ 252 | § 253 | ў 254 | Ụ 255 |

Code 160 – non-breaking space, code 173 - hyphens.

### 2.4.3 Presentation graphics

When an image is displayed on the screen, the binary information about it is in video memory. The images are divided into two – rasters and vector graphics.

Raster images are composed of pixels (pixel, by Eng. Picture element), combined in a single layer mesh. For information about the pixel color contains its binary code.

Since the human eye can distinguish between more than 100 shades of gray, then represent black-and-white images using shades of gray.

It covers only the brightness. One pixel is encoded from 1 to 8 bits. Brightness is described by a single number, black color – 0, white color – N = 2 k -l, where the k – the number of bits (8 bits), i.e. 255.

Colors are perceived by the retina of the human eye as different combinations of the three primary colors – red, green and blue (R- Red, G- Green, B - Blue).

For example, give some RGB combinations in Table 2.7

Table 2.7. *RGB combinations*

| RGB combination | Color |
|---|---|
| red + blue+ green | white |
| red + blue | lilac |
| red +green | yellow |
| red +green | orange |
| no | black |

There are three "light bulbs" in the computer monitor: red, green and blue, which shine in each pixel with different brightness. The principle of RGB (additive model) – a set of rules by which any color can be represented by a certain code of numbers and letters. This also operates a computer in the memory incorporated information about all the combinations and colors that corresponds to each set. To record the color using the hexadecimal system, put hexadecimal number sign "#". For example, #FFFFFF (255, 255, 255) – white.

But if the image is displayed on the paper, the RGB principle does not work, because the ink absorbs some colors of the spectrum, and does not emit light. These color inks are determined by subtracting one from the white RGB colors. Obtained colors: cyan, magenta, yellow (C – Cyan, M – Magenta, Y- Yellow).

For example, here are some CMY combinations in Table 2.8.

However, when printing on paper black color turns dirty–brown, gray is not like the gray, and the creation of dark shades of colors is problematic. For the settlement of the final color used another color – black. Print on paper using CMYK principle (subtractive model). Deciphering the last letter – short black (abbreviations K about a lot of controversy, it is believed that from the key plate – the key surface from *kontur* – contouring film from *kobalt* – dark gray). The CMYK value of each primary color is the "opacity" is defined from 0% to 100% (amount of ink).

**Table 2.8.** *CMY combinations*

| CMY combination | Color |
|---|---|
| blue + purple + yellow | black |
| purple + yellow | red |
| blue + yellow | green |
| no | white |

There are also color models grayscale (shades of gray), HSB and HLS (Hue – shade or tone, Saturation – color saturation, Brightness – brightness), LAB (Luminance – Illumination, A – is a range of colors from green to magenta, B – colors from blue to yellow), these things XYZ (CIE – Commission International de l'Eclairage), RYB (red, yellow and blue colors), NCS (natural color system, the natural color system), PMS (Pantone Matching system – Pantone color model) .

Vector images are made up of elements such as a line, rectangle, circle, or a piece of text, each of which is located in its own separate layer, i.e. in the multilayer grid. Pixels of each layer are set independently of other layers. Each element of the vector image is described by mathematical equations of lines, arcs, circles, i.e., object is described using a special language. From the totality of these elementary graphic objects getting complex objects (polylines, and other geometric shapes).

Therefore, vector image resized without loss of quality, as opposed to raster graphics, which when zoomed increase graininess.

### 2.4.4 Presentation of sounds

The physical nature of sound swings in a certain range of frequencies transmitted by the sound wave through the air (or other elastic medium). Using a microphone the sound can be converted into electrical vibrations and their magnitude measured at regular intervals of time (several tens of thousands of times per second). Each measurement is written in binary code. This process is called sampling.

The process of converting sound waves into binary data in the computer's memory:

Sound wave ⟶ Microphone ⟶ Alternating electric current ⟶

ADC ⟶ Binary code ⟶ Computer memory
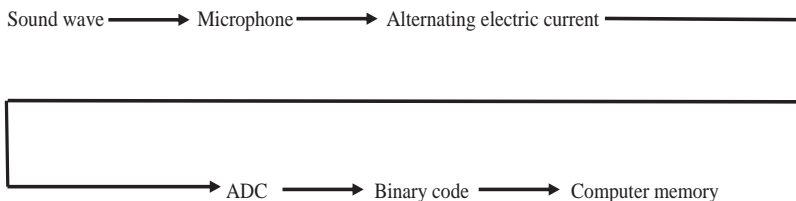
The process of reproducing the audio information stored in computer memory:

Computer memory → Binary code → DAC → ... → Electric current → Acoustic system → Sound wave
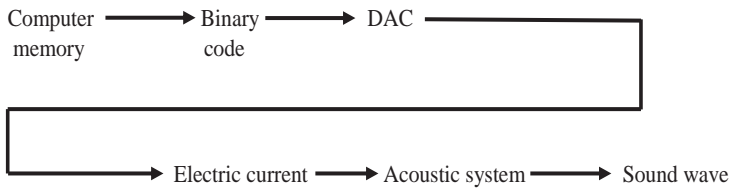
Analog-to-digital converter (ADC) – a sound card, a special device that connects to a computer, designed for converting electrical oscillations of sound frequency in numeric binary code when entering the sound.

Digital-to-analog converter (DAC) is a sound card for the reverse transformation (from a numeric code into electrical vibrations) when playing audio.

In the process of recording audio ADC with a certain period measures the amplitude of the electric current and stores in the register the binary code obtained value.

The resulting code from the register is rewritten in the RAM on your computer.

The resulting step signal is smoothed and converted into sound by means of an amplifier and speaker.

The quality of the computer sound is determined by the characteristics of the sound card: sampling rate and resolution (cell size, allotted under the amplitude values recorded).

The sampling frequency – the number of input measurement for 1 second. Frequency is measured in hertz (Hz). One measurement for 1 second corresponds to a frequency of 1 Hz.

1000 measurements for 1 second – 1 kilohertz (kHz). Typical ADC sampling frequency: 11 kHz, 22 kHz, 44.1 kHz and others.

Also, speaking of other formats of music recording, then a standard MIDI (Musical Instrument Digital Interface) was developed in 1983, which determined a code system, which stands for the height, width, the overall rate of execution. MIDI-editor allows to work with music in the form of conventional notes, a natural musician. The advantage is the extremely compact recording, easy tools replacement, change tempo and key of the melody, the naturalness of music. The disadvantage is that such coding system lets record audio only for instrumental music.

There are also MP3 format encoding music with high quality and high compression ratio, a song for example, takes about 3,5-8 Mb. The advantage is that users can now communicate over 200 songs on a network such as the Internet.

**Control questions:**
1. What is the computer system?
2. What is the generation of known computers?
3. What is included in the basic elements of the personal computer?
4. What is the principle of open architecture?
5. What types of memory exist?
6. What refers to external memory?
7. What is an adapter?
8. What applies to peripheral devices?
9. What is the application of computer systems familiar to you?
10. What areas are used in education?
11. What is the knowledge base and expert systems?
12. How to use computer systems in various spheres of social life?
13. What appears in numerical information of the computer?
14. How is a graph on the computer?
15. What appears in sound of the computer?

**Practical tasks:**
1. Get a return code numbers -29, -12, -45, -70
2. Get an additional code number -68, -41, -18, -70
3. Let Bit grid has 8 bits. Add therein of -52, 89, -45, -15, 25, individually.
4. Let discharge grid has 16 bits. Add therein of -49, 58, -14, -7, 51 separately in the additional code.
5. Imagine the number 0.00045, 32.12, in a normalized form
6. Record of 4.58 and -0.41 in the form of a floating-point 16-bit grid.
7. Write to table 2.9 the surname and given name in the codes.

Table 2.9

| Number of bytes | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | … |
|---|---|---|---|---|---|---|---|---|---|
| Symbol | | | | | | | | | |
| ASCII code | | | | | | | | | |
| KOI-7 | | | | | | | | | |
| MAC | | | | | | | | | |
| **CP1251** | | | | | | | | | |

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# CHAPTER 3. SOFTWARE. OS

## 3.1 Software

• Software. Types of software and target characteristics.
• Basic operating system concepts. The evolution of operating systems.
• Classification of operating systems, including mobile devices. Classification of desktop applications.

Under software means a series of programs executed by the computer system. The software includes also the whole area of activity for the design and development of software: software engineering technology; methods of testing programs; methods of proving the correctness of programs; analysis of the quality of the work programs; documenting programs; development and use of software tools to facilitate the software design process, and much more.

The software – an integral part of a computer system. It is a logical continuation of the technical means. Scope is determined by the specific computer software created for it. In itself, the computer has no knowledge of any one application. All this knowledge is concentrated in the programs running on the computers. The software of modern computers includes millions of programs – from gaming to research.

There are two main types of software: system (also referred to as common) and application (referred to as special). Each type of software performs a variety of functions. System software – a set of programs that manages computer components, such as processor, communication and peripheral devices. Programmers who create software system, called system programmers. For application software, there are programs written for the users or by the users themselves, to define the specific work computer. Order processing programs or create mailing lists – application software examples. Programmers who write application software, are called application programmers.

Both types of software are connected and represented as the diagram shown in Figure 3.1. As can be seen, each area is working closely with the other. System software provides and controls access to the computer hardware. Application software interacts with the hardware components through the system. End users mostly work with application software. To provide hardware compatibility, each type of software is developed for a specific hardware platform.

System Software, which includes the operating system, language translators and service program, controls access to the hardware. Application software, such as programming languages and a variety of custom applications work with the hardware through a layer of system software. Users, in turn interact with the application software.

Software systems can be classified according to various criteria. Consider the classification, which is the area use software products:
- hardware standalone computers and computer networks;
- the functional tasks of the various subject areas;
- technology development programs.
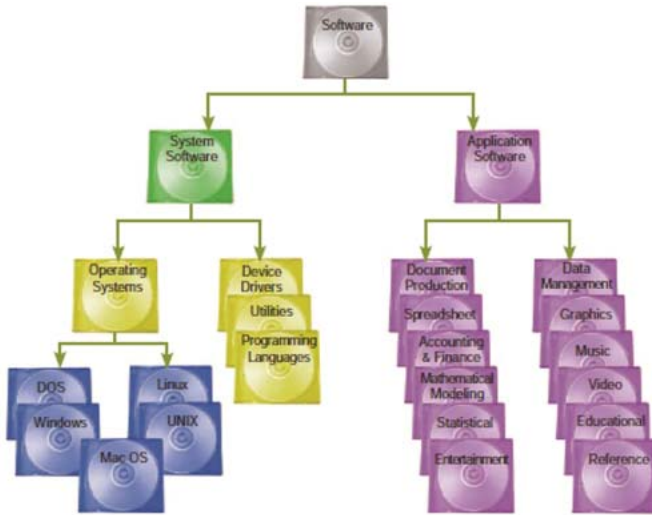


**Figure 3.1.** *The structure and purpose of the software [1]*

In support of information technology in these areas respectively emit three classes of software products on the Figure 3.2:
- system software;
- application software;
- software tool.

System software (System Software) – a set of programs and software systems designed to ensure the operation of the computer and computer networks. The system software performs the following tasks:
- creation of the operating environment of other software functioning;
- providing reliable and efficient operation of computer and computer network;
- conducting diagnostics, failures localization, errors and rejections and prevention of computer equipment and computing networks;
- execution of auxiliary technical processes (replication, archive, recovery of programs' files and databases, etc.).

The given class of software products is closely related to the type of com-

puter and is its integral part. Software products mainly are targeted at qualified users – professionals in the field of computer: system programmer, network administrator, application programmer, operator. However, knowledge of the basic technology of work with this software class is required, and with the end user of personal computer, which does not only work with the programs independently, but also performs maintenance of computer, software and data.

The software products of this class have the generic nature of the application, regardless of the specifics of the subject area. They are required by demand on reliability and manufacturability of work, ease and efficiency of use.

```
                          ┌────────────────────┐
                          │ Computer software  │
                          └────────────────────┘
         ┌──────────────────┬──────────────────────┬──────────────────┐
┌──────────────────┐  ┌──────────────────────┐  ┌──────────────────┐
│ System software  │  │ Programming software │  │ Applied software │
└──────────────────┘  └──────────────────────┘  └──────────────────┘
```

Computer software

- System software
- Programming software
- Applied software

Basik software
- Operating system
- Operating system shells
- Network operating system

Utility software
- Search networks
- Diagnostics
- Anti-virus software
- Archivers

General-purpose — Multimedia
Problem-oriented — Information retrieval
Publishing system — Others

Programming languages and system  |  Integrated programming environments  |  Software packages

**Figure 3.2.** *Classes of software*

Application software is a set of related programs designed to solve problems of a certain class of a particular subject area. Application software packages (ASP) of general purpose are software tools of solving functional problems and the most numerous class of software products. This class includes software products, performing information processing of different subject areas.

Installation of a computer application packages is carried out by system administrators, system programmers, as well as (in some cases) by qualified users.

Tools of programming technology are set of programs and software systems, providing technology of development, debugging and deployment of the created software products.

Toolkit software programming includes specialized software products, which are the tools of the developer. Users of programming technology are system and application programmers.

### 3.2. The structure of the system software

System software (Figure 3.3) can be divided into the basic software, which usually comes with the computer, and utility software, purchased additionally.

Basic software (base software) - the minimum set of software tools, providing a computer work. Utility software includes programs and software packages, which extend the capabilities of the basic software and organize more comfortable user's work environment.

The basic software includes:
• operating system;
• operating shells (usually text and graphics);
• network operating system.
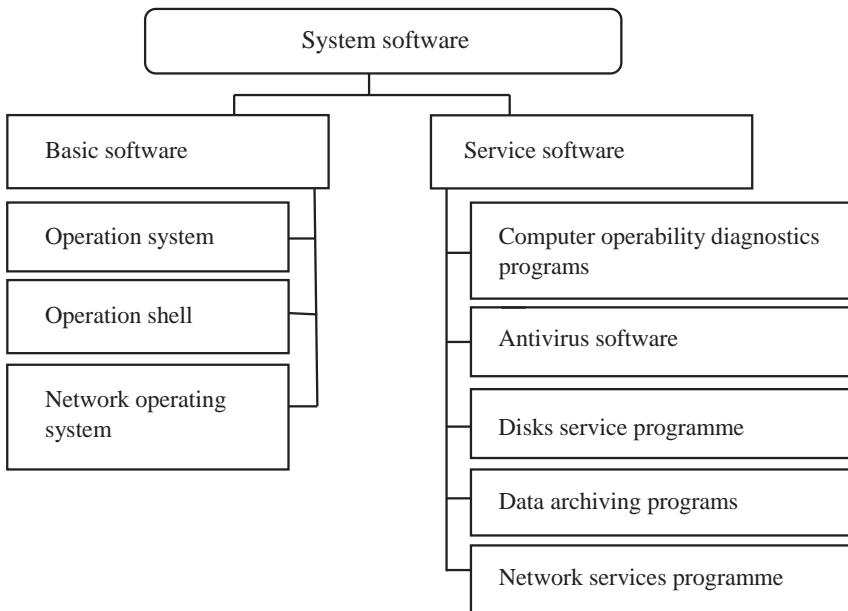
Figure 3.3. *The structure of the system software*

The operating system is targeted to control the execution of user programs planning and management of computer processing resources.

Most traditional comparison of the operating systems is performed by the following characteristics of information processing:

• memory management (the maximum amount of address space, memory types, technical data memory use);

• functionality of auxiliary programs (utilities) as part of operating system;

• presence of compression disk;

• ability to archive files;

• support of multi-tasking work mode;

• support of network software;

• availability of quality documentation;

• conditions and complexity of the installation process;

• mobility (portability), security, reliability, and others.

Network Operating System is a set of program, providing processing, transmission and storage of data on the network. Network operating system provides users with various types of network services (file management, e-mail, audio and video conferences, distributed computing, network management processes, etc.), supports a work in user systems. Network operating systems use a client-server architecture or peer-to-peer architecture. At first, network operating systems supported the local area networks (LANs), now, these operating systems spread on the association of local networks.

Operating shells are the special programs designed to facilitate the user communication with the operating system commands. Operating shells have text and graphic options for the end-user interface and in the future, options of the speech interface and handwriting recognition input data are possible. These programs greatly simplify the setting of control information task for executing of operating system commands; reduce tension and complexity of end-user work.

Expansion of basic computer software is a set of service, additional installing programs (or programs, coming directly with the operating system), which can be classified by function as follows:

• computer operability diagnostics program;

• anti-virus software, providing computer protection, detection and recovery of infected files;

• disk maintenance program, providing quality control of disk's magnetic surface, the file system safety control on logical and physical levels, compression of disks, creation of insurance copies of discs, data back up on external media, etc;

• data archiving program, providing data compression process in the files, in order to reduce the amount of memory to store it;

• network maintenance program.

These programs are often called utilities. Utilities are programs, serving to perform auxiliary data processing operations or maintenance of computers (diagnostics, testing, hardware and software, optimization of disk space use, restoring of the destroyed data on a magnetic disk, etc...).

In modern operating systems such tools may be presented, for example, on Windows programs as groups of "standard" and "service". They include a number of useful programs: calculator, sound recordings, notes, etc. In the "service" group, there is a number of programs, extending capabilities of operating system: disk cleaning and defragmentation, system recovery, etc.

Considering the evolution of the operating system, it should be borne in mind that the time difference is the implementation of certain principles of individual operating systems organization until their general acceptance, as well as terminological uncertainty does not allow to give a precise chronology of the operating system development. However, now can be accurately determined the key milestones in the evolution of operating systems.

There are various approaches to determine the operating system generations. The division of OS on generations according to the generations of computing machines and systems is known. This division is not entirely satisfactory, because the development of the methods of OS organization within one generation of electronic computers, as the experience of their creation presented is a fairly wide range. Another point of view does not bind the OS generations with the corresponding generation of electronic computers. For example, defining the generations of OS by the levels of input electronic computer language, modes of use of central processors forms of operating systems use and etc., is known. Apparently, it is necessary to consider the most appropriate allocation of the development stages of OS in the range of the separate generations of electronic computers and computing systems development.

### 3.3 Evolution of operating systems

With the improvement of electronic computers and growth of their capability, the lack of basic software became clear. The operating system of early batch – is the monitors apperance. As a part of batch processing systems, during the execution of any work in the package (translation, assembly, performance of the finished program), there is no part of the system software which was in the random-access memory, as all memory was provided for ongoing work. Then the monitor systems came, in which the memory is divided into three areas: a fixed area of monitoring system, the user's domain and shared memory (for storing data, which can be exchanged by object modules).

```
second
generation          multi-
                  programme
                      OS

                   mono
                 programme
                     OS

first
generation

Lack of OS
(zero generation)
```

1970  Dynamic allocation of main memory
        The division of time, multi-terminal systems UNIX
        (PDP-7), Ken Thompson

1965  Controlled multiprogramming
        Classic multiprogramming, OS / 360, OS CTSS
        (1963), MULTICS (start of works)
        Overlay structures
        The logic input - output  control system

1960  Interrupt systems, checkpoints
        File Management, timers
        Spoolings (SPOOL)
        Monitors

1955  Access methods, polibuffering
        Charges, connection editors

1950  Diagnostic programs
        Assemblers, macrocommands
        Library of subroutines

1946  The first computer

**Figure 3.4.** *Stages of development of operating systems*

The intensive development of data management techniques had begun, an important function of the OS – the implementation of input-output without the participation of the central process – so-called spooling (from the english SPOOL – Simultaneous Peripheral Operation on Line) appeared.

The emergence of new hardware development (1959-1963 years) – interrupt system, timers, channels stimulated further development of the OS. The executive systems had appeared which were a set of programs for distribution of electronic computer resources, relations with an operator, control of computing process and management of input-output. Such executive systems allowed to implement quite effective, at that time, a form of operation of computing system – monoprogram batch processing. These systems gave users such tools as breakpoints, logical timers, a possibility of constructing overlay structure programs, a detection of violations of restrictions by programs, adopted in the system, file management, collection of accounting information and others.

However, single-program batch processing with increasing electronic computer capability could not provide an economically acceptable level of operation of the machines. The solution was multiprogramming, which is a way

of organizing of computing process, in which the computer memory contains several programs, running alternately by one processor, and start or continue counting by means of one program, completion of others was not required. In a multiprogramming environment, the problems of resource allocation and protection become more acute and intractable.

In this period, the theory of building of operating systems was enriched by a number of fruitful ideas. Various forms of multi-program operating modes appeared, including the division of time, which is a mode, providing a work of multi-terminal system. The concept of virtual memory and then the virtual machines were created and developed. The time-sharing mode allowed a user to interact with his programs, as it was before the advent of packet-processing systems.

One of the first OS, using these latest solutions was the MCP operating system (master control program), created by Burroughs firm for its B5000 computers in 1963. In this operating system, many of the concepts and ideas were implemented, which subsequently became the standard for many operating systems (Figure 3.5):
• multiprogramming;
• multiprocessing;
• virtual memory;
• ability of debugging programs in the original language;
• writing of operating system on high-level language.

A well-known time-sharing system of that period was the CTSS (Compatible Time Sharing System), which is compatible time-sharing system, developed at the Massachusetts Institute of Technology (1963) for IBM-7094 computer. This system was used for developing of a time division system of the next generation MULTICS (Multiplexed Information and Computing Service) at the same institute, together with Bell Labs and General Electric. It is noteworthy, that this OS was written mainly in the high-level language EPL (the first version of PL / 1 language by IBM).

One of the most important events in the history of operating systems is the appearance of the family of computers called the System / 360 from IBM in 1964, and later System / 370. It was the world's first implementation of the concept of a family of software and information compatible computers, which later became the standard for all computer industry firms.

It should be noted, that the basic form of use of the electronic computers in the time-sharing systems as well as in batch processing systems became multi-terminal mode. Not only the operator, but all users were able to articulate their tasks and manage their realization from their terminal. Since it became possible, to place the terminal complexes at significant distances from the computer (through dial-up telephone connections), systems of remote

tasks entry and remote data processing appeared. The modules, implementing communication protocols were added in OS.
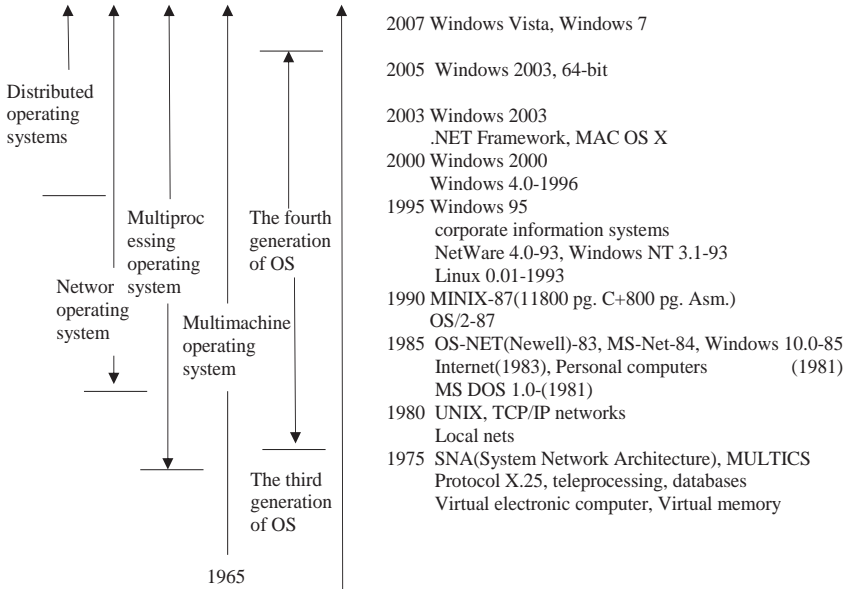


**Figure 3.5.** *Stages of development of operating systems*

By this time, there was a significant change in the distribution of functions between computer hardware and software. The operating system became "an integral part of the electrical computer", as a continuation of the equipment. A privileged ("Supervisor" in OS/360) and a user ("Task" in OS/360) operating modes, a powerful system interrupts, memory protection, special registers for fast switching of programs, means to support virtual memory and others appeared in processors.

In the early 70s, appeared the first network operating system, which allowed not only to disperse users in remote data processing systems, but also to organize distributed storage and processing of data between computers joined by electrical connections. The project is known as ARPANET MO USA. In 1974, IBM announced the creation of its own SNA network architecture for its mainframes, ensuring interoperable type "terminal – terminal", "terminal – computer", "computer – computer". In Europe, the technology of network construction with packet switching, based on the X.25 protocol is actively developed.

By the mid-70s, along with mainframes are widely used mini-computers

(the PDP-11, Nova, HP). Architecture minicomputer was significantly easier, many of the features multiprogramming OS mainframe were beheaded. Operating minicomputer systems have become specialized to do (RSX–11M – the division of time, the RT–11 – OC real time) and not always multiplayer.

An important milestone in the history of mini–computers and, in general, in the history of operating systems was the creation of UNIX OS. This system was written by Ken Thompson, one of the experts in computers in the BELL Labs, worked on MULTICS project. Actually, his UNIX is a truncated single user version of MULTICS system. The original name of this system is UNICS (UNiplexed Information and Computing Service) – "primitive information and computer service". So this system was called in jest, because MULTICS (MULTiplexed Information and Computing Service) – multiplex information and computer service. Since the middle of 70s, a mass use of the UNIX operating system, written by 90% in C has begun. Widespread C compilers made UNIX unique tolerated operating system, and since it was delivered with the source code and was the first open source operating system. Flexibility, elegance, powerful functionality and openness enabled it to gain a foothold in all classes of computers – from personal to electrical super–computers.

The availability of mini-computers served as the impetus for the creation of local networks. In the simplest local area networks, computers connected via serial ports. The first network application for OS UNIX was UUCP program (Unix to Unix Copy Program), appeared in 1976.

Further development of network systems came with a stack of TCP / IP protocol. In 1983, it was admitted as a standard by the Ministry of Education of the United States, and used in the ARPANET. In the same year, ARPANET was divided into MILNET (for US military agencies) and new ARPANET, which became known as the Internet.

All the eighties are characterized by the emergence of increasingly sophisticated versions of UNIX: Sun OS, HP-UX, Irix, AIX, etc. In order to solve the problem of interoperability, the standards POSIX and XPG were adopted, defining interfaces of these systems for applications.

Another significant event in the history of operating systems was the personal computers emergence in the early 80s. It served as a powerful impetus for the distribution of local area networks, as a result the support of network functions became a prerequisite for personal computer OS. However, user-friendly interface and network functionality were not added to operating system of personal computer immediately.

The most popular version of OS in the early stage of development of personal computers was the Microsoft company's MS-DOS - single-program, single-user operating system with a command line interface. Many features, providing an ease of user work, the OS provided as additional programs –

Norton Commander Shell, PC Tools, etc. The greatest influence on the PC software development had Windows environment, the first version of which appeared in 1985. Network functions were implemented by means of network shells and appeared in MS-DOS version 3.1. At the same time, Microsoft network products – MS-NET, and later – LAN Manager, Windows for Workgroup, and then Windows NT were published.

The Novell company went another way, its NetWare product is an operating system with built-in networking capabilities. NetWare OS distributed as operating system for a central server of local network and, through specialization of file server function, provided high-speed remote access to files and enhanced data security. However, this operating system had a specific programming interface (API), which made it difficult to develop applications.

The first multi-tasking operating system for PC – OS/2 was appeared in 1987 and developed by Microsoft in collaboration with IBM. This was a well-thought-out system with virtual memory, graphic interface and the ability to execute DOS-application. For this operating system, LAN Manager (Microsoft) and LAN Server (IBM) networking shells were extended. These shells gave way to NetWare file server's capability and consumed more hardware resources, but have important advantages. They allowed to perform any program on a server, developed for OS/2, MS-DOS and Windows. In addition, the computer on which they worked could be used as a workstation. However, the unsuccessful market fate of the OS/2 did not allow LAN-Manager and LAN-Server systems to capture a significant share of the market, but the principles of operation of these network systems largely were embodied in the OS 90s – MS Windows NT.

In the 80 years, the basic standards of the communication technologies for local area networks were taken: in 1980 – Ethernet, in 1985 – Token King, in the late 80s – FDDI (Fiber Distributed Data Interface), a distributed data fiber optic channels transmission interface, double ring with a marker. It made possible to ensure the compatibility of network OS at lower levels, as well as to standardize the operating system driver network adapters.

For a PC not only specially designed operating system (MS-Dos, NetWare, OS / 2) was used, but also adapted the existing OS, in particular, UNIX. The most well-known system of this type was a version of UNIX company Santa Cruz Operation (SCO UNIX).

In 90 years, almost all operating systems, occupying a prominent place in the market, became networking. Network functions were built into the OS kernel, being its integral part. A multiplexing of several protocol stacks is used in OS, through which computers can support simultaneous operation with heterogeneous servers and clients. The specialized operating system appeared, such as the IOS network OS of company Cisco System, working in routers.

In the second half of the 90s, all OS vendors strengthened support tools of work with interfaces. In addition to the TCP / IP protocols stack, utilities, implementing popular Internet services: telnet, ftp, DNS, Web and others began to include in the set.

Particular attention was paid to the corporate network operating systems in the last decade (and now). This is one of the most important tasks in the foreseeable future. The corporate OS should work fine and stable in large networks, which are characteristic of large organizations (companies, banks, etc.), with branches in many cities and possibly in other countries. The corporate operating system must seamlessly interact with different types of operating systems and run on different hardware platforms. The leaders in a class of corporate operating systems have defined, they are MS Windows 2000/2003/2008, UNIX and Linux-based systems, as well as Novell NetWare 6.5.

### 3.4 Classification of operating systems

All the variety of existing (and currently not in use) operating systems can be classified by different features. The main classification features will be discussed below.

By appointment, OS are divided into universal and specialized. The specialized operating systems tend to operate with a fixed set of programs (functional tasks). Application of such systems is due to the impossibility of using a universal operating system for reasons of efficiency, reliability, security, and so on, as well as due to the nature of tasks.

The universal OS designed for the solution of any user problems, but usually, the form of operation of the computer system may impose special requirements to the OS, i.e. to elements of its specialization.

By a way of downloading, the downloadable OS (the majority) and the systems, residing in the memory of the computer system can be described. The latter, as a rule, specialized is used to control the operation of specialized devices (e.g. onboard computer of a ballistic missile or a satellite, scientific instruments, automated devices for different purposes, and others.).

By the peculiarities of resource management algorithms, the main resource of the system is the processor. So, a classification on the processor control algorithms is given, although the classifying of OS by the memory management algorithms, input-output devices, etc., which is possible.

The multitasking (multi-program) supports according to the number of simultaneously running, tasks are divided into 2 classes: mono-programme (single-function), for example, MS-DOS, MSX, and multiprogramme (multitasking), the EC electrical computer operating system, OS / 360, OS / 2, UNIX, different versions of Windows.

The mono-programme OS provides the user with a virtual machine, mak-

ing the process of user interaction with the computer easier and more convenient. They also have the file and peripherals management means and the user communication means. Moreover, the multitasking operating systems, control separation of shared resources (processor, memory, files, etc.) can significantly increase the effectiveness computing system.

Support for multi-user mode. According to the number of concurrent users, the operating systems are divided into single-user (MS-DOS, Windows 3x, earlier versions of OS / 2) and multiuser (UNIX, Windows NT / 2000/2003 / XP / Vista).

The main difference of multi-user systems from the single-user systems is availability of protection means of each user's information from unauthorized access by other users. It should be noted, that there might be a multiprogramming single-user system.

Types of multiprogram work. The specifics of the operating system largely determine the method of time distribution between multiple simultaneously existing in the system processes (or threads). On this basis two groups of algorithms can be presented: no preemptive multi-program (Windows 3.x, NetWare) and preemptive multi-program (Windows 2000/2003 / XP, OS / 2, Unix).

In the first case, the active process is carried out as long, it does not give control to the operating system. In the second case, the decision about switching process is taken by an operating system. The next multi-program mode is possible, when the operating system divides into the CPU time between individual branches (threads, fibers) of one process.

Multiprocessing. An important property of the OS is the absence or presence of means of supporting multiprocessing. On this basis, OS without the support of multiprocessing can be identified (Windows 3.x, Windows 95), and with the support for multiprocessing (Solaris, OS / 2, UNIX, Windows NT / 2000/2003 / XP).

Multiprocessor operating systems are classified by the method of organization of the computational process in asymmetric OS (run on a single processor, allocating application tasks on other processors) and symmetrical OS (decentralized system).

**What is a computer file?** A computer or simply file are defined as a named collection of data that exist on a storage medium, such as a disk, CD, DVD, or USB flash drive. A file can contain a group of records, a document, a photo, music, a video, an e-mail message or a computer program.

If to use the word processing software, the text that is entered for a document is stored as a file. The file a name can be, such as *A History of Film Noir*. A music file, such as *Bach Brandenburg Concertos* that download over the Internet,and stored as a file too.

**What are the rules for naming files?** Every file has a name and might also have a file extension. When you save a file, you must provide a valid file name that adheres to specific rules, referred to as **file-naming conventions**. Each operating system has a unique set of file-naming conventions.

**Is there a maximum length for file names?** DOS and Windows 3.1 limited file names to eight characters. With that limitation, it was often difficult to create descriptive file names. A file name such as *HseBud11* might be used for a file containing a household budget for 2011. With such cryptic file names, it was not always easy to Figure out what a file contained. As a result, files were sometimes difficult to locate and identify. Today, most operating systems allow to use longer file names.

Current versions of Windows support file names up to 255 characters long. In practice, some of the 255 characters are used for the file's drive letter, folder designation and extension, so the name that was assigned to a file should typically be quite a bit shorter. A file name limitation of 255 characters gives the flexibility to use descriptive file names, such as *Household Budget 2011*, so that it can be easily identifed what a file contains.

**What is a file extension? A file extension** (sometimes referred to as a file name extension) is an optional file identifier that is separated from the main file name by a period, as in *Paint.exe*. As becoming familiar with file extensions, they will provide a clue to the file's contents. Files with .exe extensions are executable files that the computer can run. *Paint.exe*, for example, is a graphics utility packaged with the Windows operating system. Files with .dat extensions are typically data files. Files with .doc or .docx extensions contain word processing documents.

**Why are certain characters not allowed in a file name?** If an operating system attaches special significance to a symbol, it might not be able to use it in a file name. For example, Windows uses the colon (:) character to separate the device letter from a file name or folder, as in *C:Music*. A file name that contains a colon, such as *Report:2010*, is not valid because the operating system would become confused about how to interpret the colon. When  using Windows applications, avoid using the symbols: * \ < > | " / and ? in file names.

**What are reserved words?** Some operating systems also contain a list of **reserved words** that used as commands or special identifiers. You cannot use these words alone as a file name. You can, however, use these words as part of a longer file name. For example, under Windows, the file name *Nul* would not be valid, but you could name a file something like *Nul Committee Notes.doc* or *Null Set.exe*. In addition to *Nul*, Windows users should avoid using the following reserved words as file names: *Aux*, *Com1*, *Com2*, *Com3*, *Com4*, *Con*, *Lpt1*, *Lpt2*, *Lpt3*, and *Prn*.

**What else it is necessary to know about creating file names?** Some

operating systems are case sensitive, but not those you typically work with on personal computers. Feel free to use uppercase and lowercase letters in file names that you create on PCs and Macs.

You can also use spaces in file names. That is a different rule than for e-mail addresses where spaces are not allowed. You've probably noticed that people often use underscores or periods instead of spaces in e-mail addresses such as Madi_Jones@msu.edu. That convention is not necessary in file names, so a file name such as *Letter to Madi Jones* is valid.

**File directories and folders**

**How do I designate a file's location?** To designate a file's location, you must first specify the device where the file is stored. Each of a PC's storage devices is identified by a device letter – a convention that is specific to DOS and Windows. The main hard disk drive is usually referred to as drive C. A device letter is usually followed by a colon, so C is typically the designation for a hard disk drive.

Although the hard disk drive on a Windows computer is designated as drive C, device letters for CD, DVD, and USB flash drives are not standardized. For example, the CD-writer on your computer might be assigned device letter E, whereas the CD-writer on another computer might be assigned device letter R.

**What is a disk partition? A disk partition** is a section of a hard disk drive that is treated as a separate storage unit. Most computers are configured with a single hard disk partition that contains the operating system, programs and data. However, it is possible to create more than one hard disk partition. For example, a PC owner might set up one partition for operating system files and another partition for programs and data. This arrangement sometimes can speed up the process of disinfecting a computer that has been attacked by malicious software.

Partitions can be assigned drive letters. In the example above, the operating system files would be stored in partition C. The program and data file partition would probably be designated as drive D. Partitions are not the same thing as folders. Partitions are more permanent, and a special utility is required to create, modify or delete them.

If disk hundreds and thousands of files are stored, then for convenience of search is used the multi-level hierarchical file system which has a tree structure. Such hierarchical system can be compared, for example, to a table of contents of this textbook which represents hierarchical system of sections, heads, paragraphs and points.

The initial, root catalog contains the enclosed catalogs of the 1st level, in turn, each of the last may contain the enclosed catalogs of the 2nd level and so on. It should be noted that in catalogs of all levels also can be stored and files.

For example, in the root catalog there can be two invested catalogs of the 1st level (Catalogue_1, Catalogue_2) and one file (File_1). In turn, in the catalog of the 1st level (Catalogue_1) there are two enclosed catalogs of the second level (Catalogue_1.1 and Catalogue_1.2) and one file (File_1.1) – Figure 3.6.

The file system is a storage system of files and the organization of directories.
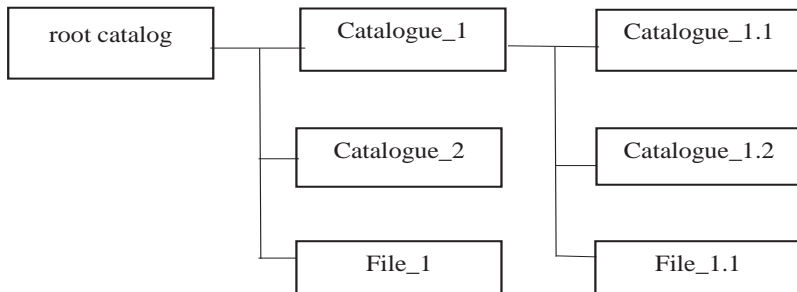
**Figure 3.6**. *Hierarchical file system*

Let us consider hierarchical file system on a specific example. Each disk has logical name (And: B: – floppy disks, With: D:, E: and so on – hard and laser disks).

In the root directory of a disk C there are two directories of the 1st level (GAMES, TEXT), and in the directory GAMES one directory of the 2nd level (CHESS). At the same time in the directory TEXT there is a proba.txt file, and in the directory CHESS – the chess.exe file (Figure 3.7).
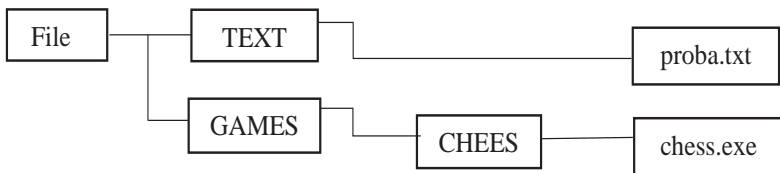
**Figure 3.7.** *Example of hierarchical file system*

**Way to the file.** How to find the available files (chess.exe, proba.txt) in this hierarchical file system? For this purpose it is necessary to specify a way to the file. The way to the file is written through separator "\" logical name of a disk and the sequence of names of the directories enclosed each other last of

which contains the necessary file. Ways to above-mentioned files can be written as follows:

C:\GAMES\CHESS\

C:\TEXT\

Way to the file together with a name of the file is called sometimes by the full name of the file. Example of a full name of the file:

C \GAMES\CHESS\chess.exe

**Representation of file system by means of the graphic interface**. MS-DOS hierarchical file system containing directories and files is provided in the Windows operating system by means of the graphic interface in the form of hierarchical system of folders and documents. The folder in Windows is analog of a directory MS-DOS.

However, the hierarchical structure of these systems is somewhat different. In the hierarchical file system, MS-DOS vertex of the object hierarchy is the root directory of the drive, which can be compared with the trunk of the tree, which grow branches (subdirectories) and leaves on the branches are located (files).

In Windows on top of the folder hierarchy is the Desktop folder. The next level is represented by My Computer, Recycle Bin, and My Network Places (if the computer is connected to the local network) – Figure 3.8.

To get acquainted with computer resources, it is necessary to open the folder My computer.

**Hierarchical system of folders Windows:**

1. In a window My computer there are icons of the disks which are available in the computer. Activation (click) of an icon of any disk removes in the left part (or below if it is WINDOWS 7) windows information on its capacity, busy and free parts.

2. Having selected one of the Type menu items (Large icons, Small-sized icons, the List, the Table), it is possible to set up the form of representation of contents of the folder.

The folder of the Networked environment contains folders of all computers connected at present to a local area network.

The Basket folder temporarily contains all remote folders and files. If necessary, the folders and documents removed and stored in the Basket can be restored.

For final removal of files it is necessary to enter team [File-Empty Basket].

**Operations over files.** In the course of work on the computer most often over files the following operations are made:
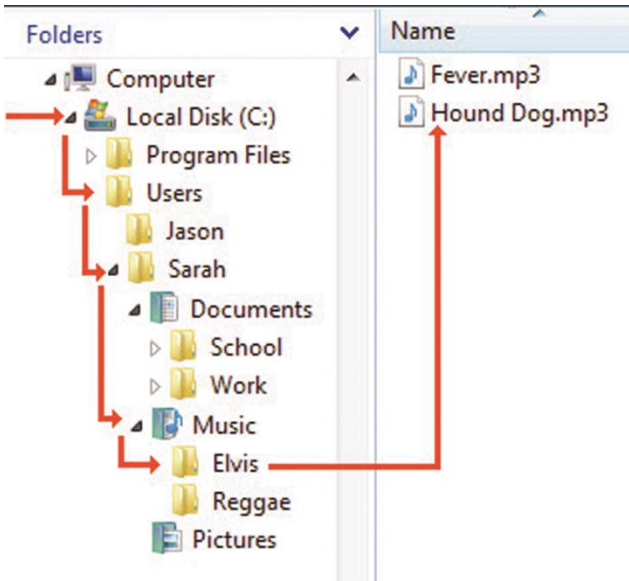
**Figure 3.8.** *Hierarchical structure of folders [1]*

- copying (the copy of the file is located in other catalog);
- movement (the file moves to other catalog);
- removal (record about the file is removed from the catalog);
- renaming (the file name changes).

The graphic interface Windows allows to perform operations over files using a mouse with use of the method Drag&Drop (drag and leave). There are also customized applications for operation with files, so-called file managers: Norton Commander, Windows Commander, Conductor, etc.

In certain cases there is a need to work with the command line interface. In Windows the operation mode with the command line interface MS-DOS is provided.

**Command line interface**

To enter a command [Programs – Session – MS-DOS] there will be an application window MS-DOS Session. In response to the invitation of system it is possible to enter the MS-DOS commands from the keypad, including teams of:

- work with files (copy, del, rename, etc.);
- teams of work with catalogs (dir, mkdir, chdir, etc.);
- teams of work with disks (format, defrag, etc.).

There are tens of the MS-DOS commands at the same time, each com-

mand has the format and parameters to remember rather difficult. To obtain the help information on command it is necessary to enter after a name of the command or a key/? For example, for obtaining the reference at the command of format in response to the invitation of system it is necessary to enter: C:\ WINDOWS&gt; format/?

### Logical structure of disks

**Formatting of disks.** In order that on a disk it was possible to store information, the disk shall be formatted, that is the physical and logical structure of a disk shall be created.

Formation of physical structure of a disk consists in creation on a disk of concentric tracks which, in turn, are divided into sectors. For this purpose in the course of formatting the magnetic head of the disk drive places in certain places of a disk tag of tracks and sectors.

The file is written to an arbitrary free sector, which can be on different tracks. For example, File_1 volume 2 of the KB could take sector 34, 35 and 47, 48, and File_2 volume 1 Kbyte sector 36 and 49.

In order to find the file by its name, the disk has a directory that represents the database.

**Kinds of formatting.** There are two various types of formatting of disks: full and quick formatting. Full formatting includes as physical formatting (quality check of a magnetic covering of a diskette and its marking on paths and sectors), and logical formatting (creation of the catalog and table of placement of files). After full formatting all information stored on a disk will be destroyed.

The quick format makes only cleaning of the root directory and file allocation table. Information, that is files, remains, and in principle restoration of file system is possible.

**Logical structure of hard drives.** The logical structure of hard drives differs from a logical structure of floppy disks a little. The minimum addressed element of a hard drive is the cluster which can include several sectors. The cluster size depends on type of the used table FAT and on the capacity of a hard drive.

On a hard drive the minimum addressed element is the cluster which contains several sectors.

**Defragmentation of disks**. Deceleration of a data exchange rate can result from fragmentation of files. Fragmentation of files (fragments of files are stored in different, deleted from each other clusters) increases eventually, in the course of deleting one files and record of others.

Since the disk can store hundreds and thousands of files and clusters, the fragmented of files will significantly decelerate access to them (magnetic

heads should move permanently from the track to the track) and finally lead in premature wear of a hard drive. It is recommended to carry out periodically defragmentation of a disk in the course of which files register in the clusters sequentially going one after another.

**Defragmentation of a disk**

1. For start of the Defragmentation of a Disk program, it is necessary to enter a command [Standard – Official – Defragmentation of a disk] from the Main menu.

2. The dialogue Select Disk panel allows to select the disk needing the procedure of defragmentation. After clicking of the OK button Defragmentation of a disk will appear loops.

3. Process of defragmentation of a disk can be watched visually if to click on the Details button. Each small square corresponds to one cluster.

### 3.5 Application software

Application programs are intended to provide application of an ADP equipment in different fields of activity of the person. In addition to creation of new software products, developers of application programs waste great efforts to enhancement and upgrade of popular systems, creation of their new versions. New versions, as a rule, support old, saving an eligibility and include a basic minimum (standard) of opportunities.
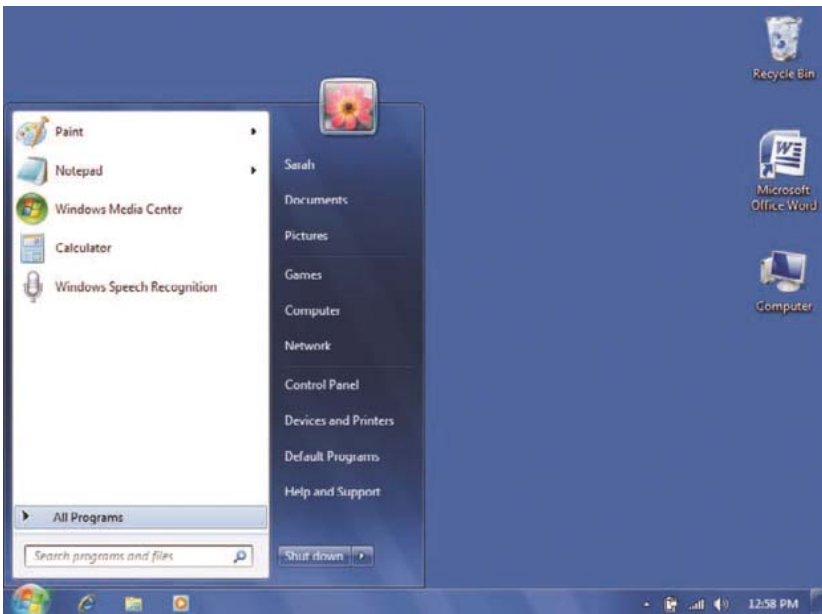


**Figure 3.9.** *The structure of the application software [1]*

One of possible options of software classification making the application software (AS) is reflected in Figure 3.9. As well as almost any classification given on a Figure is not unique. Even not all types of application programs are provided. Nevertheless, use of classification is useful for creation of general idea about AS.

### 3.6 Features of OS for mobile devices

Mobile devices became an integral part of everyday life and activities of most people around the world. Therefore, operating systems for mobile devices violently develop now.

It is accepted to carry mobile phones, smartphones and communicators to mobile devices. OS developers for mobile devices work on bringing closer possibilities of these OS to OS opportunities for desktop and portable computers. However, in OS for mobile devices there are the specifics. Their main features are the following:

**Accounting of more rigid restrictions on memory of mobile devices.** Though mobile devices actively develop, in the parameters (memory size, high-speed performance of the processor) all of them concede to desktop computers so far. Therefore, the mobile devices applications requiring the large volume of memory are reproduced on mobile devices with incomplete opportunities. A row of tools, for example Java are also available to mobile devices in the special versions developed for the purpose of memory saving with the restrictions, but not peculiar to classical versions: Java Micro Edition (JME), but not the full version – the Java Standard Edition (JSE) for desktop computers works at mobile devices. For example, there is no material arithmetics in Java and some other important opportunities.

**Accounting of lower speed of the processor.** In comparison with desktop computers, analogs of desktop applications work at mobile devices noticeably more slowly: for example, the image on the screen of the mobile phone, the text file for viewing, etc. slowly opens.

**Accounting of features of screens and screen navigators of specific models of mobile devices.** Many types of mobile devices of different firms have significantly different screens and different types of screen navigators (the trackball, etc.). By development of OS and service programs for mobile devices these distinctions should be considered that complicates software development.

**Compatibility with the main file formats**: .doc/docx, ppt/.pptx, .pdf, .jpg, etc. By operation on the mobile device it is necessary to have an opportunity to visualize, edit and create files of the same customary formats, as on

desktop computers. Support of such compatibility – one of important tasks OS and service programs for mobile devices.

**Multimedia opportunities**: Figures, video, audio, multimedia messaging. Processing of the multimedia information is especially important for mobile devices: users shall have an opportunity to take Figures, shoot video, view them on the mobile device, publish on the Internet, send to the desktop computer or in the form of the message to the correspondents.

**Support of communication and network technologies:** Wi-fi/WIMAX, Bluetooth, GPRS, EVDO, GSM, CDMA. The mobile device and its OS shall provide for users a possibility of the modern types of communication on the wireless networks.

**The market of OS for mobile devices**

Several tens of the most widespread OS are used in the market of mobile devices now. Some of them are developed on the basis of freely distributed Linux kernel. The leading producer companies of mobile devices support own OS or OS purchased together with their firms developers. The most widespread OS for mobile devices is the following:

• Nokia Symbian OS;
• Google Android;
• Windows Mobile;
• Blackberry OS;
• Apple iPhone OS;
• Samsung Bada;
• PalmOS;

Letsu consider the first four OS families for mobile devices as the most popular.

**Windows Mobile** – family of Mobile OS of Microsoft. It concerns to the Windows CE family (Consumer and Embedded) – for Windows built-in systems. The kernel of Windows Mobile OS is based on Windows CE OS.

The current Windows version of Mobile (2010) – Windows Phone Classic 6.5. In the USA the Windows Mobile – Mobile OS, the third in popularity (after BlackBerry OS and iPhone OS).

The Windows Mobile supports the following types of mobile devices: PocketPC, smartphones, communicators (for example, Qtek). The first version Windows Mobile was released in 1996.

**Windows Mobile: opportunities and software.**

Windows Mobile OS provides a various set of opportunities and the software:

**Office Mobile** – an analog of Microsoft Office for mobile devices; complete compatibility on formats;

**Windows Media Player** – the multimedia player, a player analog for Windows desktop version;

**Internet Explorer Mobile** – the Web browser, the Internet Explorer analog for Windows desktop version;

**The software for support of Bluetooth and Wi-Fi** – the modern types of communication;

**The software of Microsoft ActiveSync** for synchronization of data with desktop computers.

Windows Mobile supports the user interface with the mobile device by means of a screen contact by stylus and fingers, including (in the modern versions) – multi-touch [2].

New Windows versions of Mobile support also .NET Compact Framework that gives the chance of execution of applications for the .NET platform on mobile devices.

Mobile Windows 6 versions. Starting with version 6, Windows Mobile is issued in three major versions:

• Windows Mobile of 6 Classic – for the CPC
• Windows Mobile of 6 Professional – for communicators
• Windows Mobile of 6 Standard – for smartphones.

Custom Windows Mobile 6.5 interface is shown in Figure 3.10.

It is similar to the user interface of Windows desktop versions that significantly facilitates operation of users.

**Windows Mobile perspectives.**

Windows Mobile OS has big perspectives though the competition to another popular OS, first of all, with OS of Apple (iPhone OS) and Google (Android) becomes harder and harder. For the purpose of the competition Microsoft develops the new project – the Microsoft KIN, the new smartphone competing with the Apple iPhone.

**Symbian OS** – the Mobile OS which is most extended now developed by the consortium Symbian (Nokia, Ericsson, Psion, Motorola) founded in 1998. Nokia finances the combining Symbian Foundation which purpose is development and support uniform (for mobile devices of different companies), a mobile platform on the basis of Symbian OS. Symbian OS is developed on the basis of Psion EPOC32 OS (Psion. Language of implementation of system – C++; there is also a support of Java. The most widespread versions – Symbian OS Series 60 2nd edition; 3rd edition.

**Figure 3.10.** *User Interface Windows Mobile 6.5*

**Possibilities of Symbian OS.** Symbian OS supports the convenient user interface and has the considerable number of service programs, including – developed by Nokia vendor. The main opportunities for the user are the following:

• The menu with icons of applications;
• Contact list;
• Support built-in photo and camcorders, galleries of images and video clips; Processing of files, memory management (Smart Media);
• Web browser;
• E-mail;
• Message exchange of the SMS and MMS;
• GPS navigation support;
• Editors of a photo and video;
• Support of Java Micro Edition – loading and execution of midlets;
• Library of applications of Nokia.

**Google Android** – the application stack for mobile devices including an operating system (on the basis of Linux kernel), the middleware and service programs. The Android system is developed by Android, Inc., the acquired Google (2005) company. Now (2016) it is OS, the fourth in popularity, for smartphones in the USA. Important feature of Google Android is that service programs and libraries of this system are written on Java.

**Possibilities of Google Android.** Google Android attracts users with the convenient and esthetic user interface which is developed with use of two-dimensional and three-dimensional graphics (OpenGL library). The main opportunities of system are the following:

• SQLite DBMS for data storage;

• The supported network technologies: GSM/EDGE, IDEN, CDMA, EV-DO DO, Bluetooth, Wi-Fi, WiMAX, Bluetooth 2.0;

• Message exchange of the SMS and MMS;

• Web browser on the basis of WebKit Application Framework.

**Support of Java.** The Google for basic reasons uses in the Android system own implementation of Java – Dalvik Virtual Machine was developed especially for mobile devices. According to specialists of Google, the Java Micro Edition (JME) standard became outdated as it is expected outdated types of mobile devices and their technical capabilities. Therefore, in Google Android the JME standard is not supported.

**Support of a multimedia**. In the Google Android system, there are codecs for all widespread multimedia standards, the software for processing of multimedia files and interaction with video and audio devices.

**Applications programming support.** The Google Android system has an own integrated environment for applications programming – Android SDK which is turning on the emulator of mobile devices, debugging tools, profiling and also plug-into the popular environment Eclipse for development of Java based applications. The User Interface Google Android is shown in Figure 3.11.

**Blackberry OS** - The mobile OS with a basic set of applications working at smartphones and communicators of Research and Motion (RIM) – for example, the BlackBerry Torch 9800. The modern version of system – BlackBerry OS 6.0.

**Possibilities of BlackBerry OS.** BlackBerry OS supports a wide set of opportunities for users, including:



**Figure 3.11.** *The User Interface Google Android*

- Mark of messages and installation of time of reminders on the BlackBerry smartphone;
- Viewing of nested folders of personal contacts and editing contacts. BES

(BlackBerry Enterprise Server) inserts all user contacts into the Contacts application even if they are in different folders;
- Viewing and use of the contacts located in shared folders and their copying in the local contact list of the user, in the presence of permission;
- Viewer file for access to a shared network resource with the ability to access, add, and save documents. The ability to view information about the document, including file type, size, and date;
- Sending the invitation to meetings and records of a calendar from the BlackBerry smartphone;
- An opportunity to add, delete, move and rename personal folders;
- An opportunity to view the personal mailing list in contacts of Outlook and to send letters on it;
- The company RIM also works on the decision which will allow the letters which came from the smartphone to look the same as if they were sent from Microsoft Outlook.

**New opportunities of BlackBerry OS 6.0:**
- The new user interface intended for wide use of Multi touch-gestures, but at the same time saving possibilities of control by means of the trackball;
- Structure of a desktop similar to operating systems of Apple iOS and Android;
- The improved multimedia opportunities of OS;
- The improved opportunities for web-surfing: in the new version of OS the mobile browser on the basis of the Web Kit tool is used that allows to launch the web applications written in the HTML 5 language;
- The simplified access to mobile messages, e-mail and social networks.

**Perspectives of OS for Mobile device**

Due to the active development of mobile devices, operating systems for them have big perspectives of development. In our opinion, the main directions of further development of Mobile OS are:
- Improving and simplification of the user interface;
- The improved graphics;
- Ampler multimedia opportunities;
- Development of a set of service and game programs;
- Support of complete compatibility with desktop computers and with the file formats used on them;
- Continuation and development of use of the Java platform for mobile

devices; all leading mobile device manufacturers support the Java platform that Java technology is a warranty of development;

• Development of mobile devices: improving of resolution of screens, acceleration of processors, increase in memory size, implementation new faster of communication technologies, and support of these new opportunities in Mobile OS.

### iOS and Apple

**iOS** (formerly **iPhone OS**) is a mobile operating system created and developed by Apple Inc. exclusively for its hardware. It is the operating system that presently powers many of the company's mobile devices, including the iPhone, iPad, and iPod Touch. It is the second most popular mobile operating system globally after Android. iPad tablets are also the second most popular, by sales, against Android since 2013.[7]

Originally unveiled in 2007 for the iPhone, iOS has been extended to support other Apple devices such as the iPod Touch (September 2007) and the iPad (January 2010). As of January 2017, Apple's App Store contains more than 2.2 million iOS applications, 1 million of which are native for iPads. These mobile apps have collectively been downloaded more than 130 billion times.

The iOS user interface is based upon direct manipulation, using multi-touch gestures. Interface control elements consist of sliders, switches, and buttons. Interaction with the OS includes gestures such as *swipe*, *tap*, *pinch*, and *reverse pinch*, all of which have specific definitions within the context of the iOS operating system and its multi-touch interface. Internal accelerometers are used by some applications to respond to shaking the device (one common result is the undo command) or rotating it in three dimensions (one common result is switching between portrait and landscape mode). Apple has been significantly praised for incorporating thorough accessibility functions into iOS, enabling users with vision and hearing disabilities to properly use its products.

Major versions of iOS are released annually. The current version, iOS 10, was released on September 13, 2016. It is available for the iPhone 5 and later iPhone models, the fourth-generation iPad, the iPad Air and iPad Air 2, the iPad Pro, the iPad Mini 2 and later iPad Mini models, and the sixth-generation iPod Touch. In iOS, there are four abstraction layers: the Core OS, Core Services, Media, and Cocoa Touch layers.

### Key terms

**Blackberry OS** – the mobile OS with a basic set of applications working at smartphones and communicators of Research and Motion (RIM).

**Google Android** – the application stack for mobile devices including an operating system (on the basis of Linux kernel), the middleware (middleware) and service programs.

**Symbian OS** – the Mobile OS which is most extended now developed by consortium Symbian (Nokia, Ericsson, Psion, Motorola).

**Windows CE** (Consumer and Embedded) – Windows version for built-in systems.

**Windows Mobile** – family of Mobile OS of Microsoft.


### 3.7 Desktop application

A desktop application is a computer program that used in everyday work.

Despite the possibility of using computers to handle the different information, the most popular programs are designed to work with texts – text editors and publishing systems. Text editors are called programs for input, processing, storage and printing of textual information in user-friendly form. Experts estimate the use of the computer as a printing machine 80% of the time engagement technology.

Programs processing graphic information have become very popular. Computer graphics is currently one of the fastest growing areas of the software. It includes the input, processing and output of graphic information – drawings, photos, paintings, texts, etc. by means of computer technology. Various types of graphics systems allow you quickly to build image, introduce illustrations using a scanner or video camera, create animated videos. Graphics editors allow you to use various tools of the artist, standard libraries of images, a set of standard fonts, image editing, copying and moving the fragments through the pages of the screen.

For calculations and further processing of numeric information, there are special programs – spreadsheets. In the course of activities of any specialist is often required to present the results in tabular form, where one of the fields busy with the initial data, results of calculations and graphical analysis. Characteristic is the large volume of processed information, the need for multiple calculations in the source data changes. The automation of such routine work is doing spreadsheets. One of the most promising directions of development of computer technology is the creation of special hardware to store huge amounts of information and the subsequent non-numeric processing them, often searching and sorting. Database management system (DBMS) is used for computer processing of such databases. There are set of software tools necessary for creating, processing and displaying database records. There are several types of DBMS: hierarchical, network, relational. When working with a DBMS there are several sequential steps:

• design database;
• create a database structure;
• populate the database;
• view and edit databases;

• sorting a database;

• search for necessary entries;

• retrieve information according to certain criteria (criteria);

• creation of reports.

Typically, the most popular database management systems support these phases and provide a convenient Toolkit for their implementation.

The desire of combining the functionality of different applications into a single system is led to the creation of integrated systems. The modern concept of integration of software tools – cooperation of private application programming type systems are widely known by Microsoft Office Suite. A versatile integrated system has been developed on the principle of a unified system that contain as elements the number of programs that are useful to almost any user. These programmes include: text and graphic editors, spreadsheets, packages to develop presentations, mailers, organizers, database management system etc.

The systems included in the package are independent, moreover, they themselves are the locally integrated package, because in addition to its main tasks to support the functions of other systems. For example, Word has the ability to manipulate spreadsheets and databases and an Excel spreadsheet embedded text editor. To pair data from various software systems, they provide import and export system of exchange with conversion of data representation formats.

To the application software also includes software tools for special purposes. There is currently various special software system purpose designed for working professionals in some subject area. Such programs are referred to as the copyright of the instrumental systems. Authoring system provides an integrated environment with a given front-end shell, which the user can fill the information content of their subject area.

Among such systems, a proliferation of expert systems is. These programs behave like expert in some narrow application area. Expert systems are designed to solve problems with uncertainty and incomplete source data, requiring for their solution expertise. In addition, these systems must be able to explain his behavior and his decision.

The fundamental difference between expert systems from other programs is their adaptability, i.e. the variability in the process of learning.

Decided to allocate in expert systems three main modules:

• module knowledge base;

• module logical output;

• the user interface.

Expert systems are the basis of artificial intelligence, which are widespread in various fields of science (for example, to classify animals and plants

by species, for chemical analysis), in medicine (diagnosis, analysis of electro-cardiograms, determination of methods of treatment), in engineering (Troubleshooting technical devices, tracking the flight of space ships and satellites), political science and sociology, criminology, linguistics and etc.

In recent times popularity treatment programs of hypertext information is gained widespread. Hypertext is a form of organization of the text material is not in a linear sequence, but in the form of specifying the possible transitions (links), connections between the individual fragments. In regular text uses the normal line principle of posting information, and access to it (the text) is carried out sequentially. In hypertext systems, information similar to the text of the encyclopedia, and access to any selected text is arbitrary on the link. Organization of information in hypertext form is used when creating reference manuals, dictionaries, contextual help (Help) in application programs.

The extension of the concept of hypertext to images and audio leads to the concept of hypermedia. The idea of hypermedia has spread in network technologies, in particular the Internet technologies. The technology of the WWW (World Wide Web) made it possible to structure the vast global information resources through hypertext links. Developed software tools to create these web pages have become a highly-developed mechanisms for finding relevant information in the maze of information flows. Popular search tools in the Internet are Google, Yandex, Yahoo, AltaVista, Magellan, Rambler etc.

Multimedia (multimedia) is the interaction of visual and audio effects under the interactive control of the software. The emergence and wide dissemination of the CD-ROM (CD-ROM and DVD) made effective use of media in advertising and information services, network telecommunication technologies in education.

Multimedia play and learning system begin to replace the traditional «paper libraries». Today, DVD libraries you can «walk» through the museums of the Moscow Kremlin, etc. with the help of «electronic guide» to explore different academic disciplines, programming languages, etc.

A separate group of application software is software professional level. Each application in this group focuses on a fairly narrow subject area, but penetrates into it as deeply as possible. So, there are many ways – the automated systems of scientific research, each of which is «tied» to a particular academic field, CAD computer aided design, each of which also operates in a narrow field, ACS – the automated control systems (which are in the 60-70 was developed thousands).

**Control questions:**
1. How do we understand the software?
2. What types of operating systems exist?

3. Classification software systems in the areas of usage.

4. What is the structure of the system software?

5. Stages of development of operating systems.

6. Classification of operating systems.

7. What is file system?

8. What programs are included in the "Standard"?

9. What programs are included in the "Office"?

10. Classification of PPO.

11. Types and characteristics of operating system for mobile devices.

12. Desktop application.

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# CHAPTER 4. HUMAN-COMPUTER INTERACTION

Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of main phenomena surrounding them. Researchers in the field of HCI both observe the ways in which humans interact with computers and design technologies that let humans interact with computers in novel ways.

Researchers in HCI are interested in developing new design methodologies, experimenting with new devices, prototyping new software and hardware systems, exploring new interaction paradigms, developing models and theories of interaction [1-5].

HCI differs from human factors and ergonomics as HCI focuses more on users working specifically with computers, rather than other kinds of machines or designed artifacts. There is also a focus in HCI on how to implement the computer software and hardware mechanisms to support human-computer interaction. Thus, human factors are a broader term; HCI could be described as the human factors of computers, although some experts try to differentiate these areas.

HCI also differs from human factors in that there is less of a focus on repetitive work-oriented tasks and procedures, and much less emphasis on physical stress and the physical form or industrial design of the user interface, such as keyboards and mouse devices.

Three areas of study have substantial overlap with HCI even as the focus of inquiry shifts. In the study of personal information management (PIM), human interactions with the computer are placed in a larger informational context - people may work with many forms of information, some computer-based, many not (e.g., whiteboards, notebooks, sticky notes, refrigerator magnets) in order to understand and effect desired changes in their world. In computer-supported cooperative work (CSCW), emphasis is placed on the use of computing systems in support of the collaborative work of a group of people. The principles of human interaction management (HIM) extend the scope of CSCW to an organizational level and can be implemented without use of computers.

HCI covers next fields (see Figure 4.1):
- Computer Science
- Psychology (cognitive)
- Communication
- Education
- Anthropology
- Design (e.g. graphic and industrial)

Traditionally, the ergonomics (ergonomics) are engaged in studying physical characteristics for machines and systems, and how they affect the user work. The human factor (Human Factors) also deals with these problems. The term "ergonomics", "human factor" is designated the same, but the term "human factor" usually uses in the USA. Both from these disciplines study work with the user in any system context, the computer or the mechanism. As computer usage became more widespread and the researchers number specializing in interaction between people and computers studying, the researches originally known under the name man-machine interaction increases, became human-computer interaction.
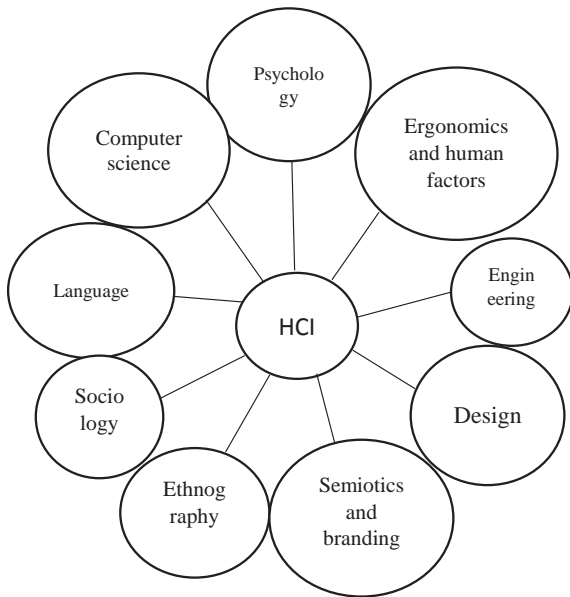


**Figure 4.1.** *Field of HCI*

Speaking about human-computer interaction, do not provide the unique user with the desktop computer. Imply the individual user, group of users working together. The user – the one who performs work, using technologies. Imply any technology from the desktop computer to computer system of large scale or a management system by the computer production process. Interaction implies any communication between the user and the computer. In fact, it is important that the user interacts with the computer to achieve specific purposes [1- 10].

**Why researches are needed in this area?**

In spite of the fact that today the huge number of software products is issued, only the few from them are distinguished by really practical program user interface, and the software products quantity possessing the overall high level a practicality and that are less. For creation really one interface professional product insufficiently. The esthetic attractive interface differing in universality and depth is required. Undoubtedly, one user interfaces shall be the key moment for software designers. Software designers shall understand the user, user needs and work environment.

Computer systems require that users remembered too much information, they are often intolerant even on insignificant errors. These and other questions consider in software design case [1].

In the last decades most of computer users were as well computer systems programmers and designers. Therefore, the person using computer system, probably was dipped in the same agreements and culture as an individual who developed it. The last years an everyday occurrence became users, not computer professionals. As a result, designer any more not an equivalent to the user. In this situation designers need workbenches and methods which will give information on opportunities and user restrictions, on his requirements to the developed system.

### 4.1 Human-computer interaction outline

The term "human-computer interaction" gives the general definition of discipline, but does not justice to the true complexity and multidisciplinary character on subject. Subject versatility allows to give five definitions, each of which describes one aspect of human-computer interaction. This determination reflects different study (Figure 4.2).

*Research on hardware and software*

The keypad, a mouse, the base unit, the monitor belongs to the hardware of the computer interface. The software contains everything that helps the user to see, hear, mark, touch on the computer screen, and also studies information with which the user works, human-computer interaction not only how the existing input-output technologies affect interaction but also as new technologies like voice recognition will influence interaction. These research purposes consist in developing new technologies and offer their best usage.

*Compliance models research*

HCI studies how the compliance models for user interacts with computer systems. Computer system models correspond to the user task. Compliance achievement requires understanding the user task and system opportunities. Users knowledge is necessary to work with system and understanding as users apply the knowledge – center of the research aimed at prediction and the user behavior description in HCI case.

Organizational influences research

Design research

Research tasks

Research models

Research on hardware and software
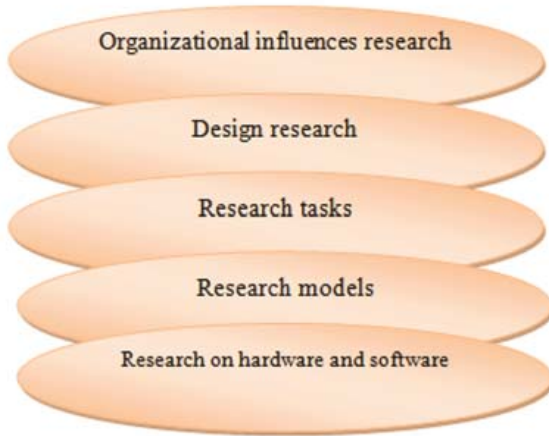
**Figure 4.2.** *HCI different areas representations*

HCI is engaged in development methods to knowledge model, which the user possesses and represents, being guided by the task. Its purpose consists in giving the chance to designers to create more than systems, suitable for use, leaning on the user model the task and systems.

*Research tasks*

Here it is researched the task nature, its characteristic and information on users needs.

The purpose HCI consists in studying the task and to develop execution task methods and provide users needs with functions, which they really need, and information which they require without excessive efforts from their side.

*Design research*

HCI studies design process. The design stage in many program products lifecycles suffers also from the inadequate specification, and from a communication lack between design group members. The specification - process where on system requirements and functions it is agreed, or are betrayed to designers in the document form (technical specification, technical task). One of the principal hindrances to systems good design that many designers pay more attention to systems technical elegance than their practical suitability. The HCI purpose consists in offering as the design can be improved, considering user needs.

*Organizational influences research*

At last, HCI is influence study which new systems have on the organization and on the personality in groups within the companies or corporations. The research in HCI is directed to expertize impact which the new system

makes for personal users roles and user groups within the organization. The purpose on such research consists in offering both execution design and methods which could prevent problems like contradictions between groups.

HCI artificially partitioned into this five-additional determination. On the one hand, this division is useful to describe the purposes and tasks HCI, but actually these areas are difficult to distinguish one from another. The true determination considers multidisciplinary approach to a different number, but the connected problems. A question in volume what disciplines promote human-computer interaction [5-9].

The HCI purpose is acquaintance to the main ideas and problems in the user interfaces software development sphere, with the interfaces principles and standards, the software interfaces quality assessment techniques. Concepts are inseparably linked with it: ergonomics, usability, interface, user.

Factors, significant for HCI:

• HCI ergonomics;

• HCI surrounding (handshaking, hypermedia and Web, communication means);

• systems design and development oriented on the user;

• user's models (perception, motility, thinking, interaction, operation organization, adaptation to a diversity);

• convenient user HCI development principles;

• usability criteria and check.

Let us define and will consider in more detail the listed concepts.

Ergonomics (from Greek Ergon – operation and nomos – the law), the scientific discipline which is in a complex studying the person (group of people) in his activities specific conditions in the modern production.

Functionomics – the section of ergonomics researching algorithms of action of the person operator in ergatic systems.

It includes:

• development trainers, the simulating installations and test benches for determination on ergonomic indices;

• trainers and fatigue research for this type of activity and information perception conditions;

• techniques functioning development for the person operator in a control circuit;

• control methods development on a psycho-physiological person status (the operator).

Usability ("an opportunity to be used") something is a level of its usability. Also, a usability call a certain doctrine among developers of user interfaces, including web interfaces.

The usability in fact is the ergonomics section devoted to software deve-

lopment. Some researchers read that the usability and ergonomics are separate concepts as the ergonomics places emphasis on physiological convenience, and the usability considers psychological aspects more than ergonomics.

Nowadays the term "usability" is even more often used as "ergonomics" synonym in the such products context as consumer electronics or communication means. Informally it is also used in relation to mechanical objects efficiency, such as the door pen or the hammer.

## 4.2 Principles and methodology

Human-computer interaction studies the ways in which humans make, or do not make, use of computational artifacts, systems and infrastructures. Most of the research in the field seeks to improve human-computer interaction by improving the usability of computer interfaces. How usability is to be precisely understood, how it relates to other social and cultural values and when it is, and when it may not be a desirable property of computer interfaces is increasingly debated [9-11].

Most of the research in the field of human-computer interaction takes an interest in:

1. Methods for designing novel computer interfaces, thereby optimizing a design for a desired property such as, e.g., learnability or efficiency of use.

2. Methods for implementing interfaces, e.g., by means of software libraries.

3. Methods for evaluating and comparing interfaces with respect to their usability and other desirable properties.

4. Methods for studying human computer use and its sociocultural implications more broadly.

5. Models and theories of human computer use as well as conceptual frameworks for the design of computer interfaces, such as, e.g., cognitivist user models, Activity theory or ethnomethodological accounts of human computer use.

Perspectives that critically reflect upon the values that underlie computational design, computer use and HCI research practice [12-13].

Visions of what researchers in the field seek to achieve vary. When pursuing a cognitivist perspective, researchers of HCI may seek to align computer interfaces with the mental model that humans have of their activities. When pursuing a post-cognitivist perspective, researchers of HCI may seek to align computer interfaces with existing social practices or existing sociocultural values.

## 4.3 Human-computer interface

The human-computer interface can be described as the point of commu-

nication between the human user and the computer. The flow of information between the human and computer is defined as the loop of interaction. The loop of interaction has several aspects to it, including:

- Visual Based: The visual based human computer inter-action is probably the
- most widespread area in HCI research.
- Audio Based: The audio based interaction between a computer and a human is
- another important area of in HCI systems. This area deals with information acquired by different audio signals.
- Task environment: The conditions and goals set upon the user.
- Machine environment: The environment that the computer is connected to, e.g. a laptop in a college student's dorm room.
- Areas of the interface: Non-overlapping areas involve processes of the human and computer not pertaining to their interaction. Meanwhile, the overlapping areas only concern themselves with the processes pertaining to their interaction [14-17].
- Input flow: The flow of information that begins in the task environment, when the user has some task that requires using their computer.
- Output: The flow of information that originates in the machine environment.
- Feedback: Loops through the interface that evaluate, moderate, and confirm processes as they pass from the human through the interface to the computer and back.
- Fit: This is the match between the computer design, the user and the task to optimize the human resources needed to accomplish the task.

### 4.3.1 User interface and its types

Developers of the program complexes often consider the user interface separately from system functionality. As a rule, users of programs do not separate functionality and the user interface. Interface (PI) is the program. For them if the interface is suitable so, and the program will be good and convenient. The set of the elements will be understant allowing the user of the program to control its operation as the user interface (UI) of the program and to receive the required results [18-20].

The user interface is often understood only as the program appearance. However, in practice the user perceives through PI all system in general, so such understanding PI is too narrow. Actually, PI includes all design aspects which exert impact on the user and system interaction. It not only the screen which is seen by the user. The user interface consists from components set, such as:

• user problems set, which he solves by system means

• the metaphor used by system (for example, a desktop in MS Windows, views on Android OS, etc.);

• controls system;

• navigation between system units;

• visual (and not only) program design screens.

Almost in information systems implementation of overall effectiveness the organization increases, at the same time researches row shows that efficiency in comparison with just implemented IC can significantly increase by competently developed PI.

*User interfaces structure and classification*

In the user interface design it is possible to select decorative and active components conditionally. The elements which are responsible for esthetic attractiveness program product concern to the first. The active elements are subdivided into operational and information computation models images and the controlling means the user interface by means, which the user controls the program. The program products of different classes controlling means can differ considerably. Therefore, it is necessary to carry out at least preliminary interfaces classification and the controlling means corresponding to them.

At the first classification level it is useful to select interfaces classes, which origin is connected to the used basic technical means of human-computer interaction (table 1). Historically appearance for such means causes origin on new classes of the user interface. However, with the advent new means usage of interfaces old classes not necessarily completely stops. Classes of the interface are too wide concepts. It is expedient to break the classes set by basic interactive means into subclasses, for example, within a graphic class subclasses differ: two-dimensional and three-dimensional interfaces. On this classification, the widespread WIMP interface (Windows-Icons-Menus-Pointing device) belongs to the first of the specified subclasses. Today such new classes of interfaces as SILK develop (speech), biometric (mimic) and semantic (public).

Also, the new type of the user interface – tactile began to gain distribution. This area is not rather studied, the equipment based on tactile feelings appeared quite recently. Tactile devices, unlike other interactive devices, are capable both "to feel", and to transfer information. Thus, designers of haptic interfaces consider two equally important sides: tactile feelings (feeling of a contact) and "kinesthetic" (kinesthetic) feeling (feeling where there is a body). These devices have the general feature: they are supplied with means force feedback, such as PHANTOM which obtains the position information and gesture, and returns value of force applied in a point.

**Table 4.1.** *Classification of the user interface controlling means*

| Interface classes | Subclasses | Controlling means types examples |
|---|---|---|
| Symbol | Command line interface | "Question-answer" Command line |
| GUI | Simple graphical | Screen forms |
| | | Direction keys |
| | Truly graphical 2D | Menu |
| | | Graphical management elements |
| | 3D | Direct manipulations |
| | | Conical trees |

Thus, the user can feel the rigid object form, including through several layers of different resistance when pressing on an external surface (that is useful, for example, in surgical simulators).

As it is already marked above, two essentially different approaches to the organization user interface were issued now. The first, historically earlier approach consists in provision to the user a command language in which programs start is issued in the separate commands form. This approach is known as the command line interface (Command Line Interface – CLI).

Alternative approach consists in the symbolical image of available actions in the form of pictures – icons (icons) on the screen and provision to the user an opportunity to select actions by mouse or other coordinate input equipment means. This approach is known as the graphic user interface. Graphical User Interface – (GUI). One of GUI subclasses (two-dimensional) can be designated an WIMP (Windows-Icons-Menus-Pointing device) abbreviation that reflects the involved interactive entities windows, icons, the menu and the positioning device (usually a mouse). The interfaces of this kind won popularity together with Macintosh in 1984 and later copied, in particular, in Windows for the PC dominate to this day.

Developers of the modern OS usually provide means for implementation of both approaches and often a jacket, the using both types of interfaces. At figure.4.3 is shown in classification of tools for user interface evaluation [11].

Basic principles on creation of the interface:

1. Naturalness (intuitivism). Operation system does not cause in the user on difficulties in search on necessary directives (interface elements) for process control the objective solution

2. Consistency. Some working methods are used in the course and on operation system by the user with some part of system, then in other part of system working methods will be identical. Also, operation with system via the interface meets the set, customary standards (for example, use of the ENTER key).

3. Not redundance. It means that the user can enter only the minimum information for operation or system management. For example, the user shell not enter insignificant digits (00010 instead of 10). Similarly, it is impossible to demand from the user to enter information which beforehand was entered or which can be automatically received from system. It is desirable to use values by default where it is only possible to minimize information input process.
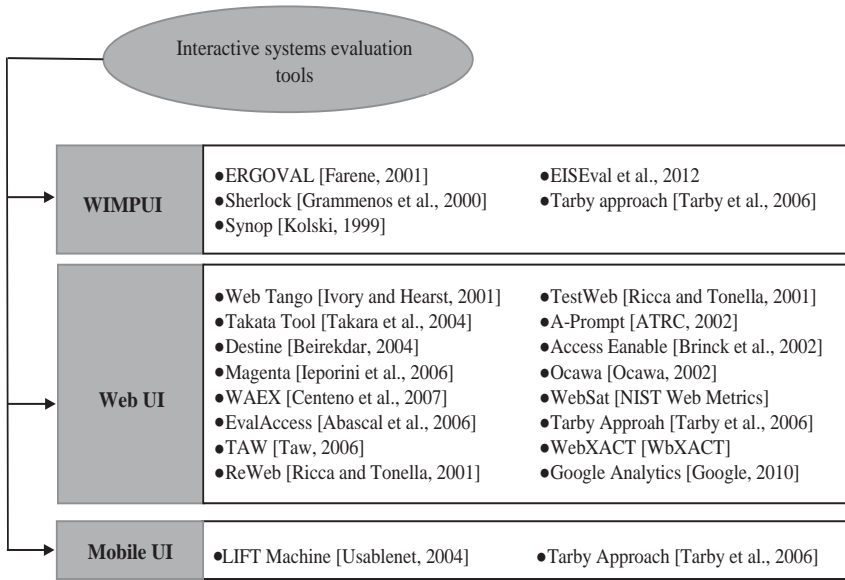


**Figure 4.3.** *Classification of the tools for user interface evaluation Source*

4. Direct access to system of the help. In the course of operation, it is necessary that the system provided the user with necessary instructions. The system of the help responds three main aspects _ quality and quantity of the provided commands; character of error messages and confirmation that the system does. Error messages will be useful and clear to the user. The ideal error message will answer only three questions:
• what the problem consists in?
• how to correct this problem now?
• how to make so that the problem did not repeat?
At the same time, perhaps more polite and clear users need to answer these questions with language.
5. Flexibility. The system interface will service the user with training different levels. For novice users, the interface can be organized as hierarchical structure of the menu, and for experienced users as commands, keys and parameters clicking combinations.

### 4.3.2 User interface quality

The principles of user interface design are intended to improve the quality of user interface design. According to Larry Constantine and Lucy Lockwood in their usage-centered design, these principles are:

• The structure principle:

The design should organize the user interface purposefully, in meaningful and useful ways based on clear, consistent models that are apparent and recognizable to users, putting related things together and separating unrelated things, differentiating dissimilar things and making similar things resemble one another. The structure principle is concerned with overall user interface architecture.

• The simplicity principle:

The design should make simple, common tasks easy, communicating clearly and simply in the user's own language, and providing good shortcuts that are meaningfully related to longer procedures.

• The visibility principle:

The design should make all needed options and materials for a given task visible without distracting the user with extraneous or redundant information. Good designs do not overwhelm users with alternatives or confuse with unneeded information.

• The feedback principle:

The design should keep users informed of actions or interpretations, changes of state or condition, and errors or exceptions that are relevant and of interest to the user through clear, concise and unambiguous language familiar to users.

• The tolerance principle:

The design should be flexible and tolerant, reducing the cost of mistakes and misuse by allowing undoing and redoing, while also preventing errors wherever possible by tolerating varied inputs and sequences and by interpreting all reasonable actions.

• The reuse principle:

The design should reuse internal and external components and behaviors, maintaining consistency with purpose rather than merely arbitrary consistency, thus reducing the need for users to rethink and remember.

According to Jef Raskin [16] in his book "The Humane Interface", there are two laws of user interface design, based on the fictional laws of robotics created by Isaac Asimov [11-18]:

First Law: A computer will not harm your work or, through inactivity, allow your work to come or harm.

Second Law: A computer will not waste your time or require you to do more work than strictly necessary.

Jef Raskin also mentions that «users should set the pace of an interaction», meaning that a user should not be kept waiting unnecessarily.

All great interfaces share eight qualities or characteristics:

1. **Clarity.** The interface avoids ambiguity by making everything clear through language, flow, hierarchy and metaphors for visual elements.

2. **Concision**[11]. It is easy to make the interface clear by over-clarifying and labeling everything, but this leads to interface bloat, where there is just too much stuff on the screen at the same time. If too many things are on the screen, finding what you are looking for it is difficult, and so the interface becomes tedious to use. The real challenge in making a great interface is to make it concise and clear at the same time.

3. **Familiarity**[12]. Even if someone uses an interface for the first time, certain elements can still be familiar. Real-life metaphors can be used to communicate meaning.

4. **Responsiveness**[13]. A good interface should not feel sluggish. This means that the interface should provide good feedback to the user about what is happening and whether the user's input is being successfully processed.

5. **Consistency**[14]. Keeping your interface consistent across your application is important because it allows users to recognize usage patterns.

6. **Aesthetics**. While you do not need to make an interface attractive for it to do its job, making something look good will make the time your users spend using your application more enjoyable and happier users can only be a good thing.

7. **Efficiency**. Time is money, and a great interface should make the user more productive through shortcuts and good design.

### 4.3.3 User interface model

User interface modeling is a development technique used by computer application programmers. Today's user interfaces (UIs) are complex software components, which play an essential role in the usability of an application. The development of UIs requires therefore, not only guidelines and best practice reports, but also a development process including the elaboration of visual models and a standardized notation for this visualization.

Languages for user interface modeling:

MARIA XML (Model-based language for Interactive Applications) is a universal, declarative, multiple abstraction level, XML-based user interface markup language for modelling interactive applications in ubiquitous environments;

UML, some aspects of user interface modeling can be realized using UML. However, the language is not mainly intended for this kind of modeling, which may render the models somewhat synthetic;

UML is an extension of UML, and adds support for representation commonly occurring in user interfaces;

UsiXML (USer Interface eXtensible Markup Language) is an XML-based specification language for user interface design. It supports the description of UI for multiple contexts of use such as Character User Interfaces (CUIs), Graphical User Interfaces (GUIs), Auditory User Interfaces, and Multimodal User Interfaces.

DiaMODEL combines a dataflow-oriented language (Pisa interactor abstraction) with UML Statecharts which has focus on behavior. It is capable of modeling the dataflow as well as the behavior of interaction objects. It may be used for documenting the function and structure of concrete user interfaces.

The different aspects of a user interface require different model types. Some of the models that may be considered for UI-modeling are [11-17]:

• Domain model, including data model (defines the objects that a user can view, access and manipulate through the user interface);

• Navigation model, defines how the objects that a user view could be navigated through the user interface;

• Task model (describes the tasks an end user performs and dictates what interaction capabilities must be designed);

• User model (represents the different characteristics of end users and the roles they are playing within the organization);

• Platform model (used to model the physical devices that are intended to host the application and how they interact with each other);

• Dialogue model (how users can interact with the objects presentation (as push buttons, commands, etc.), with interaction media (as voice input, touch screen, etc.) and the reactions that the user interface communicates via these objects);

• Presentation model (application appearance, representation of the visual, haptic and auditory elements that the user interface offers to its users);

• Application model (commands and data the application provides).

UML can be used for several of the models mentioned above with varying degree of success, but it lacks support for user modeling, platform modeling and presentation model.

Himalia combines the Hypermedia Models with the control/composite paradigm. It is a full user interface language, it may be used for specifying but also for running it, because of this the designer tool can be categorized as a guilder [10-20].

There exist several approaches to modeling a user interface:

1. Usage-centered design -the modeling task is to show how the actual presentation of a planned system and how the user interaction is supposed to happen.

2. Code–inspection based–inspect the code through meta–programming and assemble a structural model that is transformed to the UI. This approach addresses information restatement. These approaches do not fit to adaptive and context–aware UIs.

3. Generative programming–connect domain methods with GPL, address cross–cutting concerns although only at compile–time, which does not fit to future adaptive UIs that need runtime information.

4. Aspect–based UIs–integrates advantages of code–inspection based and generative programming approaches. It inspects existing code and applies aspect oriented methods to address cross–cutting concerns. It works at runtime, reduces information restatement and at the same time separates UI concerns which allows to reuse each independent of others.

5. Content models– show the contents of a user interface and its different components [14–20].

**Graphic user interface**

*User interface metaphors*

*Metaphor No. 1: servant.*

Still this metaphor of the interface of the user of wide circulation in "re-ali–ty" (real computer systems) did not receive, despite the historical background which is obviously present at the name. Really, servants existed almost at all times, it is perfectly known what shall be the good servant – executive, unostentatious, inexpensive, always accompanying the master. According to these historical canons also the new direction in the user interface and computing in general – ubiquitous computing which is actively developed at research center of Xerox in Palo Alto.

The main idea of the user interface – "servant" – total absence this interface, more precisely, its absolute invisibility. Just your alarm clock, having rung out in the morning, notifies your coffee maker on the master's "reveille", the coffee maker asks whether you want some coffee, at this time news are brought to a wall graphic panel (taking into account your interests and tastes), the water temperature loved by you in a trough and so on is set. It is natural that all this is carried out by means of an extensive network of independent controllers (how many services – so many are servants).

*Metaphor No. 2: accelerator*

According to this idea UI allows to accelerate considerably user interaction processes with machine, to reduce as the necessary operations number for setting tasks, and to facilitate (so, and to accelerate) perception and realization results of execution of these tasks. In "realification" this metaphor is present at quality of a conceptual basis of all systems, the first stage specialized, intended for operation in real time and high–critical to reliability. Here everything becomes to minimize the controlling interface organs, one–two buttons, the

multiposition lever (a joy stick analog), head and sheens positioning systems.

*Metaphor No. 3: desktop*

The most widespread UI metaphors which is rather reminding the real desktop - folders, papers, tools – all in a heap is also carefully mixed. Essential shortcomings: so-called problem "four" (select itself, recall itself, know itself, guess itself) and objects abstractions representation limitation documents hierarchy concept. Manipulations with "the virtual documents" (windows, screens and so on) convenience is sufficiently compensated by absence of well thought over mechanisms of association of an object abstraction (the file, the document) with a set of available tools. For example, at MS Windows (the Russian-language version) in the interface there are such objects abstractions as files and folders (even the confusion as file in original value means "filing of papers", i.e. as if the folder is concluded here), but their processing instruments are named programs, and the tools to objects based compliance mechanism on trigram files names extensions does not withstand any criticism. In Unix, more precisely, in Unix graphic shell, the same shortcomings aggravated generally a big difference in UI control elements separate workbenches implementations.

*Metaphor No. 4: the virtual reality*

Determination creates the interface the most natural to the user which is brought closer to "habitat". The most serious shortcomings are connected to need creation three-dimensional naturalistic models for absolutely abstract "things" and tools. Already there is a row of implementations both for Windows, and for Unix (concerning convenience these implementations disputes there is no consensus: some read such interface, for example, files conical trees, the most natural and convenient, future will force out all remaining interfaces versions, to others traveling along the file system virtual corridors and visit the virtual managers on different devices). In spite of the fact that productivity practically any modern PC allows to implement if not especially three-dimensional then pseudo-three-dimensional models similar interfaces, however they were not widely adopted unless in the future they can take the worthy place in highly specialized systems.

*Set-theoretic metaphor*

The most unpleasant moment in all the UI metaphors given above is very feeble reflection multidimensionality for virtual "world" data objects and tools. The association problem is generally not solved in one existing interface (it is possible to assign for files with the appropriate program extensions which will be caused in execution case of some activating action, but it is purely mechanical and local association). "Disparate" semantic value of interface elements can even sometimes lead to absolutely unexpected consequences (usage the button, remarkable on intuitivism, with "Cancel" text is recalled directly in case of installation of the Windows NT, clicking "Next..." continues instal-

lation). The language metaphor (command line) is optimum by opportunities, but is rather difficult mastering and requires remarkable knowledge that significantly restricts systems scopes created according to it.

Perhaps, the offered metaphor option for the interface will seem, at first sight, a little unusual, however some rational grain is also in it. So, there are two sets: data objects and tools. The good interface task - to be able to associate automatically the object selected by the user with a set of the tools capable to modify this object and represent this association results to the user in the "digestible" form. The interface will be intuitively clear that in our case defines accurate demarcation between objects data and tools programs. The interface will be rather universal, i.e. to the meeting requirements for different user groups (multidimensionality), first of all, two the most important for continuous existence at any computer system their categories: creators and the customers defined in relation to the used software tools (creators - create new, and customers - use already existing software tools).

The interface will be uniform for all applications within one system and at the same time not frightening users by "ultramodern". The Oberon system developed by N. Wirth became the first serious and very successful attempt formulation and implementation the interface similar metaphor (this statement belongs more to Oberon initial versions as in the last implementation the standard metaphor of a desktop is accepted).

Metaphor, being the best means for user training disposal does not mean good. On the other hand, metaphors sometimes after all work (to take the same musical programs) so a certain favor could be received. Analyzing experience of successful cases on their application, it is possible to output the following rules:

• it is dangerous to copy completely a metaphor, it is enough to take from it of the best;

• it is not mandatory to take a metaphor from the real world, it can safely be invented most;

• most effectively metaphorically to explain separate objects value: for example, for the graphic program layers can be represented as the glass sheets put at each other (this example is suitable also for the PageMaker program);

• if the metaphor somehow restricts system, it will be necessary to refuse it immediately.

Adding, one may say, that it is possible to apply a metaphor, but carefully.

*Graphical user interface elements*

Graphical user interface elements are those elements used by graphical user interfaces (GUIs) to offer a consistent visual language and represent information stored in computers. These make it easier for people with few computer skills to work with and use computer software

*Window*

A window is an area on the screen that displays information, with its contents being displayed independently from the rest of the screen. An example of a window is what appears on the screen when the "My Documents" icon is clicked in the Windows Operating System. It is easy for a user to manipulate a window: it can be shown and hidden by clicking on an icon or application, and it can be moved to any area by dragging it (that is, by clicking in a certain area of the window usually the title bar along the tops and keeping the pointing device's button pressed, then moving the pointing device). A window can be placed in front or behind another window, its size can be adjusted, and scroll-bars can be used to navigate the sections within it. Multiple windows can also be open at one time, in which case each window can display a different application or file – this is very useful when working in a multitasking environment. The system memory is the only limitation to the number of windows that can be open at once. There are also many types of specialized windows.

*A container window* is a window that is opened while invoking the icon of a mass storage device, directory or folder and which is presenting an ordered list of other icons that could be again some other directories, data files or maybe even executable programs. All modern container windows could present their content on screen either acting as browser windows or text windows. Their behavior can automatically change according to the choices of the single users and their preferred approach to the graphical user interface.

*A browser window* allows the user to move forward and backwards through a sequence of documents or web pages. Web browsers are an example of these types of windows.

*Text terminal* windows are designed for embedding interaction with text user interfaces within the overall graphical interface. MS-DOS and UNIX consoles are examples of these types of windows.

A child window opens automatically or as a result of a user activity in a parent window. Pop-up windows on the Internet can be child windows.

A message window or dialog box is a type of child window. These are usually small and basic windows that are opened by a program to display information to the user and/or get information from the user. They usually have a button that must be pushed before the program and can be resumed.

*Menus*

Menus allow the user to execute commands by selecting from a list of choices. Options are selected with a mouse or other pointing device within a GUI. A keyboard may also be used. Menus are convenient because they show what commands are available within the software. This limits the amount of documentation the user reads to understand the software [2].

*A menu bar* is displayed horizontally across the top of the screen and/or

along the tops of some or all windows. A pull-down menu is commonly associated with this menu type. When a user clicks on a menu option the pull-down menu will appear [3-4].

*A menu* has a visible title within the menu bar. Its contents are only revealed when the user selects it with a pointer. The user is then able to select the items within the pull-down menu. When the user clicks elsewhere the content of the menu will disappear [5].

*A context menu* is invisible until the user performs a specific mouse action, like pressing the right mouse button. When the software-specific mouse action occurs, the menu will appear under the cursor [3].

Menu extras are individual items within or at the side of a menu.

*Icons*

An icon is a small picture that represents objects such as a file, program, web page, or command. They are a quick way to execute commands, open documents, and run programs. Icons are also very useful when searching for an object in a browser list, because in many operating systems all documents using the same extension will have the same icon.

*Controls (or widgets)*

Interface elements known as graphical control elements, controls or widgets are software components that a computer user interacts with through direct manipulation to read or edit information about an application. Each widget facilitates a specific user-computer interaction. Structuring a user interface with Widget toolkits allow developers to reuse code for similar tasks, and provides users with a common language for interaction, maintaining consistency throughout the whole information system. Common uses for widgets involve the display of collections of related items (such as with various list and canvas controls), initiation of actions and processes within the interface (buttons and menus), navigation within the space of the information system (links, tabs and scrollbars), representing and manipulating data values (labels, check boxes, radio buttons, sliders, spinners).

*Tabs*

A tab is typically a rectangular small box, which usually contains a text label or graphical icon associated with a view pane. When activated the view pane, or window, displays widgets are associated with that tab; groups of tabs allow the user to switch quickly between different widgets. This is used in the web browsers Firefox, Internet Explorer, Conqueror, Opera and Safari. With these browsers, you can have multiple web pages open at once in one window, and quickly navigate between them by clicking on the tabs associated with the pages. Tabs are usually placed in groups at the top of a window, but may also be grouped on the side or bottom of a window. Tabs are also present in the settings panes of many applications. Windows for example uses tabs in most of its control panel dialogues.

*Interaction elements*

Interaction elements are interface objects that represent the state of an ongoing operation or transformation, either as visual remainders of the user intent (such as the pointer), or as affordances showing places where the user may interact.

*Cursor*

A cursor is an indicator used to show the position on a computer monitor or other display device that will respond to input from a text input or pointing device.

*Pointer*

The pointer echoes movements of the pointing device, commonly a mouse or touchpad. The pointer is the place where actions take place that are initiated through direct manipulation gestures such as click, touch and drag.

*Insertion point*

The caret, text cursor or insertion point represents the point of the user interface where the focus is located. It represents the object that will be used as the default subject of user-initiated commands such as writing text, starting a selection or a copy-paste operation through the keyboard.

*Selection*

A selection is a list of items on which user operations will take place. The user typically adds items to the list manually, although the computer may create a selection automatically.

*Adjustment handle*

A handle is an indicator of a starting point for a drag and drop operation. Usually the pointer shape changes when placed on the handle, showing an icon that represents the supported drag operation.

**Control questions:**
1. What includes a concept human-computer interaction?
2. Transfer human-computer interaction fixed funds.
3. The person and computer interaction organization.
4. Dialogue interaction features.
5. The human-computer interface concept and functions.
6. The user interface concept at the practical and theoretical levels.
7. Metaphor concept.
8. Metaphor forming user mental model, examples.
9. Shortcomings on UI modelling approaches.
10. User interface development process.
11. Preliminary operation during new application interface creation.

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19. HCI Models, Theories and Frameworks: Toward a multidisciplinary science edited by John Carroll (2003) provides an in-depth introduction to the most influential theoretical approaches across the HCI field.

20. Research methods for human-computer interaction. Paul Cairns and Anna Cox (Cambridge University Press 2008) that explains the nature of HCI research, and the range of methods used, within the context of academic HCI from a UK perspective.

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**Academic journals for HCI:**
ACM Transactions on Computer-Human Interaction
Behaviour & Information Technology
Interacting with Computers
International Journal of Human-Computer Interaction
International Journal of Human-Computer Studies
Human-Computer Interaction

**Conferences related to HCI:**
1. ASSETS: ACM International Conference on Computers and Accessibility
2. CSCW: ACM conference on Computer Supported Cooperative Work
3. CC: Aarhus decennial conference on Critical Computing
4. DIS: ACM conference on Designing Interactive Systems
5. ECSCW: European Conference on Computer-Supported Cooperative Work
6. GROUP: ACM conference on supporting group work

7. HRI: ACM/IEEE International Conference on Human-Robot Interaction

8. ICMI: International Conference on Multimodal Interfaces

9. ITS: ACM conference on Interactive Tabletops and Surfaces

10. MobileHCI: International Conference on Human-Computer Interaction with Mobile Devices and Services

11. NIME: International Conference on New Interfaces for Musical Expression

12. OzCHI: Australian Conference on Human-Computer Interaction

13. TEI: International Conference on Tangible, Embedded and Embodied Interaction

14. Ubicomp: International Conference on Ubiquitous computing

15. UIST: ACM Symposium on User Interface Software and Technology

16. I-USER: International Conference on User Science and Engineering

17. INTERACT: IFIP TC13 Conference on Human-Computer Interaction

**Additional links**

http://www.baddesigns.com/

http://humaninteractionproject.com/

http://hcibib.org/

http://hcibib.org/hci-sites/organizations


**Appendix**

Standards for HCI

ISO/TC 159/SC 4 – Ergonomics of human-system interaction

ISO 9241-420:2011

Ergonomics of human-system interaction -- Part 420: Selection of physical input devices

# CHAPTER 5. DATABASE SYSTEM

**5.1 Fundamentals control systems database: concept, characteristics, architecture**

The presence of a subject area of some real object, for example, the staff of the organization, the process of entrance tests, library book Fund, the presence of large numbers of properties, attributes, characteristics of the real object with the appropriate selection, the availability of computer implementation of this structure is the criteria for the establishment of databases in computer systems (CS) to manipulate the created model, active use.

Database (DB) is a collection of data relating to a particular subject area.

Database management system (DBMS) is a software tool, the main purpose of which is to create and maintain databases. DBMS allows you to fill the database, edit, search data, sorting, grouping data, retrieving accounting documents, etc. [1].

An entity is what to keep.

There are three main types of databases hierarchical, network and relational:

1. Hierarchical: in this storage each piece of information acts as a fact, in turn, this entity can be child elements, and so forth, but there is one element that started it all. In the end, this can be represented as a tree. Information search in such database is not convenient and takes a lot of time. This is due to the fact that the hierarchical database is represented as a tree, each branch with other branches with leaves and it is needed to avoid all these threads when searching for information. In this regard, the hierarchical database is not widely used as a relational database. But in hierarchical database there is an advantage, namely when you create complex database and the processing of loosely connected information, and not connected from a source of data and information growth in time.

2. The network database is an extension of hierarchical, because it allowed objects that have more than one ancestor. In network models the relationship between objects without restrictions. Such database is the Internet. In a single distributed network database together millions of documents and are interconnected through hyperlinks.

3. Relational database – this form has received wide application in the modern world. The objects inside the database is stored in a set of two-dimensional tables that specify column options. The number of columns is fixed. But the number of rows is not limited. And columns are logically connected among themselves.

Advantages of relational databases are:
• Presentation of data in tables.

• Logical and physical independence. Logical independence is the use of one conceptual model by different users. Physical independence is the data model which does not include any physical descriptions.

• Application of high-level languages. Using a procedural language (writing queries) the programmer can build a strategy of access to the data.

• Optimization of database access. The optimization is achieved due to the physical independence and use of non-procedural programming languages.

• Improved the integrity and protection of data. Integrity is achieved by logic circuits, and protection is achieved using a non-procedural programming languages.

• Wide application. The relational database is designed not only for programmers but also for ordinary users (e.g. Microsoft Office Access).

### 5.2 Data representation
### Normalization

With proper database design is necessary to minimize data redundancy. This is due to the fact that excessive data redundancy leads to an increase in the volume of information, errors in entering duplicate information.

The criterion of feasibility is the main criterion for the selection of attributes, i.e. the purpose of creation of the database must conform to the requirements for its further operation. For example, in the DB LIBRARY do not need to use the properties of books as the address of the printing house, its weight category, how old it is on the shelf, etc.

Mistakes in design can be very expensive, as if you are creating large database, you will be saved from thousands of entries. Improper design can lead to failure of the database due to redundancy, the loss of integrity, inconsistency of information and as a result will need a lot of material costs for its alteration [2].

In the 1970s E. Kodd developed the theory of relational databases. For no occurrence of the above-mentioned disadvantages of the design of the database was proposed the technology of database designing. According to this technology the tables that comprise the database must have a third normal form. Before that, all data that is planned to include in the database are presented in the first, then converted to second normal form. This process is known as data normalization.

Let us consider this process on the example of the choice and instructor by students. You need to create a database containing data on choice of course and instructor by students. First one table (Table 5.1) was constructed, which record the student's last name, date of birth, group number, name of instructor, date of course selection.

There are obvious disadvantages of such organization of data. On the face

of the redundancy of information repeats the date of birth of the same student, the names of the teacher of the same course. There is a situation where the constructed database is inconsistent, unreliable data. For example, if 102 group teacher changes, it would have viewing the entire database in everything related to this course, entry and even possible miss something. With each new selection of the course students will be required to re-enter the date of birth, group number, name of the teacher, i.e. information that already exists in the database.

**Table 5.1.** *DB "elective courses"*

| The name of the student | Date of birth | Group number | The name of the teacher | Date choice of course | Course name |
|---|---|---|---|---|---|
| Aitmatov E. | 20.04.1997 | 101 | Rakhimzhanova L. B. | 1.09.2016 | Modeling software |
| Abdirov A. | 25.01.1998 | 102 | Baimuldina N. S. | 1.09.2016 | Real-time system |
| Aitmatov E. | 20.04.1997 | 101 | Rakhimzhanova L. B. | 29.08.2015 | Object-oriented programming |
| Kadirhan J. | 12.03.1999 | 103 | Baimuldina N. S. | 1.09.2016 | Real-time system |
| Ospanova R. | 6.02.1998 | 101 | Rakhimzhanova L. B. | 1.09.2016 | Modeling software |
| Abdirov A. | 25.01.1998 | 102 | Baimuldina N. S. | 1.09.2017 | Digital data processing |

A table in first normal was getten form. Normalize on our table, considering and eliminating the identified shortcomings. The name and structure of such relationships has the form:

ELECTIVE COURSES (NAME, DATAMODULE, GROUP, TEACHER, DATE SELECTION COURSE)

Set the key for the records. The key will be composite, as it includes two fields: NAME and DATAWARE. In each record insert information on the specific course selections of the student. If to assume that within one year, the

student can make only one choice of course, the various recordings will not be repeated by combination of two fields: the names of the student and date of course selection.

In the second normal form all non-key fields must depend functionally from full key. In this table, only the RATE is jointly determined by the student's last name and date of choice. The remaining fields are only associated with the name and date of choice are independent. Convert the table to second normal form by breaking it into two:

CHOICE (NAME, DATE CHOICE, COURSE)

STUDENTS (NAME, BIRTH DATE, TEACHER)

In regards to the CHOICE continues to a composite key for the two fields, and in relation to STUDENTS — one key for the field NAME.

Second, the resulting table (relation) is transitive dependency. This happens in the following way:

The value of a field TEACHER is connected with the name of the student using a transitive GROUP field. In fact, every teacher assigned to their group and teaches the students belonging to this group.

In third normal form in the relation (table) should not be transitive dependencies. So you have one partition relations STUDENTS at two attitudes.

Thus, the resulting database consists of three tables (relations):

CHOICE (NAME, DATE CHOICE, COURSE)

STUDENTS (NAME, BIRTH DATE, GROUP)

TEACHERS (GROUP, TEACHER)

The third key is the field group number (group), because it cannot happen again. At the same time, it is possible that one teacher teaches more than one group. The database obtained meets the requirements of third normal form: the table's non-key fields are fully functionally dependent from its key and no transitive dependencies.

Therefore, another important property of the obtained database is that between the three relations there is the relationship through a common field. Relationship between CHOICE and STUDENTS are linked by a common field NAME. Relationships between STUDENTS and TEACHERS are connected through the GROUP field. For such related tables, there is still one concept: the type of communication. There are three alternative types of relationships: one-to-one, one-to-many, many-to-many. In our database between tables, there are relationships of type one-to-many, schematically they can be displayed as following:

The idea is: each teacher (in each group) has a lot of students; each student selects a teacher many times.

In the example of the creation our database is visible to the normalization procedure, in accordance with the theory of relational databases. Such detailed

analysis of data selection entities is necessary in order to avoid duplication of information and data. Thus, objects are created and divided between them. In our case, the table SELECTION of COURSE, you can see three different types of objects to which the information relates: clinics patients, doctors and patients visiting doctors. Respectively built three tables containing attributes that pertain to these three types of objects and linked through a common field between them.

Fact, as you can see, there are characteristics that called attributes. The attributes are divided into simple and complex, depending on their internal structure. Simple attributes are represented as primitive data types.

Give more examples of the two main types of communication:

1. One to one 1:1 – one attribute in the first table corresponds to only one attribute of the second table. Example: The Citizen of Kazakhstan belongs only to one individual identification number (IIN), respectively, one PIN can be assigned to only one citizen.

| Citizen of Kazakhstan | |
|---|---|
| **Field name** | **Field Type** |
| Code a citizen of the RK | Key, counter |
| Full name of citizen | text |

| IIN citizen | |
|---|---|
| **Field name** | **Field Type** |
| Code IIN citizen | Key, counter |
| IIN citizen | numeric |

2. One-to-many 1: M – one attribute from the first table corresponds to attributes in the second table. Example: one student can only learn in one group, but one group can study a few students.

| Group | |
|---|---|
| **Field name** | **Field type** |
| Group code | Key,counter |
| The name of the group | text |
| | |

| Students | |
|---|---|
| **Field name** | **Field type** |
| Code of student | Key, counter |
| Group code | numeric |
| Full name of student | text |

Data schema (ER-diagram – Entity Relationship) allows you to preserve data integrity and increase the speed of information processing. When mapping data, you need to pay attention to the connectedness of all tables to each other, if you have not the related table, then you need to review the structure. If you have other relationships in addition to 1:1 or 1:M it is also indicative of an error in your structure. If one field is turning more than once, then you also need to review the structure of the table. Above were listed the most common errors in the design database.

| Group | | | students | |
|-------|-----------|---|-------------------|-----------|
| Field Name | Field Type | | Field Name | Field Type |
| Code_group | key, counter | | Code_sdudent | key, counter |
| Name of group | text | | Code_group | numerical |
| | | | Full name of student | text |

Figure 5.1 shows an example of the database scheme, which is called the FACULTY, and consists of six entities, which are presented in the form of rectangles, ovals contain the attributes of each entity:

| Entities | Attributes of entities |
|----------|------------------------|
| FACULTY | Faculty_code, Faculty _name, Dean's_fullname |
| DEPARTMENT | Department_code, Department _name, Head_of_department |
| SPECIALITY | Speciality_code, Speciality _name |
| TEACHER Full name | Teacher_code, Position |
| GROUP | Group_code, Headman's_fullname |
| STUDENT | Number_of_ Student's record-book, Student's_Fullname Student's_Male |

**Figure 5.1.** *Example of the database scheme*

Five ties, represented by arrows, and they associate the entities which are subject to: connectivity INCLUDES displays that one faculty may consist of several departments; link LOGIN indicates that one department releases students of several specialties; communication WORKS show that a few teachers work in one department; link train with double arrows indicates that one teacher can work in more than one group, and one group of studies with several teachers; link STUDY says that one group consists of several students.

The projected database you must have certain characteristics:
• Integrity. The data should not be contradictory;
• Recoverability. System failure recovery program;
• Security. Data security when trying to unauthorized access of any kind.
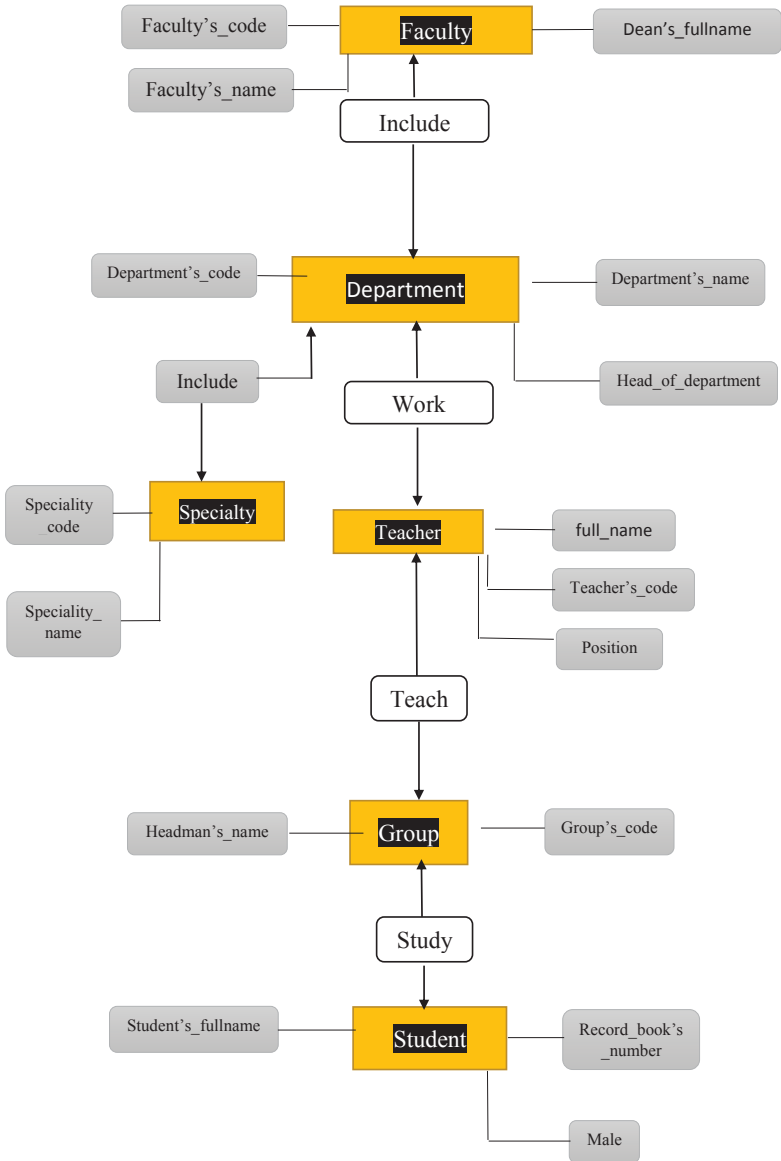
**Figure 5.2.** *Example of ER diagram of FACULTY database*

Logical primary key is a key that naturally determines the record, for example, every citizen of the Republic of Kazakhstan has IIN, ID number. These data are unique, that is, there is no citizen of the Republic of Kazakhstan which has the same PIN or ID number.

Surrogate primary key – it is created when there is no natural key for the primary key. Usually such keys give automatic numbering.

So, as already mentioned, the database is a software that allows users to define, create, modify, maintain a database and perform a controlled access to it.

Database functionality list.

1. Storage Management – the ability to add, delete and update data. As well as providing storage on external memory to accelerate data access.

2. Control RAM buffers – data is buffered in memory to increase processing speed.

3. Management system data directory – also called the data dictionary. It contains such information as the names, types, and sizes of data elements; Name ties; restrictions imposed on the integrity of the information; user names and their access rights; statistical data.

4. Management of the magazine – the magazine is not available to the user. It stores all the information about any changes.

5. Transaction Management – is a sequence of operations on the data, which are considered as a whole. If a failure occurs in one of the processing steps, it is rolled back to the original position data.

6. Security Management – Safety by establishing access rights and opportunities to the different tables in the database. For example, some are allowed to view only certain tables, some change the data in these tables, and the administrator can change the structure of the database.

### 5.3 Basic SQL

SQL (Structured Query Language) – a structured query language to work and create a relational database (RDB) on a personal computer, a Universal COP or network workstation.

SQL is the primary database standard language because of the support of leading organizations in the field of SRM technology, as well as its independence from the specifics of computer technology and elegance.

The SQL standard organizations proposed ANSI (American National Standards Institute – American National Standards Institute) and ISO (International Organization for Standardization – International Organization for Standardization).

There are two types of SQL: Embedded and Interactive. Both forms operate in substantially the same but different uses. For the operation is the database used by the SQL. It is possible to get a conclusion, which is used by the customer. Those SQL is the ability to immediately see the output when entering commands.

If the SQL statements are inside a program written in another language (for example, COBOL or Pascal), if to be more precise – Embedded SQL. Accordingly, such programs are more efficient and powerful.

But it is necessary to consider the structure of SQL and data management style that requires some expansion of interactive SQL. All variables or parameters embedded in the program, are so-called pass with SQL-commands the transfer of embedded SQL.

ANSI specified multiple of the (sub) interactive and embedded SQL forms. Since they are useful only on a conceptual level, most of these programs, SQL-subsections treated virtually separately. In fact, the SQL sub-categories become functional teams.

Data Definition Language (DDL) - data definition language, that includes commands and create a variety of objects in the database, such as tables, views, indexes, and so on.

Data Manipulation Language (DML) – data manipulation language, which includes commands determining at any time, which values are used in the tables.

Data Control Language (DCL) – Data Control Language by various means, which allows the user whether or not to perform certain actions. These tools are part of the DDL.

Sections SQL commands are grouped according to their function and use appropriate languages.

## 5.4 Designing databases

The basics in designing SQL relational database will be studied consisting of three tables (Tables 5.2, 5.3 and 5.4). It is necessary to select the amount of customer purchases, which caters to the seller qux nickname.

**Table 5.2.** *Sellers (salespeople)*

| SNUM | SNAME | CITY | COMM |
|------|-------|------|------|
| 1001 | foo | Almaty | 12 |
| 1002 | bar | Semey | 13 |
| 1004 | baz | Taraz | 11 |
| 1003 | qux | Aktau | 15 |

**Table 5.3.** *Clients (customers)*

| CNUM | CNAME | CITY | RATING | SNUM |
|------|-------|------|--------|------|
| 2001 | soo | Issyk | 100 | 1001 |
| 2002 | rub | Atyrau | 200 | 1003 |
| 2003 | zub | Astana | 200 | 1002 |
| 2004 | xud | Shu | 300 | 1002 |

**Table 5.4.** *Orders (orders)*

| ONUM | AMT | CNUM | SNUM |
|------|-----|------|------|
| 3001 | 18.69 | 2004 | 1004 |
| 3003 | 767.19 | 2002 | 1003 |
| 3002 | 1900.10 | 2001 | 1002 |
| 3005 | 5160.45 | 2003 | 1001 |

The first column of each table contains the numbers whose values are different for each line and is the primary key table. Some of these numbers are found in the columns of other tables. There is a visible link between the rows using values taken from the primary key, and rows where this value is used in the primary key.

Here is the description of the fields in Table 5.5.

**Table 5.5.** *Contents of fields*

| FIELD | CONTENT |
|-------|---------|
| SNUM | A unique number assigned to each seller |
| SNAME | Seller's name |
| CITY | Seller's location |
| COMM | Commission merchants in decimal form |
| CNUM | A unique number assigned to each customer |
| CNAME | Customer's name |

| CITY | Customer's location |
|------|---------------------|
| RATING | Code indicating the degree of preference of the customer to the other. higher number indicates greater preference (rank) |
| SNUM | Seller number assigned to that customer (from the table of Salespeople) |
| ONUM | A unique number given to every purchase |
| AMT | The value of the sum of acquisitions |
| CNUM | Number of the customer making the purchase (from the Customers table) |
| SNUM | Seller number, marketing acquisition (from the table of Salespeople) |

Preparing data for problem

CREATE DATABASE and CREATE TABLE are the operators for creating databases and tables, respectively, DROP DATABASE and DROP TABLE to remove. Each command ends with a semicolon (;).

First, create a database with the name of sale:

**CREATE DATABASE IF NOT EXISTS** sale;

Keywords IF NOT EXISTS are used for not the error that the specified database and table already exists.

Now, create the table:

**CREATE TABLE** salespeople (SNUM **INT(5) NOT NULL**, SNAME **VARCHAR(50),** CITY **VARCHAR(50)**, COMM **INT(5) NOT NULL**, **PRIMARY KEY**(SNUM), **INDEX**(SNAME, CITY, COMM));

**CREATE TABLE** customers (CNUM **INT(5) NOT NULL,** CNAME **VARCHAR(50),** CITY **VARCHAR(50),** RATING **INT(5) NOT NULL,** SNUM **INT(5) NOT NULL, PRIMARY KEY(**CNUM**), INDEX(**CNAME, CITY**, RATING, SNUM));**

**CREATE TABLE** orders (ONUM **INT(5) NOT NULL,** AMT **FLOAT (**5,2**) NOT NULL,** CNUM **INT(5) NOT NULL,** SNUM **INT(5) NOT NULL, PRIMARY KEY(**ONUM**), INDEX(**AMT, CNUM**, SNUM));**

There commands are examine in the following order. After the CREATE TABLE salespeople specify the table name, followed in parentheses list the names of the fields SNUM, SNAME, CITY, COMM with types INT (integer), VARCHAR (character) and the attributes listed through a comma and point keys. For example, the field SNUM has an integer type, and the length of five cha-racters cannot be equal to zero, is the primary key; SNAME field has a character type and (length of 255 characters) an index, etc.

If you need to check which tables you have in the database, you can enter the command:

**SHOW TABLES;**

Now the data (records) is added in the table (in the field). To add entries and enter the INSERT statement.

**INSERT INTO** salespeople (SNUM, SNAME, CITY, COMM) **VALUE** ('1001', 'foo', 'Almaty', '12')**;**

The field list (tuple) is pointed out in brackets. The VALUE command specifies the value (record) for the fields. Each entry must be in the motorcade at the respective positions. Also introduce other entries in the corresponding table field.

To verify the data using the following command:

**SELECT * FROM** salespeople**;**

Then fill the rest of the table.

**INSERT INTO** customers (CNUM, CNAME, CITY, RATING, SNUM) **VALUE** ('2001','soo', 'Issyk', '100', '1001');

You can not swap the values in tuples or field names as the result immediately change.

If an error occurs when you add records, it can be changed. For this purpose there is an UPDATE statement.

**UPDATE** customers **SET** SNUM='1001', RATING ='100' **WHERE** CNUM ='2001';

After SET, the field was specified whose values change, and accordingly set new values. The WHERE clause specifies a limit on the request, in this case, the changes will apply only to those fields where the value of CNUM is '2001'.

Other entries are also added as in example.

**The solution of the problem**

The question was this: You need to select the amount of customer purchases, which caters to the seller with nickname *qux*.

After creating the database tables it is needed to start solving the problem. Specific request is created by a solution of the problem implied in the sample database. This is done using the SELECT statement, which have been used a little bit. Syntax: SELECT name_of_fields FROM name_of_table WHERE clause [ORDER BY, LIMIT], where ORDER BY and LIMIT additional options.

Select all the values of SNAME field salespeople table.

**SELECT** SNAME **FROM** salespeople;

and for this sort them use ORDER BY

**SELECT** SNAME **FROM** salespeople **ORDER BY** SNAME;

As it can be seen ORDER BY is used for sorting by one of the fields, defined after SELECT operator. By default, sorting is performed in ascending order, to use the sort in reverse order, after the field is necessary to add DESC:

**SELECT** SNAME **FROM** salespeople **ORDER BY** SNAME **DESC;**

WHERE clause can not be used, because all values are needed.

Another example: a table of customers select field values CNUM, CNAME, the CITY, RATING which is equal to ‹200›.

**SELECT** CNUM, CNAME, CITY **FROM** customers **WHERE** RATING=200;

**SELECT** CNUM, CNAME, CITY **FROM** customers **WHERE** RATING=200 **LIMIT** 1, 3;

LIMIT operator outputs row in this range, where the lower boundary is not included. If the first argument is not specified, the default is 0.

All our three tables are related. Salespeople and customers through the field SNUM, as customers and orders through CNUM. The JOIN operator was used to connect them on the specified columns into one. JOIN means "to unite", i.e. collect into a whole number of pieces. The MySQL database tables, fields are these "pieces" and together with the sample. When combining is possible to extract data from multiple tables with a single query. In MySQL, depending on the requirements to the result, three different types are arranged association:

1. INNER JOIN (CROSS JOIN) – internal (cross-);
2. LEFT JOIN – an external drive on the left;
3. RIGHT JOIN – right-hand exterior.

INNER JOIN allows you to retrieve all the rows, always present in the joined tables.

Write a query:

**SELECT** orders.AMT **FROM** salespeople **INNER JOIN** customers **USING**(SNUM) **INNER JOIN** orders **USING**(CNUM) **WHERE** salespeople.

SNUM ='qux';                                                      (1)

The USING indicated field on which tables are linked. Using this operator is possible only if the same field is name. Otherwise, using ON:

**SELECT** orders.AMT **FROM** salespeople **INNER JOIN** customers **ON** salespeople.SNUM = customers.SNUM **INNER JOIN** orders **ON** customers. CNUM = orders. CNUM **WHERE** salespeople. SNUM ='qux';

Retrieve data from the table allow the LEFT / RIGHT JOIN command, possibly supplementing them with data from another table. The difference with INNER JOIN will be shown, first add another field to the table salespeople.

**INSERT INTO** salespeople (SNAME) **VALUE** ('quuz');

Using (1) command, replace the INNER JOIN in the LEFT JOIN, and qux on quuz:

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**SELECT** orders.AMT **FROM** salespeople **LEFT JOIN** customers **USING**(SNUM) **LEFT JOIN** orders **USING**(CNUM) **WHERE** salespeople.SNUM =' quuz';

The following result is getten:

```
+---------------+
|  AMT          |
+---------------+
|  NULL         |
+---------------+
```

The new seller will receive a new SNUM = 1005. The result is a NULL, because it is important in other tables available. When INNER JOIN when output only values that exist in all tables, the result would have been empty. There is also table salespeople and customers complemented by the value of the orders, even in the absence.

Appendix

Consider the examples of commands, a little explaining.

Remove the line with SNUM equal to 1001 of the salespeople table:

**DELETE FROM** salespeople **WHERE** SNUM = 1001;

Rename the table salespeople to seller:

**RENAME TABLE** salespeople **TO** seller;

Rename SNUM field NUM (salespeople table):

**ALTER TABLE** salespeople **CHANGE** SNUM NUM **INT**;

Change the type and attribute field RATING:

**ALTER TABLE** customers **MODIFY** RATING **VARCHAR**(100) **NOT NULL**;

Review the description of salespeople table:

**DESCRIBE** salespeople;

Add Field ODATA type DATE:

**ALTER TABLE** orders **ADD** ODATA **DATE**;

Choose from orders all field values ONUM, for which the AMT begins with the digit 1 (like checks if the character string with a predetermined pattern; % means any number of any character you like):

**SELECT** ONUM **FROM** orders **WHERE** AMT **LIKE** '1%';

Thus, the SQL is the language that used specifically to create a relational database.

### 5.5 Distributed, parallel and heterogeneous database

Characteristic features of parallel and distributed databases.

Talking about the database rather than a distributed file system, individually stored on the network nodes. Distributed databases are DDB (distributed

database), only if they adhere to the (connected) certain structure (e.g., relational model of communication), and to access them there is a single interface.

Such system has the full functionality of the database. Its functionality is not limited to transaction processing systems, this is just one of its functions. Also, these systems provide a query function. The structural organization of the data need not always be supported transaction processing systems.

Each table in a distributed database is divided into horizontal (row subset), vertical (columns subset), and the mixed fragments (portions) which are distributed over several (> = 1) nodes.

To improve the performance and availability, data replication system is organized (actual copy of a particular piece on different nodes) for some fragments.

Such distribution of the data has transparency, i.e., invisible to the user. The main objective of the technology of distributed / parallel database – is to ensure the integrity (unity) database, i.e. the user's ability to access that runs on a single node network, all located in the network database. Independence of data on the medium where is replicated and distributed over a plurality of network computers, provided by the following types of Transparency: Transparency network, distribution, fragmentation and replication. Full transparency means the existence of such a query language for distributed database management system, which is different from the language to the centralized database management system [3-4].

Distributed database is homogeneous and heterogeneous. The difference is that a homogeneous distributed database manages one type, but different types of heterogeneous databases use different data models: relational, hierarchical, network or object-oriented.

Accordingly, homogeneous distribution allows consistently add new nodes to an existing database. While the heterogeneous distributed database integrating independent units, which are controlled by its own database, in the newly created distributed database.

### 5.6 Technology Database Application

The business processes of traditional database systems are used to operate large amounts of information using online transaction processing technology, so-called an OLTP-technology. In OLTP processed and used detailed data, i.e., the main properties of these data are their relevance and completeness.

To support management, decision-making requires other technologies. The data needed to be combined from different sources (even from the external environment), collect data or sections of data over time. By analyzing these data, we can estimate the dynamics of development and the state of the organization can be estimated, and on reasonable projections to make deci-

sions. For such management decisions need to store large amounts of data, which have an effective access to the database, use advanced data analysis tools, to present the results in a convenient form for management and specialists of the organization. These capabilities have OLAP (On-Line Analytical Processing) – technology designed to make financial, administrative and personnel decisions.

OLAP-based technologies in the Data warehouses technologies (data warehouse).

A data warehouse is a repository (warehouse), which over time accumulate verified data (for example, the work of the organization over the long term), which further facilitate decision-making. Accordingly, the volume of such data in a few times is larger than the amount of data in simple OLTP-systems, and they are distinguished by their device and the destination. This store contains data that:

• Allow you to do the analysis of business operations;
• Read-only;
• Free from mistakes and do not change with time.

A large amount of data in storage creates a major problem, high performance query processing, i.e., requests to the data store have a high level of complexity. Data warehousing is a long and laborious process.

But if to consider the individual units and companies providing certain types of activity, it is possible to create a Data Mart (data marts), also called a data mart. Compared with data warehouses, data marts in the requirements for computing resources and data volumes are much smaller. Kiosks (cases) are constructed as data from the data warehouse, and independently.

The architecture of the data warehouse is a two-tier or three-tier. In a two-tier architecture on the lower level, there are a variety of database sources, the top level of the combined information. The three-level storages on a single repository for individual business units are supported by the data marts.

### 5.7 Areas of database development

A new direction in the development of the database is further enhanced in the structural transformation, the rejection of normalization of relations and the transition to object-oriented database. Currently, there are theoretical substantiation of efficiency of work with unnormalized data already exists and the practical implementation of such systems.

The basic concepts in object-oriented paradigm are class and object instance. Objects of the same type come together in classes. Specialization is modeled as a set of classes. Each object has its attributes (properties set), and a set of operations (methods) works with the object that are written inside a class. The object belongs to only one class or subclass (subclass). There are

primitive pre-defined classes, whose objects do not have attributes (integer, string, and so on. D.). Class, whose objects are attribute values (properties) of another class of objects, can be domain of this attribute.

The long-term feature of the object-oriented paradigm is the principle of inheritance. On the basis of an existing class (superclass) can be generated by a new class (a subclass), which inherits all the attributes and methods. The subclass can also be defined its additional attributes and methods. There is a simple and multiple inheritance. The object belongs to the subclass and any of its superclass.

Among the object-oriented database (OODB) the design, maintenance and development of the application system are the process of integrating the behavioral and structural aspects. To do this you need special languages that allow you to define the objects and develop on the basis of their application system.

The most important quality of an object-oriented database (OODB) is the account of the behavioral aspects of objects.

New direction requires the interpretation of the existing classic concepts and their extensions.

Because of the possibility occurrence of storage facilities required extensions to the SQL language standard within the RDB, i.e. it must also provide for the use and storage of specific methods of working with such objects. The new standard SQL3 is done only partially, not all questions have explicit permission.

To complete the transition to object-oriented database originated ODMG93 standard, supplementing the standard means of standardized design object database access.

Popular companies such as IBM and Oracle have already added an object wrapper around the core relational systems (DB2 and ORACLE). Informix chose a different path, which is built into its database object-relational acquired illustrate and there is a product that is called the universal server. Computer Associates uses a pure object Jasmine base, actively promoting its advantages. For whom the future remains to be seen.

Another new trend is the emergence of database time-sensitive, so-called temporal databases. In some application areas it is necessary to examine the change in the states of objects precisely in time, rather than in some current time, as the actual database models. If you use a relational database, you want to keep and build an additional set of relations that have the same scheme, but differ in time or removal of data existence. Convenient and promising use for certain database objects, special mechanisms for removing slices of time. Consider the temporal system a little bit more. Suppose that data object is created at the moment of time $t_1$, and destroyed at the time $t_2$, then the database

is available and all its stored state in the time interval $(t_1, t_2)$. If the interval designation puts brackets, the boundary is included in the interval, and if the parentheses on the border point is not included in the range. For example, if the object is destroyed at the time $t_2$, the right border is reserved time slot open, since at this point there is no longer the object [5-6].

Another promising area is the development so-called deductive databases with databases and expert systems technology. Deductive databases are based on the identification of new knowledge from databases not using the analytical processing of requests or, as by the use of the rules and build a chain of application of these rules to bring answers to the questions.

The most significant new direction of development of the database is the prospect of interaction databases and Web-based technologies. So far, the database remains on the sidelines, as an integral part of the Web infrastructure. Firstly, the gradual shifting of the Web page management tasks with the file systems on the database system. Secondly, the use of database systems as e-commerce servers, helping to track account transactions, inventory profiles and sheets. Third, there is so far to use database storage systems having a complex nature, content.

For a quick and cost-effective data warehousing designed for complex applications, Web-publishing authors in need of respective instruments. In turn, formed requirements of database technology for management, establishment, and security content search Web-sites.

The universality of the Web-client becomes very attractive and simple for application developers who will have the opportunity to work with databases. In this case, it is sufficient to send the access code and the client would automatically work with the database, it does not matter where the customer is possible to work in a local and global networks such as the technology allows.

For the development of the Internet applications, database related is widely used modern software: language PERL, Javascript, PHP and others.

**Control questions:**
1. What is a database?
2. What is a database (DB)?
3. What types of data are available?
4. What characterizes a relational database?
5. What are the stages in the process designing a database?
6. How do you identify the normalization?
7. What qualities must have projected the database?
8. Define the primary key.
9. What is a surrogate primary key?
10. What kinds of relationships exist?

11. List the functionality of the database.

12. What is the ER-model?

13. What is the ER-diagram depicted nature, communication, type of communication?

14. List the main functions of the DBMS.

15. What are the main components included in the database ?

16. What is used to perform any basic functions of the SQL language?

17. Give an example of the organization of the sample data in the SQL language.

18. What kind of database is called a distributed database?

19. What database is called parallel databases?

20. What database is called heterogeneous databases?

21. Describe the technology of online transaction processing – OLTP.

22. List the areas of database development.


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# CHAPTER 6. DATA MINING

## 6.1 Introduction

Knowledge can be defined as a set body of facts and principles (concepts, rules, methods etc.) accumulated by humankind or the Act, Fact, or State of Knowing (may be true, but far from complete).

The meaning of knowledge is closely related to the meaning of intelligence. Characteristics of intelligent people are having much knowledge.

In biological organisms, knowledge is likely stored as complex structures of interconnected neurons. The average human brain weights about 1.5 kg and contains about 1012 neurons (estimated potential of storage capacity is about 1014 bits). Knowledge should not be confused with data (e.g. physician treating a patient uses both data and knowledge) (What is the distinction between belief, hypothesis, and knowledge).

General scheme of knowledge representation:

Mental images → Written text (Character strings, pictures) → Computer devices store.

Actual activity in digital data acquisition and storage technology has resulted in the growth of large databases. This has occurred in all areas of human endeavour from the mundane (such as supermarket transaction data, credit card usage records, telephone call details and government statistics) to the more exotic (such as images of astronomical bodies, molecular databases, and medical records). It is not a surprize, that interest has grown in the possibility of tapping these data, extracting information that can be valuable to the owner of the database. The discipline concerned with this task has become known as Data mining (DM).

## 6.2 What is Data mining?

**Data mining** is a process of performing automated extraction and generating predictive information from large data banks. DM includes analysis of (often large) observational data sets to find unsuspected, previously unknown relationships and summarize the data in new ways that are both understandable and useful for the data owner.

Relationships and summaries derived through a data mining are often referred to as models or patterns. Examples include linear equations, rules, clusters, graphs, tree structures, and recurrent patterns in time series. It should be noted that the discipline typically deals with data that have already been collected for some purpose other than the data mining analysis (for example, they may have been collected in order to maintain up-to-date record of all transactions in a bank). This means that the objectives of the data mining usually play no role in the data collection strategy. This is one of the ways in which it

differs from many statistics in which data are often collected by using efficient strategies to answer specific questions.

DM, popularly referred to **Knowledge Discovery in Databases** (KDD), is the automated or convenient extraction of patterns representing knowledge implicitly stored or captured in large databases which can contain millions of rows related to Database subject, Data Warehouses, Web, other massive information repositories or data streams.

For example, Figure 6.1 illustrates the place of DM in the Data Warehouses (DWH) architectures.
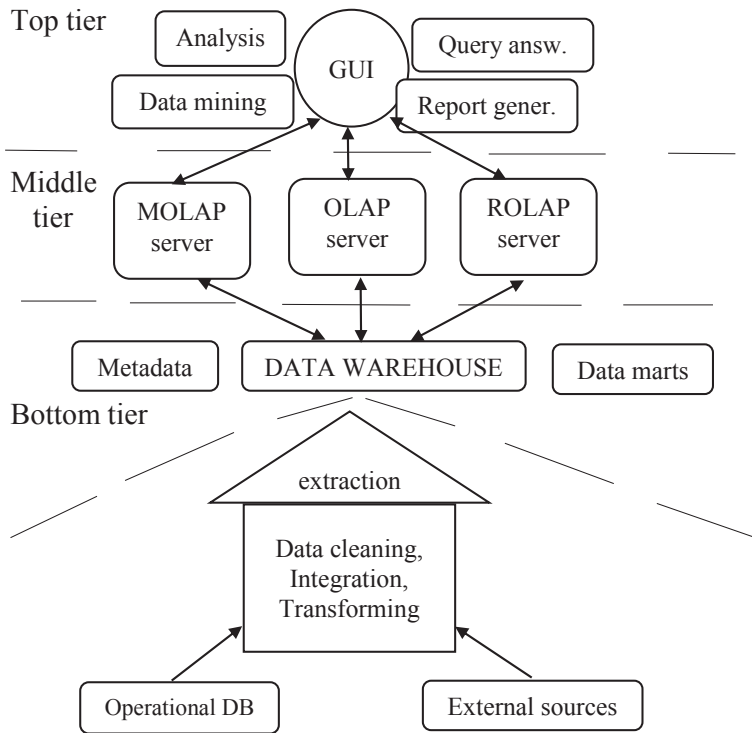


**Figure 6.1**. *General Data Warehouse architectures*

So, readers (who is supposed to know about Database system structure) can recognize main differences between conventional Database System and DWH which include **Data Mining, Analysis (**as parts of knowledge discovery in databases**), OLAP Engine** (Online Analytics Processes instead of or additionally to Online Transaction Processes**) DW/Marts servers** (set of servers for different departments of enterprises), **Back Ground process/preprocessing** (e.g. Cleaning – solving problem with missing data, noise data) and etc.

Remark about the history of terms [from https://en.wikipedia.org/wiki/Data_mining]:

Gregory Piatetsky-Shapiro coined the term "Knowledge Discovery in Databases" for the first workshop on the same topic (KDD-1989) and this term became more popular in AI and Machine Learning Community. However, the term Data mining (1990) became more popular in the business and press communities. Currently, Data Mining and Knowledge Discovery are used interchangeably. The terms "Predictive Analytics" (since 2007) and "Data Science" (since 2011) were also used to describe this field.

Actually, it can be said that DM is a step in the KDD process concerned with the algorithms, variety of techniques to identify decision-making knowledge in the data (DB) that can be used in such areas as decision supports, prediction, forecasting and estimation using pattern recognition techniques as well as statistical and mathematical techniques.

**The basic Data mining models and tasks:**

DM involves many different algorithms to accomplish different task. All these algorithms attempt to fit a model to the data. The model that is created can be either **predictive or descriptive** in nature. Figure 6.2 represents the main DM tasks used by that type of model.
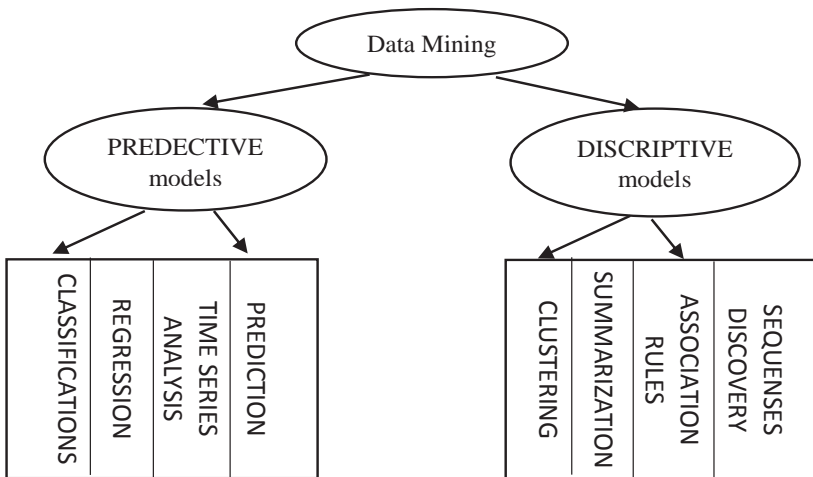


**Figure 6.2**. *Data Mining models and tasks*

**Predictive model** enables to predict the values of data by using known results from different sets of sample data.

**Classification** enables to classify data from a large data bank into predefined set of classes. The classes are defined before studying or examining

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data in the data bank. Classification tasks enable not only to study and examine the existing sample data but also to predict the future behaviour of that sample data. For example, the fraud detection in credit card related transaction to prevent material losses; estimation of the probability of an employee to leave an organisation before project's end are some of the tasks that you determine by applying the technique of classification.

**Regression** is one of statistical techniques which enable to forecast future data values based on the present and past data values. Regression task examines the values of data and develops a mathematical formula. The result produced on using this mathematical formula enables to predict future value of existing or even missed data. The main drawback of regression is that you can implement regression on quantitative data such as speed and weight to predict future behaviour of them.

**Time series analysis** is a part of **Temporal mining** which enables to predict  future values for the current set of values which are time dependent. Time series analysis makes to use current and past sample data to predict the future values. The values that you use for time series analysis are evenly distributed hourly, daily, weekly, monthly, yearly and so on. You can draw a time-series plot to visualize the amount of changes in data for specific changes in time. You can use time series analysis for examining the trends in the stock market for various companies for a specific period and making investments accordingly.

**Essence of a descriptive models** is determination of the pattern and relationships in a sample data:

**Clustering** is a data processing in some sense opposite to classifications which enables you to create new groups and classes based on the study of patterns and relationship between values of data in a data bank. It is similar to classification but does not require predefining the groups or classes. Clustering technique is otherwise known as **unsupervised learning** or **segmentation**. All these data items that resemble more closely with each other are clubbed together in a single group, also known as clusters. Examples include groups of companies producing similar products or soils having the same properties (e.g. black soil), a group of people with the same habits, etc.

**Summarization** is a technique which enables to summarize a large chunk of data contained in a Web page or a document. The study of this summarized data enables to get the gist of the entire Web page or the document. Thus, summarization is also known as **characterization or generalization.** Summarization searches for specific characteristics and attributes of data in the large set of the given data and then summarizes the same. An example of the use of summarization technology is search engines such as Google. Other examples include document, image collection and video summarization. Docu-

ment summarization, tries to automatically create a *representative summary* or *abstract* of the entire document, by finding the most *informative* sentences.

**Association rules** enable to establish association and relationships between large unclassified data items based on certain attributes and characteristics. Association rules define certain rules of associativity between data items and then use these rules to establish relationships. Sequence discovery determines the sequential patterns that might exist in a large and unorganized data bank. You discover the sequence in a data bank by using the time factor i.e., you associate the data items with the time at which it is generated. The study of sequence of events in crime detection and analysis enables security agencies and police organizations to solve a crime mystery and take preventative measures. Similarly, the occurrence of certain strange and unknown diseases may be attributed to specific seasons. Such studies enable biologists to discover preventive drugs or propose preventative measures that can be taken against such strange and unknown diseases.

### 6.3 Techniques often used for data mining

Techniques (methods, algorithms) provide a way to use various data mining tasks such as classification and clustering in order to predict solutions of a problem. They (techniques) provide a level of confidence about the predicted solutions in terms of consistency of prediction and frequency correct predictions.

Data mining includes a big number of different approaches such as statistical and information analysis, decision trees, similarity measures, neural networks, genetic algorithms, fuzzy logic, etc. Let us try to explain the essence of some popular ones.

**Statistics** is one of largest branches of mathematics which deals with the collection and analysis of numerical data by using various methods and techniques. Some of the statistical techniques that find its extensive usage in data mining are:

**Point estimation**: a process of calculating a single value from a given sample data using statistical techniques such as mean, variance, media and so on.

**Data summarization**: a process of providing summary information from a large data bank without studying and analyzing and every data elements in the data bank. Creating a histogram is one of the most useful ways to summarize data using various statistical techniques such as calculating the mean, median, mode and variance.

**Bayesian techniques**: a technique of classifying data items available in a data bank. The simplest one of all Bayesian techniques is the use of Bayes Theorem that has led to the development of various advanced data mining techniques.

**Testing a hypothesis**: a technique of applying sample data to a hypothesis in order to prove or disprove the hypothesis.

**Correlation**: a technique of determining the relationship between two or more different sets of data variables by measuring their values.

**Regression:** a technique of estimating the value of a continuous output data variable from some input data variables.

**Decision Trees:** a tree-shaped structure which represents a predictive model. In a decision tree each branch of the tree represents a classification question while the leaves of the tree represent the partition of the classified information. You need to follow the branches of a decision tree that reflect the data elements in such a way that when you reach the bottom leaf of the tree, you have the answer to the question in that leaf node. Decision trees are generally suitable for tasks related to clustering and classification. It helps to generate rules that can be used to explain the taken decision.

**Machine Learning**: a process of generating a computer system that is capable to acquire data independently and integrate data to generate useful knowledge. The concept of machine learning is to make a computer system behave and act as a human being who learns from experience, analyzes the observation in such a way that system is developed for continuously self-improvement and provision of increased efficiency and effectiveness. Machine learning enables to discover new and interesting structures and formats about a set of data that are previously unknown.

**Hidden Markov Models**: a model that enables to predict future actions taken in time series. The models provide the probability of a future event when provided with the present and previous events. Hidden Markov models are constructed using the data collected from a series of events in such way that the series of present and past events enable to determine future events in a certain degree. Simply, Hidden Markov models are a kind of time series model where the outcome is directly related to the time. One of the constraints of Hidden Markov models is that the future actions of the series of the events are totally calculated by the present and past events.

**Artificial Neural Networks**: the non-linear predictive models which use the concept of learning and training and closely resemble the structure of the biological neural networks. In artificial neural network a large set of historical data is trained or analyzed in order to predict the output of a particular future situation or a problem. You can use artificial neural network in a wide variety of applications such as fraud detection in online credit card transactions, secret military operations, and for operations which require biological simulations.

**Genetic Algorithms**: a search algorithm that enables to locate optimal binary strings by processing an initial random of population of binary strings

by performing operations such as artificial mutation, crossover and selection. You can use genetic algorithms to perform such tasks as clustering and association rules. If you have a certain set of sample data then genetic algorithms enable to determine the best possible model out of a set of models in order to represent the sample data. While using the genetic algorithm technique, first, you arbitrarily select a model to represent the sample data. Then you perform a set of iterations on the selected model to generate new models. You select the most feasible model out of the many generated models to represent the sample data using the defined fitness function.

**Meta Learning**: a concept of combining the predictions made from multiple models of data mining and analyzing these predictions to formulate new and previously unknown prediction. You can use the predictions made by different data mining techniques as input to a Meta learner which would combine each of the predictions in order to create the best-possible model or solution. For example, if you use the predictions of a decision tree, an artificial neural network, and a genetic algorithm as an input to a neural network Meta learner, it will try to implement the learning methodology to combine the input predictions to generate the maximum classification accuracy [1].

### 6.4 Data Mining Applications as tools for analysis and management

DM applications can be found in various fields in our life. It is useful for small, middle and large organizations that generate large amount of data per day.

Let us to list some examples of DM applications, main goal of which is **analysis and management** of correspondent activities.

– **Business**

Business analysis and management: data mining enables establish business organizations to consolidate business setup by providing reduced cost of doing business, improvements of profit, and enhancement of the service quality to consumers.

– **Electronic (and traditional) commerce**

Multidimensional analysis of sales, customers, products, time and region. DM provides various decision support systems for consumer acquisition, segmentation, retention, and cross-selling. Thus, it enables to classify and cluster customers for targeted marketing, better interact with consumers, improve the level of consumer services that you provide and establish a long-lasting consumer relationship.

Analysis of the effectiveness of sales of CAMPAIGNS (careful analysis can help improve company profiles), purchase recommendation and cross-reference of items: (clusters of often purchased items)

– **Computer security**

Data mining enables network administrators and computer security ex-

perts to combine their analytical techniques with business knowledge to identify probable cases of fraud and abuse that compromise the security of a computer or a network.

– **Banking and financial processing**

Prediction of loan payment and customer credit, policy analysis are factors which can strongly or weakly influence loan payment performance and customer credit rating.

Detection of "money laundering" and other financial crimes (collection, integration and analysis of information from multiple databases about bank transactions, federal or state crime history of DB).

– **Bioinformatics, Medicine, Health care**

Molecular genetic and genetic engineering (genome researches, study of human DNA sequences. Linking genes to different diseases and treatment effectiveness). As a tool for creating medical expert systems: symptoms clustering, association rules, medical treatments patterns, etc. Health organizations and pharmaceutical organizations generate large amount of data in its clinical and diagnostic activities. Data mining enables such organizations to use the machine learning technique to analyze healthcare and pharmaceutical data and retrieve information that might be useful for developing new drugs.

– **News and entertainment data**

News and entertainment industry generates large volumes of data in the form of the text, graphics, audio, and video formats that are read and viewed by people demographically different from each other. Data mining enables to study and analyze such diverse collections of data and retrieve meaningful and useful statistics that can be implemented in future for better readership or viewership of these programs.

You can find in the Internet a huge number of other examples of DM applications in such fields of human activity as Scientific and Engineering data, Telecommunications, Stocks and Investment, Insurance, Crime.

### 6.5. Process models of Data Mining

As a rule, researchers working in the field of DM practical applications for organizations and enterprises follow a systematic approach of investigations of meaningful retrieval of data from large data sets (e.g. large Databases). Let us see several popular process models of DM.

*5A (process model proposed and used by SPSS Inc. in Chicago, the USA)*

For the first time SPSS Inc. developed and used this model as a preparatory step towards DM. Then it used enhanced process model, known as CRISP_DM (discussed below), to analyze collected data. The 5A begins first by assessing the problem followed by access or accumulation of data related to the problem. Then, it analyses the data using various DM techniques, extracts neccessary information and implements (Act) the results of solving the prob-

lem. Eventually, it tries to automate the process of data mining by building proper software [2].

Steps of the 5A process model are presented in Figure 6.3.
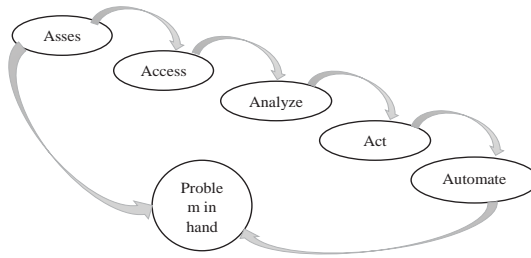


**Figure 6.3**. *The 5A process model*

**CRISP-DM (**Cross-Industry Standard Process model for Data Mining proposed by a multinational group of vendors (Denmark, Germany, UK, Netherlands).

The CRISP-DM process model consists of the following steps (Figure 6.4.):

• understand and collect the objectives and requirements to generate DM definition for the business problem;

• analyze the data collected in the first phase, matching patterns to propose a models for solving the problem;

• create final sets of needful data that are input for various modeling tools. The data are first transformed and cleaned to generate Database;

• select and apply different modeling techniques of DM using the Databases from the previous phase and analyze the generated output;

• evaluate models that you generate in the previous phase for better analysis of the refined data;

• deployment: organize and implement the gained knowledge for the end users.
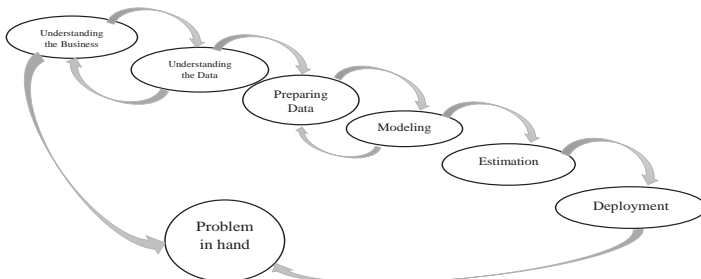


**Figure 6.4**. *The CRISP-DM process model*

Futhere there will be a list of two other process models without detailed description of their items.

**SEMMA (**process model developed by Sas Institute Inc.) (Sample- Explore- Modify- Model- Analysis), includes the next steps:
- **Problem understanding**
- **Data sampling**
- **Exploration** (explore and refine the sample portion of data using various statistical techniques in order to search for unusual trends and other irregularities)
- **Modification** (clustering, association, visualization, transformation)
- **Modelling and assessment.**

**SIX-SIGMA** (6 – σ) (process model developed by MOTOROLLA, GE, the USA) includes the following steps:
- Define main stages of the investigated process;
- Develop Measure quality methods;
- Analyze technologies quality;
- Improve of technologies;
- Control.

More formal definitions of some DM tasks mentioned above, explanation of basic methods of solving tasks and examples will be given in this subchapter. The choice of the tasks and methods discussed here is intended primarily for initial acquaintance and understanding of the most popular applications of DM. This list does not claim to be in any degree a comprehensive summary of a large number of techniques and methods of research published in numerous books and journals, articles on theoretical and applied problems of DM.

**Classification**

Classification is, perhaps, the most familiar and popular data mining technique with big number of applications including image and pattern recognizing, medical diagnosis, loan approval, detecting crime patterns, financial tendencies. A lot of researches suppose that Estimation and Prediction may be considered as types of classification as well.

Before giving a formal definition of classification, let us look at the well-known table of the estimating knowledge of students (it can be assumed the table is as a small Database with correspondent columns and rows):

Table 6.1 explains the way teachers classify students as A, B,…, F or (using traditional marks) as Excellent, Good, etc. based on their grades. This classification is possible by using simple boundaries (100, 95, …, 49, 0). So, Classification is a process and a method by which data was divided into categories, maps data into predefined groups or classes.

It seems that the following formal definition will now be easier to understand.

Definition:

A given data base $D : \{t_1, t_2, \ldots, t_n\}$ of tuples (items, records) and a set of classes $C : \{C_1, C_2, \ldots, C_m\}$, the classification problem is to define a mapping $f : D \rightarrow C$ where each $t_i$ is assigned to one class. A class, $C_j$, contains precisely tuples mapped to it; that is, $C_j = \{t_i \mid f\ (t_i)\ =\ C_j\}$, $1 \le i \le n$, and $t_i$ belongs to $D$.

**Table 6.1.** *General Scale and criteria of an estimation of knowledge*

| % points (of 100) | Letters grade | Traditional marks |
|---|---|---|
| 95-100 | A | Excellent |
| 90-94 | A- | |
| 85-89 | B+ | Good |
| 80-84 | B | |
| 75-79 | B- | |
| 70-74 | C+ | Satisfactory |
| 65-69 | C | |
| 60-64 | C- | |
| 55-59 | D+ | |
| 50-54 | D | |
| 0-49 | F | Unsatisfactory |

Classification algorithms require the classes to be defined based on data attribute values. The classification process is divided into two steps:

1. Developing model for evaluating and training data
2. Classifying tuples (rows) from target Database.

Note: training data consist of simple input data as well as corresponding classifications of data.

Figure 6.5 illustrates the classification problem: a) it shows the predefined classes dividing by the reference space (obtained using training data); b) it provides a sample input data; c) it shows the classification of the data based on the defined classes (i.e. each object/point belongs to one class)).

According to R.L. Kennedy, Yu. Lee, B.V. Roy (1998) there are three basic methods to solve the classification problem:

• Specifying boundaries: in this method classification is carried out by dividing input database into categories. Each of these categories is associated with one class.

• Using probability distribution: in this method, probability definition of

a class at a particular point determined. Consider a class $C_j$, the probability definition at one point $t_i$ is $P(t_i | C_j)$. Here each tuple is considered to have a single value and not multiple values. If the probability of the class is known to be as $P(C_j)$ then the probability that ti is in the class $C_j$ is determined by the formula $P(C_j) * P(t_i | C_j)$:

• Using posterior probability: You would like to determine the probability that $t_i$ is in a class $C_j$, where $t_i$ is a data value. In this method for classification, the posterior probability for each class is computed and then it is assigned to the class with highest probability. The formula for posterior probability is denoted as $P(C_j | t_i)$.
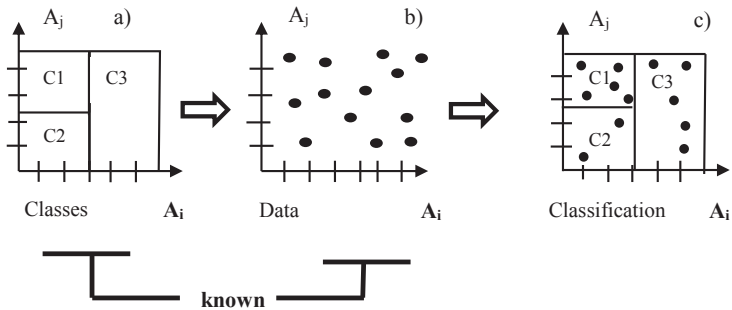


**Figure 6.5**. *Essence of classification problem*

One can notice that example involves Table 6.1 is of the first group of methods, Neural network methods is of third group.

In general, algorithms or methods of solution can be classified as follows:
– Decision tree-based algorithms
– Rule-based algorithms
– Distance-based algorithms
– Statistic-based algorithms
– Neural Network-based algorithms.
– Combining algorithms.

In the following subchapters various approaches of classification are examined.

**Decision tree (DT)-based algorithms:**

The DT algorithms are the most useful in classification problems. Using this technique a tree is constructed to model the classification process. Once the tree is built and applied to each tuple in the database and results in classifications for that tuple.

Definition: Decision Tree (DT) or Classification Tree is a tree associated with D (D is data base contains tuples $\{t_1,..., t_n\}$ and attributes $\{A_1, ... , A_n\}$) that has the following properties:

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– Each internal node (vertex) is labeled with $A_i$ attribute;

– Each arc (edge) is labeled with a predicate that can be applied to the attribute associated with the parent node;

– Each leaf node is labeled with a $C_j$ class.

Solving the classification problem using DT is a two steps process:

1. Decision tree induction: construction of DT and using training data

2. Application of DT for each $t_i$ in D, to determinate its class.

Let us consider a simple DT and understand this definition. There is a known rule to determine body weight of adult person (at age after 20-25):

Firstly, let us determine parameter DW = 100*(W/(H-100) -1),% , where W is a weight of a person, kg; H is a height of a person, cm. Dimensionless values of these attributes are used to calculate DW. The following approximate information has been obtained using statistical data of medical observations (Table 6.2):

**Table 6.2**. *Data (Gender and Interval of DW) and classification of weight*

| Gender | Interval of DW | Classification |
|--------|----------------|----------------|
| M | DW ≤ -20% | U (under weight) |
| M | -20% ≤DW ≤20% | N (normal weight) |
| M | 20% ≤DW | O (over weight) |
| F | DW ≤ -15% | U (under weight) |
| F | -15% ≤DW ≤25% | N (normal weight) |
| F | 25% ≤DW | O (over weight) |

In accordance with the above definition of the structure of DT, proper DT can be created based on classification in this table.
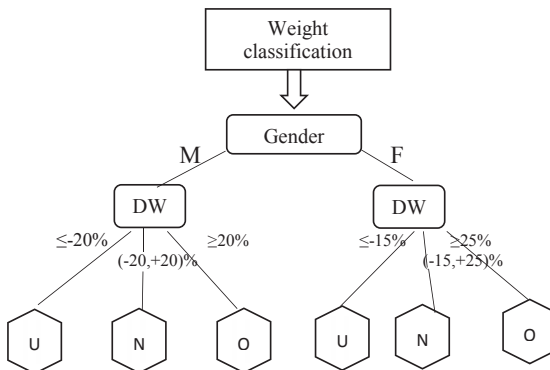


**Figure 6.6**. *Decision tree based on training data in table 6.2*

Any person can determine his/her own weight using this DT (which is just graphical representation of data from Table 6.2.). For example: Woman's height is 160 cm and weight is 72 kg (i.e. parameter of DW= 100*(72/(160-100) -1)= 20%), so, in accordance with DT she has normal weight. In accordance with the algorithm, after vertex 'Gender' edge F was used and then (after vertex 'DW') edge (-15 , +25)% which leads to leaf N (normal weight).

It is quite clear that similar DTs could be embedded, for example, in medical Decision Support Systems (DSS) which help doctor to take decision about diagnosis and type of cure for patient.

It is clear that the most important part in this classification approach is the creation of DT, and application part is standard. The basic method used to solve the classification problem involving DT is called "Specifying boundaries" (R.L. Kennedy, Y. Lee, B. van Roy, 1998): classification is performed by dividing the input space of potential database of tuples into regions where each region is associated with one class (Figure 6.5).

this approach will be illustrated using simple Database example and algorithm known as CLS (system ID3 – Interactive Dichotomizer). Let us suppose that tere is an instance of training Database (Table 6.3) which contains binary values of attributes $X_1, X_2, ..., X_8$ of entity which has to be classified along with classification obtained on the base of experts opinion or by some other methods.

On the each step of DT building it is necessary, in accordance with CLS algorithm, to define attribute which maximally separates (discriminates) tuples from different classes. It should be noted that there are a lot of researches and modifications of this algorithm which only differ in the methods of best choice of the separating attribute, but the simplest one will be applied – just to calculate difference of amounts of '1' for the tuples of Class I and Class II in each column, to determine attribute closer connected to some class. Results shown in Table 6.4.

It can be see that three attributes $- X_3, X_4, X_7$ have the same maximal value of difference $|1-3|=2$, so it can arbitrarily taked, for example, $X_4$ as a discriminator for the first vertex of DT.

**Table 6.3**. *Training data along with classifications*

| No. | $X_1$ | $X_2$ | $X_3$ | $X_4$ | $X_5$ | $X_6$ | $X_7$ | $X_8$ | Class |
|-----|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | I |
| 2 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | I |
| 3 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | I |

| 4 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | I |
| 5 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | II |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | II |
| 7 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | II |
| 8 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | II |

**Table 6.4.** *Amount of '1' in columns of table 6.3:*

| $X_1$ | $X_2$ | $X_3$ | $X_4$ | $X_5$ | $X_6$ | $X_7$ | $X_8$ | Class |
|---|---|---|---|---|---|---|---|---|
| 2 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | I |
| 2 | 2 | 3 | 3 | 1 | 3 | 3 | 2 | II |

Then, split original database table 6.3 into two tables with values of attribute $X_4 = 1$ (table 6.4(a)) and $X_4 = 0$ (table 6.4.(b)):

**Table 6.4(a).** *Tuples with $X_4 = 1$*

| No | $X_1$ | $X_2$ | $X_3$ | $X_4$ | $X_5$ | $X_6$ | $X_7$ | $X_8$ | Class |
|---|---|---|---|---|---|---|---|---|---|
| 3 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | I |
| 5 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | II |
| 7 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | II |
| 8 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | II |

**Table 6.4 (b)**. *Tuples with $X_4 = 0$*

| No | $X_1$ | $X_2$ | $X_3$ | $X_4$ | $X_5$ | $X_6$ | $X_7$ | $X_8$ | Class |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | I |
| 2 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | I |
| 4 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | I |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | II |

As a result the first (top) level of DT is obtained:
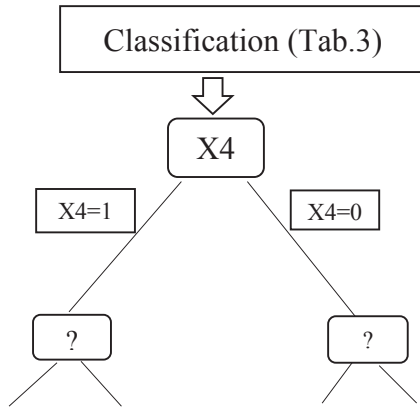
**Figure 6.7(a)**. *Beginning of DT for database table 6.3*

In the same way, we will define the next discriminator for the first edge from vertex $X_4$ ($X_4 = 1$):

**Table 6.5**. *Amount of '1' in columns of table 6.4(a)*

| $X_1$ | $X_2$ | $X_3$ | $X_4$ | $X_5$ | $X_6$ | $X_7$ | $X_8$ | Class |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 0     | 0     | 0     | X     | 1     | 1     | 1     | 0     | I     |
| 2     | 2     | 3     | X     | 1     | 3     | 2     | 1     | II    |

The maximally discriminate attribute, obviously is $X_3$, and we repeat previous type of splitting.

**Table 6.5 (a).** *Tuples with $X_3 = 1$*

| No | $X_1$ | $X_2$ | $X_3$ | $X_4$ | $X_5$ | $X_6$ | $X_7$ | $X_8$ | Class |
|----|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 5  | 1     | 1     | **1** | X     | 0     | 1     | 1     | 0     | II    |
| 7  | 0     | 1     | **1** | X     | 1     | 1     | 0     | 1     | II    |
| 8  | 1     | 0     | **1** | X     | 0     | 1     | 1     | 0     | II    |

Note!: ALL tuples in the table 6.5 (a) belong Class II (i.e. it is the Leaf Node).

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**Table 6.5 (b).** *Tuples with* $X_3 = 0$.

| No | $X_1$ | $X_2$ | $X_3$ | $X_4$ | $X_5$ | $X_6$ | $X_7$ | $X_8$ | Class |
|----|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 3  | 0     | 0     | 0     | X     | 1     | 1     | 1     | 0     | I     |

Note!: ALL tuples in table 6.5 (b) belong to Class I (i.e. it is also the Leaf Node)

Now, Decision tree is updated:

Tuples are classified 3, 5, 7, 8 from Training Table 6.3 for arc $X_4 = 1$ . Try to perform similar steps for arc ($X_4 = 0$) yourself. The result of initial step shows that solution of classification problem in general may be not unique; other variants with different discriminator can also be checked, for example, $X_7$. So, the last step is a choice of optimal DT (for example, with minimal length of all paths from root to leaves).

**Rule-based algorithms**

Another way to construct classification for tuples in Database (or for some interrelated objects in data set) is to create a set of logical rules which enable to put each tuple (or object) into one of predefined classes. There are several known techniques to provide these rules.

**Generating rules from DT**

For example, it to transform the result of DT solution into form of Rule-based algorithm describing each path from root to leaf of DT in the form of logical predicate:

**IF** $(predicate\ 1)\ \cap (predicate\ 2)\ \cap ....(predicate\ N)$ **THEN** B

For instance (tree in Figure 6.7(b)):

**IF** $(X_4 = 1)\ \cap\ (X_3 = 1)$ **THEN** Class II;

**IF** $(X_4 = 1)\ \cap\ (X_3 = 0)$ **THEN** Class I.

Similar predicates could be constructed (try it yourself) for the rest part of Decision tree (beginning from edge '$X_4 = 0$' ).

**Covering algorithms**, another type of algorithms to generate rule for classification without DT, is described in the book of *I.H. Witten and E. Frank "Data mining Practical Mashine Learning Tools and Techniques", 2000.* Idea of this approach is to generate set of rules using all possible predicates which enable to classify all tuples in training table and then choose from it an optimal (minimal) set of logical rules. For above example it is possible to can start from simple rule:

IF ($X_4 = 1$) THEN Class I; IF ($X_4 = 1$) THEN Class II; IF ($X_4 = 0$) THEN Class I;

IF ($X_4 = 0$) THEN Class II;
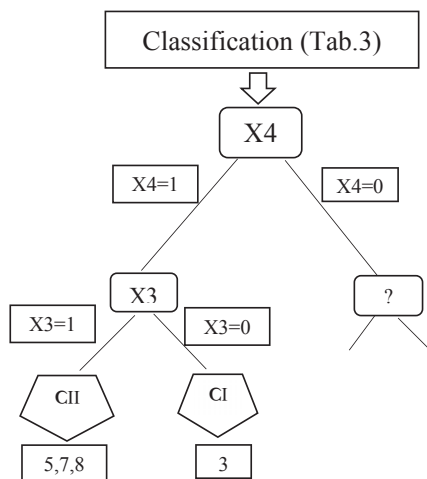
**Figure 6.7(b)**. *Part of DT for database table 6.3*

After this, it is necessary to check the way each rule matches classifications in Table 6.3. Obviously, number of errors (mismatching) were counted, e.g. first rule (with predicate '$X_4 = 1$') does not match to the given class in tuples No 5, 7, 8. After, all possible single predicate rules were checked (for ($X_1, X_2, ..., X_8$). It becomes clear that one-predicate rules are not enough to classify all tuples correctly. Next step is to use all possible double-predicate rules, i.e. rules of type.

**IF** $(X_i = K) \cap (X_j = M)$ **THEN** Class N, where $(i, j)$ take all possible values 1, ..., 8, $(i, j)$ $(i \neq j)$ and $K, M$ are equal to 0 or 1. After the same checking, the number of rules we will be found which make correct classification (at least, for example, which was getten using DT algorithm). The last step is to choose optimal (minimal) set of such rules. Of course this description is just Idea of covering algorithm and you can find a lot of published modifications and optimizations. **Algorithms generating rules using Neural Networks** should also be mentioned but details of these algorithms are beyond the frame of this chapter.

Distance-based algorithms of classification

Distance measures

It is quite naturally to assume that classified objects (e.g. tuples of Database) mapped to the same class must be more similar to each other than to objects from other class. Each object which is defined by its attributes, let it be $K$, can be considered as a point in $K$-dimensional space $E_K$, that is why instead of 'similarity' in DM the term 'distance' is often used.

So, a distance measure $d(x; y)$ is necessary that tells how 'dissimilar' or 'far' points $x$ and $y$ are. The usual axioms for a distance measure $d$ in mathematics are:

1. $d(x; x) = 0$.                          – A point is distance 0 from itself.
2. $d(x; y) = d(y; x)$.                – Distance is symmetric.
3. $d(x; y) \le d(x; z) + d(z; y)$.    – The "triangle inequality" – the sum of lengths of any two sides of triangle is not less than length of the third side.

Often, our objects (points, tuples) may be thought to belong to a $K$-dimensional Euclidean space $E_K$, and the distance between any two points, let it be $t_i = \{t_{i,1}; t_{i,2}; ...; t_{i,k}\}$ and $t_j = \{t_{j,1}; t_{j,2}; \; : \; : \; :; t_{j,k}\}$, is given in one of the usual manners:

Common (Euclidean) distance:

$$d(t_i, t_j) = \sqrt{\sum_{h=1}^{k} (t_{i,h} - t_{j,h})^2} \qquad (6.1)$$

Manhattan distance is also known as "city block" or "taxicab" distance between vectors $t_i$ and $t_j$. (Manhattan is one of New York City's 5 boroughs in which streets map looks like rectangular grid):

$$d(t_i, t_j) = \sum_{h=1}^{K} |t_{i,h} - t_{j,h}| \qquad (6.2)$$

Max of dimensions:

$$d(t_i, t_j) = \max_{\forall h} |t_{i,h} - t_{j,h}| \qquad (6.3)$$

It is not too difficult (at least in 2-dimensional space) to prove that all these distances satisfy the above axioms.

You may note that all these distance definitions can use only numeric attributes. However, the attributes may not be numerical, such as names of colors - red, green, etc. or logical expressions – yes, no, or traditional evaluation (Table 6.1) – excellent, good, etc. In such cases descriptions are usually converted into numerical determinations using different types of numeric variables. Below the commonly used types of numeric variables will be considered and associated methods for calculating distance.

Types of data in Classification and Cluster Analysis

**Interval-Scaled Variables**

Interval-Scaled variables are continuous measurements of a linear scale, e.g. weight, height, temperature and etc. To avoid the dependency of the mea-

surement units (e.g. Celsius or Fahrenheit temperature) often a standard data that is unit-less are used (e.g. in %% of means, ratio of Standard deviation, etc.), for example:

$$t^*_{i,j} = \frac{t_{i,j} - t^{MIN}_{i,j}}{t^{MAX}_{i,j} - t^{MIN}_{i,j}}, \tag{6.4}$$

where $t^{MIN,(MAX)}_{i,j} = \min_{\forall i}(\max)(t_{i,j})$, therefore normalized variable $t^*_{i,j} \in [0,1]$.

Dissimilarity can be defined as Euclidean metric ($\alpha=2$), Manhattan metric ($\alpha=1$), etc.

$$d(t_i, t_j) = \left( \sum_{h=1}^{k} |t_{i,h} - t_{j,h}|^\alpha \right)^{1/\alpha} \tag{6.5}$$

**Binary variables**

Binary variables (BV) are understood by two states **0** and **1.** When state is 0, variable is absent (in tuple) and when state is 1, variable is present.

BV is *symmetric* if both states are equal valuable and weights (Color = Red|Blue can be denoted as 0|1 or 1|0), while *asymmetric* variables are variables that have not the same state values (Medical test = Positive|Negative, often denoted as +|- or 1|0).

Dissimilarity (or distance) between the same type two binary variables can be calculated using a **Contingency table** (where A, F – amount of matching; B, C – amount of mismatching values of correspondent attributes):

|  |  | Object 1 | | Sum |
|---|---|---|---|---|
|  |  | 1 | 0 |  |
| **Object** | 1 | A | B | A+B |
| 2 | 0 | C | F | C+F |
| Sum |  | A+C | B+F |  |

Calculation of the dissimilarity between pairs of the objects (tuples) using:
  a) Simple matching coefficient (for symmetric BV)

**d (i,j) = (B+C) / (A+B+C+F)**
  b) Jaccard coefficient (for asymmetric BV):

**d (i,j) = (B+C) / (A+B+C).**
Example: let $t_1, t_2$ are two tuples with binary variables from Database

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| $t_1$ | 1 | 0 | 1 | 1 | 0 | 1 |
|-------|---|---|---|---|---|---|
| $t_2$ | 0 | 0 | 0 | 1 | 1 | 1 |

Contingency table is as following:

| | | Object $t_2$ | | Sum |
|---|---|---|---|---|
| | | *1* | *0* | |
| **Object** | *1* | 2 | 1 | 3 |
| $t_2$ | *0* | 2 | 1 | 3 |
| *Sum* | | 4 | 2 | |

Simple matching coefficient (for symmetric BV):

$$d(1,2) = (1+2) / (2+1+2+1) = \tfrac{1}{2} \; ;$$

Jaccard coefficient (for asymmetric BV):

$$d(1,2) = (1+2) / (2+1+1) = \tfrac{3}{4}.$$

For *n* tuples the dissimilarity $n \times n$ matrix $\{d(i,j)\}$ should be constructed based on Data matrix (or object by object structure)

$$X = \{X_{i,j}\}, \quad (i = 1,..., n; j = 1, ..., p).$$

*(Consider example: Objects - members of team: AA, BB, CC; with binary attributes (yes – 1, no – 0): Gender, Graduate, Experience, Mobile, Car, Home)*

**Nominal Variables**

Nominal Variables are a generalization of the BV, NV has more than two states (Color = Green, Red, Yellow,...). The dissimilarity between two objects can be calculated by using simple matching approach:

$$d(i,j) = (t – m) / t,$$

where *m* is the number of matches, *t* – total number of variables.

**Ordinal Variables**

Ordinal Variables are similar to Nominal Variables but all states are ordered in a meaningful sequence (excellent, good, satisfactory, unsatisfactory).

The dissimilarity between two objects can be calculated by using the following approach:

a) Replace each state of Xi by its corresponding rank : $R_i; R_i = \{1, ..., N_i\}$, (e.g. excellent – 5, good – 4, etc.)

b) Equalize/normalize (if neccessary) the weight of variable, for instance, use instead of $R_i$:

$$Z_i = (R_i - \mathbf{1})/(N_i - \mathbf{1})$$

c) *d (i,j)* can be computed by any of the distance measure approaches such as Euclidean or Manhattan distances.

### Ratio-Scaled Variables

A ratio-scaled variable makes measurements on a non linear scale such as exponential scale, e.g. $A*\mathbf{exp}(Bt)$, or $A*exp(-Bt)$, where A and B are constants.

*d (i,j)* can be computed by any of the distance measure approaches such as Euclidean or Manhattan distances for Ratio-scaled variables, directly using values of V or after logarithmic transformation: $Y_i = \mathbf{Log}(X_i)$ (e.g. *pH, dB* – decibel).

### Mixed Type Variables

1) Group the same types of V in a particular cluster and perform separate dissimilarity computing method for each variable type cluster.

2) If the scale set consists of N mixed types, the dissimilarity can be calculated as:

$$d_N(i, j) = \left(\sum \delta_{i,j} d_{i,j}\right)/\left(\sum \delta_{i,j}\right),$$

where: $\delta_{i,j} = 0$, *if* either $X_i$ or $X_j$ is missing or $X_i = X_j = 0$.

$$\delta_{i,j} = 1, \text{otherwise,}$$

that is, $\delta_{i,j}$ is a contribution of variable ($X_i$ and $X_j$) to the dissimilarity between tuples $t_i, t_j$ depends on variable types. The weight coefficients for $\delta_{i,j}$ also can be used.

E.g.: *If $X_i | X_j$ is binary (or nominal):* $\delta_{i,j} = 0$ if $X_i = X_j$, otherwise $\delta_{i,j} = 1$;

*If $X_i | X_j$ is interval scaled:* $\delta_{i,j} = |X_i - X_j|/(maxX - minX)$, where maxX and minX are defined over all non-missed attributes $X_i$ (normalized distance**)**.

(Consider an example about cars grouping and comparison using attributes: color, type of body, class, engine power, maximal speed, fuel consumption on 100km).

### Similarity:

Think of a tuple as a set of columns which has binary values 1 or 0. Then, **Similarity** of two tuples $t_1$ and $t_2$ can be defined as:

$$Sim\ (t_1, t_2) = \ |\ t_1 \cap t_2\ |\ /\ |\ t_1 \cup t_2\ |$$

E.g.: Let us consider the following tuples $t_1, t_2$ :

| $t_1$ | 1 | 0 | 1 | 1 | 0 | 1 |
|---|---|---|---|---|---|---|
| $t_2$ | 0 | 0 | 0 | 1 | 1 | 1 |

Simple matching: $\text{Sim}\ (t_1, t_2) = \mathbf{A}\ /\ (\mathbf{A} + \mathbf{B} + \mathbf{C} + \mathbf{F}) = \ 2\ /\ 6\ = 0.33\,(33\%)$, or

Jaccard coefficient: $\text{Sim}\ (t_1, t_2) = \ \mathbf{A}\ /\ (\mathbf{A} + \mathbf{B} + \mathbf{C}) = \ 2\ /\ 5\ =\ 0.40\,(40\%)$

Remark: distance as $\boldsymbol{d(i,j) = d(ti,tj) = 1 - Sim(ti,tj)}$ can also be defined

Now let us return to distance-based methods of classifications.

Definition: Given Database $D : \{t_1; t_2; ...; t_k\}$ of tuples , where each tuple $t_i = \{t_{i,1}; t_{i,2}; ...; t_{i,k}\}$ contains numerical values and belong to some $C_i$ from a set of classes $C$. Classification problem is to assign new tuple $t_x = \{t_{x,1}; t_{x,2}; : : :; t_{x,k}\}$ to the one of $C_i$ which tuples are similar to $t_x$.

**Simple Approach: (Simple Distance Algorithm)**

Algorithm of Simple approach: Assign $t_x$ to class $C_i$ which contains the tuple(s) with the smallest distance to $t_x$.

A representative for each class can be also be determined by calculating the **center** of each region – e.g. tuple with average coordinates and then compares distances between $t_x$ and centers of classes.

**K Nearest Neighbors (KNN) algorithm:**

The $k$-nearest-neighbor method was first described in the early 1950s. The method is labor intensive when given large training sets. It did not gain popularity until the 1960s when increased computing power became available. It has since been widely used in the area of pattern recognition.

When a classification is made for a new $t_x$, its distance to each item in a set with known classification must be determined. Only the $K$ closest (with shortest distances) entries are considered further. The new $t_x$ is then placed in the class that contains the most items from this set of $K$ closest items.

Example.

Task : Use training Table 6.3 to classify new tuple $t_9 = \{1,0,1,0,0,0,1,1\}$.

Solution:

1) Simple approach algorithm. Firstly, calculate all $d(t_i, t_x)$ using, for example, Manhattan distance (because it is simple, J). It is easy to check that distance $d(t_1, t_9) = |1{-}1| + |0{-}0| + |1{-}1| + |0{-}0| + |0{-}0| + |0{-}0| + |0{-}1| + |1{-}1| = 1$ is the smallest. Hence, $t_9$ belongs to Class I, because closest classified $t_1$ belongs to Class I.

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2) K Nearest Neighbors (KNN) algorithm. Let us take K=3. Using calculated distances from previous example three smallest distances were found which are: $d(t_1,t_9)=1$ ; $d(t_6,t_9)=2$ ; $d(t_4,t_9)=3$. Main number of these tuples i.e. $(t_1,t_4)$ belongs to Class I, therefore $t_9$ belongs to Class I as well.

From these examples it can be noticed that the Simple approach method is just particular case of KNN method with K=1, and then – it is better take K as odd number to avoid possible uncertainness when equal numbers of the smallest distances belong to different classes (fifty-fifty result).

**Fuzzy Sets and Fuzzy Logic**

In described methods of classification above it is supposed that each given object belongs exactly to one class. Nevertheless there are situations when this constraint does not hold. You can see in the Figure 6.8. one simple example of such situation. Income which is "low" in some cities (or even in one region of city) is rather "medium" in other places. So, it is impossible to provide exact boundary between Low, Medium and High classes of income. To describe these overlapping classes so-called Fuzzy set can be used.

Definition 1: A Fuzzy Set (Class) is a set, let it be *F*, in which a **set (or class) membership function *f(X)*,** is a real valued (as opposite to Boolean for conventional classification) function with output in the range [0,1].

Definition 2: An element *X* belongs to *F* with probability *f(X)* and simultaneously is in ¬*F* (NOT *F*) with probability 1- *f(X)*.

Actually, *f(X)* is not true probability, but rather degree of truth associated with the statement: "*X* **belongs to *F*".**
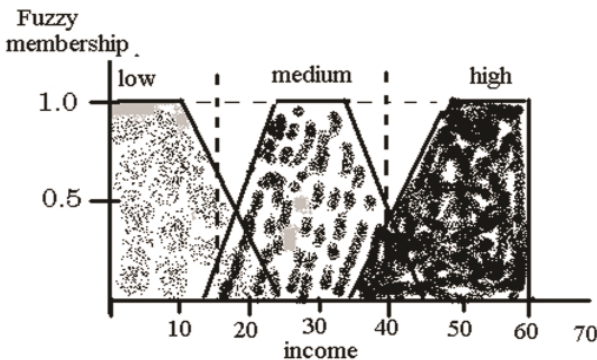


**Figure 6.8**. *An example of fuzzy membership classification.*
*(dashed lines – traditional set (Class) of membership)*

Analysing the graph of membership in the Figure 6.8 it can be seed that the membership = 0.5 for the income corresponding to graphs intersection

point (income = 20 or 40), there is no preference in the choice of class. In such cases, for classifying is possible either arbitrarily to choose one of the adjacent classes or use additional information or attributes for classification refinement.

The following values are commonly used to define the results of **fuzzy logic operations:**

$$Mem\,(-X)\;=1-\;mem(X)$$
$$Mem\,(X \cap Y)=\mathbf{min}\big(mem(X),\;mem(Y)\big)$$

(e.g. reliability of a set of serial parts is usually determined using minimal class of reliability)

$$Mem\,(X \cup Y)\;=\mathbf{max}\big(mem(X),\;mem(Y)\big)$$

(e.g. benchmark class of a company is defined by maximal class of its departments)

Actually, these formulas are the same which used for definition logical functions AND, OR in math logic with binary values (0,1).

### Regression analysis (Prediction)

Numeric prediction is a task of predicting continuous (or ordered) values for the given input. For example, it to predict the salary of college gra-duates with 10 years work experience or the potential sales of a new product. By far, the most widely used approach for numeric prediction (here in after referred to as prediction) is regression, a statistical methodology developed by Sir Frances Galton (1822–1911). In fact, many texts use the terms 'regression' and 'numeric prediction' synonymously. However, as it cad be seen, some classification techniques (such as support vector machines and k-nearest-neighbor classifiers KNN) can be adapted for prediction. In this subchapter the use of regression techniques for prediction is described. Regression analysis can be used to model the relationship between one or more independent or predictor variables (attributes) and a dependent or response variable, which is continuous-valued. In the context of Data Mining, the predictor variables are the attributes of interest describing the tuple (i.e. making up the attribute vector).

### Linear regression

Regression assumes that there is functional dependence (FD) between values of two attributes, let them be $X$ and $Y$:

$Y = F(X)$;    *FD Y→X allows to predict (determine) the value of Y at the given value of X.*

Initially, regression was investigated as statistical approach connected with correlation of random variables, but then it was proved (Legendre in 1805, Gauss in 1809) that the same results can be obtained using methods

of minimization, in particular, Least Squares Method (LSM). This technique became more popular due to uniform approach to constructing regression equations for multivariate regression, and it is implemented in the numbers of statistics softwares. Now, the idea of this approach will be described.

Assume that the data model is $Y = K f(X) + C$; ($K, C$ are some constants)
In accordance with LSM the best fit of FD is when:

$$S(K,C) = \sum_i (Y_i - Kf(X_i) - C)^2 \rightarrow \min$$

So, in accordance with theorem of extremum (this case – minimum) of differentiable functions the system of 'normal equations' for determination of $K, C$ is getten:

$$\left( \frac{\partial S(K,C)}{\partial C} = 0 \right) \Rightarrow K \sum_i f(X_i) + nC = \sum_i Y_i$$

$$\left( \frac{\partial S(K,C)}{\partial K} = 0 \right) \Rightarrow K \sum_i (f(X_i))^2 + C \sum_i f(X_i) = \sum_i Y_i f(X_i) \qquad (*)$$

The system has a unique solution (i.e. $K,C$).

Example. Suppose we get the following empirical date ($X, Y$) as a result of some observations:

| X | 0 | 1 | 3 | 3 | 5 | 5 | 7 |
|---|---|---|-----|-----|-----|-----|---|
| Y | 5 | 4 | 3.7 | 3.3 | 3.3 | 3.1 | 3 |

Then dependence of $Y$ on $X$ is described using above regression model. First of all check $f(x) = x$; i.e. regression equation in the form $Y = Kx + C$. From formulas (*) system of normal equations for $K, C$ is obtained:

$$24K + 7C = 25.4,$$
$$118K + 24C = 78.$$

Using any known method, solution: $K = -0.254$; $C = 4.5$ can be found.
Therefore, regression equation is $Y_1 = -0.254X + 4.5$ (notation $Y_1$ is use instead of $Y$ to avoid collision between given $Y$ and approximate values $Y1$). Line in Figure 6.9 represents this result.
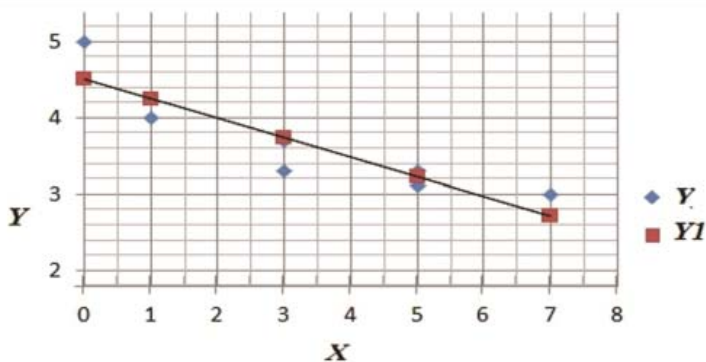
**Figure 6.9.** *Comparison of the given values – **Y**
with calculated by regression equation – **Y1***

If accuracy of regression is decided to be not satisfactory, then another type of dependence can be trud, i.e. another *f(X)*.

For example, the following function can be used for regression: $f(X) = 1/\sqrt{1+X}$, so regression equation is in the form:

$$Y2 = K\frac{1}{\sqrt{1+X}} + C;$$

Using again formulas (*), system of normal equations for **K, C** is obtained:

$$3.877K + 7C = 25.4,$$
$$2.458K + 3.877C = 15.0$$

Solution is $K = 3.002$; $C = 1.966$, so, the following regression equation is getten:

$$Y2 = \frac{3.002}{\sqrt{1+X}} + 1.966.$$

Line in Figure 6.10 represents this result.
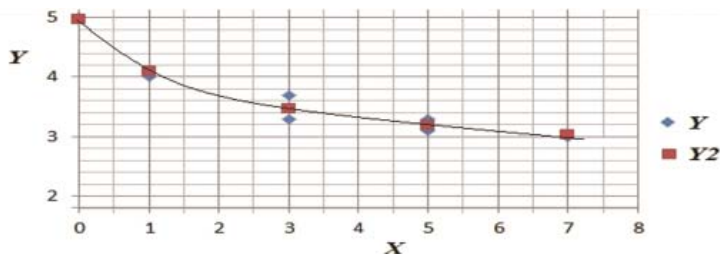


**Figure 6.10**. *Comparison of the given values – **Y** with
calculated by regression equation – **Y2***

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There is no exact recommendations which function we have to use to obtain best fit to the given data. It is a matter of researcher's experience. But we can use as a criterion of accuracy, for example, the sum of squares of differences (**SSD**) between the given and calculated (using regression equation) values, or use so called **Std.** $= \sqrt{SSD/n}$, where **n** is a number of given pairs $(X_i, Y_i)$.

Results of comparison of accuracy of regression models *Y1* and *Y2* are represented in Table 6.6.

**Table 6.6**. *Given X, Y and calculated Y1, Y2 values using linear regression equation*

| Given data | | Approx. data (regression equation) | | | |
|---|---|---|---|---|---|
| X | Y | Y1 | (Y-Y1)^2 | Y2 | (Y-Y2)^2 |
| 0 | 5 | 4.50 | 0.250 | 4.968 | 0.001 |
| 1 | 4 | 4.25 | 0.060 | 4.089 | 0.008 |
| 3 | 3.7 | 3.74 | 0.001 | 3.467 | 0.054 |
| 3 | 3.3 | 3.74 | 0.191 | 3.467 | 0.028 |
| 5 | 3.3 | 3.23 | 0.005 | 3.192 | 0.012 |
| 5 | 3.1 | 3.23 | 0.016 | 3.192 | 0.008 |
| 7 | 3 | 2.72 | 0.079 | 3.027 | 0.001 |
| | | Sum= | 0.603 | Sum= | 0.112 |
| | | Std= | 0.293 | Std= | 0.126 |

Conclusion: Model *Y2* fits better to the given data than Model *Y1*, because **Std** for *Y2* is 0,126 whereas for *Y1* is 0,294, which also can be easily noticed from graphs in Figures 6.9, 6.10.

Using these regression equations, we can evaluate (predict) unknown value of Y, for example, at *X=3.5; Y1 =3.61; Y2= 3.38*. So, if, for example, *Y* represents classes of some object, then different regression models can result in different classifications.

**Multivariate Regression:**

The general form of multivariate linear regression is:

$$Y = K_0 + K_1 * f_1(X) + K_2 * f_2(X) + ... + K_n * f_n(X) \qquad (**)$$

where $f_i(X)$ is known (given) function depending on subset of arguments $(X_1, X_2, ...)$.

In particular, the simplest equation:

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$$Y = K_0 + K_1 * X_1 + K_2 * X_2 + \ldots + K_n * X_n,$$

where all $f_i(X) = X_i$. If we have set of $M$ tuples $(M > n+1)$ then, according to LSM, the best fit of FD is when

$$S(K_0, K_1, \ldots, K_n) = \sum_{i=1}^{M} (Y_i - K_0 - K_1 f_1(X_{1,i}) - \ldots - K_n f_n(X_{n,i}))^2 \to \min,$$

i.e. the system of normal equation for computation of $K_i$ could be obtained in the same manner as it was done in the case of one independent variable $X_1$:

$$\frac{\partial S(K_0, K_1, \ldots, K_n)}{\partial K_i} = 0, \qquad i = (0, \ldots, n).$$

But there is more simple approach based on using of matrix algebra. If to write equations (**) for each of M tuples then the system of M algebraic equations with unknown $K_i$ $(i=0,\ldots,n)$ could be obtained, which can be represented in matrix form as $F * K = Y$,

where:

$$K = \begin{pmatrix} K_0 \\ \ldots \\ K_n \end{pmatrix}; \qquad Y = \begin{pmatrix} Y_1 \\ \ldots \\ Y_M \end{pmatrix}; \qquad F = \begin{pmatrix} 1 & f_{1,1} & \cdots & f_{n,1} \\ 1 & f_{1,2} & \cdots & f_{n,2} \\ \cdots & \cdots & f_{i,k} & \cdots \\ 1 & f_{1,M} & \cdots & f_{n,M} \end{pmatrix};$$

$f_{i,k} = f_i(X_k)$; $(i = 1,\ldots, n; k = 1,\ldots, M)$ ; $X_k$ is a subset of variables $X_i$ having values from $k$-th tuple.

It was proven that the system of normal equations can be written as:

$$F^T * F * K = F^T * Y,$$

where $F^T$ denotes transposed matrix $F$. Obviously, this form is more convenient for computer algorithm and can be easier implemented as software product.

Let us construct the linear regression equation using data from the first three columns in Table 6.7.

Results of solution and evaluation of accuracy are put in the rest of the table. Solutions are obtained for different models of linear regression: $Y_1$ and $Y_2$ with one independent variable, $Y_3$ with two variables. After the determination of regression coefficients from correspondent systems of normal equations, the following regression equations could be obtained:

$$Y_1 = -1.31*X_1 + 8;$$

$$Y_2 = -0.39*X_2 + 7.69;$$

$$...$$

$$Y_r = -0.41X_1 - 0.28X_2 + 7.86.$$

Evaluations of accuracy of these regression models using average of absolute relative deviations are shown in columns $D_i$, (i=1, 2,…, r). From Table 6.7 it can be noticed that in some cases (particularly, in this instance) using simplest multivariate regression does not compulsorily lead to better accuracy, therefore to decrease deviations we have to examine different functions $f_i(X)$, e.g: $f_i(X) = X_m * X_j$ or $f_i(X) = X_k^2$ and etc.

Thus, some popular "classical" methods of classifications are explained. There are other more complex techniques of classifications such as Discriminant Analysis, Genetic Algorithms, Information gain, Neural Network solutions and different hybrid approaches which are subjects of separate or advanced Data Mining courses.

**Cluster Analysis**

Clustering (Database segmentation)

The process of grouping a set of physical or abstract objects into classes of similar objects, *Clusters,* is called **Clustering.** Cluster is a collection of data that are similar to one another within the same cluster and dissimilar to the objects in other clusters.

Definition: In the given Database $D: \{t_1, t_2, ..., t_n\}$ of tuples $t_i$, a similarity measure $Sim(t_i, t_j)$ (dissimilarity or distance) is defined between each pair of tuples. The clustering problem is to define a mapping $f$ where each tuple $t_i$ is assigned to one cluster $C_j$ $(j = 1,...,k)$ by condition: distances $D(t_i, t_j)$ between tuples of one cluster are less than distances to any tuple of any other cluster (similarity definition is opposite to distance), where $k$ (number of clusters) can be predefined or not.

Cluster analysis is an important human activity, it is used in data mining, statistics work, biological computations, marketing or machine learning. There are various clustering techniques/algorithms which may be classified as it is shown on diagram in Figure 6.11.

**Partitioning methods:**

Idea of the partitioning methods is to arrange all objects into various partitions, where total number of partitions is less than the total number of objects, each partition represents a cluster. Here some algorithms are desribed.

**Table 6.7**. *Example of regressions. Given $X_1, X_2, Y$ and calculated $Y_1, Y_2, Y_r$, using regression equations*; *Deviations:* $D_i = (Y - Y_i)/Y$, %, $(i = 1, 2, ..., r)$

| $X_1$ | $X_2$ | $Y$ | $Y_1$ | $D_1 = (Y - Y_1)/Y$, % | $Y_2$ | $D_2 = (Y - Y_2)/Y$, % | $Yr$ | $D_r = (Y - Y_r)/Y$, % |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 7 | **6.69** | 4.4 | **6.91** | 1.3 | **6.90** | 1.4 |
| 2 | 6 | 5 | **5.38** | -7.6 | **5.35** | -7.0 | **5.39** | -7.9 |
| 3 | 10 | 5 | **4.07** | 18.6 | **3.79** | 24.2 | **3.89** | 22.3 |
| 3 | 11 | 3 | **4.07** | -35.7 | **3.40** | -13.3 | **3.61** | -20.3 |
| 4 | 11 | 3 | **2.76** | 8.0 | **3.40** | -13.3 | **3.20** | -6.8 |
| *Average of* $\mid D_i \mid$, % | | | | 13.8 | | 11.8 | | 11.7 |
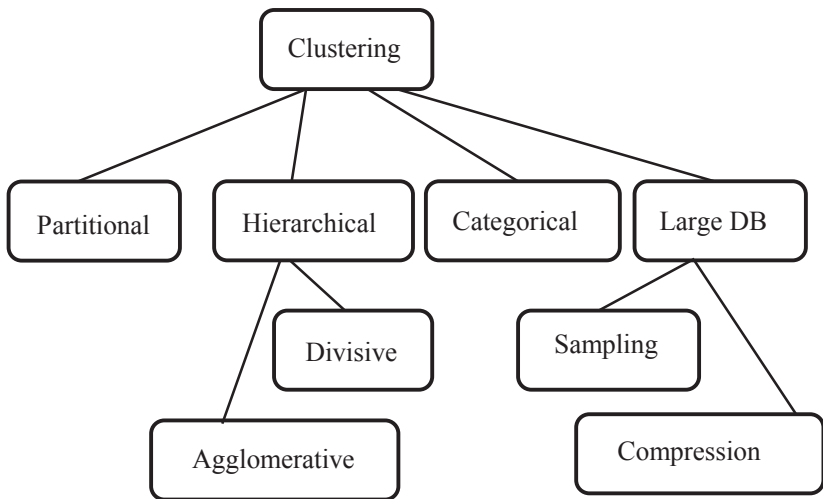


**Figure 6.11**. *Classification of clustering algorithms*

**K- means method**

Algorithm of the *K*-means method (*K*- is defined as a number of cluster):

1. Select randomly *K* objects from *D* (each of them initially represents mean of some cluster);

2. For each of the remaining objects each object is assigned to the cluster to which it is the most similar (min distance);

3. Calculate clusters mean *Mj (j=1,…,K)* and new distances between tuples and means.

4. Repeat from item 2, iteratively until the criterion function converges.

For example, one may use Squared error criterion *F*:

$$F = \sum_{j=1}^{K} \sum_{\forall t \in C_j} |t - M_j|^2$$

Example: Table 6.8 and picture below describe values of attributes of a given set of objects $(X_1,..., X_6)$ which have to be distributed in two clusters (i.e. *K=2*).

**Table 6.8**. *Example of data base (and graphic) n for K-means method*
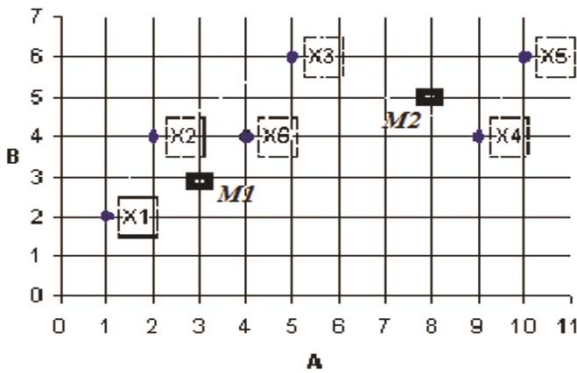


| Object / Attr | A | B |
|---|---|---|
| $X_1$ | 1 | 2 |
| $X_2$ | 2 | 4 |
| $X_3$ | 5 | 6 |
| $X_4$ | 9 | 4 |
| $X_5$ | 10 | 6 |
| $X_6$ | 4 | 4 |

Clustering using K-means method:

Firstly, select two objects from *D* randomly, for example, $X_1$, $X_5$ as the initial mean representatives of two clusters $C_1$ and $C_2$.

**1 step**: Calculate the table (Table 6.9) of distances between all objects (e.g. using Manhattan distance)

**2 step:** Attach other objects $X_2$, $X_3$, $X_4$, $X_6$ to one of the clusters using minimum distance.

In accordance with values in the table of distances $X_2$ and $X_6$ belong to cluster with $X_1$, but $X_3$ and $X_4$ to cluster with X$_5$. So, two clusters are obtained: $C_1\{X_1, X_2, X_6\}$, $C_2\{X_3, X_4, X_5\}$

**3 step:** Calculate mean of each cluster (we round results to integer values):

For $C_1$: $M_1 = M_1((1+2+4)/3, (2+4+4)/3) \approx M_1(2, 3)$ – it is the first center of new cluster.

For $C_2$: $M_2 = M_2((5+9+10)/3, (6+4+6)/3) \approx M_2(8, 5)$ – it is the second center of new cluster (see locations of $M_1$ and $M_2$ in the picture).

**Table 6.9**. *Manhattan distances between objects* $(X_1, ..., X_6)$

|       | $X_1$ | $X_2$ | $X_3$ | $X_4$ | $X_5$ | $X_6$ |
|-------|-------|-------|-------|-------|-------|-------|
| $X_1$ | 0     |       |       |       |       |       |
| $X_2$ | 3     | 0     |       |       |       |       |
| $X_3$ | 8     | 5     | 0     |       |       |       |
| $X_4$ | 10    | 7     | 6     | 0     |       |       |
| $X_5$ | 13    | 10    | 5     | 3     | 0     |       |
| $X_6$ | 5     | 2     | 3     | 5     | 8     | 0     |

Repeat **1 step**: calculate distances between $M_1$, $M_2$ and all other $X_i$, then repeat **2 step** using $M_1$, $M_2$ instead of $X_1$, $X_5$ (i.e. attach all objects $X_1$, $X_2$, ..., $X_6$ to one of the clusters with representatives $M_1$ and $M_2$ using minimum distance. After repeated steps the same clusters $C_1$ and $C_2$ are obtained, hence, we stop process of clustering with final clusters $C_1\{X_1, X_2, X_6\}$ , $C_2\{X_3, X_4, X_5\}$.

**K-medoids algorithm, PAM algorithm (Partition Around Medoids)**

The idea of this method is much similar to K-means method but instead of means of calculation existing tuples (medoids) are used.

Algorithm:

1. Select arbitrarily K medoids from D; (e.g. $X_1$, $X_2$ from above *K*-means example).   Calculate the distance matrix (between all objects in D);

2. Construct set of clusters (join each non-medoid object to some cluster in accordance with minimal distance or similarity/dissimilarity metric);

3. Choose one new medoid instead of previous one (see table below);

4. Calculate increment of total cost function ($F$) after this replacement of medoid (Save $F$ value and set of medoids)

5. Repeat from item 3 for each object.

6. Choose a set of clusters with the most negative (if any!) increment $F$, - it is optimal solution

E.g. there are 6 possible scenarios of medoids for our previous instance (*K*-means method)

| Instead of | $X_1$ | $X_1$ | $X_1$ | $X_5$ | $X_5$ | $X_5$ |
|---|---|---|---|---|---|---|
| New medoid | $X_2$ | $X_3$ | $X_4$ | $X_2$ | $X_3$ | $X_4$ |

Solution is a scenario with the minimal value of cost function $F$, for example, above defined Squared error criterion $F$:

**CLARA** (*Clustering LARge Applications*), **CLARANS** (.+R*andomize search*) are variants of PAM for large database.

The basic idea is that it applies PAM to a sample of database and then uses centers (medoids) of found clusters as medoids for the complete clustering. Each tuple from the database is then assigned to the cluster with the medoid which it is closest to.

**Hierarchical Methods of clustering. Divisive and Agglomerative clustering**

The idea of divisive approach:

Given: Data base $D = \{t_i\}$, $i = 1,...,n$; and number of clusters - $K$.

1. Calculate distances matrix $d = d\{d_{i,j}\}$;

2. Choose two objects $t_k$ and $t_l$ with maximal distance $d_{k,l}$ as centers (or medoids) of two clusters;

3. Join each of rest objects t$i$ ($i \neq k$, $i \neq l$) to some cluster in accordance with similarity/dissimilarity/minimal distance metric;

4. Choose cluster $C_{mx}$ with the most distance between its objects;

5. Repeat the same with $C_{mx}$ from item 2 until number of clusters less than $K$.

Example (using data from *K*-means method):

Step 1. Calculate the same table of Manhattan distances (Table 6.9).

Step 2. The objects (tuples) with maximal distances are $X_1$ and $X_5$, therefore we chose them as medoids of two clusters $C_1$ and $C_2$.

Step 3. Attach the rest of objects (i.e. $X_2$, $X_3$, $X_4$, $X_6$) to closest of medoids. As a result we obtain two clusters: $C_1\{X_1, X_2, X_6\}$, $C_2\{X_3, X_4, X_5\}$. It is a solution. If there is a need, for example, 3 clusters ($K=3$) then step 2 should be continued with cluster $C_2$ because it has maximal distance 6 between objects $X_3$, $X_4$, whereas in $C_1$ maximal distance is 5. Step 3 is repeated for cluster $C_2$ and finally three clusters: $C_1 \{X_1, X_2, X_6\}$, $C_2\{X_3\}$, $C_3\{X_4, X_5\}$ are obtained.

Now it is neccessary to explain the way the distance of measure between two sets to better understand some other clustering techniques.

**Measures for distance between clasters (or between point and clusters): $C_i$ and $C_j$**

a) Single link (minimum distance): *dmin* ($t_{Ci}$, $t_{Cj}$) (i.e. min d($t_{hi}$, $t_{mj}$) for all *n* and *m*, where $t_{ni}$ belongs to $C_i$, $t_{mj}$ belongs to $C_j$)

b) Complete link (maximum distance): *dmax*($t_{Ci}$, $t_{Cj}$)

c) Centroid (mean distance): $d(M_i, M_j)$ , where $M_i$ – mean center ($C_i$), $M_j$ – mean center ($C_j$). Some authors recommend to use medoids instead of centers.

d) Average distance: Mean (d($t_{hi}$, $t_{mj}$) for all *n* and *m*, where *tni* belongs to $C_i$, $t_{mj}$ belongs to $C_j$).

$$d_{avg}(C_i, C_j) = \frac{1}{N_i N_j} \sum_{t_{ni} \in C_i} \sum_{t_{mj} \in C_j} |t_{ni} - t_{mj}|$$

It should be noted that there are other methods such as Mahalanobis distance, $D^2$-Similarity (dependences) etc.

**Agglomerative algorithms**

**The Nearest Neighbor Algorithm**

With this serial algorithm items are iteratively merged into the existing clusters that are closest. In this algorithm, a threshold T is used to determine if items are added to the existing clusters or if new clusters are created.

Note: different modifications of the algorithm are based on different types of distance measures.

Given set of tuples $D\{t_m\}$; (*m=1,2,...,M*); threshold =*T* ,

1. Create cluster $C_1$. $C_1=\{t_1\}$, *m=2*

2. Check:

**if** $D(t_m, K_j)$ <=*T* **then** $t_m$ Є $K_{j0}$ (existing clusters with minimal distance) **else** create new cluster $K_{j+1}=\{t_m\}$;

3. m=m+1; **If** m>M **then** END **else** go to 2.

**Agglomerative algorithms. Dendrogram**

A tree structure called 'dendrogram' which is commonly used to represent the process of hierarchical clustering. It shows how objects are grouped together step by step.

Algorithm:

Given: data base D =$\{t_i\}$, *i= 1,...,n;* $N_c$ – number of clusters.

1. Calculate distances matrix d =d $\{d_{i,j}\}$;

2. First, each element $t_i$ **is its OWN cluster $C_i$** (See picture below);

3. **If** there are more than one cluster **then** go to 4 **else** STOP.

4. Choose two clusters with minimal distance d ($C_i$, $C_j$) and join them into new cluster (let $C_j$) as a tree-wise structure.

5. Repeat from item 3.

An example so called 'dendrogram' is obtained:
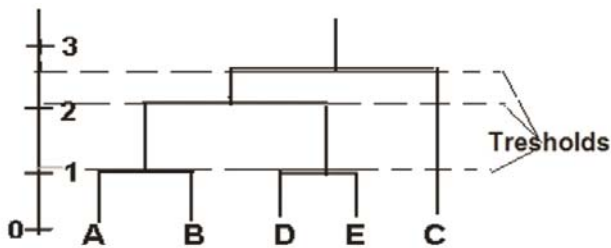
Different number of clusters can be obtained which depend on **threshold distance** determination.

Example (dendrogram clustering)**:** Suppose, there is a database (DB) Table 6.9 and there is a need to construct dendrogram of clusters existing in this DB. Graphical representation of DB objects is shown in the picture below.

**Table 6.10**. *Example of DB (and graphic) for Dendrogram algorithm*

| Object\ Attr. | $X_1$ | $X_2$ |
|---|---|---|
| A | 1 | 2 |
| B | 2 | 4 |
| C | 5 | 6 |
| D | 10 | 6 |
| E | 9 | 4 |
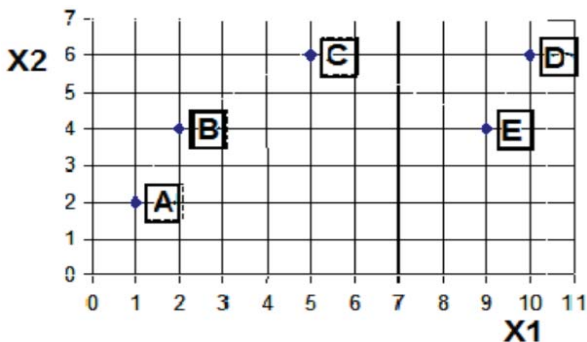


*Step 1*. Construct distances matrix $d = d\ \{d_{i,j}\}$ using, for example, Manhattan distance;

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*Step 2.* Assume objects **A, B, C, D, E** as 5 clusters $C_1$, …, $C_5$ respectively;

*Step 3.* Find min d(X, Y) in the table of distances. It is 3 for two pairs (A, B) and (D, E). Join them to two new clusters.

Result: a new set of clusters CI{A, B), CII{D, E}, CIII{C} with threshold $T$=3.

**Table 6.11.** *Manhattan distances between objects ($X_1$, …, $X_5$)*

|   | A | B | C | D | E |
|---|---|---|---|---|---|
| **A** | *0* |   |   |   |   |
| **B** | *3* | *0* |   |   |   |
| **C** | *8* | *5* | *0* |   |   |
| **D** | *13* | *10* | *5* | *0* |   |
| **E** | *10* | *7* | *6* | *3* | *0* |

$$d_{i,j} = D(t_i, t_j) = \sum_{h=1}^{k} |t_{i,h} - t_{j,h}|$$

*Remark*: this step can also be splited on 2 sequential steps and join only one pair of clusters per each step;

*Step 4.* Calculate distances between all new clusters using Table 6.11 and Average distance defined above:

$d(C_1, C_2)$= (1/4)*($d$(A, D) +$d$(B, D)+$d$(A, E)+$d$(B, E))= (13+10+10+7)/4 =10;

$d(C_1, C_3)$=(1,2)*($d$(A, C)+$d$(B, C))= (8+5)/2= 6.5 .

$d(C_2, C_3)$= (1/2)*($d$(D, C)+$d$(E, C))= (6+5)/2=5.5 - minimal distance a joint $C_2$ and $C_3$ in cluster CIV.

Result: a new set of clusters CI{A, B}, CIV{E, D, C} with threshold $T$ =5.5;

*Step 5.* Calculate distan*ce* $d$(CI, CIV) = (1/6)*($d$(A, E) +$d$(A, D)+$d$(C, C) +$d$(B, E) + $d$(B,D) + $d$(B,C)) = 8.3.

Result: 1cluster CV(A, B, C, D, E) with threshold $T$=8.3.

STOP.

Graph of the dendrogram is shown in Figure 6.12.
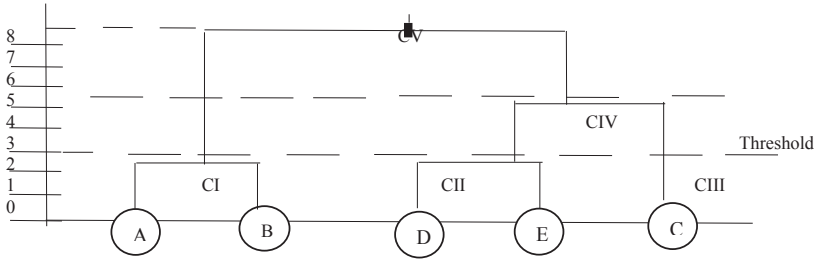
**Figure 6.12**. *Dendrogram of Agglomerative clustering for data in database table 6.10*

### Density-Based Methods of clustering:

These methods deal with arbitrary shapes clusters. In the density-based clustering method, clusters are formed on the basis of the region where density (amount) of objects is high. Method is often used in geographical, soil science, agriculture, etc. mapping,

Idea:

The density function at an object X is defined as a sum of influence functions of all data points.

Given *n* data objects D={$X_1$, $X_2$, ..., $X_n$}, the density function is:

$$FD(x_k) = \sum_{i=1}^{n} f(x_k, x_i),$$

where $f(x_k, x_i)$ - influence function of any type:

E.g. ***Square wave influence function:***

$$f(x_k, x_i) = \begin{cases} 0, & if \ d(x_k, x_i) > \sigma \\ 1, & otherwise \end{cases}$$



***Gaussian influence function:***

$$f(x_k, x_i) = \exp\left(-\frac{d^2(x_k, x_i)}{\sigma^2}\right)$$



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*Potential influence function:*

$$f(x_k, x_i) = \frac{1}{1 + \alpha d^p(x_k, x_i)},$$

where $\sigma$, $\alpha$, $p$ are parameters which determine a threshold of the influence.

One of often used algorithms is described:

**DENCLUE** *(DENsity based CLUstEring)* algorithm:

- Choose the threshold value.
- Calculate $FD(x_k)$ for all $x_k$ from $D$.
- Local maximums of FD (*density attractors*) are centers of clusters.

We can also mention without details the **DBSCAN** (Density-Based Spatial Clustering of Applications with Noise) a density-based clustering algorithm. The algorithm grows regions with sufficiently high density into clusters and discovers clusters of arbitrary shape in spatial databases with noise. It defines a cluster as a maximal set of *density-connected* points. Method has numbers of modifications.

At the end of this subchapter we can say that a lot of techniques and computer algorithms have been developed last decades for solution of specific clustering problems but there is no room here even to mention all of them.

**Association Rules**

Association rules (ARs) are the process to search relationships among data items in a given data set, so all the data items can be managed. Mainly association rules are used when a data set has large data items. It determines the sequential patterns that might exist in a large and unorganized data bank. These ideas have lots of application in medicine (diseases diagnostic), crime investigations, market-basket researches, etc.

The basic terminologies of the association rule are:

Definition: Let a data set S: $\{I_1, I_2, I_3, \ldots, I_n\}$ and a database of transactions D: $\{t_1, t_2, \ldots, t_n\}$ where $t_i = \{I_{i1}, I_{i2}, \ldots, I_{im}\}$ and $I_{iJ} O$ S, then association rule is an implication of the form $\mathbf{X} \Rightarrow \mathbf{Y}$, where X, Y   S are items of data called as item sets and X $\cap$ Y = $\varnothing$ (i.e. trivial implications X$\rightarrow$ X are eliminated).

Example of Association Rules and Frequent Item Sets: the ***market-basket problem*** which assumes that we have some large number of items*,* e.g., "bread," "milk." Customers fill their market baskets with some subset of the items, and we have to know what items people buy together, even if we do not know who they are. Marketers use this information to position items and control the way a typical customer traverses the store. In addition to the marketing

application, the similar question can be applied, for example, to the following areas of activity:

Baskets = documents; items = words. Words appearing frequently together in documents may represent phrases or linked concepts and can be used for intelligence information gathering.

Baskets = sentences, items = documents. Documents with many similar sentences could represent plagiarism or mirror sites on the Web.

**Support:**

Support for an association rule $X \Rightarrow Y$ is a percentage of transaction in the database that consists of X U Y. It is represented by S.

**Confidence:**

Confidence for an association rule $X \Rightarrow Y$ is a ratio of the number of transactions that contains $X \cap Y$ to the number of transaction that contains X.

**Large Item Set:**

A large item set is an item set whose number of occurrences is above a threshold of support. **L** represents the complete set of large item sets and **l** represents an individual item set. These large item sets that are counted from data set are called as 'candidates' and the collection of all these counted large item sets are known as 'candidate item set'.

Let us discuss an example of Association Rules (ARs) applications. Suppose that each row in Table 6.11 contains list of goods purchased by one customer (each row is denoted as "transaction").

**Table 6.12.** *Sample data of Association Rules*

| Transaction | Items |
|-------------|-------|
| $T_1$ | Bread, Jelly, Butter |
| $T_2$ | Bread, Butter |
| $T_3$ | Bread, Milk, Butter |
| $T_4$ | Beer, Bread |
| $T_5$ | Beer, Milk |

Firstly, a table of supports was constructed.

Table 6.13. *Support of all sets items found in Table 6.12*

| Set | Support (s) | Set | Support (s) |
|---|---|---|---|
| Beer | 40 | Beer, Bread, Jelly | 0 |
| Bread | 80 | Beer, Bread, Milk | 0 |
| Jelly | 20 | Beer, Bread, Butter | 0 |
| Milk | 40 | | |
| Butter | 60 | Beer, Jelly, Milk | 0 |
| | | Beer, Jelly, Butter | 0 |
| Beer, Bread | 20 | | |
| Beer, Jelly | 0 | Beer, Milk, Butter | 0 |
| Beer, Milk | 20 | | |
| Beer, Butter | 0 | Bread, Jelly, Milk | 0 |
| | | Bread, Jelly, Butter | 20 |
| Bread, Jelly | 20 | | |
| Bread, Milk | 20 | Bread, Milk, Butter | 20 |
| Bread, Butter | 60 | . . . | |
| | | Beer, Bread, Jelly, Milk, Butter | 0 |
| Jelly, Milk | 0 | | |
| Jelly, Butter | 20 | | |
| Milk, Butter | 20 | | |

Gathering all data from Tables 6.11, 6.12 the final Table 6.13 is obtained, which contains desirable information about ARs discovered in transactions (Table 6.11). Each row in the table describes one association rule with support S and confidence α.

Table 6.14. *Support (S) and Confidence (α) for some ARs in Table 6.12*

| X Ю Y | S | α |
|---|---|---|
| Bread Ю Butter | 60% | 75% |
| **Butter Ю**Bread | 60% | 100% |
| Butter Ю Jelly | 20% | 33.3% |
| JellyЮ Milk | 0% | 0% |

For example, rule in 2nd row means that 60% of customers purchased butter and 100% (i.e. all) of those customers purchased bread as well.

Below, the essence of quite popular A-priori algorithm of construction ARs in large Database is described.

**The A-Priori Algorithm**

This algorithm proceeds level-wise and has lots of implementations in parallel computing software products.

Considering the given support of threshold S, in the first pass the items that appear at least in fraction S of the baskets are found. This set is called **L\**, the frequent items. Presumably, there is enough main memory to count occurrences of each item since a typical store sells no more than 100,000 different items. Pairs of items in **L\** become the candidate pairs C'2 for the second pass. We hope that the size of C'2 is not so large that there is no room for an integer count per candidate pair [3].

The pairs in C'2 whose count reaches S are the frequent pairs in **L2\** – the candidate triplets, C'3 are those sets {A, B, C'} that all of {A, B}, {A, C'} and {B, C'} are in **L2\** – on the third pass. Then we count the occurrences of triplets in C'3 and those with a count of at least **S** are the frequent triples **L3\**, etc.

Proceed as far as you like (or the sets become empty). **Li\** is the frequent sets of goups of size $i$; $C_{i+1}$ is the set of groups of size $i + 1$ that each subset of size $i$ is in **Li\**.

Thus, essence of some core topics have been described, methods and techniques of Data Mining and advanced topics titles such as Web Mining, Spatial mining, Temporal Mining which are subjects of separate or advance courses' books and researches.

**Control questions:**
1. What is a Data Mining? What is the significance of DM application in some

modern fields of science and business dealing with large Databases (Big Data).

2. Give the main differences between Date Warehouse and conventional Database System.

3. Define and explain the typical DM tasks.

4. Explain several often-used DM techniques.

5. Explain the 5A process model.

6. Explain the CRISP-DM process model.

7. Describe some DM applications for customer services.

8. Describe DM application in computer security analysis and management.

9. How are classifications used and applied?

10. What is the Decision Tree? Give the example of how it can be embedded in Decision Support Systems.

11. What is the main difference between algorithms of building Decision Tree?

12. Classify tuple $t_9$ (0, 0, 1, 1, 1, 1, 1, 1) using DT in Figure 6.7.

13. How can set of logical rules for classification using Decision Tree be created?

14. Create Rule-based algorithm for "Traditional Marks" classes from Table 6.1 based on the values of attribute "% points".

15. What is an idea of KNN method of classifications?

16. What is the difference between KNN and Simple approach algorithm?

17. Why is it better to use odd number of neighbors in KNN method?

18. Give any example of Fuzzy Sets application of classifications problem.

19. Briefly describe the idea of using LSM for linear regression problems.

20. Give definition and describe some of the main applications of clustering.

21. Briefly describe various types of clustering techniques.

22. Calculate the distance between 2 objects A{12, 3, 40,10} and B{15, 7, 35, 12} using: a) Euclidean distance; b) Manhattan distance.

23. Give definitions of different types of Measures of distance between clasters.

24. Give explanation of K-means and K-medoids algorithm.

25. Give definition and explain some agglomerative clustering algorithms.

26. What is the essence of Density–based methods of clustering? Give example of influence function.

27. How does data mining help in market-basket analysis?

28. Describe possible analogy between market-basket problem and Web sites plagiarism.

29. What are Association rules, in which fields of human activities we can apply them?

30. Explain terms 'Support' and 'Confidence' for ARs applications, give an example.


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Additional textbooks and huge numbers original researches in different aspects of Data Mining. you can find using Google™ searching machine.

# CHAPTER 7. NETWORKS AND COMMUNICATIONS

## 7.1 The basic definition of a computer network

Combining computers into one system allows you to have access to the shared resources:

• the equipment, e.g., printers, disks, which saves material resources and time allocated to service devices;

• programs and data, which ensures easy maintenance and reduces costs for the purchase of software;

• information services.

The pooling of resources of the computers involved in processing, transmission, storage of information, allows to increase the speed of these processes, reliability, efficient communication between the members of the collaborative data processing.

This gives you the opportunity to work with the equipment, network services and application processes located on other computers.

### 7.1.1 An integral part of computer networks

The network can be viewed from different perspectives. One approach the analysis of its components. What is a network?

1. Devices
2. Communication media
3. The available network services

Let us examine these components in more detail.

**Devices**

The devices are network nodes that communicate with each other data. The devices can be divided into two types: intermediate and final. End devices are a kind of layer between the user and the network, end users communicate primarily. The intermediate device needed for the functioning of the network itself, system administrators are working with them. The following are examples of devices:

• *End (End devices or hosts)*
• A computer
• IP phone
• Network Printer
• IP Camera
• The tablet
• *Intermediate (Intermediary devices)*
• Router
• Switch
• A hardware firewall

- Hub
- IPS (Intrusion Prevention System)
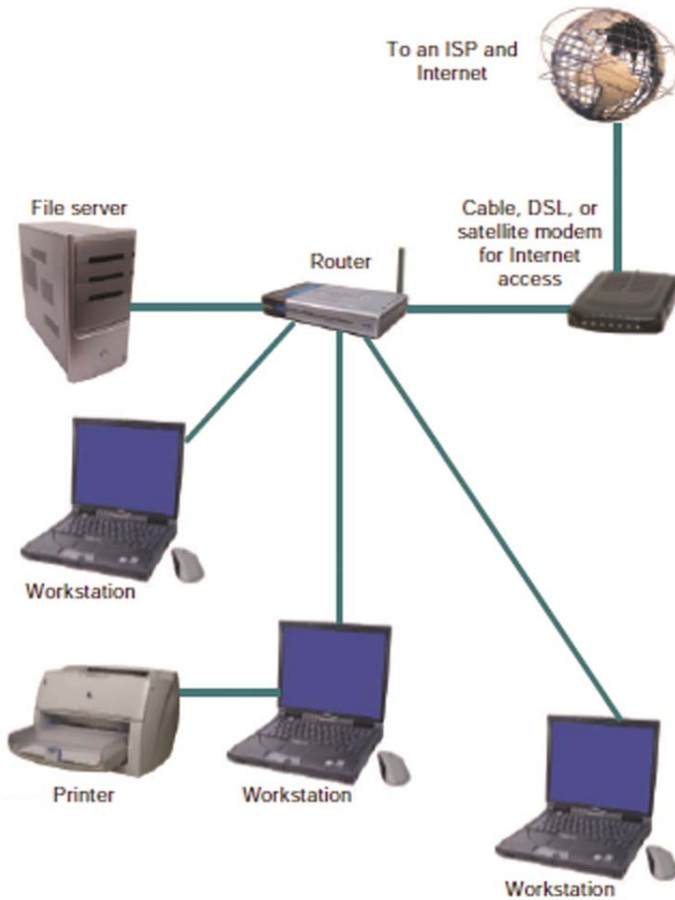


**Figure 7.1.** *A typical wired network uses a router as a central device for connecting workstations, a file server and the Internet access device [1]*

**Media**

Media is actually a network that connects devices. For example, wire (twisted pair) is a data transmission medium. Used environment has three types: optical, copper and wireless. The following are examples of these environments:
- Copper transmission medium (Cooper media)
- Twisted pair

- Coaxial cable
- Optical transmission medium (Optical media)
- Fiber optic cable
- Wireless media (Wireless media)
- Wi-Fi
- Mobile communication
- Bluetooth
- Satellite communications

**Services**

Under services refers to services running on the target and intermediate devices and services that they provide. Examples of running services on a target device can be web, mail services, file and others. Intermediate devices also have their services, for example, the router can run dynamic routing protocols, Cisco Discovery Protocol, and many other services.

An important advantage of the Association of computers is the transfer of information from one computer to another, located at any remote distance from each other.

*Communication* – a process path and means to transfer object information from one place to another.

*Telecommunications* – far, remote communication and remote transmission of all forms of information, including data, voice, video, etc., between computers via communication lines of various types.

Communication begins with a message or information that needs to be sent from one individual or device to another. People exchange information using many different communication methods. All these methods have three common elements. The first of these elements is the message source or sender. Message sources are people or electrical devices that need to send messages to other people or devices. The second element of communication is the destination (addressee) or receiver of the message. The recipient receives the message and interprets it. The third element, called a channel, consists of the means of connection that provides the conductive path that the message can go from source to destination.

*A computer network* is a set of interconnected computers to exchange data.

Network equipment is running the system and application software.

The computers in the network communicate with each other using the hardware and network software. The main hardware components of the network form the nodes, workstations and servers. Workstations are computers that are installed on client workstations and is equipped with specialized software for specific subject areas. Servers, generally, are sufficiently powerful

computers, the functions of which are ensuring all the processes for controlling the operation of the network.

To connect the nodes use a communication system comprising a communication line, transmitting equipment, various communication equipment.

### 7.1.2 The interaction between the main components of the network

The main hardware components of a computer network (Figure 7.2) are:
• Servers;
• Workstations;
• Channels (lines) communication;
• Data transmission equipment.

***Servers and workstations***

The servers are sufficiently powerful computers, since the need to provide high speed data transmission and query processing. The source server is network computer with a large capacity of RAM, hard drives and high capacity additional storage. There are can be many servers in a network.

The server runs the network operating system that provides simultaneous user access to the network located on it. Server requirements are determined by the tasks that entrusted to it in a specific network. The successful completion of the task server depends on the installed software. Servers can implement data storage, forwarding of mail, database management, remote job processing, access to web pages, print jobs, and a number of other functions, the need for which may arise from network users.

A computer connected to the network and having access to its resources, called the workstation.

The role of the server and the workstation may be different networks.

For example, the file server performs the following functions:
• data storage;
• archiving of data;
• synchronize data changes by different users;
• data transfer.

The file server receives a request to access the file from the workstation. The file is sent to the workstation. The user on the workstation processes the data. The file is then returned to the server back.

There is another division of roles between computers in a network, such as network Client/Server.
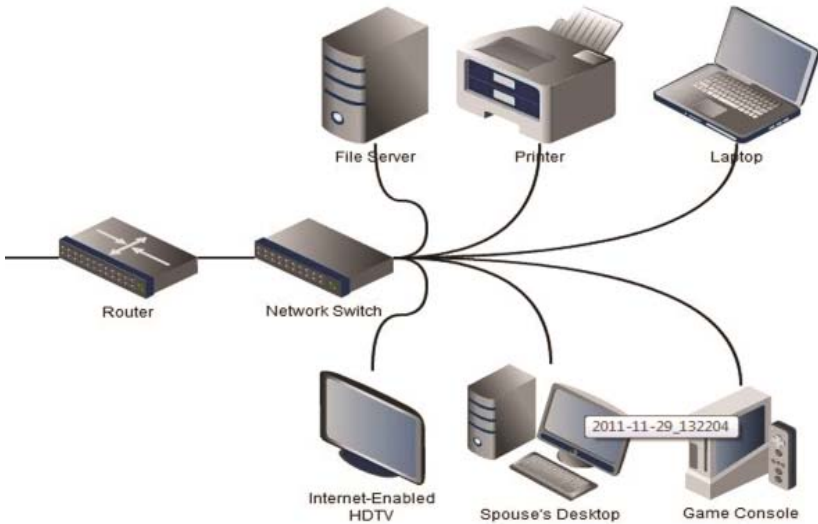
**Figure 7.2.** *The basic hardware components of a computer network*

***The client*** is called a workstation on which the software is installed, providing the solution of problems generated in the process of the user.

In the process of processing the client request the server to perform different tasks: forwarding messages, viewing web pages, etc.

The server executes the query received from the client. The results of the query pass to the client. The part of the tasks can be executed on the client side. Data exchange, query and data processing are ongoing between the server and the client until they complete the task. Data processing can be performed by both the server and the client.

The server provides data storage for general use, organizes the access to this data and transmits the data to the client.

The client processes the received data and processing results in the form convenient for the user.

### *Communication channels*

Communication channel (or *communication line*), the physical medium in which information signals are transmitted to the data communication equipment.

The transmission medium can be based on different physical principles. For example, it may be the cable and connectors. The physical transmission medium may serve as the earth's atmosphere or outer space, through which distributed, information signals.

In telecommunication systems, data is transmitted using electric current,

radio signals or light signals. All these physical processes are oscillations of the electromagnetic fields of different frequency and nature. The main characteristic of physical channels is data transmission speed measured in bits (Kbps, Mbps) per second.

Depending on the physical environment of the communication line can be classified into the following groups: wire, cable line, radio signals of terrestrial and satellite communications.

*Line wire* is unshielded wires laid above ground in the air. According to it, in general, transmitted to the telephone or Telegraph signals, but they can be used to transfer data sent from one computer to another. The data transfer speed on such lines is measured in tens of Kbps.

The *cable line* is a set of isolated different layers of conductors. Basically, using fiber-optic cables are based on copper wires: twisted pair (speed from 100 Mbps to 1 Gbit/sec) and coaxial cable (speed – tens of Mbit/sec). Cables are used for internal and external wiring. External cables are divided into the underground, underwater cables and overhead wiring.

The best quality of cable is fiber optic cable. It consists of a flexible glass fibers which propagate light signals. It provides signal transmission with very high speed (10 Gbps and above). This type of cable is a reliable as well protects data from outside interference.

*Radio terrestrial and satellite communications* represent a channel formed between the transmitter and receiver. The different radio channels use frequency band and range of the channel. They provide various data transmission rate. Satellite channels and radio communications are used in cases when you cannot use cable channel, for example, in sparsely populated areas for communication with the mobile radio network.

In computer networks all the described types of physical environments of data transmission are used, but fiber optic cable is the most promising. It has been widely used as backbones of territorial, urban networks, as well as use on high-speed local area networks.

### Data transmission equipment

The data transfer equipment serves for the direct connection of the computers to the communications line. It includes data transfer device, which is responsible for the transmission of information in the physical medium (communication line) and the reception of data: network card (adapter), modem, device connections to digital channels, terminal adapters networking ISBN, bridges, routers, gateways, etc.

*Network card (adapter)* specifies the address of the computer. The computer network must be properly identified, that is, its address must be unique. Therefore, manufacturers of network cards allocate a number of different locations that do not coincide with each other.

*Modem* – device to convert digital computer signals to analog signals of telephone lines and back. Common data transfers speed of 56 Kbit/s.

*Terminal adapters networking ISBN* (Integrated Services Digital Network) telephone network with integrated services. The basis of such network is digital signal processing. The subscriber is provided with two channels for voice and data transmission with a speed of 64 Kbps.

*Devices connect to digital channels* are intended to improve the quality of signals and the creation of a permanent composite link between two network subscribers and used mainly on lines of great length.

*Bridge* – device connecting two networks using the same and methods of data transmission.

*Routers* are devices that connect networks of different types, but using the same operating system.

*Gateways* – devices that allow you to organize data exchange between two networks that use different rules of engagement, for example, to connect a local area network to global.

*Bridges*, routers, gateways can operate as a full selection of features and combining them with the functions of the workstation network.

The data transfer equipment also includes:

• *Amplifiers* – devices that increase the strength of the signals;

• *Regenerators*, restoring the shape of pulse signals distorted by transmission over long distances;

• *Switches* – instrument to create between two network subscribers of a long-term continuous composite channel from segments of the physical environment with the amplifiers.

Invisible to users of the network intermediate apparatus of the communication channel forms a complex network, called primary network. It does not support any services for the user, and only serves as a basis for building other networks.

**Types of networks**

Computer networks are often classified according to various criteria. The most common type is classification by size depending on the occupied site (Figure 7.3):

• **local** computer network LAN (Local Area Network);

• **regional** computer network – MAN (Metropolitan Area Network);

• **global** computer network – WAN (Wide Area Network).

*Local area network* consists of subscribers, located in small distances. Usually a local network is used for solving problems of individual enterprises, for example, a local network of clinics, shop or school, resources LAN users of other networks.

*Regional computer networks* include nodes at considerable distances from

each other. They may include local area network and other subscribers inside of a big city, economic region, selected countries. Usually, the distance between subscribers of regional network is in the tens to hundreds of kilometers. An example of such network is the regional network of libraries of the region.

*Global computer network* brings together the resources of computers that are removed on large distances. A global network connects the subscribers located in different countries on different continents. The interaction between subscribers of the network can be based on telephone lines, radio and satellite communication systems.
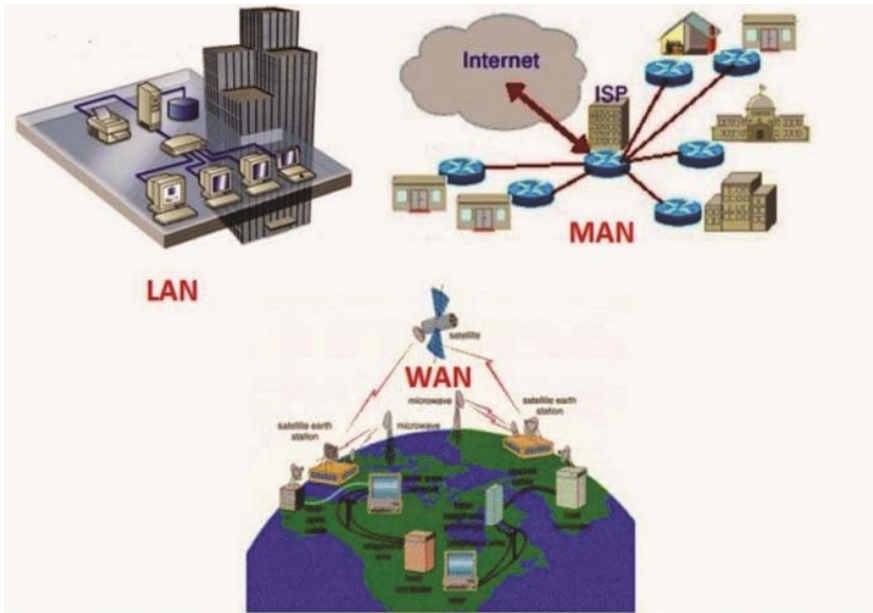


**Figure 7.3.** *Different types of network*

The global network will allow to solve the problem of integrating the information resources of all mankind and the organization of access to these resources.

Networks have a hierarchical organization. They can enter one another, bringing the local network to regional, and regional to global. The global network includes a regional network and can integrate another global network. An example of such merging of networks is the Internet, where network users have a single interface for access to the global networks. Currently, widely distributed enterprise networks, which on the one hand they solve the problem of local networks, linking computers to share company's internal information,

on the other hand they use the technology of global networks. Corporate network – network mixed topology, which includes several local area networks. It integrates the branches of the Corporation and the property of the company. Corporate network using a single network technology, common interactions and applications connect to the global network and for the solution of internal problems is called intranet (Intranet).

## 7.2 Types of networks

Computer networks are of two types – *peer-to-peer networks* and *server-based*. Peer-to-peer network is more suitable for those people who do not have the ability to organize a large network, but want to check how it works and what are the benefits. As for the network-based server, it is typically used to monitor all jobs. In fact, these two types of computer networks are virtually identical principles of operation, and it allows you easily and quickly navigate from a peer to peer network to server – based.

*Peer-to-peer network*. The creation of peer-to-peer network is a fairly simple process, and the primary characteristic of such network is that all computers in it are functioning independently. Peer-to-peer network actually consists of several computers that are connected through one of the most common types of communications. It is because of the lack of servers in this type of network, it is considered more simple and affordable. But it should also be noted that peer-to-peer network, the computers should be as powerful as they have to cope not only with the main work, but with different problems. In such network, there is no computer that plays the server role, and therefore any computers can be. It is generally determined by the user, and therein lies the main drawback of peer-to-peer network: the user must not only carry out work on a computer, but also to perform the functions of the administrator. He also should be responsible for the Troubleshooting of the computer, to ensure maximum protection of your computer from virus attacks. Peer-to-peer network supports any operating system, so it may be Windows 95, for example. Usually peer-to-peer network is constructed to combine a small number of computers (up to 10) via cable and in those cases, when there is no need for strict data protection. And one incompetent user of a network can jeopardize not only its performance, but also the existence!

*Network-based servers*. Network – based servers is the most common type of network. It can be used one or more servers that control the jobs. The server features the power and performance, it quickly processes the user requests and ensures work usually one person, called the system administrator. The system administrator monitors the update of antivirus databases, eliminates network problems, and also handles shared resources. As for the number of jobs in the network, it is unlimited. Only to maintain the normal operation

of the network necessary, install additional servers. The servers are different depending on the kind of work they perform. The file server is used to store various information in files and folders. This server is managed by any OS type Windows NT 4.0. The print server provides services to network printers and provides access to them. The database server provides the maximum speed of the search and write the necessary data into the database. The application server executes queries that require high performance. There are also other servers: email, communication etc. the Network – based server provides much more features and services than peer-to-peer, it features high performance and reliability.

### 7.2.1 Basic topology

*Under the topology* (layout, configuration, structure) of a computer network generally refers to a physical location of the computers on your network, one on one, and a way to connect them with lines. It is important to note that the term topology refers primarily to networks in which the relationships can be easily traced. In global networks the relationships are usually hidden from users not too important, because each session can run its own path. The topology defines hardware requirements, type of cable used, it is possible and most convenient methods of exchange control, reliable performance, expansion of the network.

There are three basic network topologies:

1. *Network topology bus* in which all computers in parallel are connected to one communication line and information from each computer is simultaneously transferred to all other computers (Figure 7.4);

2. *Network topology star* in which one central computer join the other peripheral computers, each of which uses a separate line connection (Figure 7.5);

3. *Network topology ring* where each computer sends information to only one computer, next in the chain, and receives information only from the previous computer in the chain, and this chain is closed in the "ring" (Figure 7.7).
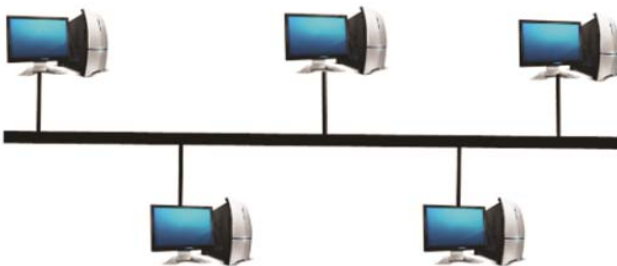


**Figure 7.4**. *Network topology "bus"*

In practice, a combination of basic topology often uses, but most of the networks focus on these three. Let us consider briefly the features listed network topology.

**Topology "bus"** (or, as it is called, "General tire") its very structure allows for the identity of network equipment computers and also the equality of all subscribers. With this connection, computers can only transmit at a time, because the communication line only. Otherwise, the transmitted information will be distorted due to overlapping (conflict, conflict). Thus, the bus implements a half-duplex mode (half duplex) exchange (in both directions, but in turn, not simultaneously). In the topology "bus" is missing the central unit through which all information is transmitted, which increases its reliability (after the failure of any centre ceases to operate all managed this center system). Adding new subscribers to the bus is quite simple and usually possible even during operation of the network. In most cases, when you use the tyres need a minimum number of connecting cable compared to other topologies. However, we must note that to each computer (except the two extreme) fits two cables, which is not always convenient. Because the resolution of possible conflicts in this case rests on the network each individual subscriber equipment to the network adapter when the topology "bus" goes harder than with the other topologies. However, using widespread networks with the topology of a bus (Ethernet, Arcnet) cost of network equipment is not too high.

The tyre is not a terrible failure of individual computers because all the other computers on your network can normally continue the exchange. It may seem that the bus is not terrible cable, since in this case we are obsessed with two fully functional tires. However, the features of propagation of electrical signals along long lines of communication are necessary to include in the ends of the bus specific devices – terminators. Without the inclusion of terminators, the signal is reflected from the end of the line and distorted so that the network connection becomes impossible. So at break or the cord is damaged, disturbed coordination of the communication line, and terminates the exchange, even between those computers that remain connected. Short circuit at any point of the bus cable disables the entire network. Any failure of network equipment in the bus is very difficult to localize because all the adapters enabled in parallel, and see which one is out of order, not so easy.

When passing through the communication line network topology «bus» information signals are attenuated and did not resume, which imposes rigid limitations on the total length of communication lines, moreover, each subscriber can receive from the network, signals of different levels depending on the distance to transfer the caller. This puts additional requirements on adoptive nodes in the network hardware. To increase the length of the network topology «bus» is often used several segments (each of which is a bus), con-

nected together using a special refreshers signal repeaters. However, this increase of the length of the network can not last forever, because there are also limitations associated with the finite speed of propagation of signals along the communication lines.

**Topology "Star"** is a topology with a clearly defined center, which is connected to all other subscribers. All communication is solely through the Central computer, which in a way is placing a very big burden, because nothing other than the network, it cannot do. It is clear that network equipment Central subscriber must be significantly more complex than the peripherals subscribers. The equality of the subscribers in this case do not have to talk. As a rule, the Central computer itself is powerful, and it is laid all management functions for the exchange. No conflicts on the network with topology "star" is impossible in principle, because the management is completely centralized, no reason to interfere. If to talk about the resistance to failure, then the failure of the peripheral computer does not affect the functioning of the network, which has remained, but any failure of the Central computer making the network completely unusable. Special measures should be taken to improve the reliability of the central computer and networking equipment. Abril has any cable or short circuit in the topology "star" and violates exchange with only one computer, all other computers can normally continue.
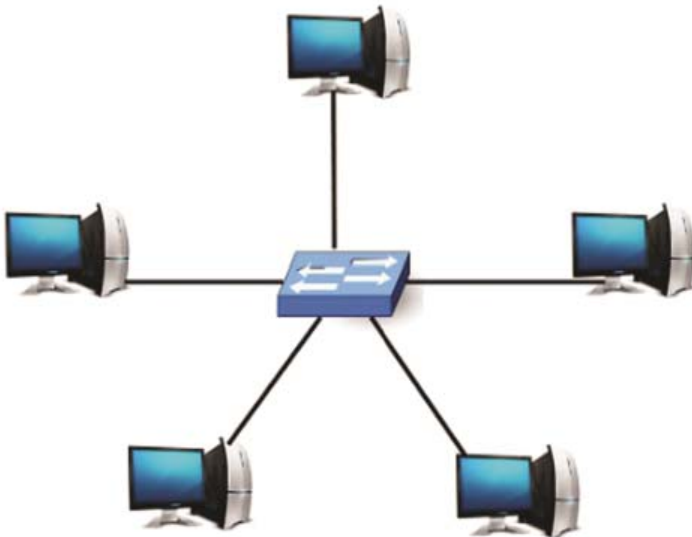


**Figure 7.5.** *Network topology "star"*

There are only two parties of the decline of the bus in the star on each trunk: the central and one peripheral. This files most often for their connection uses two communication lines, each of which transmits information in one direction only. Thus, for each trunk there is only one receiver and one transmitter. All this greatly simplifies the network setting in comparison with the tire and saves you from having to use an additional external terminator. The problem of signal attenuation in the communication line is also resolved in star easier than the bus, because each receiver always receives the signal of the same level. A serious drawback of the topology "star" is a hard limit on the number of subscribers. Usually, the central subscriber can serve no more than 8-16 peripheral subscribers. If within these limits the connection of new subscribers, simply, that when exceeded, it is simply impossible. However, sometimes the star provides the scalability, that is, the connection is one of the peripheral subscribers of central subscriber (in the end it turns out a topology of multiple interconnected stars).

Star, shown in Figure 7.5 is called the active or true star. There is also a topology, which is called a passive star that only looks like a star (Figure 7.6). At this time, it is common much more than the active star. Suffice it to say that it is used in the most popular Ethernet.
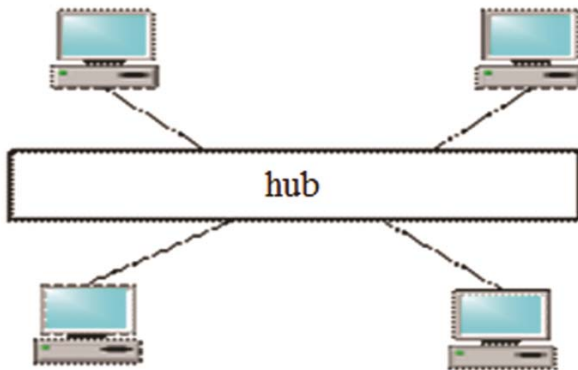


**Figure 7.6.** *Topology "passive star"*

In the center of the network with this topology contains not a computer, *hub*, which performs the same function as the repeater.

It resumes the signals that are received and forwards them to other lines. Although routing cables such as the present, or active star, in fact we are dealing with the bus topology, because the information from each computer is simultaneously transferred to all other computers, and the Central subscriber

does not exist. Of course, passive star comes out more expensive than conventional tires, because in this case you also need the hub. However, it provides a number of additional opportunities associated with advantages of star. That is why in recent time the passive star is increasingly replacing real star, which is considered unpromising topology.

The great ***advantage of stars*** (both active and passive) is that all the connection points are collected in one place. This allows you to easily control the operation of the network to localize network faults by simply disabling from the centre or those of other subscribers (which is impossible, for example, in the case of tires), and restrict unauthorized access to the vital network for the connection points. To each peripheral device in the case of a star can be treated as a single cable (on which there is transfer in both directions) and two cables (each of them transmits in one direction), and the second situation is more common. A common drawback across the topology of the star is considerably greater than in the other topology, cost of the cable. For example, if the computers are located in one line (as in Figure 7.4), selecting a topology «star» will need several times more cable than the topology of «bus». This may significantly affect the value of the network as a whole.
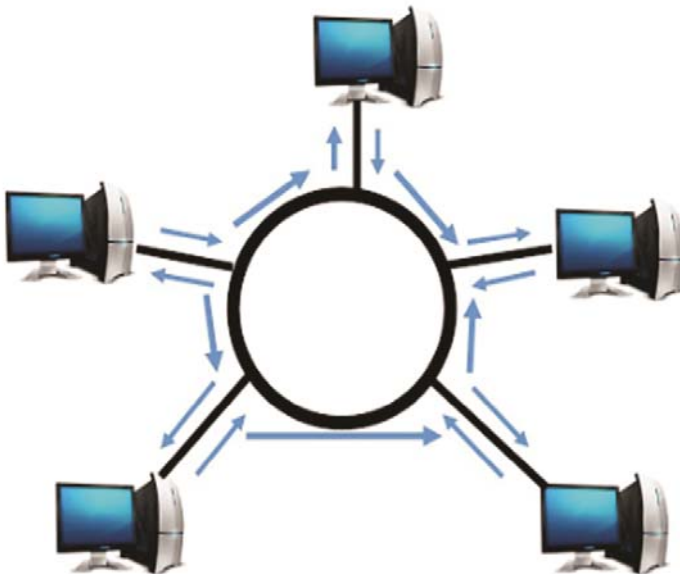


**Figure 7.7.** *Network topology, "ring"*

***Topology the Ring*** is where each computer is connected by communication lines with only two others: one, it only receives information, and the other only passes. On each trunk, as in the case of stars, is only one transmitter and one receiver. This eliminates the use of external terminators. An important feature of the ring lies in the fact that each computer relays (resume) signal, i.e. acts as a repeater, because the attenuation of the signal around the ring is irrelevant, what is important the attenuation between adjacent PCs bands. Clearly the centre in this case, not all computers can be the same. However, quite often a special subscriber in the sprat has that controls exchange controls or exchange. It is clear that the presence of such subscriber manager reduces network reliability because its failure immediately paralyzes the whole exchange. Strictly speaking, computers in the sprat are not equal (in contrast to bus topology). Some of them will receive information from the computer that is transmitting at this moment, earlier, and later others. This feature of the topology and construction methods of management of the exchange network is specially designed for "ring". In these methods, the right gear (or, as they say, for capture the network) moves consistently to the next computer.

The connection of new subscribers in the "ring" is usually quite painless, although it requires a mandatory stop of the whole network connected. As in the case of topology "bus", the maximum number of subscribers in the anchovies can be quite large (thousands). Ring topology is usually the most resistant to overload, it provides a solid performance with the very large flows transferred over the network information, because there is usually no conflict (unlike the bus), and there is no Central subscriber (unlike stars).

Because the signal in the sprat passes through all the computers on the network, the failure of at least one of them gives the robot the entire network as a whole. Similarly, any open or short circuit in each of the cables of the ring makes the entire network impossible. Ring most vulnerable to cable damage, because in this topology typically involves the construction of two (or more) parallel communication lines, one of which is in reserve.

At the same time the great advantage of rings is that the retransmission of signals from every subscriber allows to significantly increase the size of the entire network as a whole (sometimes up to several tens of kilometers). Ring on this is significantly superior to any other topology.

The *disadvantage* of the ring (in comparison with the star) can be considered the fact that each computer on the network must supply two cables.

Sometimes the topology of the ring is based on two ring communication lines that transmit information in opposite directions. The purpose of such solutions – increase (ideally double) the speed of transmission of information. Besides damage to one of the network cables may not work with another cable (although the speed limit will decrease).

Besides the three considered basic, underlying topology is often employed in network topology "**tree**", which can be considered as a combination of several stars. As in the case of a star, a tree may be active or true (Figure 7.8), and passive (Figure 7.9). With the active tree in combining multiple lines of communication are Central computers, while passive hubs (hubs).



**Figure 7.8.** *The topology of the "active tree"*

Apply often enough and combined topologies, for example star bus, star ring



**Figure 7.9**. *The topology of the "passive tree"*

### The meaningfulness of the notion of topology

The network topology determines the physical layout of computers, but, more important, the nature of the relations between them, especially propagation through the network. The nature of the links determines the degree of the complexity of the network equipment, the most appropriate method of management of the exchange, the possible types of communication media

(communication channels), the permissible size of network (length of lines and number of subscribers), the need for electrical matching, and many other things.

In literature it was mentioned about the network topology, that can mean four completely different concepts that belong to different levels of network architecture:

1. Physical topology (i.e. the arrangement of computers and cables). In this content, for example, a passive star is no different from active stars, because it is often referred to simply as a "star".

2. The logical topology (i.e. the structure of links, the distribution of signals across the network). It is probably the most correct definition of topology.

3. Topology exchange management (that is, the principle and the sequence of transfer of the right to the delight of a network between different computers).

4. Information topology (that is, the direction of the flow of information transmitted across the network).

For example, the network physical and logical topology of "bus" may be as a method of control to use a relay transfer of the right capture of a network (that is, to be in this content ring) and simultaneously transmit all the information through a separate computer (to be in this content star).

### 7.2.2 Network cable of the physical transmission medium



The transmission medium is the physical medium in which the propagation of information signals in the form of electrical, light, etc. pulses. Currently, there are two main types of physical connections: connections using cable and wireless connections.

Technical characteristics of the transmission medium affect such consumer network parameters as the maximum distance of transmission maximum data transfer rate.

***Cable system***

Cable (cable) used to build computer networks is a complex structure, consisting of the conductors, insulating and shielding layers. In modern networks there are three types of cables:

• coaxial cable;
• "twisted pair";
• fiber-optic cable.

Each cable type is different from other internal structure and has a set of specifications that affect the basic consumer parameters of the networks:

| Type of cable | Characteristic | |
|---|---|---|
| | The maximum transmission distance | The maximum transmission rate |
| coaxial cable | 185 – 500 m | 10 MBit/sec |
| «wisted pair» | 30 – 100 m | 10 MBit/sec – 1 GB/sec |
| fiber optic | 2 км | 10 MBit/sec – 2 GBit/sec |

### *Coaxial cable*

Coaxial cable was the first cable type used to connect computers to the network. Cable of this type consists of a Central copper conductor covered with a plastic insulating material which is in turn surrounded by a copper mesh and/or aluminum foil. This external wire provides ground and protects the center conductor from external electromagnetic interference. When laying, networks use two types of cable – «Thick coaxial cable» (Thicknet) and «Thin coax» cable (Thinnet). Networks based on coaxial cable provide transmission speeds up to 10 Mbit/s Maximum segment length is in the range from 185 to 500 m depending on cable type.
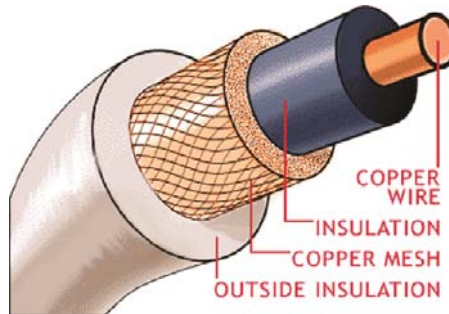
*Device coaxial cable*

### «Twisted pair»



The cable type «twisted pair» (twisted pair) is one of the most common cable types currently. It consists of several pairs of copper wires, covered with a plastic sheath. The wires that make up each pair twisted around each other, which provides protection from mutual interference. Cables of this type are divided into two classes — «shielded twisted pair» («Shielded twisted pair») and «unshielded twisted pair» («Unshielded twisted pair»). The difference between these classes is that shielded twisted pair is more protected from external electromagnetic interference due to the additional screen of copper mesh and/or aluminum foil surrounding the wire cable. Network on the basis of «twisted pair» depending on the category of cable provide transmission speeds ranging from 10 Mbps – 1 Gbps. segment Length of cable cannot exceed 100 m (100 Mbps) or 30 m (1 Gbps).
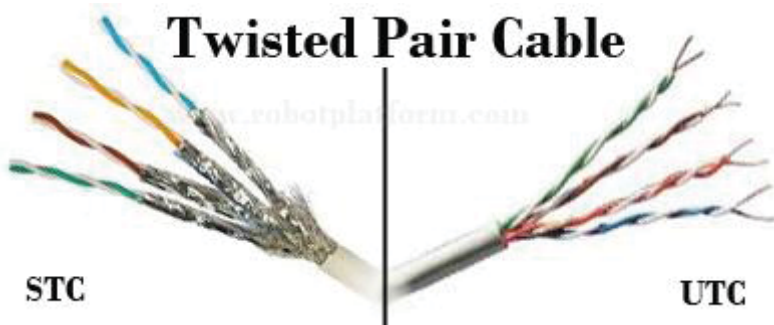


*Device cable type «twisted pair»*

### Fiber optic cable



Fibre optic cables represent the most advanced cable technology that provide high speed data transmission over long distances, resistant to interference and eavesdropping. Fiber optic cable consists of a Central glass or plastic conductor surrounded by a layer of glass or plastic coating and the outer protective sheath. Data transmission is done using laser or led transmitter that sends an unidirectional light pulse through the center con-

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ductor. The signal at the other end is taken by photodiode receiver converting the light pulses into electrical signals that can be processed by the computer. The transfer rate for fiber optic networks is in the range of 100 Mbps to 2 Gbps. the restriction on the segment length is 2 km away.



| 1 | 2 | 3 | 4 |
|---|---|---|---|
| **CORE**: Light travels here. Depending on type, either 9.5, 50, or 62.5 microns in diameter. | **CLADDING**: Optical material that facilitates containment of light within the core. | **BUFFER**: Provides mechanical protection and flexibility. | **JACKET**: Protective outer coating. |
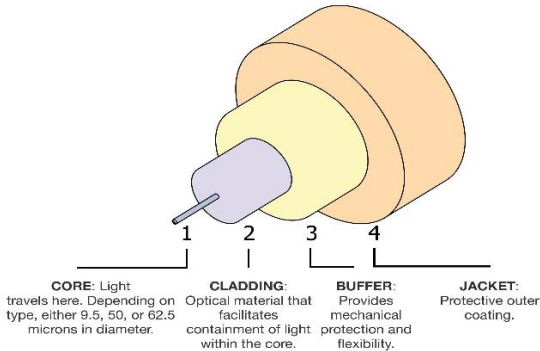
*Device fiber optic cable*

### 7.2.3 Types of cables
Among the most popular types of cable products you can call the cable VVG and its modifications. Denoted VVG power cable EC PVC sheath (a plastic tube) made of PVC, copper core material, with no external protection. Used for transmission and distribution of electric current, working voltage is 660V – 1000V, frequency 50 Hz. Number of cores can vary from 1 to 5. The cross section is from 1.5 sq. mm to 240 sq. mm Core can be both single-and stranded.

Depending on the type of cable, different variants of protection are:
• UTP or unprotected, without a general screen for the pairs of wires;
• FTP or foil with a screen of aluminum foil;
• STP or protected with common screen of copper mesh, in addition, each twisted pair is surrounded by a single screen;
• S / FTP or foil shielded with a common screen foil, moreover, each pair is additionally included in the screen.

In addition, the twisted pairs are categorized by number of pairs in a cable joint. The most common type used for computer networks - a category CAT5. It consists of 4 pairs of wires of different color. The data rate - up to 1 Gb / s for all pairs.

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rubber core
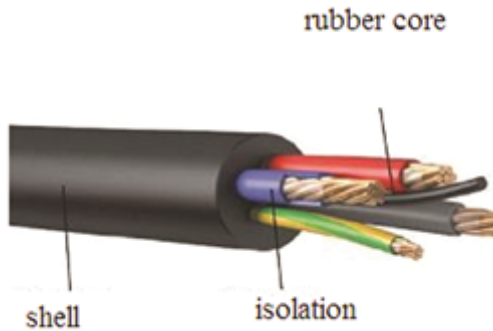
shell                    isolation

Strands of copper, flexible or highly flexible. Their number varies from 1 to 6. Isolation of EC rubber, the outer shell of the same material. Operating temperature range is from –60 to + 50ºC. The cable is mainly used for connecting various portable devices. There is a variety of Khng with combustible insulation. KG has proven itself in the capacity of a cable operating in almost any environment outdoors.

*Cables for information transmission*

In addition to the electricity cables information signals betray.

*Coaxial cable*

Coaxial cable is an electrical cable consisting of a Central wire and metal braid, separated by a layer of dielectric (inner insulation) and placed in a common outer shell.

It is harder to mechanically connect to unauthorized listening network, it also gives significantly less electromagnetic radiation outward. However, the installation and repair of coaxial cable is significantly more difficult than twisted pair, and the cost of it is higher (it is higher by approximately 1.5-3 times compared to cable based on twisted pairs). Harder and installation of the connectors on the cable ends. Therefore, it is now used less often than twisted pair.

The screen has 2 functions:

1) protection from electromagnetic interference;

2) transfer of information signals.

*Advantages*: low sensitivity to electromagnetic interference, high transmission frequency (about 50 MHz) on long lines in the order of kilometers. *Disadvantages*: high weight, complexity strip. It is typically used for transmission of high frequency signals. Because of coincidence of axes of both conductors have an ideal coaxial cable the two components of the electromagnetic field which is completely concentrated in the space between the conductors

(dielectric isolation) and do not go beyond cable, which eliminates the loss of electromagnetic energy on radiation and protects the cable from external electromagnetic interference. In real cables limited output radiation output and sensitivity to interference are caused by deviation of the geometry from ideality.



1. CSS
2. a dielectric layer of insulation
3. screen of aluminum foil
4. screen of aluminum wire
5. shell

### 7.3. What is a wireless computer network?

Wireless computer network is a technology that allows you to create computer network, fully comply with the standards for conventional wired networks (e.g., Ethernet) without using wire cable. As a carrier of information in such networks are the radio waves of the microwave range.

Wireless networks are widely spread in Western countries. As a rule, they are used as the corporate network inside the buildings, on the territory of industrial enterprises, and link remote offices together.

Typical customers of such decisions – hospitals, warehouse and commercial organizations. This also includes the temporary network deployed for the period of any events (exhibitions and seminars).

Our situation is fundamentally different. Most wireless networks ope-rate out of buildings, providing services of high-speed transmission of user data scattered over a distance of several kilometers even tens of kilometers. Wireless LAN is often the only economically feasible solution when the cable system is missing or of low quality that there is in our country.

Means and wireless communication systems are typically used in networks, including wired (cable) means, and make it possible to conveniently,

quickly, and economically solve the problems arising in the solution process and modernization of the pure cable networks.

Wireless communications should therefore not be considered an alternative to cable networks and only alternative technology for the realization of individual segments (or entire levels) in the design, expandable or upgradeable via LAN.

Wireless networks are used where cabling is difficult or impossible. The network, deployed in accordance with the standard **"Radio Ethernet",** is similar to the usual cable Ethernet collision mechanism to access the medium. The only difference is in the nature of this environment. Radio Ethernet fully satisfies all the demands of wireless data transmission indoors.

Radio Ethernet is very convenient to use the network at the last stage, instead of cable, i.e. for the connection between the subscriber and the nearest node of the core network. While the actual length of this distance can be from several hundred meters to 20-30 km and is limited only by the presence of direct visibility.

*Office wireless networks*

Until recently, the deployment of office wireless networks was associated with obtaining the permission of bodies of Communication supervision on the use of frequencies. In early 2002, the situation has changed and now office wireless networks can be deployed without permits for the frequencies, just enough to register such a network.

Office wireless peer-to-peer local network "with each other" (Ad-hoc) is designed for rapid deployment of temporary networks for exhibitions, in the process of conducting various seminars and workshops and in the offices of small companies. All network computers equipped with wireless network adapters (external USB, or internal PCI or PC card) operating in the 2.4 GHz band in accordance with IEEE 802.11 standard.

The network is easy to install and workable immediately after installation of the drivers. Range is from 30 to several hundred meters. The maximum data transfer rate reaches 54 Mbps. Effective throughput – 6 Mbit/s. the Network supports mobility of subscribers within the network coverage and the protection channel in accordance with the WEP (Wired Equivalent Privacy).

*The organization of wireless networks for small business*

Office wireless peer-to-peer local network "with each other" (Ad-hoc) is designed for rapid deployment of temporary networks. Examples of such networks may be the organization of a network connection at exhibitions, in the process of conducting various seminars and workshops and in the offices of small companies. All network computers equipped with wireless network adapters (external USB, or internal PCI or PC card) operating in the 2.4 GHz band in accordance with IEEE 802.11 standard.

A prerequisite of implementing such network – radio widget each. The range depends on the transmission speed, the characteristics of the premises vary from 30-50 m at the channel 54Mbps, up to several hundred meters at a speed of 1 Mbit/s Effective throughput up to 6 Mbps.

The most important requirement for the small office – has access to the Internet, so the network uses a base station (Internet gateway), including the modem port for dial-up or dedicated channels and a wireless access point that coordinates the operation of the wireless network adapters. Thereby providing the Internet access and wireless Association of computers on your network at speeds is up to 54 Mbps.

### The organization of wireless networks office of a large company

In some cases, the deployment of cable systems to create the office network is impossible or inappropriate. This situation is typical for fast-growing companies often change their location, for offices located in historical buildings, as well as for companies whose personnel are forced to move within the building with mobile computers. The best solution in these situations is the deployment of multicell wireless office network infrastructure topology.

The network consists of multiple wireless SOT, which access points with a single wire channel. Such network provides the highest performance, the free movement of users within the coverage areas of access points and provides the security level of wired channels.

### Protection of wireless networks

Generally speaking, corresponding to the IEEE 802.11 products for wireless networking offer four levels of security: physical, service set identifier (SSID - Service Set Identifier), the identifier of the control the medium access (MAC ID Media Access Control ID) and encryption.

Technology DSSS to transmit data in the 2.4 GHz frequency band for the last 50 years have found wide application in military communication to improve the security of wireless transmissions. Under the scheme DSSS the stream requiring a data transfer "is set" channel width of 20 MHz within the ISM band with schema keys additional code (Complementary Code Keying, CCK). For decoding the received data, the receiver must set the correct frequency channel and use the same schema CCK. Thus, technology based on DSSS provides the first line of defense against unwanted access to data transfers. Furthermore, DSSS is a "soft" interface, so almost all of the bug would be to filter it as "white noise".

The **SSID** allows to separate wireless networks that may exist in the same place or region. It is a unique network name to be included in the header of data packets and management of IEEE 802.11. Wireless clients and access points use it to filter and accept only those requests that relate to their SSID. Thus, the user will not be able to access the access point, and if he had not provided the correct SSID.

The possibility of acceptance or rejection of the request to the network may also depend on the value of the ID MAC ID which is a unique number that is assigned in the production process of each network card. When the client PC tries to access the wireless network, the access point should first check the MAC address for the client. Similarly, the client PC must know the name of the access point.

Mechanism, Wired Equivalency Privacy (WEP) defined in IEEE 802.11 standard provides another level of security. It is based on the algorithm RC 4 encryption company RSA Data Security with 40 - bit or 128-bit keys. Despite the fact that using WEP reduces throughput, this technology deserves more attention. Additional functions affect the processes WEP network authentication and data encryption. The authentication process shared key to access my wireless network uses 64-bit key 40-bit WEP key acts as a secret, and a 24-bit initialization vector (Initialization Vector) - as a partial. If the configuration of the access point allows you to take only the cases with a partial key, it will send the client a random challenge string with a length of 128 octets. The client must encrypt the challenge string and return the encrypted value of the access point. Further, the access point decrypts data received from the client string and compares it with the original challenge string. Finally, the client's right to access to the network is determined depending on how he checks encryption. The process of decoding data encoded using the WEP is to perform a logical exclusive OR operation (XOR) on the key stream and the accepted information. The authentication process shared key does not allow a real transfer of 40-bit WEP key, so this key is almost impossible to obtain by monitoring network traffic. The WEP key is recommended to periodically change to ensure the integrity of the security system.

Another advantage of wireless network is due to the fact that the physical characteristics of networks make it localized. As a result, the range of the network is limited to only a particular coverage area. For eavesdropping by a potential attacker must be in direct physical proximity, and thus to attract attention to himself. This is the advantage of wireless networks from a security point of view. Wireless networks also have a unique feature: you can disable them or modify their parameters, if the safety zones in doubt.

Thanks to the authentication and WEP encryption the attacker is almost impossible to access the network or intercept data being transferred. In combination with the security measures at the network level Protocol (connection to the network, password access, etc.), and security features of particular applications (encryption, password access, etc.) security products wireless open the way to a secure network.

***Unauthorized access to the network***

For the invasion of network, you need to connect to it. In the case of a wired network requires an electrical connection, wireless – enough to be in the area of coverage of the network with equipment of the same type on which it is built network.

In wired networks, the main means of protection at the physical and MAC levels are administrative control of access to the equipment, preventing the attacker to a cable network. In networks based on managed switches, access may be further limited by matching the MAC addresses of network devices.

In wireless networks to reduce the likelihood of unauthorized access provides access control via the MAC addresses of the devices and the same WEP. Because the access control is implemented using access points, it is only possible with an infrastructure network topology. The control mechanism involves preliminary preparation of a table of MAC addresses of allowed users to the access point and provides communication only between registered wireless adapters. When topology is "ad-hoc" (each) access control level of the radio network, it is not provided.

To penetrate a wireless network, the attacker must:

• have the equipment for wireless networks that is compatible with your network (in terms of standard equipment – appropriate technology wireless network DSSS or FHSS);

• when using FHSS non-standard equipment sequence of jumps of frequency to know them;

• know the network ID, closes the infrastructure and one for the whole logical network (SSID);

• know (in the case of DSSS), which of 14 possible frequencies of the network or turn auto scan mode;

• to be listed in the table of allowed MAC addresses in the access point under the infrastructure network topology;

• know 40-bit key cipher WEP if your wireless network is encrypted transmission.

To solve all this practically impossible, so the likelihood of unauthorized entry to your wireless network, in which it is taken under the standard security measures can be considered very low.

### Faces Radio Ethernet

Wireless connection or a connection via radio is used for the construction of highways (radio relay lines) and create local networks, connect remote subscribers to the networks and highways. A very dynamically developing in recent years is wireless technology Radio Ethernet. Initially it was intended to build local wireless networks, but today is increasingly being used to connect remote subscribers to the highways. It addresses the problem of "last mile" (though in some cases, this "mile" could vary from 100 m to 25 km). Radio

Ethernet now provides bandwidth up to 54 Mbps and allows you to create a secure wireless channel for transmission of multimedia information.

This technology corresponds to the 802.11 standard developed by the International Institute of electrical engineers and electronics (IEEE) in 1997 that describes protocols that enable to organize a local wireless network (Wireless Local Area Network, **WLAN**).

One of the main competitors 802.11 standard HiperLAN2 (High Performance Radio LAN), developed with the support of companies such as Nokia and Ericsson. It should be noted that the development of HiperLAN2 is tailored to ensure compatibility of this equipment with systems based on 802.11. And this fact demonstrates the popularity of wireless access on the basis of Radio Ethernet growing with increasing numbers of users of laptops and other portable computing means.

### 7.4 Protocol for dynamically allocating addresses (DHCP)

The Protocol dynamically allocating addresses (DHCP) is a network service that allows computers on a network to automatically obtain settings from the server instead of configureuring each network host manually. Computers conFigured to be DHCP clients do not control what settings they receive from the DHCP server, and this setting is completely invisible to the computer user. In the General case, the settings sent by DHCP server to DHCP clients include:

1. The IP address and network mask
2. The IP address of the default gateway
3. IP address of the DNS server

However, the DHCP server may also provide such settings as:

1. The hostname
2. Domain name
3. The address of the time server
4. The address of the print server

The advantage of using DHCP is that in line, for example, changing DNS servers will require changes only at the DHCP server, and all network hosts will be reconFigured the next query their DHCP client to the DHCP server. An additional advantage is the simple connection of new computers to the network because it does not require to test the availability of IP addresses. Conflicts on the allocated IP addresses are also minimal. DHCP server can provide configureuration using the following methods:

***The allocation manually (for MAC address)***

This technique entails using DHCP to identify the unique hardware address of each network card connected to the network, and then prolonged the provision of constant configureuration each time the DHCP client makes a request to the DHCP server using that network device. This ensures that a

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given address is automatically assigned to this NIC based on its MAC address.

*Dynamic allocation (address pool)*

In this method, the DHCP server will allocate an IP address from a pool of addresses (sometimes also called a range or scope) for a period of time (or lease) that is configured on the server or until the client informs the server that no longer needs the address. Thus, the clients receive their configuration dynamically on a "first come, first served". When DHCP client is missing in the network a certain time, the setting considered late and returned to the address pool for use by other DHCP clients. This means that the address is rented or issued for a specified period of time. After this period, the client shall re-negotiate ' with the server.

*Automatic selection*

Using this method, the DHCP automatically assigns a static IP address to a device selected from a pool of available addresses. Usually DHCP is used to issue temporary addresses, but the DHCP server can use an infinite lease time. The two last methods can be viewed as automatic, since the DHCP server issues a ' no further intervention. The only difference is in how the address is leased, in other words, when the time runs out use ' client. Ubuntu comes with a DHCP server and a client. The server is dhcpd (service Protocol dynamic allocation of addresses). The client provided with Ubuntu is dhclient and it can be installed on all computers that require automatic settings. Both programs are easy to install, configure and automatically start at system boot.

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# CHAPTER 8. CYBERSECURITY

## 8.1 Threats to information security and their classification

As it is known prosperity, security and improvement of welfare of all Ka-zakhs" as a long-term national security priority were identified in President's address to the people of Kazakhstan on the October 10, 1997 "Kazakhstan – 2030. Moreover the one component of which is the information security.

The development dynamics of information technologies in the socio-economic and cultural life of society and the state places of high demand is on the solution of information security issues.

Ensuring information security of the state requires a comprehensive approach, including the organizational, technical, software, social mechanisms that can implement the constitutional rights and freedoms of man and citizen in the field of information, use it in order to protect the constitutional order, sovereignty and territorial integrity of the Republic of Kazakhstan, political, economic and social stability, law and order, development of mutually beneficial international cooperation in the field of information security.

An important component of information security is the identification and classification of threats. Threats to information security are a kind of combination of factors and conditions that pose a risk in respect of protected information.

To do this, you must determine the threats against which it is necessary to protect the information you need to determine the protection of objects. For information, some of the data carriers which can be both tangible and intangible objects. For example, the carrier may be confidential information documents, means of processing and storing information and even people.

*Information security* – protection of the confidentiality, integrity and availability of information.

*Confidentiality* access to information resources only to authorized users.

*Integrity* invariability of information during its transmission or storage.

*Availability* Information resources property that determines the ability to obtain and use information data by authorized users at any given time.

*Information security* – the state of information protection stored on the negative impacts.

*Network security* – a set of requirements for network infrastructure businesses and politicians working in it, under which the protected network resources from unauthorized access. Under the network security is commonly understood as the protection of information infrastructure of the object (using authentication, authorization, firewalls, detection systems IDS Intrusion / IPS and other methods) from malicious intrusions from the outside, as well as protection against random errors (using DLP technology) (Data Leak Prevention)

or deliberate actions of personnel having access to the information within the enterprise. DLP is modern technology of confidential information protection from possible leaks of information system with the use of software or firmware. The channels of leakage may be a network (e.g. e-mail) or local (with the use of external storage devices).

*Authentication* – procedure to verify user identity (usually username and password) for access to the information system.

*Authorization* – the provision of specific user rights to perform certain actions. Authorization occurs after authentication and uses the user ID to determine what resources have access. In the information technology via authorization is established and implemented the right of access to resources and data processing systems.

*Authenticity* in the transmission and processing of data, that is data integrity, the authenticity of data that was created legitimate participants in the information process, and non-repudiation.

*Data protection* is an activity aimed at preventing diversion of protected information, unauthorized and unintentional (accidental) impacts on the protected information.

Possible effects of objects in information systems are:
• hardware;
• software;
• communication (provision of data transmission and processing through the communication channels and switching equipment);
• staff.

The objects of the impact are to violate the confidentiality, integrity or availability of information may not only be an information system elements, but also maintain its infrastructure, which includes a network of utilities (electricity system, heating, air conditioning, etc.). Given the wide range of impacts of threats to information security requires a comprehensive approach.

*Controlled zone* is a protected area (land, building, office, etc.), which is located within the communication equipment and all the connection points of local peripherals enterprise information network.

*Terms of access control* is a set of rules governing user access rights to information system resources.

*Authorized access* to information does not violate the rules of access control.

*Unauthorized action* is the access to the information or action information, carried out in violation of the rights and / or the rules of access to information.

**General classification of information security threats**

*Threats to the security* of information systems are classified according to several criteria (Figure 8.1).

*Threats to privacy violations* aim at obtaining (stealing) of confidential information. When implementing these threats, information is known to the persons who should not have access to it. Unauthorized access to information stored in a retrieval system, or transmitted through the channels (networks) data, *copying* of this information is a violation of the confidentiality of information.
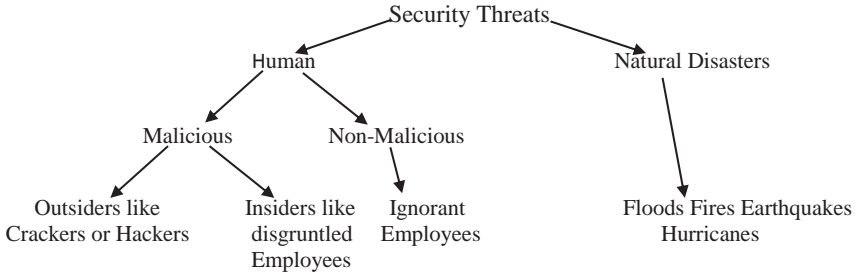


**Figure 8.1.** *Classification of threats to the security of information systems*

Threats compromising the integrity of information are store in a retrieval system or transmitted via a data transmission network, aimed at changing or corruption of data, resulting in the disruption of the quality or the complete destruction of data. Integrity information may be compromised by an attacker intentionally and objective effects resulting from the environment surrounding the system (noise). Deliberate violations of the integrity of information should not be confused with its authorized change that is performed by authorized users with a reasonable goal [1].

*Threats violations system availability* (denial of service) are aim at creating situations where certain actions or reduced performance information system, or block access to some of its resources.

Threatened breach of system availability (denial of service) is aim at creating situations where certain actions or reduce the efficiency of the information system, or block access to some resources.

Causes *random effects are:*
• emergency situations due to natural disasters and power outages;
• bugs in the software;
• errors in the work staff and users;
• interference in the communication line due to the impact of the external environment, and also due to the dense traffic in the system (typical for wireless solutions).

Under *external security* threats are understood the threats created by third parties and arising from the external environment, such as:

• attack from the external network (e.g. Internet), to distort, destroy, steal information or cause denial of service of enterprise information systems;

• distribution of malicious software;

• unwanted mail (spam);

• impact on the information carried out by applying an electromagnetic field source for guidance in the information systems of electromagnetic energy level, causing disruption of normal functioning (failure) of hardware and software of these systems;

• interception with the use of radio receivers;

• impact on information by the unauthorized use of utility networks;

• impact on staff of the enterprise with the aim of obtaining confidential information.

In the modern world, services more and more began to use information communication environment (e-payments, Internet shopping, electronic queue etc.), greatly increases the risk of external threats. This is unauthorized *access,* interception, theft of information transmitted via communication channels, is conducted by means of technical intelligence, such as radio receivers, means of retrieval of acoustic information, the interception system signals from computer networks and control of telecommunications, means of removal of information from communication cables and others.

### 8.2 Industry of cybersecurity

According to the Vice-President of Gartner (Gartner has the largest base of IT research analysts and consultants in the world. Gartner's global research organization offers the combined brainpower of 1,280 research analysts and consultants who advise executives in 85 countries every day), the industry of cyber security is forcing companies to spend huge amounts of money on technology that they actually do not need. The expert compared the techniques used by vendors with a financial pyramid.

Vice President and distinguished Gartner analyst John Girard (John Girard), who devoted 33 years working in the field of information technology and 23 years of analytical research in one of the leading companies in the industry said that all companies ever heard about cyber-security are wrong and a consequence of deliberate fear-mongering.

Such statement he made at the conference Gartner Security & Risk Management Summit in Sydney, Australia. Words of the analyst reports the publication Computer world.

According to Girard, every company before you agree to spend huge sums on technology to protect, you should consider whether it is necessary.

«In this area there is a lot of money. Give them the same companies as yours. Therefore, you should first think,» said Girard. «Quite a few of the

problems associated with cybersecurity, requires attention. This is not what is needed to every enterprise», – he added.

Girard also compared the cybersecurity of a pyramid scheme (original «Ponzi scheme»). According to analysts, suppliers of protection technologies behave in the same way as scammers use this scheme. «It all starts with the innocuous project. You invest money, and then a new round comes. You promise unprecedented ROI and convince to stay in the scheme,» - said the expert.

Companies should spend 90% of the funds for necessities, according to Gartner.

«After you agreed, escape will be difficult. Because, once you do this, as you immediately have a problem», adds the analyst. In his opinion, many vendors are using this approach and the method of persuasion to their customers.

Girard believes that customers should not spend large sums on the search for unknown vulnerabilities, and analysis of local threats. «Ninety percent of your money should be spent on necessities, such as protecting your computer network from intrusion and registration hacker attacks».

«Companies should ignore all the noise around cybersecurity. Collaborate with government, participate in government programs within reasonable limits and know your rights», the analyst recommends.

According to the forecast Markets and Markets  in the period from 2012 to 2017 the global market for cyber security will grow by an average of 11.3% and by the end of the reporting period to reach $120.1 billion Key players in this sector are companies such as Cisco Systems, Check Point Software Technologies, Kaspersky Lab, Fortinet, IBM, CA Technologies, McAfee and Symantec.

### 8.3 Cyber security and Internet governance

Cybersecurity is the collection of tools, policies, security guidelines, security safeguards, guidelines, risk management approaches, actions, training, practical experience, insurance, and technology that can be used to protect Cybercity, the resources of the organization and the user. The organization's resources and user include connected computing devices, personnel, infrastructure, applications, services, telecommunication systems, and the totality of transmitted and/or stored information in the cyber. Cybersecurity strives to ensure the security properties from the resources of the organization or user, against relevant security risks in the cyber. The General security objectives comprise the following:
• availability;
• integrity, which may include authenticity and non-repudiation;
• confidentiality.
The cyberspace has for several years regarded the United States as one of

the strategic domains of possible warfare, along with land, sea, air and space. According to documents obtained from former NSA employee of the USA Edward Snowden, U.S. intelligence agencies are confident that the next major global conflict will take the form of cyber warfare, which they are preparing. The costs of the program associated with cyberspace grow and make, at least several billion dollars. To the primary goals of offensive cyber-attacks include the management of the armed forces, as well as critical infrastructure, which include energy, banking and industrial sector.

The main problem is the lack of common, well-defined conceptual and behavioral norms in cyberspace, which would define, for example, what is considered a cybersecurity threat and what response would be allowed. Currently the virtual space is a virtually uncontrolled environment, where each actor can act in accordance with its understanding of each particular situation, which may result in disproportionate responses, excessive preventive actions and so on. Realizing the seriousness of the situation, Russia along with other countries-participants of Shanghai Cooperation Organization, at the beginning of this year suggested that the UN's new version is «code of conduct 102 States in the field of international information security».

The Foreign Ministry Spokesperson Hong Lei expressed China's willingness to cooperate with the world community to ensure the security of cyberspace. It should be noted that similar initiatives aimed at enhancing the general, joint efforts, still appear quite rare. More often, there is the conclusion of bilateral agreements between States belonging to one association. For example, in January 2015 an agreement was reached between Japan and Israel on cooperation in the figureht against cyber-terrorism. The main obstacle to the adoption of draft legislation regulating the entire domain of cyberspace, stands controversy two groups of countries on the key issues of conduct of states in it. One group, which includes, for example, Russia and China, insists on providing the sovereignty of the state in the management of its national network segment as well as the use of technology for interference in the internal affairs of States. Such position is fundamentally according to the second group of countries, in which the main role played the United States, which stands for a lot of freedom on the Internet, and in addition, seeks to increase its influence on the management of cyberspace. Another significant problem in ensuring the information and cyber security as a state, as well as individual companies and organizations is the lack of staff. Moreover, this issue is relevant to the whole world. And this at a time when the information security industry is growing at a rate 12 times greater than the rate of growth in all other areas of the economy. Thus, the US Department of Energy intends to allocate $ 25 mln. to grant programs for the next five years to address it [2].

In the context of globalization of contemporary international relations, as

well as due to the increasing role of information and communication systems in modern society, the prompt decision expressed above problems, as well as an adequate response to threats to international and national cyber security is a matter of extreme importance, largely requires the concerted action of the world community.

### 8.4 Malware and their classification

Software and mathematical effects is the impact on the protected information using malicious programs.

A malicious program is a program designed for unauthorized access to information and (or) the impact on the information or resources information system. In other words, a malicious program called some independent instruction set that is able to do the following:

1. to hide its presence in the computer;

2. have the ability to self-destruction, masking as legitimate software and copy itself to other operational or external memory;

3. modify (destroy, distort) the code of other programs;

4. independently perform destructive functions – copying, modification, destruction, blocking, etc.

5. deface, block or substitute outputted to an external link or external storage media.

The main ways of malicious programs in the AU, in particular, to a computer are networking and removable media (flash drives, disks, etc.). At the same time the introduction of the system may be of a random nature.

The main types of malware are:
• backdoors;
• software viruses;
• worms;
• other malicious programs designed to implement NDCs.

The software program includes bookmarks and snippets of code designed to generate opportunities not declared legal software.

**Not declared capabilities of software** – software features that are not described in the documentation. Software tab often serves as a guide for other viruses, as a rule, are not detected by standard anti-virus monitoring.

Bookmarks are sometimes divided into hardware and software, but virtually all of the bookmarks – software as a hardware trojan refers to so-called firmware.

Software tab varies depending on the method of their application in:

• Hardware and software. This tab is integrated into the firmware of the PC (BIOS, firmware peripheral equipment);

• Boot. This tab is integrated into the boot program (downloader programs), which are located in the boot sectors;

• Driver. This bookmark is integrated into drivers (files needed for the operating system of the router to the computer peripherals);

• Application. This tab is integrated in the application software (text editors, graphic editors, various utilities, and the like);

• Executable. This tab is integrated into the executable program modules. Software modules are often batch files, which consist of the operating system commands that are executed one after the other as if they were typed on a computer keyboard;

• Bookmarks imitators. Bookmarks using similar interface mimic the programs in progress that you want to enter confidential information;

To identify the software bookmark frequently used a qualitative approach, which consists in monitoring the functioning of the system, namely:

• Speed reduction;

• Changes in the composition and the length of the file;

• The partial or complete blocking of the system and its components;

• Simulation of physical (hardware) failures of computer work equipment and peripherals;

• Message forwarding;

• Passing the software and hardware cryptographic transformation of information;

• Ensuring access to the system with unauthorized devices.

There are also diagnostic methods for the detection of bookmarks. For example, antivirus programs are successfully boot tab. With the initiation of the static errors on disks copes well Disk Doctor, part of the common set of Norton Utilities tools. "Trojan horse" refers to the most common software bookmarks.

Trojan horse called:

• a program, as part of another program with well-known user functions, can secretly from him to carry out some additional steps in order to cause him a certain damage;

• a program with well-known to the user functions, which was amended to, in addition to these functions, it can secretly from him perform some other (destructive) action.

The main types of Trojan programs and their capabilities are:

• **Trojan-Notifier** – notification of a successful attack. The Trojans of this type are designed to communicate to his "owner" of the infected computer. At the same address, "host" is sent information about your computer, such as computer IP-address, open port number, email address and so on.

• **Trojan-PSW** – theft of passwords. They steal confidential data from the computer and transfer them to the owner by e-mail.

• **Trojan-Clicker** – Internet clickers – the family of Trojans, who is main

function – organization of unauthorized access to the Internet resources (usually web pages). The methods used for this are different, such as installing malicious page as your home in your browser.

• **Trojan-DDoS** – Trojan-DDoS turn the infected computer into so-called bot that is used to organize attacks denial of access to a particular site. Coming from a site owner need to pay.

• **Trojan-Proxy** – Trojan proxy server. A family of Trojans that secretly performing anonymous access to various Internet resources. Commonly used to send spam.

• **Trojan-Spy** – Spyware programs. They are able to track all your actions on an infected computer and transmit data to its master. These data could be passwords, audio and video files from microphone and video camera connected to the computer.

• **Backdoor** – Remotely control the compromised computer. Its possibilities are endless, your whole PC will be available to the host program. He can send out on your behalf the message, to get acquainted with all the information on the computer or just destroy the system and data without your knowledge.

• **Trojan-Dropper** – Installs other malware. Very similar to Trojan-Downloader, but they install malicious programs contained in them.

• **The Rootkit** is capable of hiding itself in the system by substituting a different object. Such Trojans are very unpleasant, since the ability to replace their software and source code of the operating system that does not give the antivirus, the ability to identify the presence of the virus.

Absolutely all tabs, regardless of the method of their implementation in a computer system, their length of stay in memory and purpose have one thing in common: required performing a write operation in RAM or external memory system. In the absence of this operation any negative effect backdoors have not.

**Virus (computer, software)** executable code or interpretable set of instructions having the properties of unauthorized distribution and reproduce. Created duplicates of computer virus do not always coincide with the original, but retain the ability to further spread and reproduce. Thus, a required property of a software virus is the ability to create copies of itself and to introduce them to computer networks and/or files, system areas of your computer and other executable objects. The duplicates retain the ability to further spread.

The life cycle of a virus consists of the following steps:
• Penetration to the computer
• Activation of the virus
• Screening for infection
• Prepare a copy of the virus
• Introduction of virus copies

Classification of viruses is presented in Figure 8.2.
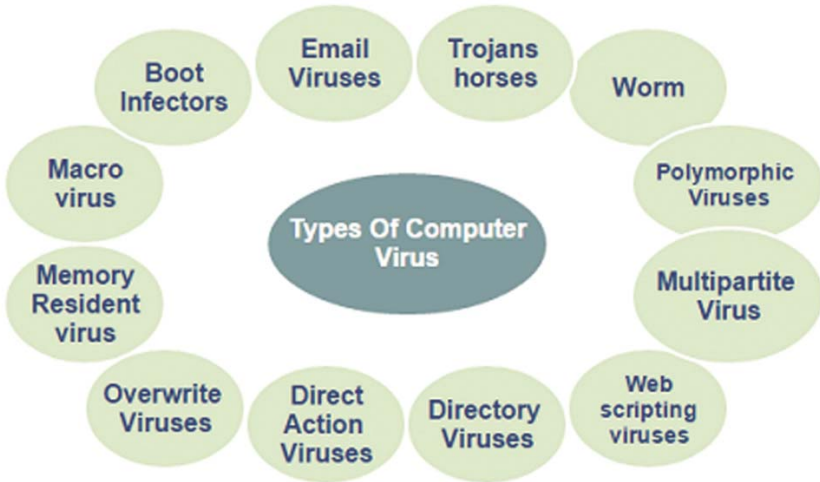


**Figure 8.2.** *Classification of software viruses*

The virus boot code allows you to take control of the computer at the stage of initialization, even before the launch of the system. Boot viruses write to the boot sector or a sector containing the boot loader on the hard drive or change the pointer to an active boot sector. The principle of boot viruses is based on the algorithms runs when you turn on or restart the computer: after the required tests of installed equipment (memory, disk, etc D.) program, the system boot reads the first physical sector of the boot disk and transfers control to A:, C: or CD-ROM, depending on the settings made in *BIOS Setup.*

In the case of a diskette or CD-ROM management gets the boot-sector of the disk, which analyzes the parameters table of drive (BPB – *BIOS Parameter Block*), calculates the address of the system OS files, reads them into memory and starts the execution. System files are typically MSDOS.SYS and IO.SYS or IBMDOS.COM and IBMBIO.COM or the other depending on the installed version of DOS and/or Windows or other OS. If the boot disk is missing files in the operating system, the program located in the boot sector of the disk gives the error message and offers to replace the boot drive.

In the case of the winchester office receives program located in the MBR of the hard drive. It analyzes the table partitioning (DiskPartition Table), computes the address of the active boot sector (usually the sector is the boot sector of the C: drive), loads it into memory and transfers control to it. Having con-

trol of the active boot sector of the hard drive is doing the same actions that boot-sector floppies.

When infected disk boot viruses substitute your code instead of a program that receives control when the system is booted. The principle of infection, thus, is the same in all the above ways: the virus "forces" the system when it is restarted to count into memory and give control to the original code, not bootloader, and the code of the virus.

Example: a Malicious program Virus.Boot.Snow.a writes its code to the MBR of a hard disk or the boot sector of floppy disks. The original boot sector is encrypted by the virus. After receiving control, the virus remains in the computer's memory (residency) and intercepts interrupts. Sometimes the virus manifests itself visual effect – on the computer screen it starts to snow.

**File viruses** – viruses that infect files directly. File viruses can be divided into three groups depending on the environment in which the virus spreads:

**1. File viruses –** work directly with the resources of the operating system. Example: one of the most famous viruses is called "Chernobyl". Due to its small size (1 KB) virus infecting PE-files so that their size did not change. To achieve this effect, the virus looks for files in "empty" areas that occur because of the alignment of the start of each section of the file under multiple values of the bytes. After receiving control, the virus intercepts the IFS API, tracking calls to access files and infecting executable files. 26 April triggered a destructive function of the virus, which is to erase the Flash BIOS, and the initial sectors of the hard drives. The result is the inability of the computer to boot at all (in the case of successful attempts to erase the Flash BIOS) or loss of data on all hard drives on your computer.

**2. Macro viruses** – viruses written in macro languages built into some data processing systems (text editors, spreadsheets, etc.). The most common type of viruses for Microsoft Office programs. For this propagation of such viruses use the capabilities of macro languages and with their help transfer themselves (their copy) from one document to another.

For the existence of macrovison specific editor built into it, the macro language must have the following capabilities:

• snap programs in the macro language to the specific file;

• copy macroprogram from one file to another;

• taking control of the macro without user intervention (automatic or standard macros).

These conditions satisfy the application program Microsoft Word, Excel, and Microsoft Access. They contain macro languages: Word Basic, Visual Basic for Applications. Modern macro languages have above features to provide automatic data processing.

Most macro viruses are active not only at the time of opening (closing)

the file, but as long as the editor itself. They contain all of its functions to the standard macros, Word/Excel/Office. However, there are viruses, using tricks to hide their code and storing it in the form of not macros. Three similar methods are known, they all use the opportunity of macros' to create, edit and execute other macros'. Typically, these viruses have little macro-downloader virus, which causes the built-in macro editor, create a new macro, fill it with the main code of the virus, and then, as a rule, destroy (to hide the traces of the presence of the virus). The main code of such viruses presents either in the macros of virus in the form of text strings (sometimes – encrypted), or stored in the variable field of document.

**3. Networking viruses** are viruses, which use protocols and possibility of local and global networks to spread itself. The main property of a network virus is the ability to self-replicate themselves across a network. At the same time, there are network viruses, which can run itself on a remote workstation or server.

The main destructive activities, performed by viruses and worms are:
• loading of communication channels
• attacks "denial of service"
• data loss
• software malfunction
• loading of computer resources
• theft of information.

In addition to all the above, there is a combined type of viruses, which includes the properties of different types of viruses, for example, file and boot. As an example, a file boot virus called "OneHalf" popular in years past is presented. This virus code, having appeared in the computer environment of the operating system "MS-DOS" has infected the master record download. In the process of initializing the computer, it codified the basic disk sectors starting from the end. When the virus is in memory, it begins to monitor any reference to encryption sectors and can decode them so that all programs will run in normal mode. If the virus "OneHalf" has simply erased from memory and boot sector, the information, stored in the encryption disk sector will become inaccessible. When the virus encrypts part of the disk, it warns the following inscription: "Dis is one half, press any key to continue ...". After these steps, it is waiting for you to press any key and continue. In the virus "OneHalf", different camouflage mechanisms are used. It is considered an invisible virus and performs polymorphic algorithmic functions. To detect and remove virus code "OneHalf" is problematic because it can be seen by not all the antivirus programs.

At the stage of preparation of viral copies, modern viruses often use masking techniques of copies with the purpose of their difficulty finding anti-viral agents:

• Encryption - the virus consists of two functional pieces: the actual virus and encoder. Each copy of the virus consists of an encoder, a random key and the actual virus, encrypted with that key;

• Metamorphism is creating different copies of the virus by replacing the command blocks on the equivalent, rearrange pieces of code, inserting code between the meaningful pieces of «junk» teams, which practically do nothing;

• The combination of these two technologies gives rise to the following types of viruses;

• Encrypted virus is a virus that uses a simple encryption with a random key and immutable encoder. Such viruses are easily detected by the signature of the encoder;

• Metamorphic virus is the virus that applies to the whole metamorphism of your body to create new copies;

• Polymorphic virus is a virus that uses metamorphic encryptor to encrypt the main body of the virus with a random key. The information used to generate new copies of the encoder may also be encrypted. For example, the virus can implement multiple encryption algorithms to create a new copy of the encoder to change not only the team, but the algorithm itself.

**Worm** is a type of malware propagating through the network channels, capable to overcome the autonomous protection of automated systems and computer networks, establish and further spread its copies, is not always coincident with the original, and the implementation of other harmful effects. The most famous worm is a worm Moriss, mechanisms of which are described in detail in the literature. The worm appeared in 1988 and for a short period of time paralyzed many computers on the Internet. This worm is a "classic" of malware and attack tools developed by the author in writing it is still used by hackers. Moriss was self-propagating program that spread copies of itself over a network, obtain privileged access rights on the host network by exploiting vulnerabilities in the operating system. One of the vulnerabilities used by the worm, was a vulnerable version of the sendmail program (function "debug" sendmail program that sets the debug mode for the current session), and the other – fingerd program (it contained a buffer overflow error). For destruction systems, the worm also used the vulnerability of rexec and rsh, it is also wrong to selected user passwords.

At the stage of penetration in the worms are divided mainly on the type of protocol used:

• **Network Worms** – worms are used to spread the Internet protocols and LAN. Usually this type of worm spreads using improper handling some applications tcp / ip protocol stack base packages.

• **Mail worms** – worms that propagate in the format of e-mail messages. As a rule, the letter contains a body of code or a link to an infected resource. When you run the attached file, the worm is activated; when you click the link,

download and then open the file, the worm also starts performing its malicious action. After that, it continued to distribute copies of, searching for other e-mail addresses and sending infected messages to them. The following methods are used to send messages worms: direct connection to the SMTP-server, using the built-in library of email worm code; Use MS Outlook services Use Windows MAPI functions. To search for victims of addresses is most commonly used address book MS Outlook, but can also be used WAB address database. The worm will scan the files stored on the disks, and to allocate one line related to e-mail addresses. Worms can send copies of itself to all addresses found in the mailbox (some have the ability to respond to the letter in the drawer). There are instances that can combine methods.

• **IRC-worms** – worms that spread via IRC (Internet Relay Chat). This class of worms uses two types of distribution: sending user to the URL-link to the file-body; sending the file to the user (in this case the user must confirm the reception).

• **P2P-worms** – worms that spread using peer to peer (peer-to-peer) file-sharing networks. The mechanism of most worms is quite simple: to implement in the P2P-network worm can simply copy themselves into a shared directory, which is usually located on the local machine. All other work on its spread P2P-network takes over - when searching for files in the network informs other users about the file and provides the infrastructure to download it from the infected computer. There are more complex P2P-Worms that imitate a specific file sharing system and network protocol respond positively to search queries (the worm offers to download your copy).

• **IM-worms** – worms that use to disseminate instant messaging (IM, Instant Messenger – ICQ, MSN Messenger, AIM, etc.). Famous computer worms of this type have a single propagation method - mail to contacts found (from the contact list) messages containing a URL to a file located on any web - server. The method is practically identical to the distribution and uses mail worms.

We have listed the most common types of worms, their practice much more. For example, now more and more «popular» acquire mobile worms and worms that spread copies of itself through shared network resources. Last used operating system functions, such as sorting out the available network folders, connect to computers in the global network and attempt to open their drives for full access. Different from standard network worms so that the user needs to open a file with a copy of the worm to activate it.

The destructive capabilities of viruses and worms can be divided into:

• harmless, i.e., does not affect computer operation (except for reducing free disk space as a result of its distribution);

• non-hazardous, the effect of which is limited to a decrease in available memory on the disk and graphics, sound and other effects;

• the dangerous viruses that can cause serious malfunction of the computer;

• very dangerous – in the algorithm of their work clearly laid down procedures, which could cause loss of programs, destroy data, delete the necessary information of a computer recorded in the system memory areas, and even, as stated in one of the untrusted computer legends facilitate the rapid wear of moving parts mechanisms – to enter into resonance and destroy certain types of head drives.

But even if the algorithm of the virus found branches, causing damage to the system, the virus can not confidently be called harmless, since its penetration into the computer may cause unpredictable and sometimes catastrophic consequences. After a virus, like every program has an error, the result of which may be flawed both files and disk sectors (for example, it is quite harmless at first glance DenZuk virus quite working correctly with a 360-kilobyte floppy disks, but can destroy data on diskettes more volume). Until now caught viruses that define the COM EXE or not the internal format of the file, and on its expansion. Naturally, when the format does not match the file name extension, and after infection it is inoperable. It is also possible «jamming» of a resident virus and systems by using new versions of DOS, Windows, or work with other powerful software systems.

If to analyze all of the above, it can be seen the similarity of worms and viruses, in particular, a complete coincidence of the life cycle and self-replication. The main difference of the worms from virus software is the ability to spread through the network without human intervention. Sometimes the worms belong to a subclass of computer viruses.

Due to the rapid development of the Internet and information technologies the quantity of malicious applications and options of their implementation in an information system constantly grows. The greatest danger is constituted by new forms of viruses and net worms which signatures are not known to producers of means of information protection. Now the increasing popularity is received by such methods of fight as the analysis of abnormal behavior of system and artificial immune systems allowing to find new forms of viruses.

According to the analytical report about virus activity of the Panda Security Company for the 3rd quarter 2011 the ratio of the created malicious applications had the appearance provided in the Figure 8.3.

Three of four new samples of the software were trojans, on the second place – viruses. If earlier the malicious software was created most often in the experimental or «comic» purposes and this powerful weapon for obtaining the material or other advantage acquiring rather a nature of cybercrime was rather an act of cyber-vandalism.

Anyway malicious applications are capable to cause the significant da-

mage, realizing threats of integrity, confidentiality and accessibility of information about which we spoke earlier. The most popular method of fight against them is installation of means of virus protection.

Today it is safely possible to call anti-virus programs, the most popular security feature of information. Anti-virus programs – the programs intended for fight against the malicious software (viruses). Now there is no uniform classification of anti-virus security features of computers, however they can be divided into five main types.

Programs detectors (scanners) provide search and detection of specific viruses. They are based on comparing of the specific sequence of the bytes (signatures, or masks of viruses) which are contained in a virus body, with bytes of the checked files. Their shortcoming is that they can find only the viruses already known to developers of such programs.

Universal detectors check an invariance of files by calculation and comparison of their checksum with a standard. Reference checksum is specified in documentation the software product or counted at the beginning of operation by means of the special module of the program. The lack of such detectors is connected with impossibility of determination of the reasons of misstatement of files.
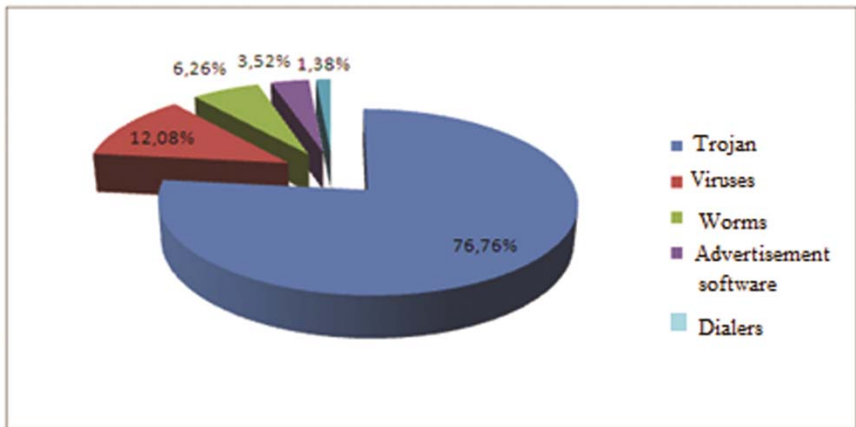


**Figure 8.3.** *Ratio of the malicious software, created in the 3rd quarter 2011*

Specialized detectors carry out search of the known viruses in their signature (the repeating site of a code). Their shortcoming consists that they are capable to find only a part of the known viruses (for which in their virus base there are signatures) and can not find the new viruses which are not brought in their virus base yet.

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The detector allowing to find several different types of viruses is called the polydetector.

Programs doctors (a phage, disinfectors) find not only the files infected with a virus but also treat them, deleting a body of a virus from files and returning files in an initial state. Polyphagues – the programs doctors intended for search and destruction of a large number of different types of viruses.

Programs auditors analyze current state of files and system areas of disks and compare it to information saved earlier in one of files of the auditor. At the same time the condition of the Boot sector, FAT, and also length of files, a code of cyclic control (file checksum), date and time of modification attributes and other parameters of files is checked.

Programs filters – resident programs which notify the user on all attempts of any program to perform suspicious operations and the user himself makes the decision on permission or prohibition of performance of these actions. Filters control updating of program files and system area of disks, formatting of a disk, loading of programs in the RAM. However, they are not capable to neutralize a virus, for this purpose it is necessary to apply a phage.

Programs immunizator (vaccines) – the resident programs preventing infection of files. The principle of their work consists that in the program signs of a specific virus so the similar virus considers it "already infected" register and does not make repeated infection. These programs are least effective and morally became outdated.

The most widespread modern anti-virus programs have approximately identical opportunities, and any of them does not exceed others in all respects at the same time (on work speed, on the frequency of updating of virus base, on stability and reliability of work, etc.). One programs antiviruses work quicker, others provide higher percent of detection of viruses, the third are capable to determine new viruses, the fourth have the bigger number of records of signatures of viruses in virus base, the fifth possess additional functions and are most convenient in use, etc. Each anti-virus program has the specifics, therefore optimum tactics are complex application of several types of anti-virus means.

**8.5 Methods of prevention and protection against computer viruses**

For protection against penetration of viruses it is necessary to hold the events excluding infection of programs and data of computer system.

The main sources of penetration of viruses are:

• removable mediums (removable winchesters, a flash memory, compact disks of CD and the DVD) on which there are files infected with a virus;

• computer networks and their services, including system of e-mail and World Wide Web;

• hard drives on which the virus as a result of operation with the infected programs penetrated;

• a virus which remained in a random access memory after operation of the prior user with the infected programs.

Whatever was the virus, the user needs to know the main methods of protection against computer viruses.

For protection against computer viruses it is necessary to use:

• the general means of information protection which are useful to protection not only against viruses, but also against physical damage of disks, incorrectly operating programs or erratic actions of the user;

• the preventive measures allowing to reduce probability of infection with a virus;

• specialized programs for protection against viruses.

**8.6 Standards and specifications in the field of information security**

The concept of information security of the Republic of Kazakhstan is developed based on the Constitution of the Republic of Kazakhstan and laws of the Republic of Kazakhstan of June 26, 1998 "About a homeland security of the Republic of Kazakhstan", of March 15, 1999 "About the state secrets", of July 13, 1999 "About figureht against terrorism", of January 7, 2003 "About the electronic document and the digital signature", of May 8, 2003 "About informatization" and of February 18, 2005 "About counteraction to extremism", Concepts of competitiveness development of information space of the Republic of Kazakhstan for 2006-2009 approved by the Presidential decree of the Republic of Kazakhstan of August 18, 2006 №163. The legal protection is provided by this law extends to all types of the computer programs (including to operating systems and program complexes) which can be expressed in any language and in any form, including the source text in a programming language and a machine code.

State standards of the Republic of Kazakhstan in the field of information technologies:

| № | Standard notation | The name of the standard |
|---|---|---|
| | 35.020 | Information technology(IT) |
| 1 | ST RK 34.005-2002 | Information technology. Basic terms and definitions. Introduced for the first time |
| 2 | ST RK 34.007-2002 | Information technology. Telecommunication networks. Basic terms and definitions. |

| | | |
|---|---|---|
| 3 | ST RK 34.015-2002 | Information technology. The complex of the standards for automated systems. TW for creation of AS. – Introduced for the first time |
| 4 | ST RK 34.020-2006 | Information Security. Technical tools of data protection. Radiation Simulators. General specifications – Introduced for the first time |
| 5 | ST RK 34.021-2006 | Information technology. Technical tools of data protection. Generators spatial noising General specifications – Introduced for the first time |
| 6 | ST RK 1184-2003 | The quality of service information. Terms and Definitions – Introduced for the first time |
| 7 | ST RK ISO\MEK 27001-2007 | Information technology. Methods and security features. Information Security Management Systems. Requirements – Introduced for the first time |
| 8 | ST RK GOST R 50739-2006 | Means of computer facilities. Protection against unauthorized access to information. General specifications – Introduced for the first time |
| 9 | ST RK GOST R 51275-2006 (GOST R 51275-99, IDT) | Means of computer facilities. Protection against unauthorized access to information. General technical requirements. |
| 10 | ST RK GOST 52292-2007 | Electronic exchange of information. Terms and Definitions |
| 11 | ST RK GOST R MEK 60950-2005 | Safety of Information Technology Equipment – Introduced for the first time |
| | 35.040 | Character sets and information coding |
| 12 | ST RK 5.0-2005 | Unified system for classification and coding of technical, economic and social information. Basic – Introduced for the first time |
| 13 | ST RK 5.1-2007 | The order of development of state classifications of technical, economic and social information – Introduced to replace 5.1-92 |
| 14 | ST RK 5.2-2005 | Unified system for classification and coding of technical, economic and social information. The statutes for maintenance of state classifiers of technical and economic information – Introduced to replace ST RK 5.2-99 |

| 15 | ST RK 5.3-2005 | State system of technical regulation of the Republic of Kazakhstan. Classification system and coding of technical and economic information. The procedure of conducting the register of state classifiers of technical and economic information -Introduced for the first time |
|----|----------------|-----|
| 16 | ST RK 6.0-2005 | The system of bar coding products. Basic – Introduced to replace ST RK 6.0-96 |
| 17 | ST RK 6.1-2005 | The system of bar coding products. Requirements to the symbolism of «interleaved 2 of 5» – Introduced to replace ST RK 6.1-98 |
| 18 | ST RK 34.014 -2002 | Information technology. Set of standards for automated systems. Automated systems. Terms and definitions – Introduced for the first time |
| 19 | ST RK 34.017-2005 | Information technology. The electronic edition. Electronic textbook – Introduced for the first time |
| 20 | ST RK 34.023-2006 | Information technology. Methods of assessing the conformity of the requirements of information security systems – Introduced for the first time |
| 21 | ST RK 34.024-2006 | Data protection. Automated systems in the protected design. General specifications – Introduced for the first time |
| 22 | ST RK 34.025-2006 | Data protection. The order of creation of automated systems in the protected design. General provisions – Introduced for the first time |
| 23 | ST RK 1048-2002 | Information technology. 8-bit code table Kazakh alphabet – Introduced to replace RST KazSSR 920-92 |
| 24 | ST RK 1073-2007 | Means of cryptographic protection of information. General technical requirements instead of Vedène ST RK 1073-2002 |
| 25 | ST RK 1087-2002 | Unified system for program documentation. User guide. to the composition requirements, content and design – Introduced for the first time |

| 26 | ST RK 1089-2002 | Unified system for program documentation. Program and test procedure. Planning for software testing – Introduced for the first time |
|----|----|----|
| 27 | ST RK 1090-2002 | Unified system for program documentation. Specification of software requirements -Introduced for the first time |
| 28 | ST RK 1238-2004 | The system of bar coding products. Terms of EAN bar codes placed on consumer products and transportation upakovkah – introduced to replace PR RK 50.6.1-96 |
| 29 | ST RK 1694-2007 | Protective equipment for telephone information leakage by acoustoelectric conversion and high-imposition |
| 30 | ST RK 1697-2007 | Data protection. Remedies Technical remedies for leakage power circuits information |
| 31 | ST RK 14516-2007 | Information technology. Security techniques. The use and management of the services of a trusted third party. General requirements |
| 32 | ST RK GOST R ISO/ MEK 15408-1-2006 | Information technology. Methods and security features. Criteria for Information Technology Security Evaluation. Part 1: Introduction and general model – Introduced for the first time |
| 33 | ST RK GOST R ISO/ MEK 15408-2-2006 | Information technology. Methods and security features. Criteria for Information Technology Security Evaluation. Part 2: Security functional requirements – Introduced for the first time |
| 34 | ST RK GOST R ISO/ MEK 15408-3-2006 | Information technology. Methods and security features. Criteria for Information Technology Security Evaluation. Part 3: Requirements for security assurance -Introduced for the first time |
| 35 | ST RK GOST R ISO/ MEK 15419-2007 | Automatic identification. Bar-coding. Digital images of a system and print barcode symbols. General test requirements – Introduced for the first time |
| 36 | ST RK GOST R ISO/ MEK TO 15443-1-2007 | Information technology. Security techniques. The structure of the security of information technology. Part 1: General requirements |
| 37 | ST RK GOST R ISO/ MEK TO 15443-22007 | Information technology. Security techniques. The structure of the security of information technology. Part 2. Methods of ensuring |
| 38 | ST RK ISO/MEK 10118-1-2006 | Information technology. Information protection methods hash function. Part 1: General. |

| 39 | ST RK ISO/MEK 10118-2-2006 | Information technology. Information protection methods hash function. Part 2. The hash function using n-bit block encryption |
| 40 | ST RK ISO/MEK 10118-3-2006 | Information technology . Information protection methods hash function. Part 3: Dedicated hash function. |
| 41 | ST RK ISO/MEK 10118-4-2006 | Information technology. Information protection methods hash function. Part 4: Hash-functions using modular arithmetic. |
| 42 | ST RK ISO/MEK 14888-1-2006 | Information technology. Methods of protection of information. Digital signatures with the application. Part 1: General – Introduced for the first time |
| 43 | ST RK ISO/MEK 14888-2-2006 | Information technology. Methods of protection of information. Digital signatures with the application. Part 2: Mechanisms based on identity – Introduced for the first time |
| 44 | ST RK ISO/MEK 14888-3-2006 | Information technology. Metnods protestion of-of-information. DIGITAL signatures vith te applikation. Part 2: Mehanists he Waseda identity – Introduced for the first time |
| 45 | ST RK ISO/MEK 17799-2006 | Information technology. Methods to protect a set of rules for information security management. |
| 46 | ST RK ISO/MEK 18028-4-2007 | Information technology. Security techniques. Protecting the network from information tehnologiy.Chast 4. Remote Access Protection |
| | 35 080 | Documentation for software development |
| 47 | ST RK 34.003 -2002 | Information technology. Nomenclature of quality indices database information systems -Introduced for the first time |
| 48 | ST RK 34.004 -2002 | Information technology. Methods for determining the baseline values of software quality metrics – Introduced for the first time |
| 49 | ST RK 34.008 -2002 | Information technology. Statistical analysis software – Introduced for the first time |
| 50 | ST RK 34.009 -2002 | Information technology. Dynamic software analysis – introduced for the first time |
| 51 | ST RK 34.010 -2002 | Information technology. Certification of software. The procedure for the examination of program documentation. – Introduced for the first time |

| 52 | ST RK 34.011 -2002 | Information technology. Technological factors that determine the efficiency of software – Introduced for the first time |
|---|---|---|
| 53 | ST RK 34.012 -2002 | Information technology. Certification of software. Typical methods of assessment of the quality of software documentation – Introduced for the first time |
| 54 | ST RK 34.016 -2004 | Technical and software distance learning. General specifications - Introduced for the first time |
| 55 | ST RK 34.018-2005 | Information technology. Evaluation of software products. Characteristics and quality of their application management – Introduced for the first time |
| 56 | ST RK 34.019-2005 | Information technology. The processes of software life cycle – Introduced for the first time |
| 57 | ST RK 34.027-2006 | Information technology. Classification of software – Introduced for the first time |
| 58 | ST RK 1695-2007 | Information Security. Attestation of information systems and computer equipment. General requirements – Introduced for the first time |
| 59 | ST RK 1699-2007 | Access control |
| 60 | ST RK 1700-2007 | Technical protection of information in work areas |
| 61 | ST RK 1701-2007 | Technical protection of information in computer equipment, automated information systems and networks from leaking through the side electromagnetic radiation and crosstalk. |
| 62 | ST RK ISO/MEK 6592-2002 | Information technology. Guidelines for documentation of computer application systems - Introduced for the first time |
| 63 | ST RK GOST R ISO/ MEK 12119-2006 | Information technology. Software packages. Quality and testing requirements. |
| 64 | ST RK GOST R ISO/ MEK 14764-2006 | Information technology. Maintenance software – Introduced for the first time |
| 65 | CT PK GOST R ISO/ MEK 15026-2006 | Information technology. Levels of integrity systems and software – Introduced for the first time |

| 66 | ST RK GOST R ISO/ MEK TO 15504-1-2002 | Information technology. Assessment of the development of software tools. Part 1: General concepts and an introductory guide |
|----|----|----|
| 67 | ST RK GOST R ISO/ MEK TO 15504-2-2002 | Information technology. Assessment of the development of software tools. Part 2: Basic model of the processes and their maturity |
| 68 | ST RK GOST R ISO/ MEK TO 15504-3-2002 | Information technology. Assessment of the development of software tools. Part 3: Assessment |
| 69 | ST RK GOST R ISO/ MEK TO 15504-4-2002 | Information technology. Assessment of the development of software tools. Part 4: Guidance on the use of evaluation |
| 70 | ST RK GOST R ISO/ MEK 15910-2006 (RK GOST R ISO/MEK 15910-2002, IDT) | Information technology. The process of creating user documentation software tool. |
| 71 | ST RK GOST R 51188-2007 | Data protection. Testing software for viruses |
| 72 | ST RK GOST R ISO/ MEK TO 16326-2006 | Software Engineering. Guidance on the application of ST RK 34,019 at project management. Introduced for the first time |
|  | 35.100 | Open Systems Interconnection |
| 73 | ST RK 1178-2003 | Protecting the information system of the State Fund standards from unauthorized access. General specifications – Introduced for the first time |
|  | 35.100.70 | Application layer |
| 74 | ST RK GOST R ISO/ MEK 7498-1-2006 | Information technology. Open Systems Interconnection. Basic Reference Model – Part 1: Basic model – Introduced for the first time |
| 75 | ST RK GOST R ISO/ MEK 7498-2-2006 | Information technology. Open Systems Interconnection. Basic Reference Model. Part 2: Architecture of information security – Introduced for the first time |
|  | 35.160 | Microprocessor systems |

| 76 | ST RK 34.002 -2002 | Information technology. personal electronic computing machines. The requirements for the composition and characteristics of quality assessment rules – introduced for the first time |
|---|---|---|
| | 35.240 | The use of information technology |
| 77 | ST RK 34.001 -2002 | Information technology. Database Certification. Methods for detection of spelling mistakes in the text data – Introduced for the first time |
| 78 | ST RK 34.022-2006 | Data protection. Requirements for the design, installation, commissioning, operation and security of information systems |
| 79 | ST RK 1698-2007 | Data protection. data protection and technical intelligence from leaking via TECHNICAL channels on the subject of computer equipment |

### 8.7 Cryptographic data protection

Cryptographic methods of information protection - a special encryption methods, encryption or other transformation of the information, in which its content is no longer available without a cryptogram and key reverse conversion. A cryptographic method of protection, of course, the most reliable method of protection, as the information itself is directly protected and do not have access to it (for example, the encrypted file can not be read even in the case of theft of vehicle). This protection method is implemented as programs or software packages.

Modern cryptography includes four main sections:

1. Symmetric cryptosystems. In symmetric cryptosystems, encryption and decryption using the same key. (Encryption - transformative process: the source code, which is also the name of the plaintext is replaced with ciphertext, decryption - the reverse process of encryption cipher text is converted to a source on the basis of the key.);

2. The public-key cryptosystems. Public-key - public and private are used in systems with two keys, which are mathematically related to each other. The information is encrypted using the public key, which is available to all comers, and decrypted with a private key known only to the recipient of the message. (Key – the information necessary for the smooth encrypt and decrypt the text.)

3. An electronic signature. The system of electronic signature is said to join the text of its cryptographic transformation, which allows the preparation

of the text of the other user to verify the authorship and authenticity of the message.

4. Key Management. This process of information processing systems, the content of which is the compilation and distribution of keys between users [3].

The main directions of the use of cryptographic techniques – transmission of confidential information via communication channels (e.g., e-mail), authentification of messages transmitted, storage information (documents, databases) on media in encrypted form.

**Requirements cryptosystems**

The process of closing a cryptographic data can be both software and hardware. Hardware implementation differs considerably greater cost, but is inherent and advantages: high efficiency, simplicity, security, etc. Software implementation is more practical, certain flexibility. For modern cryptographic protection of the information sets forth the following common requirements:

• encrypted message must be capable of reading only with the key;

• the number of operations needed to determine the encryption key used by a fragment of an encrypted message and its corresponding plaintext must not be less than the total number of possible keys;

• the number of operations required to decrypt the information by trying all possible keys must be strict lower bound and go beyond the capabilities of today's computers (with the possibility of the use of network computing);

• knowledge of the encryption algorithm should not affect the reliability of protection;

• extra bits in the input message in the encryption process must be fully and safely hidden in the ciphertext;

• the length of ciphertext must be equal to the length of the source text;

• there should be simple and easily establishes a relationship between the keys, consistently used in the encryption process;

• any key from the set of possible must ensure reliable protection of information;

• algorithm should allow both software and hardware implementation, and the length of a key change should not lead to a deterioration in quality of the encryption algorithm.

*Symmetric cryptosystems*

All variety of existing cryptographic techniques in symmetric cryptosystems can be reduced to the following four classes of transformations:

• permutation characters of the input text are rearranged according to some rule within a specified block of the transmitted text;

• analytical conversion – the encrypted text is converted according to some analytical rule, such as summarized which is applied to the source text of some pseudo-random sequence based on the key;

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• the combined transformation represents a sequence (with possible repetition and alternation) main methods of the transformation applied to the unit (s) of the encrypted text. Block ciphers in practice are more common than "pure" conversion of a class because of their higher crypto strength. Russian and encryption standards are based on this class.

**System public key**

No matter how complex and secure cryptographic systems – weaknesses in the practical implementation – the problem of key distribution. In order to allow the exchange of confidential information between the two entities of IP, the key is to be generated by one of them, and then somehow again confidentially transferred to another, i.e. in the general case to pass, the key again requires the use of a cryptosystem. To solve this problem on the basis of the results obtained with classical and modern algebra, was proposed system with the public key.

Their essence consists that each destination IP has two keys related to each other by a specific rule. One key is public and the other closed. The public key is published and available to anyone who wishes to send a message to the recipient. The secret key is kept secret. The source text is encrypted with the public key of the recipient and passed it. The encrypted text cannot be decrypted with the same public key. Decryption of the message is possible only using the private key known only to the recipient.

A cryptographic system with a public key uses so-called irreversible or one-way functions which have the following property: for a given value of x is relatively easy to calculate the value of $f(x)$, however, if $y=f(x)$, there is no simple way to calculate the value of x. Many classes of irreversible functions give rise to all the variety of systems with a public key. However, not every irreversible function is suitable for use in real IP in the definition of irreversibility of uncertainty. Under irreversibility is not irreversible theoretical and practical impossibility to calculate the return value using modern computational tools for the foreseeable period of time. Therefore, to ensure reliable protection of information systems with public key (CSR) are two important and obvious requirements:

1. Transformation of the original text must be irreversible and preclude its recovery on the basis of the public key.

2. Determining the private key based on an open should also be possible on a modern technological level. And the desired precise is lower bound for the complexity (number of operations) the disclosure of the cipher [4].

Algorithms for public key encryption are widespread in modern information systems. So, the RSA algorithm has become the global de facto standard for open systems. In general, today all of the proposed cryptosystem with a public key is based on one of the following types of irreversible transformations:

• The decomposition of large numbers into Prime factors;
• Calculate the logarithm in a finite field;
• Computation of roots of algebraic equations.

It should be noted that the algorithms of the cryptosystem with public key (CSR) can be used in following assignments:

1. As an independent means of protection of transmitted and stored data.

2. As a means for key distribution.

Algorithm the JUICE is more time-consuming than traditional cryptosystems. So often in practice wisely with the JUICE are distributed keys, which as minor. And then are used conventional algorithms for the exchange of large information flows. One of the most common type is system with public key – RSA. The RSA cryptosystem developed in 1977 and was named after its creators: Ron Rivest, ADI Shamir and Leonard Adelman. They took advantage of the fact that finding large Prime numbers is computationally easy but factorizing the product of two such numbers, which are almost impossible. It is proved (theorem of Rabin) that the disclosure of the RSA encryption is equivalent to this decomposition. Therefore, for any length of the key can give a lower estimate of the number of operations for realizing the cipher, and given the performance of modern computers to evaluate the time. The chance is guaranteed to assess the security of RSA was one of the reasons for the popularity of this JUICE compared to dozens of other schemes. Therefore, the algorithm RSA is used in banking computer networks, especially for remote customers (credit card servicing).

### 8.8 Electronic signature

Electronic signature (ES), Electronic digital signature (EDS) is the requisite of the electronic document obtained as a result of cryptographic transformation of information using a private signing key and verifying the absence of distortion of information in an electronic document since the formation of the signature.

When registering a digital signature in specialized centers the correspondent receives two keys: private and public. The secret key is stored on a diskette or smart card and should be known only to the correspondent. The public key should be available to all potential recipients of documents, typically sent via e-mail.

The process of electronic signing of the document is processed using the secret key of the message text. Next the encrypted message is sent via email to the subscriber. For message authentication and electronic signatures, the subscriber uses the public key.

Using a digital signature, you can:

– carry out the treatment in a virtual foster public authorities, but also the

Republic (this service provides the possibility of transferring citizens of the Republic of Kazakhstan of their appeals to state bodies and guarantees a response from the authority that provides the ability to track case status: delivered to the state Agency, transferred for execution, executed, etc.);

– obtain government services 24 hours a day, 7 days a week without leaving home;

– represent and choose the most advantageous price offer of goods and services in electronic trading, auctions and tenders.

Consider some of the norms of articles 10 and 17 of the law of the Republic of Kazakhstan dated January 7, 2003 «About the electronic document and electronic digital signature».

In particular on the basis of paragraph 2 of Article 10 «The use of electronic digital signature» we understand that private keys of electronic digital signature are the property of the persons owning them legally.

The user may have the key signature for different information systems. Closed EDS keys may not be transferred to other persons.

It must be remembered that private keys are not transferable. What dictated such a rule? Getting your private key, the attacker can for you to sign documents electronically and to use different services. Do not forget that a digital signature is similar to your handwritten signature.

Paragraph 4 of article 17 reminds us about our rights and responsibilities as the owner of the registration certificate. It sounds the following way – «take action to protect he owns the private key of electronic digital signature from unauthorized access and use, and to store the public keys in the order established by the legislation of the Republic of Kazakhstan».

From the above provisions imply the following necessary. Your means of EDS that contain private and public key that you obtained legally, you can not transfer to another person, and you are obliged to take all measures for the protection of you private key digital signature.

First and foremost, you will protect yourself from possible consequences caused by the actions of the criminals.

As an example, the loss of EDS will give the following case.

To date, one of the most popular social networks in contact, with the implementation of the function add documents to a social network, users in addition to the usual information, upload documents with their passwords, photocopies of identity card and even an e-signature – unaware that all of this information can be available to all registered users of this social network and all of this can be exploited, for their own selfish purposes.

For example, to locate a public digital signature of citizens in the «Documents» section to search by file extension «.p12», or the standard header sig-

nature «AUTH_RSA», resulting in a list available for download of a digital signature of a third party.

From this it must be concluded that users put their personal information, do not have knowledge in the above mentioned functions and norms of law of Kazakhstan «On electronic document and electronic digital signature», which we discussed above.

It is important to note, in addition to what person lost their means of EDS, will suffer some damage from actions of malefactors, they also bear the responsibility for violation of legislation of the Republic of Kazakhstan on electronic document and electronic digital signature.

**Control questions:**
1. Give the definition of "information security" (IS).
2. What are you aware of threats to information security?
3. What are you aware of the source of threats to information security?
4. The types of attacks.
5. Give the classification of viruses.
6. Basic properties of viruses.
7. The main ways of infection.
8. What types of responsibility provided for violations in the sphere of information security?
9. List the software and technical measures to ensure information security.
10. Ways to ensure the preservation and safe data recovery.
11. What is a firewall? Classification and capabilities of firewalls.
12. What is antivirus protection?
13. Classification of software anti-virus protection.
14. Examples of antivirus programs.
15. What is cryptography?
16. Replacement ciphers in cryptography.
17. What does a digital signature mean?
18. How do the citizens of Kazakhstan use EDS?

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# CHAPTER 9. INTERNET TECHNOLOGY

## 9.1 Introduction to the Internet technologies

The Internet – a global computer network covering the whole world.

The Internet management belongs to the following organizations:

ISOC (Internet Society) - an organization on a voluntary basis, the purpose of which is to promote global information exchange via the Internet.

IAB (Internet Architecture Board) is the organization that approves standards and allocates resources (such as addresses).

IETF (Internet Engineering Task Force) – a public body that meets regularly to discuss current technical and organizational problems of the Internet.

InterNIC (Network Information Center) – an organization which is responsible for allocation of IP addresses in the global address space.

And of course, the Internet is not a chaotic random movement signals between computers and applications, there are standard ways of interacting with each other.

When transferring data using a specific set of conventions and rules, called a protocol. Protocol in the interconnected network transmits so-called packets (information, broken into pieces) or datagram.

Consider the Internet TCP / IP underlying protocol.

Internet Protocol (IP – Internet Protocol)

Networks are heterogeneous, of their complexity. IP protocol forwards packets in such complex networks based on their switching.

Packets (datagrams) are sent over IP - networks in the IP envelope.

According to the standard protocol a synonym for a «package» - a «firewall datagram» (Internet datagram) [1].

| Version | HLEN | Type of Service | Total Length | |
|---------|------|-----------------|--------------|---|
| Identification | | Flags | Fragment Offset | |
| TTL | Protocol | Header Checksum | | |
| Source IP Address | | | | |
| Destination IP Address | | | | |
| IP Options (if any) | | | Padding | |
| Data | | | | |

**Figure 9.1.** *Format of Datagram*

Special equipment, computers or computer systems connect to network, then decide which direction of packages or datagrams are called routers. (Figure 9.1).

**Figure 9.2.** *A router in the network*

To communicate in a network Internet, each computer has its own IP-address and it must be unique. IP-address consists of 4 numbers (from 0 to 255) separated by periods. Each number has 8 bits, and combined digital address of 32 bits. An IP address consists of two parts: subnet address and host address.

Host or Node is a computer, server, or any unit of computer equipment connected to the network.

Examples of IP – address:

192.12.78.190

10.10.4.68

195.125.15.44:205 (non-standard port)

The boundaries between the identifier (address) and a network identifier (address) of the node can be made more flexible by using a *subnet mask*. The subnet mask is a number (binary code), used in conjunction with IP-address; "1" is stored in rows where available IP-address and the network is interpreted as a number.

Consider the subnet mask value of the standard IP classes:

▪ class A – 11111111. 00000000. 00000000. 00000000 (255.0.0.0);

▪ class B – 11111111. 11111111. 00000000. 00000000 (255.255.0.0);

▪ class C – 11111111. 11111111. 11111111. 00000000 (255.255.255.0)

*Module* – software (usually) implementation of a certain protocol or procedure.

*Transmission Control Protocol (TCP).*

When the information exchanged, it has a large volume and need for fragmentation. Fragmentation is the splitting of large packet (datagram) into fragments (smaller blocks).

The TCP protocol deals with the solution of the problem of large amounts of data transfer.

TCP is highly reliable protocol that provides communication between hosts running on application processes in computer networks.

The objectives of TCP are the flow control, reliable data delivery, management of logical connections.
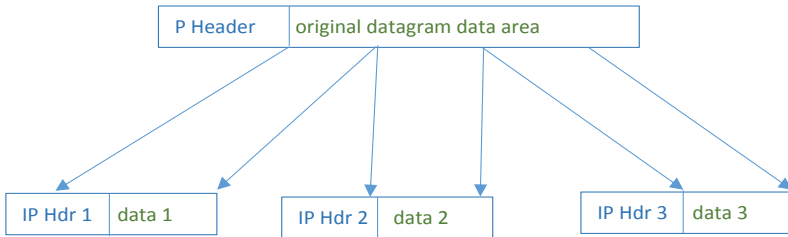


**Figure 9.3.** *Fragmentation of Datagram*

Information →Packages® TCP-envelope ® TCP-packet ® IP-envelope ® IP-packet ® Receiver (TCP-module)

TCP divides the information (you need to send) for a few numbered pieces, covers every piece of information with TCP-envelope and resulting TCP packet is placed in a separate IP-envelope, and IP-packet is obtained. After receiving Recipient (TCP-module) unpacks the IP-envelopes and see TCP-envelopes, unpacks them and puts the data with successive parts in the appropriate place. At the end of the information collected in the correct order and is completely restored.

In the TCP-header of each packet stores checksum, when placed in a TCP-envelope is calculated. If re-admission computed checksum does not match the one specified on the envelope, so in a way it has a distorted place, so that this package is necessary to re-send what actually we do.

Thus, appeared the term «TCP / IP», meaning their co-established work.

*Control Message Protocol (ICMP – Internet Control Message Protocol)*

For feedback between sender and receiver of IP-datagrams, between the communication equipment that transmits datagrams (packets) is used ICMP protocol on the network.

Integral network, which end nodes connected to networks, has a different characteristics and interconnected by special devices called Catenet. Such special connecting devices to the network is called the gateway.

*User Datagram Protocol (UDP).*

UDP uses a simple mechanisms forwarding application data, but the protocol does not guarantee protection against duplication and delivery.

*Multiplexing* – a technology that separates data communications between a group of objects that use them.

*Demultiplexing* – a process reverse multiplexing.

*TELNET (terminal network) protocol*

TELNET allows data transmission between a process and a terminal, and is used for terminal emulation remote station.

*Terminal* – a device that consists of input-output means and used to communicate with hosts that are running applications.

*File Transfer Protocol (FTP)*

FTP enables file exchange between clients and servers.

*TFTP (Trivial File Transfer Protocol)* is a simple file transfer protocol.

*Network File System (NFS)*

NFS is a network service, that allows you to combine multiple remote file systems of computers in one.

*Simple Mail Transfer Protocol (SMTP)*

SMTP is used to transmit e-mail messages (text graphics, video and audio files), using reliable delivery TCP means between networked systems.

*Simple Network Management Protocol (SNMP)*

SNMP monitors network activity and controls the switching network equipment and workstations.


### 9.2 Client-Server Technology

*The Domain Name System (DNS)*

A digital representation of the IP-address is inconvenient to memorize, so there was the Domain Name System, which consists not of numbers, but of symbolic names, called domain.

The Internet IP-address and the domain name is completely equivalent. DNS serves for mapping a domain name to IP-address www.yandex.ru – 87.250.250.3

You can query the defined DNS-servers with using command (utility) nslookup by the DNS names that allows you to diagnose problems with their resolution in the DNS system.

*Unique Resource Identifier*

A lot of resources can be at a certain with DNS name server: a lot of videos on youtube and etc.. Therefore, there was addressing mechanism that

determines where the server is located and what kind of life on it, called URL (Uniform Resource Locator – a unique resource allocation), URI (Uniform Resource Identificator - Unique Resource Identifier).

URL format: Protocol: // server address / e-resource

Examples:

https://mail.kz/ru/instruction

protocol     server's        resource
name (DNS)   address

file:///C:/0/example.html

protocol     server's        resource
name (DNS)   address
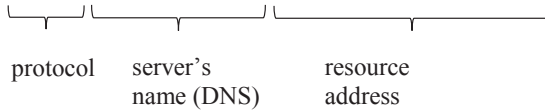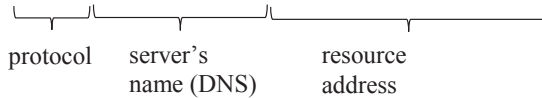
*HTTP Protocol*

Consider the basic network protocol HTTP (Hyper Text Transfer Protocol), which uses the technology "CLIENT-SERVER" and it is divided into three categories:

1. Servers – supply storage and query processing services.

2. Customers – send requests to the server to use its services.

3. Proxies – support the work of transport services.

"Classic" HTTP – session can be presented as schemes :

Establishing a TCP-connection ® Customer Query ® Server Response →break of TCP-connection.

Interaction between the client and server ends as soon as the client receives the response from the server to itself request. Typically, client makes a request for transfer of a resource, for example, the HTML-document, in response to the Server sends the code of the requested resource [2].

HTTP-request consists of the following components:

1. Request Header (status bar, header fields).

2. An empty string.

3. The body of the request.

Method of_query URL_resource version of protocol_HTTP

Query method determines manner of impact on the URL resource, preassigned in the same row.

Exist the following values of the method: GET, HEAD, POST, PUT, DE-LETE, etc.

GET is used to obtain the URL of the resource. Server receives a GET request, reading the specified resource should be in response to the client to enable the resource code.

URL resource can even point to the executable code that runs on the server, of course, subject to certain conditions.

Then, the server returns to the client generated during its execution data, not a code program.

POST is used to transfer data to the server. The POST method can also be used in many ways, to obtain information from the server and this method can start the process.

Format versions of the HTTP protocol: HTTP / version.modification

Header Fields lookup, title name determines the assignment of the field.

The format of the header fields: Field_name: Value

When working in the WEB, in many cases, the request body is missing. In the body of the request can be placed data transmitted for of CGI-scripts in the request are executed.
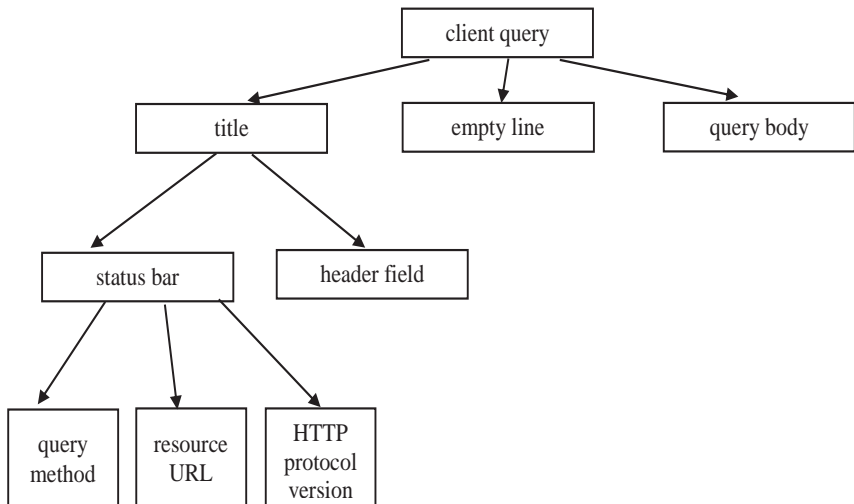


**Figure 9.4.** *The structure of the client's request*

HTTP header field – a client request is in the table.

| HTTP request header fields | Meaning |
|---|---|
| Host | Domen name or node IP-address, accessed by the client |
| Referer | Document URL, referred by resource, specified in state line |
| From | Mail of user that working with client |
| Accept | MIME-types of data processed by the client. This field can have multiple values, separated from one another by commas. Often ACCEPT header field is used to tell the server what types of image files supported client |
| Accept-language | Set of double symbols identificators, meaning languages that supported by client |
| Accept-charset | List of supported symbols |
| Content-type | MIME-types of data contained in request body |
| Content-length | Symbols number contained in request body |
| Range | is present if a client requests than the entire document, but only part of it |
| Connection | Used to control the TCP-connection. If the field contains Close, this means that after the server processing the request to close the connection. The value of Keep-alive offers not close the TCP connection so that it can be used for subsequent requests |
| User-agent | Information about client |

Response server also consists of the following four components: status bar, header fields, an empty line, the response body

The format of Status bar is:

Protocol_version, Response_Code, Explanatory_message

Explanatory_message duplicates response code in symbolic form.

It must be remembered that this character string is decoding the response code and is intended for an operator or system administrator, who provides services to the system, and is not processed by the client.

Consider the value of the three digits that make up the response code. The first (senior) class number indicates the response, the other two digits represent the number of the answer, which is inside a class.

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For example, if the client receives the message HTTP/1.0 200 OK

Then it means that request is processed successfully. **1.0** – version of protocol, **200** – code of response. Number **2** shows that client's request is processes successfully, two numbers **00** indicate the number of messages. Currently, the implementation of HTTP first is Figure 5. There are no longer classes of responses:

**4** – Error of client. It means that there are syntax mistakes in client's request.

**5** – Error of server. It means that the server will not execute the request by some reason [3-4].

| Code | Encryption | Interpretion |
|------|-----------|--------------|
| 100 | Continue | Part of request is accepted, server waiting from client other parts of request |
| 200 | Ok | Request successfully processed, in answer of client sends data that was specified in request |
| 201 | Created | In request processing as result was created new resourse |
| 202 | Accepted | Request accepted by the server, but the process is not over. This response code is no guarantee that the request will be processed without errors |
| 206 | Partial content | The server returns a portion of the resource in response to a request containing the header field of Range |
| 300 | Multiple choice | The request indicates more than one resource, an indication may be contained in the body of a response on how to correctly identify the requested resource |
| 301 | Moved permanently | The requested resource Do not place more on the server |
| 302 | Moved temporarily | The requested resource resides temporarily changed his address |
| 400 | Bad request | The client request has a syntax error |
| 403 | Forbidden | Available on the server resource is not available for this user |

| 404 | Not found | The resource specified by the client, the server is not |
|-----|-----------|----------------------------------------------------------|
| 405 | Method not allowed | The server does not support the method specified in the Request |
| 500 | Internal server error | One of server components working not correct |
| 501 | Not implemented | Server functionality is not enough to fulfill the customer's request |
| 503 | Service unavailable | Service temporarily unavailable |
| 505 | http version not supported | HTTP version specified in the request is not supported by the server |

*Client scenario and applications*

When the client is a browser and server – WEB server, it is a WEB – application. But in addition to the client and the server in the HTTP – exchange involved and programs – programming – WEB sites. The result of this work is the WEB – a page that is displayed in the browser window.

WEB – application runs on the client computer, and on the server computer.

Let us consider *the programs that run on the client computer*

Scenarios – one of the types of programs that are running on the client computer, these include, for example, a JavaScript program, VBScript.

The part of the web page contains the source code of the script and transferred along with the document, as part of which it is located, the client.

Browser when processing HTML-document executes discovered the source of the script.

There is a general requirement for all transmitted from the server to the client computer programs that run on the execution: it is impossible, to access resources on that computer.

The requirement is necessary for the security of your computer, because the user is not involved with the transmission on the network and running JavaScript-scenarios and of Java-applets, everything happens automatically. For example, such programs are not viruses, etc.

*The programs that run on the server computer*

Unlike the program code executed on the client computer, the program code is executed on the server, the client is not transmitted. The server will only send funds to generate a special customer request, included in the HTML-document and parameters that are part of the request. At the same time the server starts the execution of the program.

*The interaction of client with program that executes on the server*

By using plugins, most browsers support rich Internet application technology (Rich Internet application). This approach, in which the application is complete or partially implement the user interface, using software modules, such as Adobe Flash, Java-applets.

This approach eliminates this problem, as the user interacts with the application via the server, i.e. the client sends data, receives a response from the server reloads the page on its side. The structure of HTML-document has a special handle, through which one can see the location of the file, which contains the Java code – the applet on the server. The client generates an additional request to the server after it receives the applet code of HTML – the document, with the applet itself is executed.

But there are disadvantages of using rich Internet applications:

It is necessary to ensure a safe execution environment;

The need of permission to script execution;

Due to perform on the client side there is the loss of productivity;

A long loading time is as a result of using such packages like Macromedia Flash, Curl, Adobe Flex, Microsoft Silverlight and others.

*The server Web – applications*

On the side of WEB- server, you can develop applications, scripts and plug-ins that expand its capabilities.

To expand the opportunities or the main program is being developed independently of the compiled software module, called plug-in (plug-in), which is dynamically connected to the main program. Typically, these software modules are executed in the form of shared libraries [5].

Some of the tasks that a of the program interfaces manually they can be automated with the help of a special program, called a script (script, script).

## 9.3 The technology of Web - page development

Web application – a client-server application. Where the client performs a user's browser. A server - web server, which means it takes HTTP requests from the user and outputs-response, response is usually displayed on the HTML pages, in the form of images, files, media streams, etc. The web server can act as the software and the computer on which this software works is installed.

Client is usually the web browser, it sends a request for some resources (HTML pages), through the URL-address. In response, the web server transmits the requested data, the exchange occurs by HTTP protocol. The functions of web-servers are:

1. The automatization of the web page work

2. The filling of  user's handling to resources at journal

3. The authentication (indicating) and authorization of users

4. The support of dynamic page generation

5. The support of protected connection with user

Web application logic is in storage at the server and data is exchanged over the network. This gives the advantage to the customer regardless of the particular operating system, that is, the web application will run on any operating system, such opportunities have a cross-platform services.

Below there is a classification of the types of sites.

If the target is of creating separate, two types can be distinguished by:

1. Non-commercial;

2. Commercial.

Accessibility of users can be divided into:

1. Closed (available only for certain people);

2. Semi-closed (possible to register new users);

3. Open (available for any user without registration).

Design style and functionality:

1. Flash-sites (flash animations are presented);

2. Dynamic (data in site can be changed);

3. Static (data of site cannot be changed).

Depending on the audience:

1. Narrowly focused and thematic;

2. Internet – portals;

3. Simple (cutaway, home page and etc.).

Physical location:

1. Local (in certain computer network, without internet connection);

2. Public (available to all by Internet).

Let us consider basic types of sites and their categories:

1. Informative site (represent some information for users);

2. Corporate site (the site for narrow circle of people, for example employees of some firm).

### 9.3.1 HTML

HTML (HyperText Markup Language) – a tagged document markup language. Every HTML document consists of a set of elements, which is the beginning and the end of the designated tag (special notes <>). Elements may be empty, in such cases there is no need to close the tag. Also, the elements can have attributes that define font size, italic, color, etc. (Each has its own attribute tags)

Consider basic structure of HTML document:

**<html>** – beginning of  html document

**<head>** – beginning of head, title of the document

**\<title\>** – beginning of title of header

Header name

**\</title\>** – closing of header name

**\</head\>** – closing of document header

**\<body\>** – opening of document body, basic part of the document

   Prescribes everything that we want to see on our web site

**\</body\>** – closing of basic part of document

**\</html\>** – closing of html document

All these tags, we write in any text editor, such as Notepad, changing the type to \*.txt or to  \* .html on the resulting new file format can be opened in Notepad ++.

Work of links is to move from one page to another. There is a communication link in the same folder, it is sufficient to specify the name of the file type, for example:

**\<a href = "index.html"\>** move to page named index.html **\</a\>**

If both documents are in different folders, we have to specify the full path to it, for example

**\<a href = "D:\\Papka\index.html"\>** move to page named as ndex.html **\</a\>**

If you need to reference, the text is not performed and the image instead prescribes image tag, for example:

**\<a href = "index.html"\> \<img src=»Img1.jpg»\>\</a\>**

We indicate only the name of the image, just in case, if the image and the html file are in the same folder, otherwise we need to specify the full path to the picture. Using this language, you can create tables, frames, menus, scrolling, etc. (For each item use the tags).


### 9.3.2 XHTML

For comparison, the languages HTML and XHTML give their differences. First of all, the HTML is application of SGML (standard generalized markup language) and XHTML (extensible hypertext markup language) – a language that is created, based on XML and uses its syntax, which is more stringent.

Because of the strict rules of XHTML syntax has the advantage that the analysis of the document becomes faster and easier processing of XHTML, it is possible on mobile phones, even with few resources.

Consider what severity of the basic rules of XHTML:

1. All tags must be closed, even a single (for example: \<h1\> \</h1\>). Single tags (such as \<img\>, \<br\>) must have at the end "/" (for example: \<br /\>);

2. Tags must be properly nested.

3. Names of tags and attributes recruited in lower case, for example: \<img src="" alt="" width = "" height="" /\>).

4. Symbols "&" and "<" must respectively replace to "&amp;" and "&lt;". This applies to the URL. However, the W3C does not recommend the browsers handle XHTML documents and report the error occurred, as soon as there are these symbols, but so far this has not happened.

5. All element values of attributes must be enclosed in quotation marks or apostrophes (single quotes), for example, <img heigh = «100» /> or <img heigh = '100' />).

### 9.3.3 CSS

To write up the style of the entire document or individual elements of the site and even its overall use, so-called CSS – (Cascading Style Sheets – Cascading Style Sheets) is used. Now you can define the style once for existing tags or create a new style, for example, all the pages you have created a site, the size of the headlines <h1> will be green, paragraphs <p> will be aligned in the center, and links <a href...> become dark gray and unstressed (for difficultness to detect them). You can also change the style of the page or the entire site at once.

When writing code in CSS, it can be written in several ways, either directly in the HTML file (inside the <HEAD> ... </ HEAD>), using the tag <STYLE> ... </ STYLE>, or in a separate file with the extension .css, and then make a reference to that file in the HTML-page. Here is an example of the first method of displaying CSS code:

<STYLE TYPE=»text/css»>

<!--

H1 {background: yellow; font-size: 50px; text-align: center; font-family: arial}

H3 {font-size: 14px; font-style: bold; font-family: sans-serif}

P {background: beige; text-align: right; font-family: fixed, arial}

-->

</STYLE>

Consider this example line by line. To determine the style of the created page using the attribute TYPE = «text / css» for compatibility with older versions of browsers bring the information in the commentary («<! -» ... «->»). To create a style sets the style name (e.g., H1) and in curly brackets indicates its attributes ({...}). The browser knows that any text is placed between tags <H1> and </ H1> (in the <BODY> ... </ BODY>) must appear arial font height of 50 pixels on a green background and be centered. Style H3 determines that the font in the <H3> can be bold and a height of 14 pixels from the family of sans-serif. A style defines all P paragraphs on the page like this: on a beige background, right-justified, font - fixed or arial [6].

But there is a situation that we do not have to withstand all the paragraphs on page one style, then you need to create your own style (class) and give it a name, for example:

```
<style type=»text/css»>
<!--
.myabsaz {text-indent: 30px; background-color: silver; color: yellow;}
-->
</style>
```

A dot should be put before the name. When referring to the created class is indicated by its name, but without the point:

`<P CLASS=»myabsaz»>`

It is possible to create a separate text file of styles, define the style for the entire site. In a text document covers all styles and is stored with the extension .css, such mystyle.css. And then, in the file of any page it is linked to the stylesheet:

```
<head>
<link rel=»stylesheet» type=»text/css» href=»mystyle.css»>
</head>
```

Now, making changes to a text file - in «mystyle.css» You can change the style of the site, which can consist of hundreds of pages.

You can also create style of individual pages on your site, this is indicated in the code inside, the tag is a keyword STYLE (for example, <P STYLE = «.......»>), with the styles that are described in .css file overlap.

So, when using CSS:

– Download speed increases, and the code size is reduced;

– More rapid and convenient means to control the appearance of the site;

– CSS styles give more opportunities for the design of web pages, such as moving blocks from one style to any place on the page.

– You can vary the look of the site and for different output devices, such as a monitor, a smartphone, printer, PDA and others.

### 9.3.4 JavaScript

WEB-page created only on HTML and CSS languages has no interactivity. A prototype-based scripting language JavaScript programming is created to make web-pages more attractive, and for using beautiful and diverse effects. The java language became the prototype for the JavaScript, nevertheless Java is a language for writing programs, and JavaScript is a language for writing HTML-pages management scripts.

But still there is JavaScript and object-oriented programming language. It is programmed at the client computer, but does not have access to external objects. As well as using CSS, the program code can be written directly into the HTML-file, and you can create a separate file with the extension .js. Even without the use of HTML it is possible to build with JavaScript HTML DOM structure.

<SCRIPT></SCRIPT> is required to enable the JavaScript code in the HTML-file tags:

```
<SCRIPT LANGUAGE=»JavaScript»>
<!--
alert(«Iusescripts «);
-->
</SCRIPT>
```

When you create a separate file with extension *.js, a reference to this file, for example prog.js, is quoted after the src attribute.

```
<SCRIPT LANGUAGE=»JavaScript1.2» SRC=»programma.js»>
</SCRIPT>
```

*jQuery*

This is a JavaScript library focused on the interaction of JavaSsrirt and HTML. It helps to gain access to any element of the document, refer to them and manipulate them.

### 9.3.5 CMS

But what to do when you do not possess WEB programming skills and want to create a personal blog, movie database, a small business site, ecommerce site on the estate, even a large university life, etc. There is a decision.

CMS software (content management system) makes it easier to create, organize, edit and publish content. This is a set of scripts (programs), which allows you to upload pictures, texts fill site and has already started making changes in the page.

WordPress is a popular CMS, which allows you to create and publish content on the Internet. With WordPress you can manage the contents on the intranet and on the same computer.

WordPress allows users to have complete control over documents, files, and monitored how they will be displayed.

The great advantage of WordPress is a free content management system open source. Joomla and Drupal are popular free CMS examples.

### 9.3.6 XML

XML (eXtensible Markup Language) is used for handling and storage of structured data. The file is saved with the extension .xml, for example, Prog1.xml. Initially, the xml-document indicates the version of XML.

```
<?xmlversion=”1.0” encoding=”UTF-8”?>
```

Let us consider an example of creating the xml-document.

```
<?xml version=»1.0» encoding=»UTF-8»?>
<ict>
<task>
```

```
<memo id=»1» date=»11.11.2016» time=»12.00»>
<topic> Create your first page </topic>
<content> 11.11.2016 in 12.40 Extensible Markup Language </content>
</memo>
<memo id=»2» date=»11.11.2016» time=»12.45»>
<topic> Show teacher </topic>
<content />
</memo>
</task>
</ict>
```

The first line contains the version of XHTML and encoding. Tag <ict> is occurred from name of ICT discipline. Within the discipline there are tasks, as the <task>, which are described between <memo>...</memo>, only 2 of them. Each of them is assigned the id attribute and the time when it is necessary to perform. Contents of setting is located between tags <topic> ... </ topic> and the contents of the assignment between the tags <content> ... </ content>. The next is closing tag </ task>, and the last one is</ ict>.

So,

• Xml-document begins with the XML version and encoding of the document;

   • In contrast to the html tags and attributes can have any name;

   • Opening tag has a closing tag, first are nested tags;

   • No unpaired tags;

   • Record type <content /> means that there is no content between the tags;

   • Comments are between those brackets: <!--…-->;

   • Tags are case-sensitive, i.e. <ict> it is correct while the <Ict> or <ICT> is wrong;

   • Attribute values are always enclosed in quotes.

XML to Web technology is used to create maps of sites (prog1.xml), exchange data between programs. On this basis, it is created an extended version of HTML – the language XHTML.

### 9.4 Internet Services

The list of mains among the numerous number of services (services) of the Internet:

WWW (World Wide Web);

FTP – (File Transfer Protocol);

e-mail – Email;

*Internet communication*

The most popular Internet resource is the World Wide Web the WWW, which contains more than a billion of multimedia documents associated with each other over the network. Links can be internal (within the document) or external (links to other documents), can be used to refer to the word, text, image, button, page, the so-called hypertext link. A plurality of individual documents, pages that have links to each other are called *hypertext*.

Of course, the oldest Internet resource is the system of sending e-mails (E-mail). Everyone who has access to the communications network, can exchange messages on E-mail. With e-mail it is possible to conduct personal correspondence, work with some Internet information resources, such as off-line newsgroups, mailing lists, and use the system transfer and store files. E-mail is used in the process of the library. Business correspondence is carried out by e-mail, and E-mail is a technological basis of electronic business documents, «Request-response».

FTP (File Transfer Protocol) is used for storage and file transfer. As it is known file archives. With FTP it is possible to connect to FTP servers, the server allows you to view the contents of their directories and download files from it and the server; between FTP servers as possible file transfer mode.

Direct communication online system provides us with ICQ (I seek you). In a unique number UIN (Universal Internet Number ) in the system, in addition to direct communication, it is possible to search the network for different user ICQ indirect data. This is one of the first systems appeared, providing direct communication on the Internet. Now, of course, there are many of these systems, for example, Magent, Whatsapp etc.

There are also services such as:
• IPhone – working through the Internet computer phone;
• CU-SeeMe – transmission of video via the Internet
• RealAudio – audio transmission from the server to the client; etc.

Currently relevant service "cloud", for example, e-mail is possible to store information, etc.

### 9.5 Ethical standards in the Internet

IFIP (International Federation for Information Technologies) recommends that the national organizations of other countries to adopt codes of computer ethics in accordance with local ethical and cultural traditions. Consider the following conditional set of moral attitudes:

1) do not use a computer to harm other people;
2) do not interfere with other users of computer networks;
3) do not to use files that are not intended for free use;
4) do not use a computer to steal;
5) do not use your computer to spread false information;

6) do not use stolen software;

7) do not assign the intellectual property of others;

8) do not use computer equipment or network resources without authorization or proper compensation;

9) think of the possible social consequences of the programs that you write, or systems that you develop;

10) use a computer with a self-restrictions that show your courtesy and respect for others.

## 9.6 Security

If your computer is connected to the Internet, of course, there is a need of adequate protection.

You need to install updates for the operating system, such as the Windows, as the update is completely relate to the problems of the operating system security. Microsoft closes the operating system vulnerabilities found. After upgrades the system will be more secure and stable. Updates are going to Service Pack and is specifically designed for this kit.

*A source of danger.* All malware aimed at breaking and theft of information on your computer, especially financial information. The following methods are used today:

1) social engineering – a method based on psychological receptions. For example, a message with a link to a file that has the "importance", and a letter can come from the alleged administrator. Once you click the link, immediately run to their malware.

2) viruses are often hidden in a free download programs or pirated discs.

3) even popular software has holes through which you can hack, but only if you do open the link in the email from an unknown sender or forum.

4) phishing – a copy of the site known services, companies, banks, etc. As soon as you log into your account, then read your login and password [7].

*Protection measures.*

1) Install Firewall (firewall). Built-in Windows firewall, it has no reliable functionality. It is safer to install Firewall separately.

2) Purchase and install a fresh anti-virus and anti-spyware software. Do not forget to update the database with the Internet. Antivirus software must be run at Windows startup and constantly check for viruses in the background programs that are run, and external media.

3) Download a timely manner and install updates for Windows, Internet Explorer, and so on.

4) Uninstall or do not install unnecessary, the Windows services, such as service access to printers and files, and so on.

5) Do not open emails from unknown suspicious senders, and even more

attachments and links in them. Do not send or enter a password on your accounts for suspicious sites.

6) Use strong passwords. Passwords must consist of upper and lowercase combinations, not repetitive numbers (at least 8 characters). Do not use the same symbols, numbers, and words that are in the dictionary. Do not use continuously the same password.

7) Be careful when using a proxy server in public places (Internet cafes, etc..).

8) Work with electronic payment systems (web money, Yandex-money, etc.) Through the WEB-interface, not through the downloaded and installed software, such as online wallet for Yandex, webmoney keeper etc.

9) Do not visit sites of questionable, inappropriate content (porn, etc.).

10) Watch out for traffic when growing fast, active malware. Immediately turn off the connection to the Internet.

**Control questions:**
1. Define the term of the Internet?
2. What is an IP address?
3. What is a TCP packet?
4. Explain the structure of the stack TCP / IP protocol.
5. Define the client - server technology
6. List the top-level domains
7. What protocols do you know?
8. Give the module definition datagram fragmentation
9. What is a router?
10. What languages are used in the creation of web - applications technology?
11. What are tags?
12. Why is cascading style sheet used for?
13. What are the main differences between HTML and XHTML languages?
14. What language is called a scripting language?
15. What is a content management system?
16. What services do you use in the Internet?
17. List ethical standards on the Internet
18. How do you ensure the safety of your computer connected to the Internet?

**Practice**
Create the following WEB-page as shown in the Figure, using HTML, CSS:
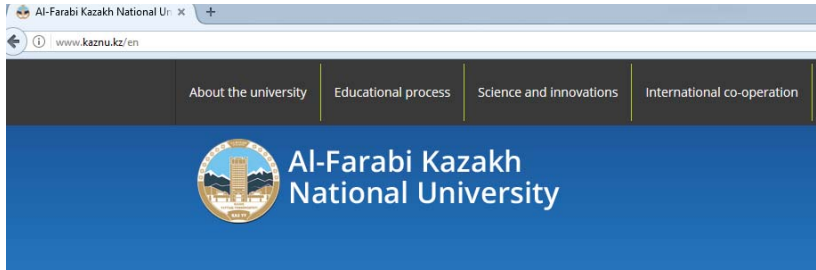
**Figure 9.5.** *WEB-page example*

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# CHAPTER 10. CLOUD AND MOBILE TECHNOLOGIES

Nowadays because of revolutionary shifts in areas of Cloud Computing and mobile applications development, unified communications become very popular and widely discussed topic. Introduction of unified communications gave customers advantages, mainly in an area of application integration for voice communication, attendance accounting and instant message exchange. Users like simplicity and high speed of transition from one communication environment to other.

Therefore, cloud and mobile technologies puts unified communications into very center of our attention, making them more simple and available for users and providing to them latest opportunities of which they recently could not even dream.

## 10.1 Essence of Cloud technologies

Cloud Computing is a model of ubiquitous and convenient network access on demand to shared computational resources (e.g. data transfer networks, servers, data storage devices, computer programs, apps and services – either together or separately) which can be operatively provided and released with minimal operational costs and appeals to a provider.

Many organizations use existing resources not optimally for data storage and involve less than 30% of capacity of their servers for calculations. Low level of usage in given case shows presence of idle reserve capacities necessary for ensuring periodic or unexpected demand for execution of key functions. Helping to solve this and other issues Cloud Computing becoming the market answer to the systematic specialization and strengthening the role of outsourcing[2] in the Informational and Communicational Technologies (ICT). Whereas for a customer the network infrastructure representing equipment and services offered by providers not visible, e.g. "hidden behind clouds" (Figure 10.1).

Majority of modern providers of Cloud Computing area solutions allows not only use existing cloud platforms but also create custom ones, taking into account technological and legal requirements of customers.

Generally, all cloud providers in their equipment use the Virtualization technology – in simple terms, running single or several systems within another operating system on a single computational machine. For example, the Virtualization system allows to allocate certain space in the machine's memory for separate virtual servers and computers performing their own operations independently from each other. Such approach gives the number of the advantages.

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[2] *Outsourcing – passing to an external organization number of non-core functions required for full functioning of an enterprise. Difference of outsourcing is that a customer puts before an outsourcer ultimate goals and methods, tools and paths to achieve this goals depend solely on the outsourcer. Whereas the outsourcer takes all responsibility for obtaining required results which always distinctly specified in the agreement.*

Here are the main ones:

1. Efficient use of computational resources. Instead of several servers loaded on 5-20% one can use a single used on 50-70%. With help of the Virtualization one can reach much more efficient use of resources because it provides unification of standard infrastructural resources and prolongs constraints of the outdated "one application one server" model.

2. Reduction of the infrastructural costs. The Virtualization allows to reduce the number of servers and the related ICT-equipment within an informational center. As a result, the demands in service, power and cooling of hardware resources reduced and much less resources will be spent on the ICT.

3. Reduction of the software costs. Some software manufacturers introduced the separate licensing schemes specifically for the virtual environments.
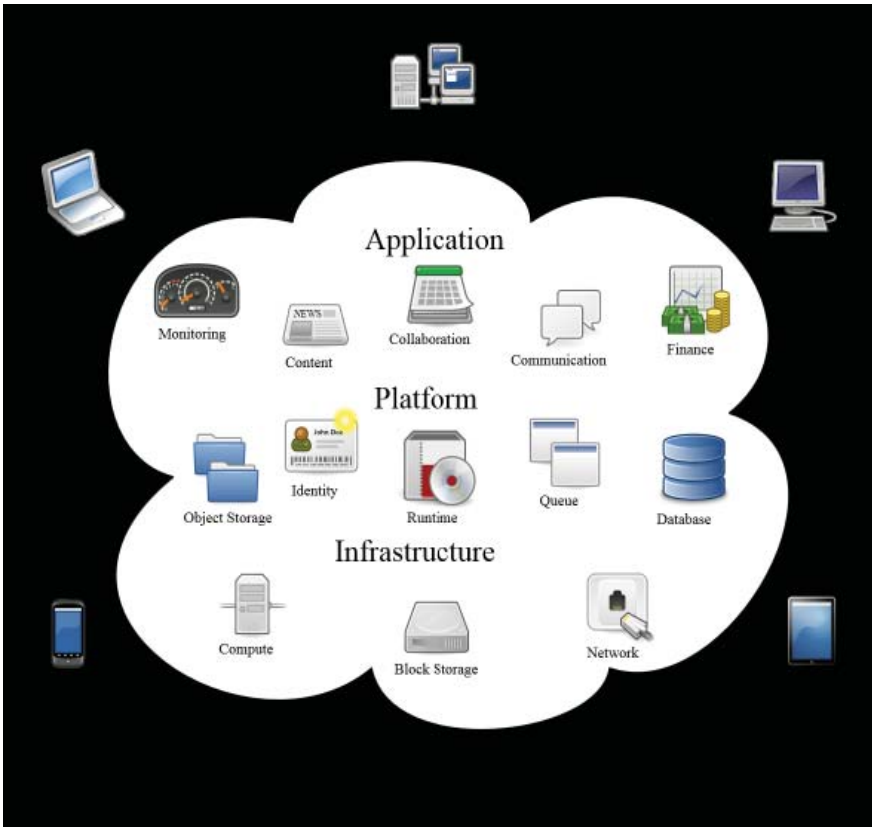


**Figure 10.1.** *Review the cloud technologies with the set of applications supported by the given computing model (link to the original Figure –* https: //en.wikipedia.org/wiki/ Cloud_computing#/media/File:Cloud_computing.svg*)*

1. Increase of an agility and a response rate of a system. The Virtualization offers the new method of the infrastructural management and helps ICT-administrators to spend less time on performing repetitive tasks – e.g. navigation, setup, tracking and technical maintenance. Using a virtual server instant launch on any computational hardware infrastructure is possible and in case of absence of such virtual server it is possible to download the premade virtual machine with the installed and adjusted server from libraries supported by companies – hypervisor[3] developers (virtualization programs).

2. Incompatible applications can work on the same computer. When using the virtualization on a single server it is possible to install both linux-servers and windows-servers, gateways, databases and other incompatible software.

3. Increase of an availability and providing continuous work of an organization. Because of reliable backup system and migration of virtual environments entirely without service interruptions one can reduce planned idle periods and provide rapid system restore in crucial cases. Unavailability of a single virtual server will not lead to loss of other virtual servers. Moreover, in case of failure of the physical server, it is possible automatically replace it with the backup. It happens in an unnoticeable manner for users (without reboot). Therefore, continuous operation is guaranteed.

4. Light archiving capabilities. Because hard drive of a virtual machine usually represented as a file of a certain format located on some physical media, the virtualization allows to simply copy this file to backup media operating as archiving and backup tool for the entire virtual machine. Another marvelous feature is the capability to extract from the archive an entire server. It is possible to extract server from archive without destroying current one and to see operation logs from previous period.

5. Increase of architectural manageability. Use of central management of virtual infrastructure allows to reduce time on management of servers, providing load balancing and live migration of virtual machines.

Finally, cloud technologies allow simplify operation of specialized ICT-organizations, which are no longer need to support complex heterogeneous technologies of a large geographically distributed governmental or commercial customer.

**10.2 History of cloud services**

Nowadays popular term "Cloud Computing" began to be used in ICT from 2008. As a result of the evolution of information technologies the idea of cloud computing achieved its rapid development in the last decade. It can be

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[3] *Hypervisor (or virtual machines monitor) – in computers a program or a hardware scheme providing simultaneous, parallel execution of several or even many operating systems on the same host-computer. Hypervisor also provides isolation of operating systems from each other, security and protection, separation of resources between different OSes and management of this resources.*

stated that the concept of the "cloud" is not something drastically new because ideology of the cloud is here already for half a century. As the starting point in history of cloud computing considered in the 1960s.

In 1961 John McCarthy the author of the Lisp programming language concept of the Artificial Intellect, and the founder of functional programming, Turing Award winner proposed that computational capacities could be offered as public utilities (like water and electricity).

Joseph Carl Robnett Licklider during 1962–1964 worked in ARPA and made foundation of the ARPANET (Advanced Research Projects Agency Network). He made opinion on necessity of creating union of computers into network with free access for any man from any place in the world to its resources. Conducting research in area of Information Technologies Licklider long before invention of the Internet foreseen necessity of merging computers into a network with simplified user interfaces anticipating appearance of web-services and cloud computing.

In May 1964, Martin Greenberger published the article in Atlantic Monthly called "The Computers of tomorrow". He made astonishingly accurate predictions related to development of modern computing [1]. He stated that the unexpected barriers then online interactive computer service commercially provided as informational service by 2000 could be as common as telephone communication today. Greenberger among the first compared computer services with electricity. The researcher pays attention on common feature of these services – universality and possibility of usage on demand. Electricity can be used for wide range activities: launch of equipment, control, data transfer, generating sound, heat and light. Computers also can be applied to wide range of routine tasks, numerical calculations, text processing, automated control of instrumentation, simulation of dynamical processes, statistical analysis, entertainment, storage, search and representation of information. In mid 1960s cost of computers were incomparable to modern prices, yet Greenberger proposed that in future cost of computational powers becomes comparable with electricity. The issue about distribution and delivery of computing services left unsolved in absence of networks. In his article M. Greenberger postulates the possibility of "informational utility", writes about computer business based on computational services and raises the question about government regulation in this new market.

Douglas Parkhill in his book "The Challenge of the Computer Utility" published in 1966 and gives descriptions of many properties of what today called cloud services [2]. For example, he mentioned something nowadays called "the Elastic Cloud" (scalable, provided on demand) as provision of public utilities. These utilities comparable with electricity and can be provided in private, public, civil and social forms.

Thus, even in the last century researchers understood that the computing must transform into public utilities representing new form of public infrastructure similar to electric or telecommunication systems. This idea of computer and informational services popular in 1960s lost popularity towards mid 1970s because of the several factors. First of all, due to limited capabilities both hardware and software of that period and lack of technological development of networks. Secondly, due to vast popularity of personal computers in 1970-80s. Amount and variety of hardware and software grows every year. Whereas there is necessity of ICT-specialists for installation, setup, testing, execution, update of software and hardware. Rapid development of computers and information technologies caused to forget concept of "machine time" – some time on some machine – when computers become personal. The need of obtaining and use of necessary number of computers not hours appeared. During all of this development of cloud technologies were postponed till 1990s.

Extending bandwidth of the global Internet network and its rapid distribution in 1990s gave necessary push for further development of cloud services provision as the concept. The Internet according to NUA research company by 2000 unified 408 million users across the world. Further development of hardware and software allowed making cloud computing more available for either average customers or small to middle businesses. Prime time for cloud technologies came with new millennium (Figure 10.2).
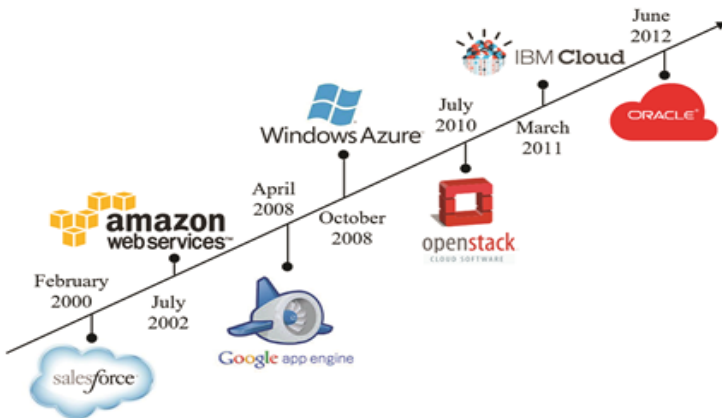


**Figure 10.2.** *Key events in cloud computing 2000–2012*

"End of software" – such slogan generated by American company Salesforce.com, the pioneer of cloud services founded in March 1999. Salesforce.com considered first company provided access to its application though web-

site i.e. offering software as a service concept (SaaS) [3]. Currently Salesforce. com being the author of the CRM (Client Relationship Management) system with same name delivered solely under SaaS model. Company provides the Platform as a Service (PaaS) for full-fledged application development under Force.com brand along with Database.com – the Cloud-based Database Management System.

Next step in the development of clouds were Amazon Web Services (AWS) consisting of the set of the cloud services including storage, calculations and even the Artificial Intellect through Amazon Mechanical Turk. In 2002, the popular Internet store Amazon.com announced first version of the Amazon.com Web Services – the platform for creating innovative web solutions and services specifically designed for developers and website owners.

From the beginning of 2006, the AWS represents the set of remote computational services (web-services) which together compound the platform for cloud computing (PaaS) offered through the Internet by Amazon.com to organizations of different sizes. Being one of the first internet services dedicated to sale of mass demand real goods Amazon.com extends its markets outside the US.

In March 2006 Amazon.com presented Amazon Simple Storage Service (Amazon S3) which represented according to developer's simple interface of web-services which can be used for storage and obtaining any amount of data, any time, from anywhere using the Internet [4].

In August 2006 Amazon launches Amazon Elastic Compute Cloud (EC2) – commercial web service representing scalable computational powers in the Cloud which allows to lend computers for running customer's own applications [5].

The Machine Time concept returns in the new "cloudy" form. Therefore, in 2005 the IBM company offered everyone to lend at flexible prices (depending on required resources) machine time of Blue Gene supercomputer consisting of 2000 PowerPC CPUs.

The Machine Time concept returns back in a new "cloudy" way. Thus, in 2005 IBM offered all to lease the machine time of the Blue Gene supercomputer at flexible prices (depending on required power), consisting of 2000 PowerPC CPUs. It is interesting that initially the Blue Gene created to solve complicated computational problem of forecasting a synthesis process of complex proteins, such as hemoglobin from chain of biochemical components according to DNA program [6].

Cloud computing infiltrated into mass public consciousness during 2007 when Google Docs free online office appeared. Google corporation presented virtualized office package available from any connected to the Internet computer [7].

"Killer apps" title given by Dan Germain, director of technologies of Cobweb Solutions ICT services provider to worldwide companies Microsoft and Google for their contribution in development of cloud technologies.

Towards end of 2008 Microsoft announced new server operating system Azure, initially known as Windows Cloud then renamed to Windows Azure, eventually became Microsoft Azure in March 2014. Microsoft Azure, implementing Platform as a Service (PaaS) model consists of following components, operating system within Azure cloud, SQL Azure relational database located in cloud and Azure AppFabric – set of services for developers [8].

In July 2010 Rackspace Housing and NASA together launched an initiative of open-source Cloud Software known as Open Stack. Project Open Stack created to help organizations provide services of Cloud Computing using absolutely standard computers. Earlier the project codename was "Nebula" platform from NASA, and even before it was "Cloud Files" platform from Rackspace. In March 2011 IBM announced IBM Smart Cloud framework to support Smarter Planet project founded by Smarter Computing fond. In June 2012 Oracle announced Oracle Cloud. Despite the fact that many aspects of Oracle Cloud are still in development, given initiative considered as first of a kind giving customers access to full set of ICT solutions including software (SaaS), platform (PaaS) and infrastructure (IaaS) [9-11].

Clouds became evolution of Information Technologies with revolutionary consequences for business and society. Providing on customer demand access to shared sources of computational power in autonomous and scalable mode, cloud computing provides obvious advantages in organization and maintenance of ICT-infrastructure.

The appearance and evolution of cloud computing fueled by several technological achievements, including:
• Invention of reliable high bandwidth networks;
• Visualization capabilities;
• Open-source software (e.g. Linux, Apache and Hadoop) which reduced cost of software for commercial data centers;
• Acceptance of Web 2.0 technology open standards which made application development within cloud much simpler and quicker;
• Development of Infrastructures deployed by large vendors such as Google and Amazon.
• Development and upgrade of server equipment.
• In classic form cloud technologies appeared relatively recently but in is worth to mention that given computation methodology had its predecessors:
• distributed computing;
• grid computing.
Cloud Computing differs from previous computing models firs of all by

principle of provision of computational capabilities, more precisely rent of required software and hardware, if necessary even providing entire infrastructure as an internet utility.

### 10.3 Main definitions and models of Cloud Computing

#### 10.3.1 Cloud Computing definitions

Professor of University of Milan Federico Etro in his article mentioned that Cloud Computing (CC) a new main goal of internet-oriented technologies allows to store data on servers and providing services on customer demand. In Etro's work economic impact from CC integration analyzed as well as expenses amount from deployment of IT infrastructure on an enterprise. Author's calculations based on DSGE (Dynamic Stochastic General Equilibrium) model show that Cloud Computing allow EU to create several thousands of small and medium sized enterprises and ensure business grow. EU governments must contribute to adaptation of cloud computing solutions [12].

The document prepared by group of experts for EU commission summarizes worldwide experience in the area of cloud computing and gives recommendations on future development of cloud technologies in EU countries.

Miller's book named "Cloud Computing: Web-based applications that change the way you work and collaborate online" notes that computing in form which we know it has been changed. Modern technologies allow not to buy expensive computer software making possible to deploy cloud infrastructure and get access to it from anywhere, any equipment connected to the Internet. It is worth to mention, that access to cloud can be possible by thousands of people with appropriate access rights. Miller's book presents ways to deploy cloud infrastructure, possible network architectures, cloud deployment models, possible risks and alternative options.

Large number of definitions to the term "cloud computing" exists in literature.

National Institute of Standards and Technology – The NIST in document called "The NIST Definition of Cloud Computing" defines cloud computing as following:

– The Model of cloud computing gives utility of convenient access using network to shared pool with configureurable computational resources (e.g. networks, servers, data storage, apps, services);

– The Cloud Model contributes to accessibility and characterized by general elements (self-maintainability by demand, wide access to network, shared resource, independent location, agility, measurable services, scalability, payment by real usage).

Cloud contains 3 service models (Software as a Service, Platform as a Service, Infrastructure as a Service).

Four deployment models can be highlighted (private clouds, group clouds, public clouds, hybrid clouds).

Professor of Massachusetts Technological Institution Karl Hewitt noted that when cloud computations occur data constantly stored on virtual servers located in cloud and temporarily cached on client side computers, laptops, netbooks, mobile devices etc.. In other words, cloud is a virtual IT infrastructure provided by online cloud providers [13-16].

### 10.3.2 General properties of Cloud Computing

Five general properties for every cloud product can be highlighted:

1. On-demand self-service. Customer can access in necessary amount and manage required computational resources without need of system administrators;

2. Ubiquitous network access. Cloud service must be accessible from any device worldwide at any given time;

3. Metered use. Only actually used by customer amount of service must be paid;

4. Elasticity. Possibility of instant measurement of use amount and time of computing resources allocated to customer;

5. Resource pooling. Providing cloud services must not depend on operation of single hardware node.

### 10.3.3 Service models of Cloud Computing

Figure 10.3 shows service model of cloud computing architecture in which it can be seen that core of cloud is Infrastructure as a Service (IaaS), and on top of it Platform as a Service (PaaS). On top of PaaS Software as a Service (SaaS) located. Therefore, it is possible to have 6 variations of cloud technology architecture implementation.

Software as a Service (SaaS). Model of software distribution as a service provides opportunity to lend applications access to which carried though the Internet. Support of an operation of applications is responsibility of a provider. Customer only pays for actual use of software (either for quantity used or periodically fixed charges). As a result, customers can work with complete necessary for them software using computer with any configureuration. Generally, it is not necessary to install any core application on computer (or phone or any other device) and ensure security of computer programs. Cloud technologies allow working with documents, keep accounts, manage warehouse and other activities using only browser window.

Nowadays hundreds of SaaS applications exist: starting from specialized domain locked software finishing with common everyday customer apps such as e-mail cloud services. For example, Business Productivity Online Suite pro-

viding collaborative work of users, on the other side Office Live Workspace from Microsoft dedicated for single user only use. Other examples, Google Apps online office, Oracle CRM on Demand applications set.

Payment method of SaaS usually calculated based on number of active users of application.

Examples of Platform as a Service can be Force.com from Salesforce. com, Microsoft Azure, Google App Engine, Cloud Foundry from VMWare, Oracle PaaS Platform.

Payment for using cloud platform calculated based on amount of used computing capacities such as software work time, data amount and number of transactions, network traffic.

Infrastructure as a Service (IaaS). Given service model offers possibility of lending hardware resources – servers, data storage devices, network equipment. IaaS model according to Microsoft, allows customer to formulate "its request to cloud in terms of required computational resources: number of processors, operative memory, disk space, network communications and basic software" [17].

IaaS providers usually provide:
- Hardware;
- Computer network;
- Virtualization platform;
- Service Layer Agreement;
- Computation accounting instruments.
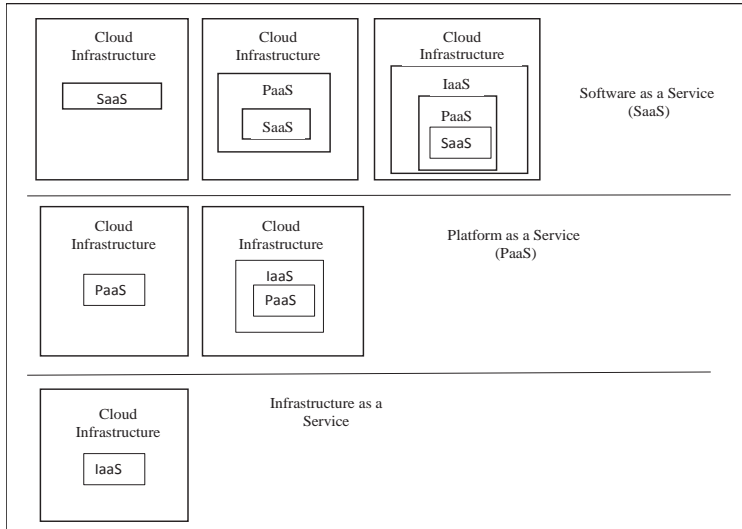


**Figure 10.3.** *Service model of Cloud Computing architecture*

In given model virtualization technologies applied, for example, at dividing physical server to virtual ones and providing given virtual parts to different customers.

As examples of Infrastructure as a Service can be Amazon Web Services, Rackspace Cloud, Terremark, gandi.net, GoGrid, Scalaxy.

As in the case of PaaS payment of Infrastructure as a Service usually depend on used computing capacities. IaaS allow enterprises to reduce capital and current expenses related with necessity of maintenance of data center infrastructures and server rooms.

### 10.3.4 Deployment models

There are 4 models of cloud deployment (Figure 10.4): private clouds – proper or rented enterprise clouds; community clouds – clouds with common infrastructure for particular group of users; public cloud – publicly available clouds; hybrid clouds – clouds consisting from two and more clouds of different type.

Private cloud is controlled and managed by private data centers; usually intended for use by single organization, but can be physically located outside its boundaries, maintained and managed by third-party organization.

Public clouds are used by many organizations (users) jointly, maintained and managed by external service providers.

Group clouds are used collectively by several organizations wanting to use shared public cloud computing environment. For example, group of organizations can be composed of all educational facilities of given region or all customers. Using group cloud does not mean that organizations has access to applications and data of each other.
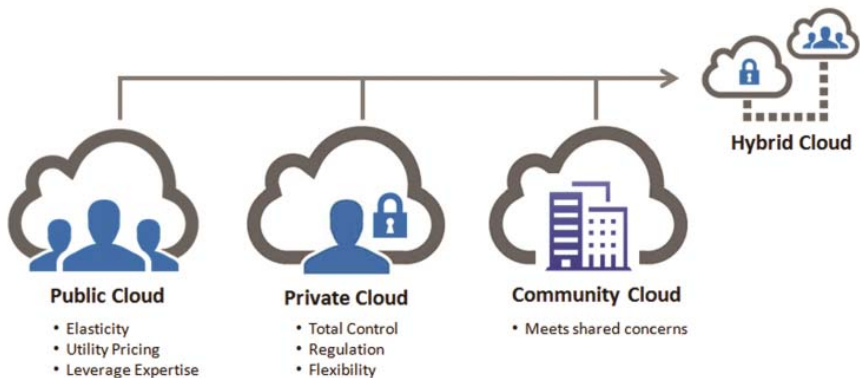


**Figure 10.4.** *Models of cloud deployment (link to original Figure* – http://cloud computing types.com/cloud-computing-models/*)*

Hybrid clouds is a composition of two and more models, described above used for same application to use advantages of cloud of different type.

Figure 10.5 presents visual model of cloud technologies discovery. Model of cloud technologies gives opportunity of convenient access to shared pool using network, called on given Figure "union of resources" with ubiquitous network access, elasticity, metered use, on demand self-service, resource pooling.
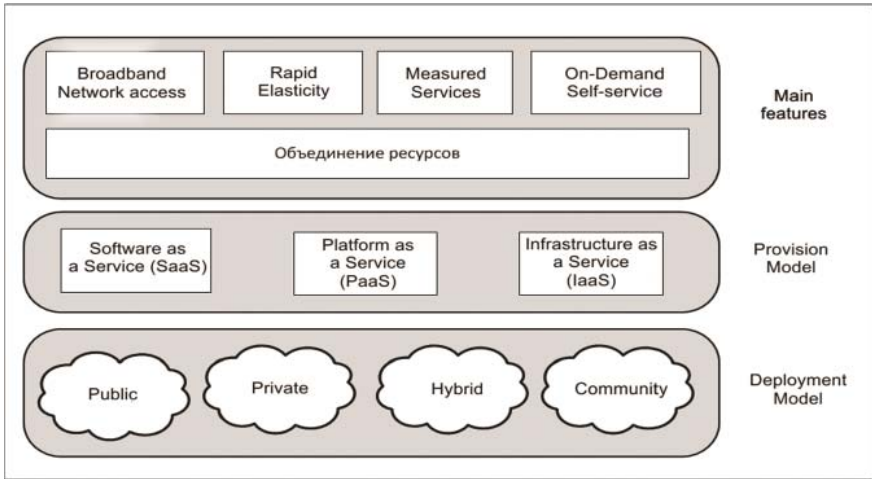


**Figure 10.5.** *Visual model of cloud technologies discovery*

### 10.4 Cloud taxonomy

Cloud definition allows to conduct classification (taxonomy) of clouds on 4 levels (roles, activities, components, subcomponents).

If you look at cloud in terms of roles ($1^{st}$ level of cloud taxonomy) then following subdivision is possible:

Cloud service customer – person (physical or legal) consuming services of cloud providers.

Cloud provider – person (physical or legal) responsible for provision of cloud services.

Broker – person (physical or legal) establishing relations between customers and providers (let us denote that customers can receive public services directly from providers).

Transporter – mediator providing services of connection and delivery of cloud services from providers to customer.

Cloud Auditor – person or organization which executes independent evaluation of cloud services, maintaining, performance and security.

Every representative of first level can be classified from the point of view of its activity which provide 2nd level of cloud taxonomy. Cloud service customers are divided depending on service – Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS). Cloud service providers on type of activities can provide services in clouds deployment, instrumentation, management, providing security, confidentiality. Cloud brokers are responsible for consuming and providing cloud services. Cloud transporters distribute services and provide access, cloud auditors conduct security, confidentiality and execution audit.

3rd level of cloud taxonomy suggests that cloud services deployment components contain 4 cloud models – private, group, public and hybrid clouds. Instrumentation services contains 3 components:

• Service layer (discovers basic services offered by provider).

• Resource abstraction and control layer (provides elements of software, virtual data storage, associated functional modules).

• Physical resources layer (includes computer equipment, technical capabilities).

Cloud management includes all related with cloud services functions providing compatibility, configureuration and also necessary for management business operations. Cloud broker when providing cloud services provides that through mediation, aggregation (combination and integration of services in one or more entity), services arbitration (provide agile and profitable services). Cloud transporter distributes services using electronic or physical transfers and also provide access to service through network and telecommunication operators or with help of transport agents.

4th level of cloud taxonomy contains subcomponents of "portability / compatibility" and "reservation/configuration" components. Portability expecting possibility of data transfer from one system into another provide mechanisms for 3 subcomponents of data portability, services compatibility, system portability and reservation is provision of resources change, monitoring and reporting, measurement, Service Layer Agreement (SLA) management.

Cloud taxonomy described above illustrated on Figure. 10.6. In the NIST document represents reference architecture of cloud technologies.

Interaction of customers and providers of cloud services presented on Figure 10.7 Cloud provider using capabilities of its data centers provides the cloud to customer with different utilities. Using different web apps given clouds provided to use by end users, using not only cloud but Software as a Service. Agility and scalability of cloud resources allow to ensure economy not only in purchase of additional equipment but in energy consumption [18-19].
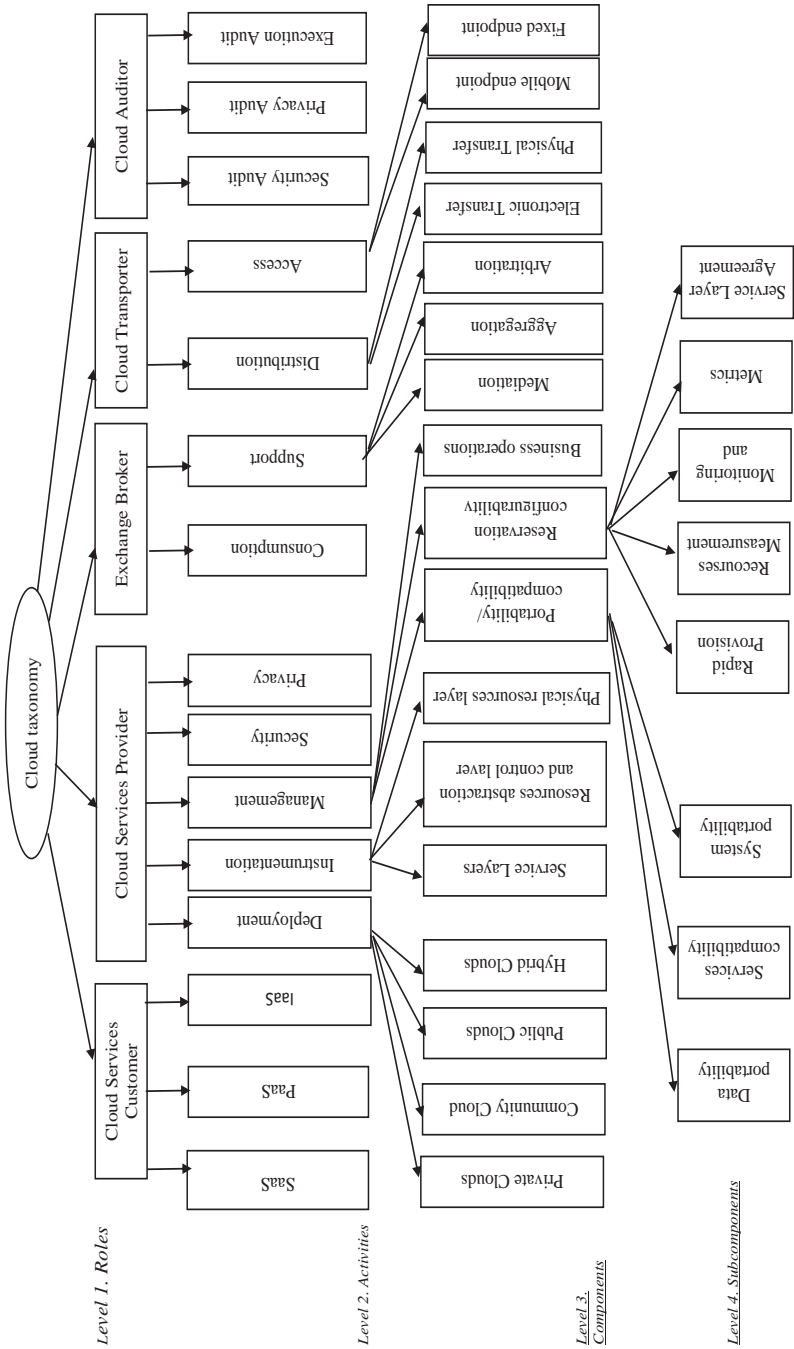
**Figure 10.6.** *Taxonomy of cloud technologies*
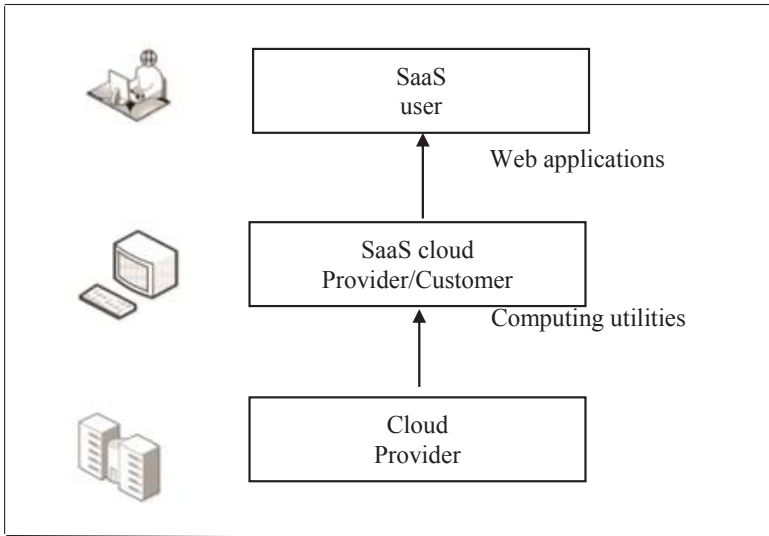
**Figure 10.7.** *Users and providers of cloud technologies*

### 10.5 Cloud providers and certification programs

Despite explicit advantages of usage of Infrastructure, Platform and Service provided by cloud provider, its applicability can be defined by nature and scale of problems. Together with constantly growing list of cloud technology providers, choice of appropriate for solution of assigned tasks become truly complex problem. Table 10.1 presents review of most popular cloud providers and comparison of services provided by cloud providers presented in [20].

**Table 10.1.** *Review of most popular cloud providers (vendors)*

| Provider (Vendor) | Cloud service model | Description |
|---|---|---|
| Amazon Web Services | IaaS / PaaS | Amazon offers several different cloud services. Most popular of them Amazon Elastic Compute Cloud (EC2). Other services can be used separately or together for creation of complete platform in cloud: Amazon Simple Storage Service (S3), Simple DB, Cloudfront, Simple Queue Service (SQS), Elastic Map Reduce. |

| Microsoft Azure Services Platform | IaaS / PaaS | Windows Azure Platform is platform for development and execution of cloud services implementing PaaS model and consisting of following components: Windows Azure – operating system in cloud (also called "operating system as a service"). SQL Azure – relational database available as a service (also called "database as a service"). Windows Azure AppFabric – program modules (services) for provision of communications (Service Bus) and access control. |
|---|---|---|
| IBM | IaaS / SaaS | IBM Cloud generally oriented on software development and testing, storage and analytics of vast data arrays. |
| Savvis | IaaS | Savvis offers cloud infrastructure as a service and web-hosting. |
| Google Apps Engine | SaaS | Google offers one of the most popular cloud services: Gmail, Google Docs, Google Calendar and Picasa, also cloud services, oriented in the first place on enterprises, such as Google Sites, Google Gadgets, Google Video, Engine Google Apps. Google Apps Engine allows users create and manage its web applications on Google infrastructure. |
| VMware | IaaS | VMware greatest software and technologies developer in virtualization area. VMware offers products for virtualization of different level. From VMware Workstation directed towards end user up to WMware ESX Server intended for deployment of virtual infrastructure of middle and large enterprises. |

| Rackspace | IaaS / PaaS | Offers cloud hosting. One of the leading PaaS providers. Rackspace launched on-line supermarket of applications called Cloud Tools. Provide basic services for collaborative work: post server (Rackspace Email) and file server (Rackspace Cloud Drive). |
|---|---|---|
| GoGrid | IaaS | Cloud provider of Infrastructure services. |
| AppNexus | IaaS | Cloud provider of Infrastructure services. |
| Salesforce | IaaS/PaaS/SaaS | Salesforce.com known by its online services of CRM. Company provides under Force.com label PaaS platform for independent development of apps and also cloud system of database management under Database.com label. |
| Oracle | PaaS/SaaS | Oracle offers PaaS for public clouds service providers and for enterprises with purpose of creation of their own public clouds. Oracle name given platform Oracle PaaS. Oracle CRM On Demand one of examples of SaaS with providing options both as divisible server and single customer. |
| Cisco | IaaS | Cisco cloud computing – it is development of company business in area of Infrastructure for creation and maintenance of data centers. |

One of actual methods to get necessary knowledge and abilities in Information technology area is to conduct certification programs which currently actively offered by lead cloud providers. Table 10.2 gives short review of certification programs from experts in cloud computing industry.

**Table 10.2**. *Review of certification programs from experts in cloud computing area*

| Certification program | Studied software and products | Expected Learning outcomes on chosen certification program |
|---|---|---|
| AWS Certification Web address: https://aws.amazon.com/certification/ | Amazon Web Services products | AWS certification allows specialists to confirm their qualification and skills of operation with AWS services. |
| G Suite Certified Administrator Web address: http://certification.google-apps.com/ | Google Apps platform services | Skills and knowledge required for deployment, setup and migration of Google Apps for business. |
| MCSA: Cloud Platform Solutions Associate Web address: https://www.microsoft.com/en-us/learning/mcsa-cloud-platform-certification.aspx | Microsoft Azure cloud platform; Microsoft Servers OSes; Microsoft Cloud Data Platform and Big Data Analytics solutions | Ability to build complex solutions of server architecture. Skills required for running modern data centers. Skills on desktop virtualization as well as building private clouds using Microsoft Azure platform. |
| IBM Certified Solution Advisor – Cloud Computing Architecture V4 Web address: http://www-03.ibm.com/certify/certs/50001104.shtml | IBM Smart Cloud Application Services platform; IBM Smart Business Test & Development Cloud infrastructural solutions | Knowledge of principles of cloud computing: deployment models, service models, cloud business models. Working skills with IBM application for cloud computing. |
| Certified Cloud Professional Web address: http://www.cloud-school.com/certifications/professional | Without binding to cloud solutions (applications) of particular vendor | Understanding of fundamental concepts and terminology of cloud computing by NIST definition. Practical knowledge allowing to use service models such as SaaS, PaaS, IaaS. |

| VM ware Certified Associate 6 – Cloud Management and Automation (VCA6-CMA) Web address: http://mylearn.vmware.com/portals/certification/ | Complex integrated products package for creation of cloud infrastructure VMware vCloud. VMware vSphere virtualization platform. vCloud Director – cloud infrastructure management center. | Ability to deploy, conFigure and manage cloud environment using vCloud Director and related components. Knowledge and skills necessary for successful installation, deployment, scaling and management of VMware VSphere environment. Practical knowledge in are of virtualization and consolidation of server environments. |
|---|---|---|
| Cisco professional certification Web address: http://www.cisco.com/web/RU/learning/le3/learning_career_certifications_and_learning_paths_home.html | Cisco network equipment | Skills of installation and testing of basic network functions, diagnostics of small routable and commutable networks including setting IP addresses, administering simple security measures and understanding of common working principles of wireless networks. Ability to design commutated network consisting of LAN, WAN and other services. Skills and knowledge in area of network technology and telecommunications. |

In a modern society basic knowledge of information technologies is necessary to all specialists independently of operation area. Professional certification gives opportunity to ICT specialists pass the training and get official confirmation of their competences in the area of the newest information computer technologies. Certification programs and study in virtual academies computing technologies can become good basis for high education in the ICT. Beside knowledge of modern information technologies students get additional advantages for further professional activity.

**10.6 Development and perspectives of cloud technologies in work and Kazakhstan**

Gartner Group analysts say that in 3-5 years most of ICT market move to "clouds" and amount of cloud computing market reach $204 billion by 2017 and continues further increase. Moreover, by 2020 there will be almost no companies prohibiting their employee use of cloud technologies at work with purpose of information security. According to International Data Corporation (IDC) report profit from cloud services provision achieve $195 billion by 2020 which is more than doubles 2016's $96.5 billion. Nowadays main providers of cloud services are Amazon, Rackspace, Microsoft, Google, IBM, HP, NEC and other companies.

Currently ICT industry of Kazakhstan enters in very interesting phase of its development. Requirements to infrastructure from business grow much faster than ICT budgets. Analysing modern trends it seems that only single question will be left in future – where to store data in private, public and hybrid cloud. Undoubtedly, possibility to pay only for used time or capacities is very attractive. Business can breadth much freely without necessity to increase own resources, think of compatibility, licencing and expenses on personal. But customers must think not only about which data center must be sponsored – private or commercial. Issues of reliability and security, configureurability, billing and scalability stay extremely important at any approach [21-24].

One of important issues of cloud technologies usage in RK are legal aspects. For example, the law has recently accepted in Republic, called "On making changes and additions in some legislative acts of the Republic of Kazakhstan on informatization issues" largely talks on government structures and use of cloud services in general still not regulated New law of informatization does not use concepts which today featured in ICT. Unfortunately, our government does not catch for quick development of cloud technologies. General issues, which must be addressed the personal data and their broadcast within Republic, transboundary data transfer [25].

Analysts predict that by 2020 20% of data around Globe will be stored in clouds and expenses on, and cloud technologies will be doubled. This tells that it is necessary to clearly point usage rules of cloud systems in legislation. But given topic is quite hard for Kazakhstan in which legislation in cloud computing area must be regulated in a proper way. Today neither ICT vendors nor government structures do not consider complex complete solution for given topic.

Despite all problem that exists perspectives of cloud technologies in Kazakhstan producing big hopes. Sooner or later almost every company in the Republic comes to problem of applying cloud technology. The way in which

"clouds" will be used depend on particular tasks and current capabilities of a company. It can be private clouds as well as public or hybrid ones. It is possible to outsource separate services which are not core ones for company in case of some economy of resources from using cloud solution. But there are general rules that must be addressed by all experts when working with cloud services. In this regard, Kazakhstan market of cloud services still in its early stage and will move to its maturity [26].

Strong side of cloud technologies is virtualization. Applying virtualization leads to reducing of consumed energy, optimization of use of infrastructure and reducing expenses of data centers exploiting, while increasing indicators of efficiency and economy.

Virtualization and cloud computing are relevant trends because for customers the issue of operational and non-capitals expenses becoming important in current state of economics. Therefore, if earlier customers thought about economy of physical server implementation, currently first place occupied by issues related with management, support and development. Developer-integrator companies which offer solutions of virtualization and cloud computing emphasize reducing operational expenses of customers. It should be mentioned that big steps in area of standardization of many applications and platforms made at which people spent much money, time and nerves. The choice of an operating system becomes less significant. If before ICT director made choice towards one or another operating system and forcibly or due to lack of choice in compatibility built everything else around this system, nowadays given issue is not so impactful. Developers often are responsible for making their products of cross-platform oriented and operating systems are key element in software.

Today's cloud technology services market in Kazakhstan is represented by several domestic and many foreign vendors. Largest domestic company on this market is state holding JSC "Kazakhtelecom" which possesses complex of data centers around all Kazakhstan. Data center has complex network and computational equipment and specialized software for provision of cloud technology infrastructure. 14 data centers are located in regional centers of Kazkhstan. In 2012 new data centers were opened in Astana (400 $m^2$), Almaty (450 $m^2$) and Pavlodar. Pavlodar data center area equals to 1000 $m^2$ and it was developed jointly with Hewlett-Packard company – worldwide leader in data center production. Reliability level complies with Tier III class which means possibility to conduct repair works without need to shutdown data center services, engineering systems reserved once, it has several channels of distribution of energy and cooling [27].

In recent years, almost all large financial and commercial organizations in country are attracted mobile technologies for their needs.

Government organizations of Republic scale also actively are engaged in process of informatization through cloud technologies. In Almaty data centers were opened by JSC "National Informational Technologies". This is last data center built by company during project "Creation of server internet platform for provision of hosting services to government structures of RK". Given project is infrastructural playground for development of electronic government in the Republic of Kazakhstan and designed for provision to government structures hosting services, collaboration services (deployment of equipment and lease of infrastructure), Software as a Service (Software on Demand) and technical maintenance of software/hardware complex [28].

Education and science organizations of the Republic is not behind in this matter. In 2010 L.N.Gumilyov Eurasian National University (ENU) opened its own data center (center of storage and maintenance of information) which allowed to link all university campus into united network. This joint project by ENU, JSC "Kazakhtelecom", Microsoft Corporation and Chinese Huawei Technologies Co. Ltd can be called unique project in Kazakhstan educational system. Just after biggest university of Kazakhstan al-Farabi Kazakh National University opened its own data center. Much later other large higher education institutions opened their data centers. First scientific Lab in this direction was ICT Lab in Almaty. In August 2011 "Zerde" holding jointly with Huawei Almaty and International Information Technology University opened R&D Lab of open systems and cloud computing. During given period other domestic institutions open their Labs devoted to study Cloud Computing issues and technologies [29].

Cloud Computing related events conduct in Kazakshtan every year involving leading domestic and global vendors of cloud services as well as large companies to discuss issues and perspectives of cloud technologies area. Most active organizer of such events is international company IDC – provider of informational and consulting services in ICT industry.

Recent innovation in cloud technologies industry of Kazakhstan is opening self-service portal for cloud services. JSC "KazTelePort" – domestic provider of data center services – launched cloud services of self-service portal. Given project is unique because of two main moments. Firstly, it is first full stretched self-service portal of cloud service in Kazakhstan, where client in minutes can get access to ready virtual server or entire virtual data center [30].

It is worth mentioning that cloud technologies in Kazakhstan are developing according to global cutting edge technologies and generally always within technological trends in neighbouring developed and worldwide leading countries.

## 10.7 Fog computing

Fog Computing – aggregation of entire complex of technologies similar to clouds but closer to "ground". Fog Computing – necessary condition for introduction of the Internet of Things. "Fog" – because processing of information acquired from end devices occurs not in data center (cloud) but in computing centers (drops) which located on "edges" of infrastructure, e.g. as close as possible to devices. Architecture of fog computing extends cloud technologies up to physical Internet of Things and allows to shift computing, network functions of information storage on edges of infrastructure.

Fog as previously is continuation of what called "cloud" but with certain distinctive features. In this regard, weather is quite accurate comparison. Hereby, cloud is distant from users and often not enough reachable. Computing will be conducted in data centers with thousands of servers, location of which actually unknown to their customers. On the contrary, computing fog surrounds users and they even can touch it.

Probably, most simple definition will be fog computing model in which data processing applications and devices concentrated on edges of network but not located entirely in cloud. Given form of distributed computational proximity where each of devices connected to network can process data and transfer only summary output to next level or make it only in particular emergency or unpredictable behaviour cases.

It does not depend, at least completely, from cloud server as the center of processing and access to data. At the same time, it is more understandable for user. Let us take as example fitness wristband. It is known, that data generated by human everyday measured by wristband, stored in device and only part of it, already processed stored within cloud if necessary.

It is simpler to process data on the device itself with its local computing resources that to transfer data twice, e.g. first send raw data for processing in cloud and then download that processed data for storing in memory of physical device. More elegant approach is to send processed on the device locally result once into cloud for long duration storage.

Development of Internet of Thing (IoT) partially is responsible for given change in cloud technologies trend. Given phenomenon provoked generation of data with billions of sensors and their further transition from increasing number of devices which calls increase of requirements in bandwidth and also will generate necessity in excess computing capacity of data centers which must process this vast amount of information. Therefore, many sees fog computing as the future of cloud technologies and more rational and efficient method of operation with all this generated data [31].

**Figure 10.8.** *Fog computing allows to link wide range of Smart devices of home and industrial automation (link to original Figure –*http://readwrite.com/2016/08/05/fog-computing-different-edge-computing-pl1/*)*

Indeed, in critical applications it is worth to avoid unnecessary delays in data transfer. It makes no sense that connected automobile must enter the Internet to check if its lights switched on or off when it can connect with lights controller directly. Smart cities or medical technologies and other areas in which gather and processing of data occurs get huge profit from fog computing.

Given trends related not only with computations for home automation but its technology can be used for data aggregation within intellectual cities, creation of data transfer networks for connected transport vehicles independent from cloud and less vulnerable in case of connection failure. IT industry making its first steps and increase of amount of generated information will be raising in upcoming years in geometrical progression.

### 10.8 Introduction into mobile technologies

When discussing mobile technologies all types of gadgets, applications, processors, accumulators and displays usually are mentioned. Being interesting topic it usually lacks important aspect like degree of impact of mobile technologies on our everyday life.

Several decades ago, at the beginning of its formation, mobile technologies were not too mobile. Proud and quite rich owners of such devices should be quite strong to carry and handle heavy and cumbersome gadgets. Besides, it

was necessary to have access to power cord in order to use first mobile devices because they did not have batteries.

Since then technology advanced beyond belief, moreover especially huge step forward made in last ten years. They infiltrated into all spheres of everyday activities of people and their role continues to increase. Availability of all types of smartphones, tablets, readers and also smart watches and in near future smart glasses promotes their fast distribution across the world. Of course, all this thousands of types of mobile devices are having serious impact on quality of people's lives.

### 10.9 Brief history of mobile technologies development

*First generation mobile technologies (1G).* Only several decades ago first mobile phones appeared but mobile network since then undergone significant changes.

First mobile systems were based on principle of analogue connection systems. First mobile phones used exclusively as an alternative to traditional analogue stationary phones. In time, mobile technologies were supplemented with several basic services.

*Second generation mobile technologies (2G).* Second generation systems and GSM standard differs from its predecessors by better quality of transfer, signal protection, including also additional services and low speed data transfer. GSM mobile technologies provide user roaming services for convenient movement of subscriber at countries and continents without change of mobile provider.

Almost immediately after introduction of second generation mobile systems arose necessity in design of standards of mobile communication for a next generation networks. Studies are conducted both on global and regional levels. New frequency range is chosen around 2GHz boundaries and, therefore, often designated as 2000.

Different projects are proposed for transfer to third generation systems. Specialists differentiate two alternative ways of transfer; evolutionary approach from old technologies to new ones and sudden switch. Majority of votes decided to smoothly integrate new generation systems which reflected in development.

*Third generation mobile technologies (3G).* Third generation technologies provide high quality voice (speech), image and multimedia content transfer. Besides, 3G implies access to the Internet and data exchange between PC and mobile phone. Transfer speed increased from 9.6 Kbit/sec up to 2 Mbit/sec.

High-priority task for third generation networks was to increase quality of second generation networks operation adding many new services to them.

Mobile technologies of third generation include:
• IP telephony;
• voice calls;
• video-telephony;
• audio and video streams (video capture, photo capture, television);
• mobile office;
• web browsing;
• service related to customer location (navigation in unknown place), travel guides and maps, providing security;
• games;
• electronic mobile commerce (search and choice of goods, services, payment for products).

*Fourth generation mobile technologies (4G)*. Mobile technologies of fourth generation generally include technologies allowing transfer of data in mobile networks with bandwidth exceeding 100Mbit/sec.

LTE (Long-Term Evolution) technology is the main evolutional direction of third generation networks. In January 2008 international union Third Generation Partnership Project (3GPP) developing perspective standards of mobile communication, approved LTE as next standard after UMTS broadband mobile communication network. 4G networks based on LTE standard are able to work almost on all spectre of frequencies from 700 Mhz up to 2.7Ghz. LTE provides theoretical peek bandwidth of data transfer up to 326.4 Mbit/sec from base station to customer and up to 172.8 Mbit/sec in reverse direction.

*Fifth generation mobile technologies (5G)* currently at development state and presumably will be gradually introduced after 2020.

### 10.10 Software for mobile devices

Each year mobile gadget become smarter and increase their functionality. An average smartphone nowadays has access to the Internet, receives and sends emails, reads books, acts as GPRS navigator and making payments through NFC.

Small handheld device more and more is becoming to look like full-fledged PC. In smartphones, for example, mobile version has already installed of most popular operational systems. Many companies release not only additional software, but also special operating systems to complement them.

Software intended to be installed on mobile phone, smartphone or tablet with desire to extend/fulfil its functionality.

Without software any device is just a hardware platform without ability to interact with it. Software connects wire and integrated chips (ICs) into single fine functioning system. For the normal operation of such system Operating System (OS) is provided. Because of OS only device and user can interact

with each other. Using OS user has ability to install additional software, control operation of additional devices etc.

General types of software for mobile devices are:
• Operating Systems;
• Office programs;
• Antiviruses;
• Graphical editors;
• Games and others.

For example, office applications allow to work with text, tables, eases documentation management, systemize files, provides comfortable information exchange etc. Antivirus protects device from malware software. Graphical software gives opportunity to work with photos, create pictures and graphics regardless of complexity level.

Most widespread software for mobile contains games, players and navigators. But recently, besides entertainment and specialized programs office and graphical editors are becoming popular which tells that business oriented people already moving toward mobile. Popularity of smartphones and tablets related with it, in essence, representing small personal handheld computer installation of additional software on which allowing to solve, at least, everyday routines of an employee.

Therefore, expansion of software for mobile devices in today's amount depends on objective reasons and is likely consequence of current market situation.

### 10.11 Mobile Operating Systems

Mobile OS is a system which allows from multifunctional phone make complete PC.

Operating Systems are installed on smartphones and tablets for provision of their normal operation. Recently, mobile OSes network has flooded by software solutions. Here can be seen Windows along with Android and iOS, even quite popular in Korea Bada system from Samsung presented as well as Symbian which is out of fashion already. Because of that choice of mobile device is starting to depend on OS installed on it.

Let us list most popular operating systems for mobile devices.

Android is OS for mobile devices created on a basis of Linux. Developed by Android Inc. which is currently swallowed up by Google company.

Apple iOS (former iPhone OS) is Operating System for mobile devices from Apple based on Mac OS X. It is installed on iPhone, iPod Touch and iPad. Apple iOS created on the base of Darwin which in its case based on Mach microcore.

Windows Phone – mobile OS from Microsoft operating on number of

devices which include Pocket PC namely smartphones and communicators.

Diversity of mobile OSes cause to think of choice of communication tool. Rich functionality of mobile phone becomes a natural part of people's everyday routine.

Making purchase every human thought about what profit it gives to him/her. If you need phone which does only calls, do not bother with choice of mobile OS installed on it. But if you need multifunctional instrument – read about every of listed above OSes more.

### 10.12 Problems and perspectives of mobile technologies

New possibilities brought new challenges. Every technology has its own pros and cons with which we should either agree or search for ways to solve them.

Several years ago boom in smartphone market started. Smartphones start to rapidly push out keyboard based mobile phones. Evolutionary change of generations occurs. Unusual devices looked absolutely impossible, absence of button were at first inconvenient. But bigger screens (compared with usual phones) are taken almost all device control functions appeared to be very "gluttonous". Increase of display area led to rapid development of different software for such screens which in its turn boosted use of more powerful processors and graphical chipsets. As a result of increase in energy consumption work duration of modern gadgets rarely reach two days in case of active use. Of course, rechargeable compact power sources also had a long way of evolution in recent years. But to be on foot with appetites of modern gadgets not fully achievable goal yet with current technologies.

As for the prospects that besides changes in current social activity and extension of available information, mobile technologies in short time can start to actively impact our health. Today actively developed and approbated technologies which, in theory, allow to receive medical consulting using smartphones and tablets including based on statistics of people's everyday physical activities and wellbeing. In addition to it "remote doctor" is access to analysis results of remote patients and ability to measure some physical parameters with sensors embedded into mobile device. Therefore, it will be possible in near future to establish initial diagnosis and provide medical consulting in extreme cases. And part of similar scenarios has already implemented in number of countries in regions with difficult access and underdevelopment.

Another one of many medical applications of mobile technologies is to help disabled people with low or absent movement as well as people suffering autism. Using mobile gadgets millions of such people acquire ability to contact with world. For example, patients after insult and cranial injuries currently very successfully use tablet for restoration of previous abilities. Deaf people

now can chat with other people because of SMS and messengers. Diabetics got ability to control their level of glucose and send data with wireless channel on compact insulin pumps. Thanks to smartphones, blind people less dependent of sighted people because there is already software that helps them to orientate in cities, pick up appropriate clothes for current weather, scan issued change and tell the amount of cache.

### 10.13 Social aspect of mobile technologies

Talking about mobile technologies usually different types of gadgets, apps, processors, batteries and displays are ment. While it is quite interesting and even exciting it is moment to think about not less important aspect like type and degree of impact of mobile technologies on people's everyday lives.

Many years ago, at the beginning of its journey, mobile technologies were not very mobile at all. Because people that wanted comfortability of having phone with them in return were forced to carry quite heave and gross gadget. Moreover, first models required constant access to power cord in order to use them because of lack of batteries.

Since then technological evolution made several steps forward most valuables of which were in last ten-twelve years. Mobile devices became smaller, faster and much more useful. They sneaked into all areas of people's activities and their role continues to rise. Availability of all kinds of smartphones, tablets, e-books, smart watches and even smart glasses allows their rapid distribution across the planet. Therefore, milliards of this devices being used on a daily basis affect people's quality of life significantly.

Using mobile technologies one can pay for its parking directly from his phone. Embedded maps allow not to lose in any district of unfamiliar city. People have access to city transport schedules by pressing a single button. At last, now they can find out and explore points of interest near which they happen to walk.

Today, people have more information in their pockets and bags than ever before in an entire history. Actually for hundreds of millions of people it became absolutely natural and customary immediately start to search in their smartphones and tablets information on almost every activity. Gadgets already can predict which information can be of interest for its owner and present it in convenient form.

This, on the first look, shallow and easy going everyday use of mobile technologies changed human society. It made connection with other people much wider and tighter. In network people can acquire new friends who never met in their real lives. They can discover and discuss any relevant for them topics and events happening across the world. It stimulates emergence of societies and exchange of opinions which before were not possible.

On the other side, possibilities for anyone to share their thoughts and opinions led to some negative phenomena called network trolling. Unfortunately, many people to much engage in squabbles, unconsciously splashing accumulated frustration and displeasure. Also many users practice trolling as pleasurable pastime method. Besides quite explicit destructive influence of conversations and discussions trolling lead to creating of large amount of useless commentaries and quarrels making opponents to become personal.

All of this is just small part of how mobile technologies transformed, improved and simplified life of billions of people. And given process moves along with development of technologies. Given technologies in15 years become irreplaceable assistants. Which of you periodically did not feel without phone like without hands? A role of gadgets become significant in many of large and long pro-jects, everyday routine and unique events.

Mobile technologies firmly established in life of modern people and, therefore, it is impossible to imagine successful business without using progressive technologies in order to achieve desired goals.

**CONCLUSION**

Combination of Cloud Computing and mobile technologies make information more available and widespread. Combination of ubiquitous mobility, almost omnipresent connectivity, industrial level computing services and availability of information reduce time gap between an idea and effect. In order to use advantages of binding forces, students and employee must spend their efforts on extension of their outlook, skills and thinking. People which ignore given trend will be superseded by those who could operatively react to emerging possibilities and appropriate perspectives.

As evidence of given statement, the analytical agency Gartner published quite interesting report in which they define trend of the formation of "nexus of forces" – combination of social media, cloud computing and mobile technologies in the framework of universal consumerization of ICT [32-33].

Given "nexus of forces" must make new revolution in business environment and even entire society destroying old business models and contributing to appearance of new industrial leaders. In this regard the Information stored in local cloud resources (available from any device respectively) become "binding matter". Companies which can orientate and use, as denoted in the study "to use force of ubiquitous information and dispel it on social, mobile and cloud platforms", will get significant advantage over competitors.

Gartner underscored that mobile devices, cloud technologies and social media formulate new ecosystem of informational technologies where main driving force is average customers. It is hard to disagree with Gartner in the

fact that appearance of mobile gadgets had most impact on lifestyle of people from the moment of invention of a car! Social media also made huge contribution. Emergence of the social media cardinally changes the way of interaction of people with information because it is much easier and faster to receive and share information. Now it is enough to press "Share" or "Like" button, and friends, colleagues already aware of our preferences. After widespread distribution of mobile gadgets social media even more tightly entered in user life.

### APPENDIX A

Practicum «Get acquainted with Google Cloud Platform and the example of practical activity»
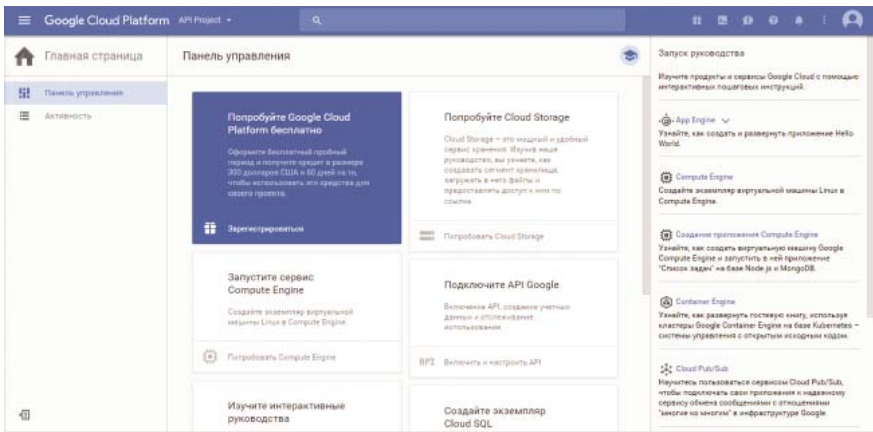


**Figure A.1**. *Main interface of Google Cloud Platform*



**Figure A.2**. *First page of Ice breaker Demo – practical example of interaction with Google Cloud Platform through mobile device. Offered QR code scan or to type direct hyperlink on a device*

**Figure A.3.** *Second page of Icebreaker Demo – practical example of interaction Google Cloud Platform through mobile device. Data incoming into cloud from connected mobile device displayed in real-time*
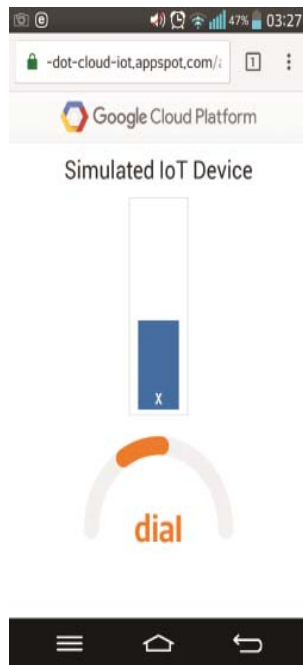


**Figure A.4**. *Icebreaker Demo interface on a mobile device – practical example of interaction with Google Cloud Platform through mobile device. Data acquired with device's sensors and input element on the page send to cloud for further processing*

**APPENDIX B**

Lab assignment No. 10. «Collaborative work with Google Docs»

Goal: using ability to jointly use documents, create and discuss a project.

Objectives: learn to create documents with Google Docs, open access to them for co-authors, jointly work with document.

Completing the work:

1. *Work with text document.*

a) Login or create account. Open Documents tab. Using New button, create text document.

b) Create document containing name of the topic and study plan. Enter object and subject of study, formulate hypothesis.

c) Open access to given element for user specified by lecturer.

d) Using different font colors discuss study materials.

e) Enter for every paragraph of the document, specifications, tips to improve.

f) Perform editing of Your own document.

2. *Working with table.*

a) In your account open Documents tab. Using New button create table.

b) Create Plan of study conduction.

c) Open document for joint use of table for user specified by lecturer.

d) Discuss plan of study. Enter Your own suggestions into tables of students opened access to You.

f) Edit You own table.

3. *Work with presentation.*

a) Plan Your presentation which can be used for speech at department dedicated approval of topic of Your study.

b) In Your account open Documents tab. Using New button create presentation.

c) Open access to presentation for user specified by lecturer.

d) Demonstrate presentation him/her. Examine presentation offered to You by other students. Using smiles provide Your opinion about that presentation.

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# CHAPTER 11. MULTIMEDIA TECHNOLOGIES

**11.1 Multimedia technologies. The basic concept of multimedia. Multimedia capabilities. Media terminology. Classification of multimedia**

Media is a technology which allows to combine the different nature of the data, such as audio, images, animation, text, video, etc. The word "Multimedia"is formed by the words: "Multi" – «a lot of» and "media" – environment. That is, one may be translated as "the abundance of media," it means that the media assumes over different storage and presentation of data (graphics, sound, animation and so on). Multimedia can be written or have access to information processing devices such as computerized and electronic devices, but may also be part of live performance. Multimedia devices are electronic media devices used for storing and processing the multimedia content. Multimedia differs from mixed media in fine art; through the use of audio, for example, it contains more than mental coverage. The term "rich media" is synonymous for interactive multimedia. Hypermedia is scaled a number of media content in the multimedia additions.

Many years ago, multimedia limited typewriter "Concul", which could print and attract the attention of the sleeping operator bang. Further computers decreased pre-consumer equipment, which allowed them to collect in the rooms and garages. Attention fans gave an unprecedented development of multimedia (computer prediction in 1980 that with a programmable timer and dynamics synthesized vague verbal threats still moves around the screen stars (rudiments of animation)). Multimedia term around time interval appeared.



**Figure 11.1.** *The typewriter «Consul»*

A huge mass of technologies. Appear CDROMs, blasters and other types of technology are appeared and there is the Internet and microelectronics. Humanity is going through a new stage of the information revolution. And

there is a need to become spectators as the public need to display information and communications, brings to life the new-fangled technology, media and appearing term. In our lives this representation can replace the whole computer at almost any table of contents [1].

**Multimedia applications are classified by the method of presenting information to the media:**

Notify into linear and non-linear (or interactive). Interactive method of computer and human interaction most fraught manner are presented in the categories of computer fun modern forms. The non-linear manner is sometimes called an equal footing, "hypermedia". As an example of the linear and non-linear fashion news information, you can consider holding the presentation. When the presentation was recorded on a disc or a USB flash drive and shows the audience that this method of linear image information, the audience viewing of this presentation are not able to ask the rapporteur or to influence the speaker. In the case of the live presentation, the audience has the opportunity to ask questions and influence it, which enables the rapporteur depart from the topic your presentation, for example, explaining some of the new terms or give a more thorough information on the report. Thus, we can say the live presentation of this non-linear (interactive) data delivery method.

On the field of application it includes:

• Business scope:

· Editorial activity (MM-publishing);

· Advertising and information products (brochures, leaflets, presentations);

· Online education;

· Interactive presentations;

· Internet.

• Education**:**

The idea for the use of the computer was for a long time in training, but its action was admissible only after the appearance of a PC equipped with hastily devices.

Computer applications in the national education system are an important topic, diverse, extensive and urgent. The Ministry of Education and the State Committee of Russia for higher education recently has paid more attention to training programs for the sake of learning. Republican Center of interactive learning tools has developed a series of multi-media textbooks in the humanities, natural and technical cycles.

Multimedia products developed by teachers in accordance with the objectives of academic disciplines and courses are:

• Tutorials, lectures;

- Educational video tutorials, movies.
- Training presentations;
- Electronic multimedia encyclopedias, textbooks, atlases geography, dictionaries, etc.
• Remote (online) learning through multimedia learning program for education.
• Entertainment: movies, games, virtual reality, music and etc.

**According to the resources used in the media:**

Hypermedia System is combining images, text, video and audio fragments. Classification of multimedia resources includes:

- The electronic edition of a literary work;
- E-production of audiovisual works;
- The electronic edition of the musical products;
- Publishing according plastic Fine Arts (up real painting techniques, etc.);
- Publications cybernetic arts.

**Hardware:**

Hardware Media is the main means: a computer with a large amount of memory and high-performance processor, manipulators and multimedia monitor with integrated stereo speakers; special tools: graphics accelerators, drives CD-ROM, video playback card, speakers, sound cards. Hardware includes:

- The recording equipment;
- Manipulators;
- Sound reproduction means;
- Means of communication;
- Means of virtual reality;
- Image processing;
- Recording means.

**Classification multimedia tools (applications) includes:**

- Presentations;
- Computer graphics;
- Video applications;
- Digital Sound;
- Multimedia gallery.

Below, we look at each classification of multimedia tools in more detail [2].


**11.2 Computer graphics. The concept of computer graphics. Types of computer graphics. The use of computer graphics. General information about the image and save it**

Computer graphics is the section of computer science, that studies

methods mechanisms of creation and processing graphical images using a computer. For working with computer graphics an excess kinds software can be distinguish into the main 4 types of computer graphics:

- vector graphics;
- bitmap graphics;
- fractal graphics;
- three-dimensional.

All 4 types of computer graphics are different principles of image formation when printing on paper or in the presence of the screen.

**Vector graphics**

The primary element of the vector graphics image for the screen is a line. Raster graphics also have a line, however, these lines consist of a set of points and each point has its place in the memory. In vector graphics memory value occupied this line does not depend on the size of the line, because the line is in the form of a special formula, and correct in the form of several parameters. As if will not the line be changed only its parameters can be stored in the memory cells. The number of cells will not change for any line. Every illustration in vector graphics consists of a line.

Properties of lines include: line thickness, shape, line type (solid, dashed, etc.) and color. The simplest line, if it is not closed the top two signs that are called nodes. Units also enclosed property, through which depends on the top of the line and the two lines are matched with each other. Closed lines have fill attribute. Home area of the closed loop can be filled with texture, color card.

**Raster graphics**



**Figure 11.2.** *Increasing the bitmap*

In computer graphics raster image is a matrix of specks, i.e. it is generally rectangular grid of pixels differently colored speckles. The point is the main (lowest) element of bitmap. Each pixel raster image has properties: color and

placement. The greater the number of pixels and the smaller their size is the better the image will look. A large number of pixels need computers with high-performance processors and the immense size of the RAM. The disadvantage of raster images is due to the fact that the amplification point raster images become larger and resemble a mosaic, and any additional parts you can not see. The second disadvantage for working with it a large number of pixels need computers with high-performance processors and large size of RAM. Moreover, an increase in dots visually distorts the image and makes it rough.

**Three-dimensional graphics**

Three-dimensional graphics, three-dimensional objects, three-dimensional technique widely used in our present life, and is now used by programmers in the computer modeling of physical objects and processes, animation, film and computer games.

Three-dimensional graphics (3D-graphics) is engaged in the creation of volumetric models of objects, which are to some extent correspond to the real. These three-dimensional images can be rotated and viewed from different angles. For example, to create a three-dimensional image in 3DMAX environment are used different graphic shapes and smooth surfaces. With their help, created frame first object, then its surface is coated with materials that are very similar to the real thing.
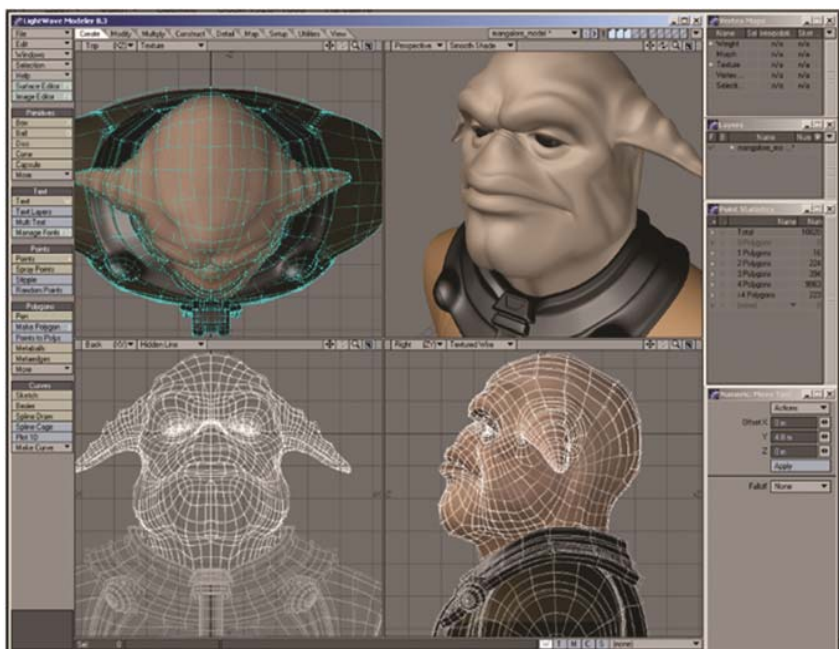


**Figure 11.3.** *Dimensional graphics*

After all this, used light effects, gravity, atmospheric properties, or other parameters of the space in which the object can be located. It can move given trajectory, velocity and other similar parameters.

Fractal images are created using mathematical functions. To create fractal image, it does not mean that it is necessary to paint and decorate, it means that we must programming. In the creation of printed or electronic documents fractal graphics are rarely used, often for entertainment purposes.

**Fractal graphics**



**Figure 11.4**. *Fractal graphics*

Fractal (Latin fractus – Broken) – an image that combines elements similar to each other. The following examples of fractals are: Koch curve (Koch snowflake), Levi curve, curve of Minkowski, Hilbert curve, Dragon (fractal Harter-Heituey)polygonal line (curve), Peano curve, curve of Myakishev.

To build a fractal pattern you want to use an algorithm that is based on mathematical formulas. Changing values in the algorithms or the coefficients in the formula and the modification of the image. Using fractal graphic saves memory footprint on your computer, due to the fact that only algorithms and mathematical formulas are stored in the fractal image file.

**Basic concepts of computer graphics**

In computer graphics the following concepts are distinguished into: the screen of the printing apparatus and the image resolution.

Display resolution of the image is a property that measured in pixels. It means the image size can fit on the screen.

Printer resolution is an important feature, which means the number of dots per inch print image to the printer. Unit - dpi (dots per inch).

Its size is horizontal (width) and vertical (height), they are measured in pixels, and the length units (millimeters, centimeters, inches). The value of the image size is defined and stored with the file. If the image is intended to be displayed, then the width and height in pixels are important to ask in order to know how much of it takes the screen. If the image is ready for printing, important to set the size in units of length and know in advance which part of the paper it will take.

Image resolution is the property of the image. It is also measured in dots per inch – dpi is determined to create the image on the graphical editor. For example, to view the image on the screen is enough that it has a resolution of 100 dpi, and print on the printer – no less than a 300 dpi. Value-resolution images stored in the image file.

The concepts of the physical size and resolution of the image are associated with each other very closely. When the image resolution is changed, it can be seen that the physical size changes automatically.

When you have to work with color is also used by the following concepts: color depth and model.

Different number of bits can be used. It depends on how many colors can be displayed on the display simultaneously. The longer binary code colors, the more colors can be used in the drawing.

Color depth (bit depth images) – the term computer graphics, which means the amount of space image in bits. One-bit color ($2^1 = 2$ colors) - often black or white colors. 2-bit color ($2^2 = 4$ colors) used in video mode the NeXTstation, 8-bit gray scale ($2^8 = 256$ colors in order) to display the black-and-white photographs, 16-bit color ($2^{16} = 65\ 536$ colors) is used to obtain images with a large range.

The colors of nature are rarely simple. Most of the color is formed by mixing primary colors. A method of separating the color tone into components called color model. There are many different types of color models, but in computer graphics is used not more than three. These models are known as: RGB, CMYK, HSB.

**RGB color model**

RGB comes from the Red Green and Blue color name. This model sees your computer color. In fact, it is important to know that each pixel on your screen is switched on or off light. RGB is appear as a series of numbers ranging from 0 to 255. For example the combination of black color appears the numbers 0, 0, 0; and white - 255, 255, 255. Using this model it can be expressed in 16 million colors.

**Figure 11.5.** *RGB color model*

RGB additive color model, that is, to get a color that we impose one color to another. Overlay at the same time give three colors white. Other examples of colors for this model: red – (255, 0, 0), green – (0, 255, 0) and blue – (0, 0, 255).

**CMYK color model**

CMYK Abbreviation formed by a combination of the following name colors - blue (Cyan), (lilac) (Magenta), yellow (Yellow), black (blacK). This model is frequently used in printing. Maybe you noticed that these four colors are in the color printer cartridge.



**Figure 11.6.** *CMYK color model*

This model uses subtractive model. Surfaces that reflect light, consider the amount of light reflected from the surface, rather than how many were absorbed. If we subtract from white three primary colors, RGB, we will get three additional CMY colors. "Subtractive" – subtract from English – "deductible" – white deducted primary colors.

Get the black color is very difficult to polygraphy. Theoretically, it can be obtained by using three colors, but in practice the result is unusable. Therefore, in the CMYK color model can add a fourth color – black. Therefore, the system in its name is at the end of a letter K (blacK).
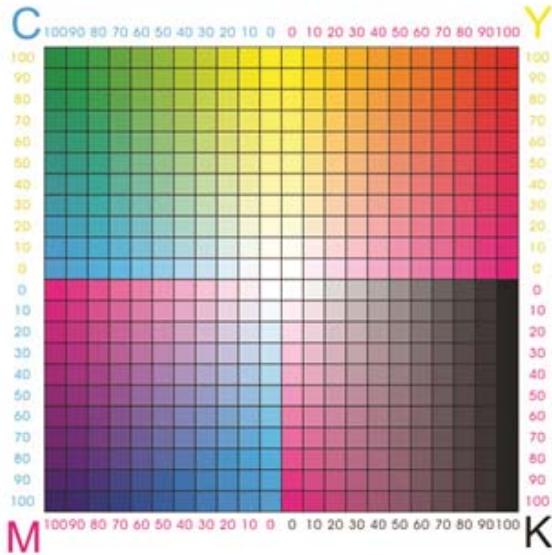
**Figure 11.7.** *CMYK color model*

### Color model HSB

Sometimes it is convenient to use the color model RGB used for computer graphics software, CMYK – in printing, and the HSB model is very clear human-readable. Its simplicity and clarity makes it used frequently. In its work, there are three elements: hue (Hue), saturation (Saturation) and brightness (Brightness). According to this color is represented by three numbers, the first value is the color shade and its value can vary from 0 to 360 degrees. Each degree is a special color.
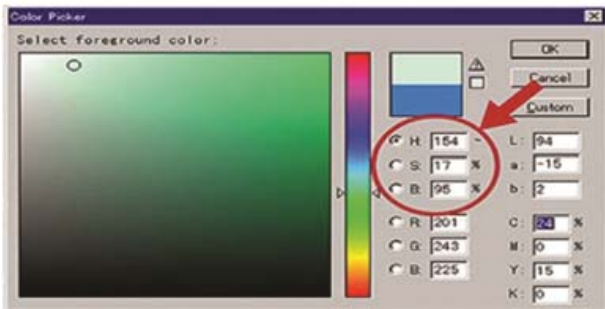


**Figure 11.8.** *Color model HSB*

For example, red (0 or 360 degrees) and other colors (for example, 120 degrees yellow, green 180 and blue 240 degrees). All colors of the rainbow are presented in this model. The second number is the value of color saturation. It means the amount of color, or more precisely its percentage. Its value ranges from 0 to 100, 0 may mean the absence of color, and 100 – full rich color. Finally, this 3-color – brightness. You can boost the brightness of the colors by adding white, or vice versa to reduce the addition of black. In this case of 0 is white and 100 - black color [3].

**Image formats**

Each graphic image should be saved in a file. Graphic file format defines different ways of placing the image data when they are stored in a file. The types of image formats are bitmap and vector.

At a table in a file usually stored bitmaps. A binary color code of the corresponding pixel is written in each cell. File also stores information about other properties of a graphic image, and the type of compression.

As the list of objects stored in a vector image file. Also, as the value of their properties - the coordinates, sizes, colors, etc.

Select the format to save the image depends on the purpose of the work with the image. Often the advantage is given to a bitmap format, if you need to recreate the color accuracy. And in vector formats is better to store logos, diagrams and design elements. File format affects very much. For example, memory. This volume takes the file. Graphic editors reserve sample preservation of user-picture format. If you want to work with graphic images in one editor, the best option is to choose the format that is the default. If data processed by other programs, it is advisable to use one of the formats.

There are some image file formats, which simultaneously support both vector and bitmap images.

Format – PDF (Portable Document Format English). This format is designed to work with the Acrobat software package. There may be a raster image and stored,  the vector format, hypertext links, text with a large number of fonts, and the settings of the printing apparatus. The size of such files is very low. And it only allows you to view data files. Editing images in this format is not possible.

Format – EPS (English Encapsulated PostScript). The format is used in desktop publishing. Typically, print  illustrations. The format allows you to save a vector path, which it will limit the bitmap.

**Raster graphics file formats**

JPEG (Joint Photographic Expert Group). Files in this format often are used for storing multicolor images. Image compression algorithm is used with a large factor (up to 500 times). Of course, such algorithms are of a data loss problem from that image quality deteriorates. The effect of the JPEG format

deteriorates if the image has a smaller number of colors. True to color pictures on the monitor, this effect is not very noticeable.

PNG (Portable Network Graphic) – Image File Format. It supports a variety of different color than the rest.

Bitmap (English Bit map image) – The file formats differ in extension .BMP. This format is used by all graphics software raster graphics. The files in BMP format occupy a lot of memory, since the image compression algorithms are not provided therein.

GIF (Graphics Interchange Format) from the most compressed image formats. Loss of data compression is only marginal. File size can be reduced by several times. The format provides the functions of conservation and alternate small colors images (up to 256 colors). The GIF format has great features. Using them, it is possible to maintain the transparency of the background and an animation. And you can keep drawing on cursive, that is, with only some part of the file, you can see the entire image, but with a lower resolution.

PSD (Eng. PhotoShop Document). The format of Photoshop, allows you to record a bitmap image with many layers, additional color channels and masks. This format preserves all, that the user has created visible on the monitor.

TIFF (Tagged Image File Format). Commonly used in the areas where there are high demands on image quality. It commonly used in the printing and printed matter. These requirements show a fairly good level of compression. Compression occurs with sufficient coefficient storing additional data in a file. They are typically located on additional layers in the Figure.

**File formats of vector graphics**

CDR (from the English CorelDRaw files – files to posts CorelDraw) - format, which is created in a vector graphical redactor Corel Draw.

AI – a graphical format, which is always used vector redactor Adobe Illustrator.

WMF (Windows MetaFile the English – metafile Windows operating system) – universal format for Windows-based supplements. It often used for storage sets Microsoft Clip Gallery graphical drawings. Main advantages are how much important additional keeping parametrs objects of distortion colours.

CGM (of English Computer Graphic Metafile – metafile computer graphics) - uses a vector format standard graphical data on the Internet [4].

**Presentation**

Presentations – a tool visualizing data using audio and video means. The presentation – a combination of video, music and audio series, computer animation, graphics, which are assembled into a single environment. Usually, the presentation is the content, plan, plot and structure for convenient information perception.

Multimedia presentations may have different properties and appearance depending on the objectives to be achieved with the use of a presentation. For example, the presentation of the new company can advertise the project, company, or use the learning process.

Word Presentation – (praesentatio lat.) – presentation, introducing something new. From here the conclusion that the multimedia presentation - a presentation of something new, using multimedia technologies.

### *Elements of multimedia presentations*

Multimedia presentation differs from the standard that it comprises a combination of the following major components:

- Video
- Audio
- 3D model
- The illustrations of the image
- Text
- Animation
- Navigation

These elements are represented in a completely different combinations.

Interactive multimedia presentation

Also, the multimedia presentation may be interactive, in this case, a user can view the presentation and the material can be modified. For example, when you view the presentation menu, which can be clicked on to jump to different sections of the presentation or there is an option to change the language.

### **Formats of multimedia presentations**

There are several formats of multimedia presentations. For example:

- Adobe Flash presentation – usually a swf file that can contain all the basic elements of a multimedia presentation. This presentation can be placed directly on the web page of the site. This presentation can be created using Adobe Flash CS5, Adobe Flash Builder;
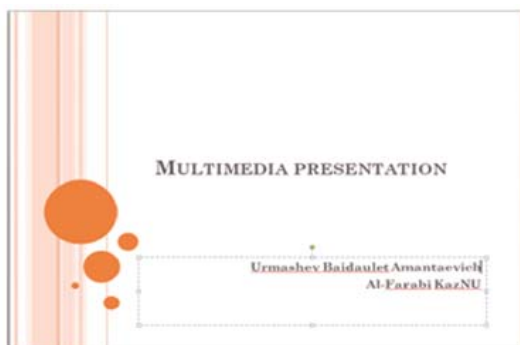


**Figure 11.9**. *The presentation in Microsoft Power Point environment*

• PowerPoint presentation – we all know from ppt format to Microsoft, made up of the slides. Also, it is easy to include in a presentation the multimedia elements of PowerPoint to date [5];

• The video file – a normal video file can also be a multimedia presentation, if it contains a sequence of data, such as a new product of the company.

**Show or view presentation**

Display presentation or view may also be carried out in various ways.

• In the classroom or a room on the screen;

• Through the Internet, in real-time. For example, during web video conference;

• On the web site. The user views a presentation, for example, on the company website;

• Save a presentation. Users download and view a multimedia presentation on your computer;

• Electronic media with the presentation. For example, a flash card or disc [6].

**11.3 Basics of working with sound. The concept of sound and the basic functions of it. Key features audio formats. Sound processing**

Audio applications (players of sound files) – programs that work with digital sound. Digital sound – a way of representing the electrical signal by the individual numeric values of its amplitude.

Sound card – the device as part of the computer that allows you to play and record sound. To play the sound – speakers, headphones; for the record – the microphone.



**Figure 11.10.** *Sound Card*

There are 2 computer audio formats: digital (WAV format) and synthesized (MIDI).

Digital sound – an analog audio signal in the form of a bit sequence, which corresponds to a level of electric sound vibrations at certain intervals.

Like the picture, you need to sound a large amount of memory. For example, one minute digital sound recorded at the highest quality, takes about 10 megabytes of memory.

The presentation of audio information in the computer. Since the end of the last century, there was an opportunity to work with sound information on the PC. Any computer that has a sound card, microphone and speakers can record, store, edit, and play back audio information. With the help of special software application there are opportunities for creating, editing and listening to audio files. Speech recognition programs are created and, as a result, it becomes possible to control the machine by voice. Let us define the concept of sound. Elastic waves in the air at a frequency of 16 to 20000 Hz cause human audible senses. Waves with a frequency below 16 Hz is called infrasound, and with a frequency of more than 20000 Hz – ultrasound. The speed of sound depends on the elastic properties of the medium, its density, temperature and other parameters. The speed of sound is independent of frequency.

According to well-known classification, the sound can be divided into musical sounds (tones) and noise. Musical sound can be considered a swing. And any fluctuation can be expressed through a series of harmonic certain functions. Physically, the pitch determines the frequency. The larger it is, the higher the tone is. Timbre depends on the structure of complex vibrations and harmonic spectrum. The volume can be considered as the intensity of which is measured in W / m2. Sound is a sound wave, with constantly changing parameters such as amplitude and frequency. The high value of the amplitude increases the volume of the sound, audible to humans. A higher value means the signal frequency pitch. In order to process sound in the computer, continuous sound signal must be converted into a series of electrical signals (a pair of ones and zeros – binary code). The continuous sound wave consider the time axis, i.e., the signal is divided into units, depending on time, and each unit has its own value for the amplitude. Thus, instead of a continuous amplitude versus time, A(t) considering discrete sequence volume levels. Physically it looks like a replacement of a smooth curve in the sequence of "steps".

Each "step" corresponds to the value of the volume level of the code (1, 2, 3, etc.). Volume levels can be seen as a set of possible states, the more the volume level will be allocated to the encoding process, the more information will be borne by the value of each level and the more quality is sound. Modern sound cards provide 16-bit audio coding depth. The number of different signal levels or states of a given coding can be calculated by the

formula $N = 2^i = 216 = 65536$. Thus, modern sound cards can provide 65536 encrypt the signal levels. Each value of the amplitude of the audio signal is assigned a 16-bit code. When binary encoding continuous tone is replaced by a sequence of discrete signal levels, encoding quality depends on the number of measurements of signal level per unit time, i.e., the sampling frequency. The more  of measurements is for 1 second, the more accurate procedure is for binary encoding. The sound quality is influenced by such factors as the "depth" and the sampling frequency. The number of changes per second may range from 8000 to 48000, i.e. the sampling frequency of the analog audio signal may have a value of 8 to 48 kHz. You can determine the amount of memory the audio of one second, if we consider that used sound with high quality of 16-bit is48 kHz. To do this, proceed as follows: multiply the number of bits per sample in the number of samples per second and multiply by 2.16 bit * 48000 Hz * 2 = 1536000 bits = 192,000 bytes = 187.5 Kbytes.

The quality of the binary coding of a sound is determined by the depth of encoding and sampling rates. coding depth - the number of bits dedicated to encrypt the volume (amplitude) of the sound signal. The sampling frequency - the number of signal strength measurements per unit time.

Sound file formats are commonly used:

1. Real AUDIO (.ra, .ram) – designed for audio playback in the network online. The resulting quality is certainly not the best. For high–quality recording of musical works use MPEG-3 format is preferred. Low resolution is achieved by using algorithms and compression techniques.

2. MOD (.mod) – music format, it stores the digitized sound patterns that can then be used as models for individual notes.

3. WAVE (.wav) – audio format by far the most widespread. It is also used in computers for storing audio files. Files in this format have a large size, which depends on the bit of sound, sampling (sampling frequency), mono or stereo and  duration.

4. MPEG-3 (.mp3) – best known to date audio file format. When the compression encoding is applied, resulting in music sounds are deleted, not perceived by the human ear (perceived range 20-20,000 Hz).

5. MIDI (.mid) – commands for audio playback. The sound is synthesized via FM- or WT-synthesis. If the sound card does not contain a synthesizer, such  sound is not played.

Creating music on your computer, there are two basic ways:

1. To write the music directly to your computer: a) in music programs (applications) it is convenient to create music, transferred to a computer with notes of synthesizer or MIDI–keyboard; b) you can mouse to draw all the right notes (this is a very time consuming activity);

2. Record live sound with a microphone or line-in sound card, using the

computer as a mini recording studio. After digitizing audio files using the editing software is for editing music, all sorts of modifications and add special effects [7].

**11.4 Digital video and its characteristics, compression standards and video formats**

At the previous time, few people could have imagined that with the help of the non-singular simple computer we can watch movies, add personal video library, digitize old VHS tapes, mount family videos and even produce their own blockbusters. Immemorial digital video is an analog signal which is converted into a digital format. The disadvantage is some loss of quality of the converted material. The latest digital video cameras, such as DVD and Blu-Ray players allow instantly to receive the signal into digital form. In addition, analog television gives the way little by little to a digital.

**The main characteristics of digital video:**

In digital video we can distinguish five main features:

– screen resolution;

– frame frequency;

– enormity color;

– bitrate;

– image quality.

Screen resolution –emphasize number of pixels horizontally and vertically, from the image (video frame). The written permission, we first specify the horizontal resolution of points that we have in the line, and then specify the vertical resolution – our number strings. For example, for the European PAL video standard frame size is 720 by 576 pixels, and for the North American video standard NTSC– 720 by 480 pixels, and video extra quality (HD 720p) resolution amounts – 1280 by 720 pixels. A video standard for modern HDTV (Full HD) – 1920 by 1080 pixels. Probably everyone knows, the higher the resolution is, the better is the video quality.

It is pessible to find out how many frames per second are running. The standard speed – 30 frames / s, and for the film – 24 frames / sec.

The scale of colors and feature indicate the number of colors that can be related to the creation of the video. In the digital video colors we measure in bits. And 1 bit can take on two different values: 0 or 1. Therefore, only two colors could be encoded: black and white. By using two bits can be coded into 4 colors (22 = 4), using three bits – 8 colors (23), four – 16 (24), and so on.

Bitrate (the magnitude of the video stream) – it shows the number of processed bits of information per second. In other words – this video speed and we measure it megabits per second MB / s. For the type of a DVD – Video magnitude of the flow will be about 5 Mbit / c, but for high–definition

television HD TV - for 10 Mbit / s. it can be said the higher it is, the better the quality according to these data.

The image quality of this feature evaluates the quality processing video from baseline.

**Compression standards**

A minute of uncompressed digital audio on your computer takes approximately 10 MB of hard disk space. Because of this, many music files are stored in compressed form. And how about a minute of pure uncompressed video? For example, to locate minute video at 30 frames/s, which has a resolution of 720x576 pixels and 16-bit color enormity can be questioned about 1.5 GB of free space! And this is without the track.

There are several dozen popular compression formats that use different compression logic for the different outcomes in proportion.

DV (Digital Video) - Sony, JVC, Panasonic, the Philips and Hitachi, these companies have developed this format. DV format provides a low compression ratio (5:1) and has a high bit rate, thus leaving a fairly large video file. DV-minute video takes place about 200 MB (60 min - 12 GB) in the digital storage media. The format is often used to compress shooting video with the help of consumer digital cameras and professional camcorders. At the same time because of the low compression ratio is obtained pictures of very high quality and compression procedure itself, which is carried out in real time manner, not on demand strong technical components.

But, of course, to store video in the home computer or in disks DV-type it is inconvenient because of the large size. So that those skills were to think of additional compression algorithms with which it was possible to reduce the size of digital film several times.

MPEG (Moving Picture Experts Group) is the standard for compression of digital data, developed in 1988.

MPEG-1 is the first version of this standard and in 1993 with the participation of the companies JVC and Philips it has developed its specification Video CD (VCD). We can determine the name that VCD is a type of storage archiving video with sound on conventional discs.

The application to encode MPEG-1 algorithms allows the video stream to become a width of up to 1.5 megabits per second with a frame resolution of 352x288 pixels for PAL or 352x240 for NTSC, and then on a regular CD can fit 74 minutes of video with sound properties VHS (as a conventional VCR) .

MPEG-2 is received by a volume expansion in the digital DVD video discs, and in the administration of cable and satellite TV signal. Pictures property is much higher than that of its predecessor: at 25 frames per second, resolution is 720x576 pixels for PAL systems, and for NTSC – 720x480 at 30 frames / sec. And the magnitude of the highest average flow = 9.8 Mbit/s, which is 7

times higher than that of Video CD. Another advantage of the MPEG-2 is the ability to save the five-channel audio tracks (Dolby digital is 5.1 and DTS).

MPEG-3 is predetermined to encode audio and video streams in high-definition television broadcasting with a speed of sending information from 20 to 40 Mbit / s. But it turned out that for encoding audio, video streams can be converted to use a little version of the MPEG-2 standard, and after all of the following MPEG-3 projects have been stopped and now the standard is not applied.

MPEG-4 was made to improve the properties of the image at a low speed audio and video stream. MPEG-2 The previous standard, planned for a high bit rate, could not cope with this dilemma and had quite seriously improved compression algorithms. This the MPEG-2 is not suitable for storing high-definition video (HD) with resolutions from 1280x720 (720p) up to 1920x1080 pixels (1080i or 1080p).

Today MPEG-4 is the main audio compression standard for video content, but the DVD is forgotten. In reality, all the latest photos and video cameras capture HD-quality. And so to save multimedia devices with a PC will have to look at the category of MPEG-4 codecs.

### Codecs

Videos made on a cell phone and video downloaded from the web or HD-format film with a Blu-Ray drive will be different quality. One can make improvements to the picture, the other limping sound, and the third on the contrary – the ideal quality. But they are all coded with the same standard – MPEG-4.

All these differences are determined by the codec – deliberately scheduled program that performs the compression (encoding of) the original data. Each of them employs its own algorithm (logic), which affects the property and coding rate.

The word «codec» is a contraction of two words «coder-decoder». It means that the codec should include not only the compression module (encoder), and view (decoder). Consider some of the most popular codecs:

MPEG-4 Part 2 Asp - built on its basis codecs equipped with fairly low property facing materials. It does not provide a high-definition, but this flaw can close your eyes, so as MPEG-4 Part 2 Asp has a high speed of action and does not require hardware resources. This algorithm is now popular in video encoding for different mobile media players and compact, as the rollers on the network.

Commercial DivX and XviD free alternative are the basis of these algorithms and familiar to many users.

MPEG-4 AVC or H.264 is one of the most advanced and well-known algorithms that are used successfully to compress the low-resolution video and

even HD video content. The most first-class movies on Blu-Ray discs are encoded by this codec directly. In the same order, it repeatedly used in everyday HD-camcorders (AVCHD).

VC-1 - a codec developed by Microsoft. This creation of personal video compression format is WMV (Windows Media Video) and the concept of encoding WMV 9. Originally dilemma VC-1 video encoding was for X-Box game consoles. But today, VC-1 has entered the video market and the full repertoire competing with H.264, supported type for Blu-Ray format.

**Media container formats**

As any other digital content, video is stored on disk as a file or media container, which the content includes video, audio and other streams in the same order and metadata. At any time we can take a video of the container, the audio track, transcode and squeeze them into a container, that is to modify the format of the video file. Multimedia containers can be of different types (formats). And on the file extension, we  know that they belong to what type.

Now, we take a look at the known formats of video files and terse, analyze their advantages and drawbacks.

AVI (AUDIO Video Interleave) in 1992 it was first used by Microsoft. It may comprise video and audio data compressed combining a variety of codecs. Therefore, AVI files with external unity can strongly stand out of the womb, and that would be to as certain of their contents, have to resort to special programs, for example, VideoToolBox.

MKV (Matroska or Matryoshka) is frequently used by multimedia container format that meets all the requirements of Art Nouveau. More aimed at families H.264 codecs. Its main features include:

• Organization of the display menu;

• Separation of content into chapters;

• Quick warping on the file;

• Jumping "on the fly" between the audio and video tracks as well as subtitles.

MP4 (MPEG-4 Part 14) -new file format for storing digital video and audio streams. It is part of the MPEG-4 standard. It knows all the opportunities that the MKV. But there is one MP4 dignity, we can play files in this format on virtually any device, from smart phones to game consoles.

To store multimedia content on a DVD-ROM, we use the VOB main container (Versioned Object Base). He is able to maintain a little bit MPEG-2 video streams, up to nine audio materials, up to 32 lines with subtitles and menu display.

To locate and send the video to the universal Internet, we use the media

container FLV (Flash Video). Video hosting RuTube, YouTube, Vimeo and etc. are used by the media container. The video stream into FLV-encoded file to the promotion of H.263 or H.264 are codecs, and audio to MP3 or AAC.

For storage of video, graphics, animation and 3D, we use the MOV file format, produced by Apple. The form has QuickTime.

TS and M2TS  are prepared containers to store HD-video. The streaming of digital TV, IPTV and DVB are applicable TS. However, the container may not include subtitles. M2TS – typical container for Blu-Ray video, which can be included video and audio streams, predefined type BD-ROM and PGS subtitles in graphical format [8].

### 11.5 Multimedia application. Wired and wireless networking technologies. The history and origin of the Internet

Online services. Search software on the Internet.

Intrusion of multimedia in Trainings (Computer Based Training – CBT) for business and own using. Almost all researches show the effectivity of the study with systems of using computers. Save time in the study of a particular material is on average 30%, while acquired knowledge is stored in the memory much longer.

Newest media is to cover many areas of life every year; education, culture, business, science and technology, as well as used in the service environment for creation of electronic devices with a dip in the real environment and multitec.

One of the commonly used applications of multimedia systems is education. The elements of media can be seen in the video tutorials, interactive whiteboards, online simulators, situational role-playing games and etc. Multimedia equipped with a computer  immediately became an important training and informational tool for any branch of knowledge and human activity. Especially modern medicine uses multimedia, knowledge base cards of patients, drug directories, etc. In the area of company for implementation of pizza sales are already using multimedia technology to create catalogs of products sold – the buyer can see on the screen the different kinds of pizza, make the imposition of interactive necessary ingredients on the pizza, available with a price list of goods sold.Technological media is a success in the military sphere for example, the Ministry of Defense of Kazakhstan began to suffer on DVDs all technical, operational, legal and educational records on all weapons systems, creation and mass use of simulators based on such discs. Vehicle identification of presentation and advertising.

Multimedia elements in this environment aim to promote products in the market and its implementation. And also provides the user account related to this product, review, order and purchase.

**Computer modeling.** Multimedia allows the industry with mathematical precision to describe natural phenomena, processes, using graphics, sound and video. It is also possible to change, modify and improve fault of such system.

**Multimedia in organizations.** The most simple example of using media in organizations and institutions is digital scanners, allowing identify text, digital printers with an automatic paper feed increase tendency to enter in personal computer of making technical illustration and text for future processing or documenting.

Multimedia in the organizations for service information agents (external service).

Long ago there were pocket computers with which the company's employee in conversation with customer has the opportunity to substantiate the facts, using computer graphics (diagrammmy, visual elements of statistics, etc.). There is also the possibility of using a visual representation of the product or service. It is an opportunity to see the full range of products and change some of their parameters (such as size to buy clothes, shoes).

**Orientation.** There is a wide range of programs that aim to work with interactive maps. The bright examples of software applications are as google. map, 2gis. Users know how to get to the desired location, as well as all information about the optimal route, transport, time stops and must be able to work in these applications. The program is able to calculate and find the most comfortable and optimal driving directions, both on foot and transport. And if in the path of any traffic jams, they are able to offer a variant of the fre way.

**Instructions manual.** Guide and reference operation of hardware and software can be displayed on the screen using the interactive program. Fipm is launched its own Windows Mulimedia expansion starting with version 3.0 Windows CD and offers a detailed help system with specific support HoperGuide. The system based on hypertext, provides high-speed access to the necessary information.

**Maintenance and repair.** It is important and necessary to have on hand an audio or even better video instructions for troubleshooting and error. The use of this kind of media is suitable in most individual activity than in manufacturing. Such a framework would provide the best solution of all kinds of problems.

Manufacturing and production control. The ability is to issue receipts for funds: services and goods; Accounting users and at the end of processing, analysis, carrying out statistics and issue the final results; Production planning, processing of contracts, quality control and other similar operations determine the use of the media in the production.

**Documenting and archiving.** Using CDs, hard disks for data storage have replaced existing outdated audiotapes technology-based films. Now it is easier to compress text, audio, video information and place them on a variety of media.

In account management, contracts, documents of official correspondence, etc., use of the media is considered be to not only necessary, but also very important. The storing of such information on media needes for browsing in the future. Using a special application, this information may be reproduced in any requested time for you.

Obsolete originals of important historical documents tend not to pick up, in view of the imminent threat of destruction to them. So using the media tools allow to impress these documents, it is possible to make copies, take a picture, scan [9].

### 11.6 Wireless Technology

At the end of the last century, the era of wired and wireless data transmission technology. At the same time, the Scirocco has used the technology for delivery of voice (telephone) and data (the telegraph). However, a wired connection in that era was simpler, reliable and secure. It began to develop wired telecommunications. Millions of kilometers network formed web on Earth. The population of the earth had used more and more information and bogged down in a web of copper wire and quartz optical fiber.

By the end of the twentieth century there was a digital signal processing. It started using the information in binary code, i.e., Any information is transformed into 1 and 0.

### The era of digital communication

Developing technologies in parallel telephones connected with a digital data processing, so that with the release of packet networks are blend together virtually. The rapid development of the Internet only proves the fact that the digital networks for modern civilization has become so necessary not less than motorways, pipelines and power lines.

Now all activities use local and regional networks including science, politics, culture, economy, education, industry, etc. Technology Internet (10 Mbit / s) were replaced by Fast Internet / Gigabite Internet / 10 Gigabit Internet (100/1000/10000 Mbit / s), wide area networks just as the widespread use of new technology and super-fast. It is hard to imagine without them in today's world of email, telephone, access to remote servers in real-time news service and so on.

Finally, at the end of XX beginning of XXI centuries the world's population begin the transition from wired to cordless technology. The massive appearance of cordless technology tools will get rid of extra cables and wires. The use of cellular telephones does not subside over the past 30 years. And the number of cell phones is growing exponentially, and more than 60 percent of the population of the earth are subscribers of cellular communication. Incredibly steps evolving technology of wireless local area networks are personal wireless network and regional scale.

The same acceleration received personal devices in their development and in modern computer of world smartphone, laptop, notebook, tablet, netbook, PDA – a common phenomenon. It has become recently in the development of multimedia technologies during the most recent invention the network of the future fourth (4G) generation. 4G is a new technology that provides high-speed Internet services on mobile devices means a media [10].

### 11.7 History of the Internet

During the war the United States was necessary network which would provide a stable, reliable and high-speed link. To solve this problem the Pentagon has turned to the RAND Corporation.

One of its employees proposed to create a network that would transmit data through packages instead of through the analog signals, as it was before. analog signal transmission is usually implemented with the loss of some of the data. The Pentagon has supported the project and offered it to the AT&T telephone company. But AT&T company rejected the application, explaining that such a network is not realizable.

Later single scientific organization was created with the support of the Ministry of Defence, which had the name of the DARPA (Defense Advanced Research Projects Agency), the main purpose of this organization was a sample of the proposed projects would be the most promising and interesting.

After some time, the director of DARPA Larry Roberts became interested in computer networks. His idea troubled scientist Wesley Clark of network packets. V1967, Larry Roberts spoke at the ACM Symposium SIGOPS with the report. At the same symposium was presented a similar, but realized at the National Physical Laboratory in English system. Its implementation has shown that packet transmission can be applied in practice. DARPA Director went there with the idea to create such a computer packet network in America.

In December 1969 an experimental network was established, which made it possible to connect four centers:
• University of California, Los Angeles (UCLA)
• University of California, Santa Barbara (UCSB)
• Research at Stanford University (SRI)
• Utah State University

Further, the network began to expand and later spread around the United States.

In 1983, the military part of the ARPANET was separated in a separate network - MILNET, which later became known as NIPRNet.

In January 1971, with the assistance of the state and the National Science Foundation Network has been developed, which brought together three of the University of Michigan.

At the present time, the Internet makes it possible to use the following online services:

• Social services;
• Educational services;
• Tourism services and recreation;
• Training services apparatus;
• Services for data storage;
• Services of creation and promotion of sites.

This list is not all of the services, but their names are not difficult to guess the goals, objectives and types of services provided by them [11-12].

## 11.8 Working with user accounts. Control routing. Troubleshooting network problems

User account – a record that contains the information necessary for the user when you log in, the data for authentication and accounting. The account consists of a user name (login) and password (or other forms of recognition – such as fingerprint recognition and voice or digital signature). Password is often stored on the server side in an encrypted or hashed form. This is done in order to improve security against intruders.

Besides all this for saving it can be provided other means, such as a special secret question (or several questions, which contain information known only to the user. These questions and answers are also stored in the account.

The account may also include the following additional information or personal data about the user:

• personal information (full name);
• alias;
• floor;
• nationality;
• information about hobbies;
• information about the parents, the family;
• information about your favorite music, videos, books;
• and much more

The user has the ability to store one or more photos in your account, and select one of them as the main photo – avatar. "Avatar" will be visible to other users in a profile person, a lot of important information about the users are stored in the account. And it provides a feature as event logging (event journal): time and date of the last visit or login duration of the last stay in the system, IP address, used connecting node, the frequency and intensity of using system, the total number of transactions, produced in the system and so on.

**Create user accounts**

Creating user accounts is not a time-consuming process, and is usually

done in a very short time. To create an account you must complete a simple intuitive steps.

Various methods and techniques can be used to create 7 Windows operating system account. Similarly, you can create user accounts for computers that are in your domain. In computer networking domains, work and home groups may differ in the methods used.

The Working Group called computer group united by a network to use a shared resource (printer, scanner, etc.). When you set up a computer network, Windows automatically creates a workgroup and gives it a name provided by default.

Under a large group of network computers combined into a network and have access to the source and network interfaces. In this group there is the total user base, group and local policy and common security settings. If the number of computers used in her large, some parameters such as the time limit work account and other, to some extent make simplifying systems analyst of this organization [13-14].

**Manage IP-routing**

IP-Routing is a very important, essential and indispensable tool to access the Internet. Properties such as the protocols can be configured in the IP-routing tab routing table and address table, etc. To manage and modify any properties of IP-routing is necessary in the Management Console branch of the Routing and Remote Access to select a branch from the local server name and follow the route IP tab. Branch IP-routing consists of individual branches to configure the general properties of IP-routing and existing protocols [15].

Web Search Troubleshooting

A working network troubleshooting is an integral part to create and support. This process includes a process of analysis (diagnosis, measurement error, placement) and synthesis. Synthesis involves deciding what modifications need to be made in the network to fix and restore its operational state.

To determine and find the system efficiency coefficient, values perform the analysis process to predetermined parameters, which is no less important kind of monitoring, a simple process – the process of collecting initial data on the web: state of hub ports, statistics on the number of network frames and packets of different protocols, switches and routers, etc. Then comes the implementation phase of analysis that differ complexity and intellectual understanding of the process of the collected data at the stage of monitoring, mapping and comparing it with the data previously obtained, and making assumptions about the possible causes of slow or unreliable network.

When the monitoring is important to use tools such as software and hardware sensors, gauges, testers, network analyzers and built-in monitoring control system networks and systems.

The most demanding of the active participation of the person is a stage – analysis. The problem analysis also requires the use of sophisticated tools, such as expert systems, accumulating experience of many experts in the field of networks.

Synthesis is performed to evaluate the efficacy, which we achieve by selecting appropriate values for variable parameters. Given threshold is an indicator of efficiency, the result of synthesis should be one of the network options kootory exceeds a predetermined threshold.

**Control questions:**
1. Multimedia technology.
2. Basic concepts of multimedia.
3. The multimedia capabilities. Media Terminology.
4. Multimedia Classification
5. General information about the image and save it.
6. List the main audio formats.
7. How is the sound processing information?
8. List the main video formats.
9. List the scope of multimedia applications.
10. How is the search for information on the Internet?
11. What can you tell us about wired and wireless network technologies?
12. Tell us about the history and origins of the Internet. Online Services.
13. How is the work with user accounts?
14. How can I troubleshoot network?

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# CHAPTER 12. SMART TECHNOLOGY

## 12.1 Priorities for SMART Technologies

Features SMART-education system of professional skill improvement of teachers realize through the use of mobile devices or SMART- gadgets (tablets, tablet computers, smart phones, SMART TV, laptop computers) to deliver knowledge, and as a tool for the formation of an integrated intelligent virtual learning environment. Gadgets can help better study and understand any subject, providing mobility and help to adapt new methods of teaching by means of SMART-technologies. Today it is difficult to imagine a school without computers, interactive whiteboards and the Internet. In each class, the children are aware of the modern means of communication and confidently use them. The idea that we need a phone just for calls, sending letters need to only employees of post offices, or search for information is possible only after going to the library, now it seems already yesterday. The formation of the flow of information under the pressure requirements of the modern world is growing from year to year. Printing does not have time to issue the required number of textbooks, not to mention the delivery of the end-user. But education is a forge our future. Therefore, modern education without the use of gadgets in their new approach of teaching is difficult to imagine.

For SMART-feedback education organization (two-channel communication), advanced data access and collaboration are important factors. Within the framework of national programs in Korea implements the scheduling information strategy (Information Strategy Planning, ISP), creating a cloud computing infrastructure (cloud-based computing infrastructure) for the SMART-education in order to motivate students to store their training materials and records in the cyber space, further sharing. A system based on cloud technologies that will integrate individual educational services and resources to provide more convenience for users, the safety of its data. Under the cloud services and cloud storage is commonly understood as a service of any organization user individual storage space for them to different files. These can be documents, media files, archive photos, in general, any files required by the user, the seat of SMART-education services. Many users often use the free service for storing large amounts of information. SMART-education is a teaching method that promotes the development of creativity, cooperation, ability to solve problems, as well as communication skills of students. Different models that use Web 2.0 for data acquisition, Google «Documents» and «Applications» for the organization of cooperation and work on projects, SNS (social networking) for discussion were developed. Google employees develop an application «Play Market», by which any application installed on the mobile operating system Android. Play Market is an application installed in the standard means of the

mobile operating system Android. This application is a client site for down-loading and installing new software, music, movies, books on your smart-phone, tablet, or a tablet computer based on Android idling (HH – version number) mail.ru, Apps for Education is a set of SMART-free services, security tools, which include the mail (postal service), Calendar and Docs. They are useful for collaboration and communication, no matter where you are or what device you are using. More than 20 million students, teachers and staff in schools around the world use Mail with Mail services to education.

Google Apps for Education is a set of free, safe tools, which include Gmail (postal service), Calendar, Docs and Sites. They are useful for collaboration and communication, no matter where you are or what device you are using. More than 30 million students, teachers and staff in schools around the world use Google with Google Apps for Education.

Online learning expands the boundaries of education, providing a link in the cyber space, where they can participate in hands-on experiences, remote video conferencing, online experts to attend lessons. The learning process is the interaction of the teacher, the student and teaching aids. The possibilities of modern computer and information technologies make it possible to lay the means of learning of the teacher's functions and features of the trainee received training in classical form. A key element of building, a learning using the Internet technology provide remote access to educational content. Widespread receive such training as a variety of online virtual school, distance learning courses its Online training is perfect for those who live in remote areas, as well as for those who, due to certain reasons cannot attend full-time training. In addition, the obvious advantage of distance learning courses via the Internet is that the student can choose at what time of day it is more convenient to deal with, as well as to determine for themselves the individual duration of employment.

The student does not have a rigid class schedules, and all the details can always decide the fastest way via e-mail, Skype or ICQ. In addition, there is an opportunity to talk with the teacher on-line and ask all the questions on a particular subject. In a system using a variety of assessment tools, it is possible to pass an online test to help students continue their education. For example, National English Ability Test (NEAT) and the National Assessment of Educational Achievement (national assessment of educational achievements).

The priority values are SMART-society creativity and tolerance, creativity and open-mindedness, flexibility and originality. To prepare citizens SMART-society it is able to work and think in a new world – the task of modern education.

To ensure the quality of training of teachers in the conditions of realization of ideas SMART-education, it is proposed to implement the following activities:

– Creation of a network community of educators to address professional issues;

– Creation of a centralized online community of teaching staff of JSC «NTSPK» leading and «(including all branches) in order to exchange experiences, fruitful cooperation with the placement of educational and methodological materials (creation of a» methodical piggy banks «based on the priority of education);

– Development of special content for ICT training of teachers;

– The creation of educational clouds (through the provision of Google, Google Docs and «Cloud» service Mail.ru users (teachers and students) a wide range of possibilities of conducting educational activity on the basis of cloud services (conditions: a wireless network and tablets, smart phones, ICT skills to use 1111S)

– E–content creation activities with the use of videos, insert animated characters (demonstration of academic material in a clear and realistic way);

– The organization of training centers with training institutions to establish specialized resources;

Implementation of the proposed areas is possible under the following conditions:

– The availability of free (or cheap) wireless high–speed Internet (throughout the country);

– Training of teachers and parents to use SMART–devices;

– Introduction to the educational process of primary education (and possibly pre–school) learning SMART–devices;

– The creation of specialized departments in the development of leading structure, implementing distance education: definition of the content providers, training of specialized personnel for full implementation of the project, the development of training materials (program planning, animated lessons, video and audio lessons, adaptation of the program to the interests of society, etc.), advertising and attraction of subjects of education to the project.

The need for the development of integrated intelligent learning environment is based on a sufficient degree of SMART-technology intensity of their penetration into everyday life, of the formation of the system response to the ever-changing challenges. The main reason for the use and implementation of SMART – education is the need to improve the existing education system in accordance with the new requirements of the economy and SMART-society.

### 12.1.1 Intelligent Network

The use of computer technology in telephone systems enables to rea-lize new services provided by the subscriber directly connected to the PBX. However, some services may be provided through a PSTN subscriber to any net-

work. But this requires a control software is not at the level of separate ATS, and within the entire network.

**Service 800**

The first in the history of telephony "network" of such services appeared in the US in 1967 so-called service 800 or Free Phone. Various organizations were able to rent rooms in the "non-geographical" intercity code 800, pledging to pay for all incoming calls. Thus, a call to any number starting with area code 800 is free to the caller that it is essential to attract consumers in the conduct of business across the country.

The implementation of such service requires special tools for routing and billing (billing) Calls on the scale of the national telephone network: each long-distance exchanges should have information on the actual geographic location of each recipient of calls. This requires a "network database" that stores every line number of the 800-th zone to the real long-distance number. This database must be accessible from any settlement. Since this information is continuously updated (for example, new companies, renting rooms), it is not enough simply to duplicate at each PBX across the country.

The transition to "network database" was completed by 1982 under the name of *800 Expanded service* **("extended service 800"). Since then, the US national network became involved not only the transmission of speech between subscribers, but also the special control data between the PBX, becoming the first in the history of the concept of an example of** *IN (Intelligent Network*, i.e., the "smart grid"). The scheme of the service 800 is shown in Figure 12.1.
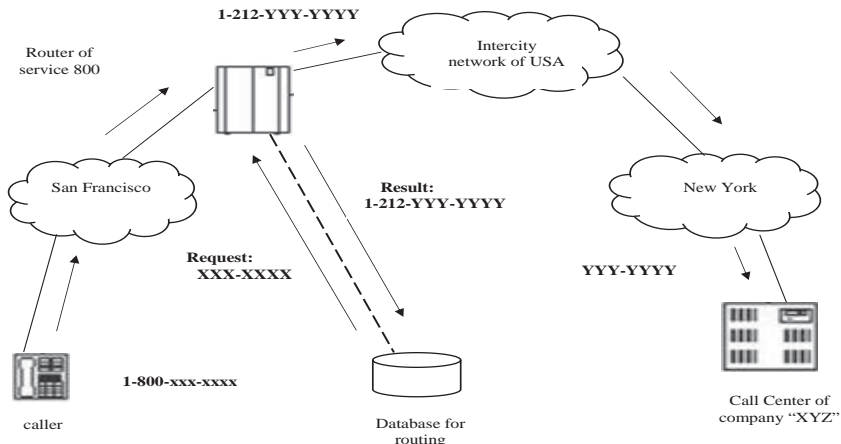


**Figure 12.1.** *Service 800*

So, under the IN is realized network control software. Thus, the smart grid is in a certain sense, an independent aspect of computer telephony concerning the creation of network-level services, rather than a separate PBX.

**SS7**

Heavier-than-air flying machines are impossible (Lord Kelvin, President of the Royal Society 1895).

Modern intelligent networks are based on the recommendations of the International Telecommunication.

Union (ITU-T) Signaling System N7 (SS7), the first version of which was accepted in 1992. At present, SS7 widely implemented around the world, including in Russia (under the called ACS N7).

SS7 defines all main intelligent network components and protocols of their interaction, which on a plan of their development:

- not depend on the type of service,
- on the network structure,
- from the equipment manufacturer.

The SS7 uses a data network based on packet switching, a logically independent of a conventional network for speech channels. The nodes of this network are called SP (signaling point, "alarm points"), and their connecting lines – SL (signaling link, "signal units"). To improve reliability, the duplication of equipment used, as between any two SP must exist at least two non-matching by independent chains route SL.

The following types of nodes in the SS7 network (Figure 12.2) are:

• *transit signaling point* STP (signaling transfer point). This is a network element, the two vides the routing of packets between other nodes on the SL.

• *Service Switching Node* SSP (service switching point). This PBX, software-driven.

• *intelligent peripherals* IP (intelligent peripheral). SSP is only responsible for switching voice channels and the IP implements an interactive dialogue with the subscriber plays voice guidance, receives the DTMF tones response, subscriber dialed on a telephone keypad or voice recognition. IP can be integrated into the SSP, or to realize the individual equipment.

• *SCP Service Control Node* (service control point). This computer hardware, which runs the program that implements the logic of the service. SCP can be located thousands of kilometers from its managed SSP and IP nodes, giving them command over a network or in close proximity, being associated with them via high-speed communication link. The latter case is called AD (adjunct). SSP and SCP functions may be combined in a single unit – SSCP (service switching and control point).

• *storage unit* for SDP services (service data point). This database, which

share the other nodes to implement services. For example, the database may be stored subscriber account, routing tables 800 and for service t. D.

• SMP *Service Control Node* (service management point). This operator console through which you can manage the parameters and configuration of the service during its operation.

• *Node creation* SCEP services (service creation environment point). This is the computer that contains creation environment SCE service (service creation environment) – software design, modification and testing services before the start of their operation. Services are designed as a combination of a standardized set of SIB universal service units (service-independent block).

It comprises a set of SS7 protocols for interaction between intelligent network nodes. Basic protocols that implement the transport medium, called *MTP* (Message Transfer Part) and SCCP (Signaling Connection Control Part). On this basis, working protocol for controlling voice connections (calls) – ISUP (ISDN user part), as well as a protocol for remote call program procedures – TCAP (Transaction Capabilities Application Part). Through these protocols SCP nodes (computers) to remotely manage nodes SSP (ATS) and their "intelligent peripherals", as well as interact with the SDP (databases). Minutes of the interaction between the SCP, SMP and SCEP are not defined, so the developers implement their own on the basis of TCP/IP or X.25.

On the basis of the SS7 network can implement a service like roaming in mobile networks. For example, the cellular GSM network subsystems are based on MAP (Mobile Application Part), running on top of the TCAP, and BSSAP (Base Station System Management Application Part) – parts of the SS7 standard.
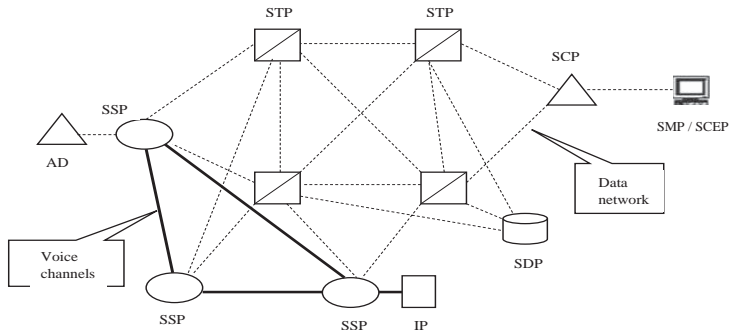


**Figure 12.2.** *The structure of the intelligent network*

In an intelligent network, in contrast to the usual is:
• All elements of the network are programmed control;
• Parallel networks for voice calls enter (at least logically) additional

network for the transmission of commands from the control computers to managed nodes;

• There are tools for building distributed database.

These are important differences allow you to create new services "network level" rather than individual exchanges.

### 12.1.2 "Smart" building

Global warming, depletion of resources, pollution of the environment – all of these processes can lead to disaster in the distant future, if you do not try at least to slow them.

There are restrictions on the content of CO in exhaust gases of internal combustion engines, there are number of other requirements and standards aimed at preserving the environment. But is it enough? And can you help not to reduce the pressure on the ecosystem of high technology?

You should begin with the construction of «smart buildings», then combining them into a «smart city», and continue this process as long as the «digital intelligence» is not endowed with the entire planet.

However, is it building a threat to the environment? Let us look at some facts. Buildings around the world consume 42% of electricity more than any single industry. Buildings lose half their water supplied. The cost of the electricity consumes 30% of the total value of the content. But by 2015, buildings are the largest sources of greenhouse gases on the planet.

Ecology is certainly important, but the dividends are somewhat vague, at least from the standpoint of the owners. Therefore, the main focus is on the significant reduction in operating costs of such buildings. According to experts, smart buildings can reduce energy consumption 40%, 30% – use of water and reduce by 10-30% on maintenance costs.

Let us briefly consider how to operate modern buildings. They provide daily services such as lighting, HVAC, water, elevators, as well as provide security. All these services were used, and it was not noticed that them until they are OK. However, there are other services such as the provision of the lease, management of the life cycle of equipment, service and living their payments. Most of these systems operated independently have different suppliers, different protocols and transport mechanisms. If to add to this the problems created by external factors such as weather, accidents, various utility tariffs, and so on. N., you can imagine how difficult is the management of the building.

What is meant by intelligent building? This building, which can be intelligently controlled to provide optimal services to tenants of a reliable, economical and rational way. This building, which establishes the relevant equipment and systems that allow to carry out monitoring, prediction and management. They are connected to a «smart» power supply systems, which take into ac-

count used for the time tariff scheme and minimize consumption during peak hours. They are able to cover at least part of their energy needs, collected rain water and minimize water consumption, and finally most importantly, they have a user interface tools, to provide the manager or even the inhabitants of the building parameters in real time and the opportunity to influence them.

Buildings of any type can: the commercial, government, educational centers, airports, hospitals, data centers. But in order to benefit from this technology, and really understand that this means all information, services and IT organizations must work together to manage the building of a united way.

Systems for intelligent buildings use extensive network of sensors that collect data for analysis. The data received in real time, so that the building system can continuously adapt to changing environmental conditions, sending directives or instructions performing systems. Data from the sensors is collected over a period of time to help in long-term planning of improvements and modifications to buildings. Using the analytical results of the processing, the owners and managers of buildings can make informed decisions on all systems.

Property administrators think and manage the buildings in three areas: energy consumption, operation and handed over the square.

In the field of energy, they want to know how to use energy, how much it costs, where consumption is excessive, what are the possibilities to reduce losses and increase efficiency of resources.

On the part of the operation, they should have the information about what types of equipment installed in the building during its operation and maintenance cost, downtime, how to improve its service.

As for the area, the administrators need to understand how the building is used, the level of its population, what is the rent and the extent to which occupies an area correspond to the type of business, whether it is a hotel, data center or commercial structure.

IBM Corp. (Centralized global management of production facilities from a single console IBM TRIRIGA offers a single system for managing the life cycle of production facilities. This integrated real estate management system improves the operational, financial and environmental performance of the premises. Thanks to business analytics, warnings about critical failures and automated processing functions, the IBM TRIRIGA solution increases the visibility, controllability and automation of the following tasks: Property management, Capital projects, Space management, Room management, Energy management), which has put forward the concept of Smarter Planet, promises to help in all these areas.

Perhaps the increase in energy efficiency in conditions of constant cost growth and preservation of the environment is the most important issue.

«Thermal behavior of» a building depends on its location and configuration, its construction, and finally from the «way of life». If the building has already been built, there is little that can be changed in its location and layout. However, there are different materials, and may be worthwhile to improve roof insulation, window frames, in other words, the wrapper of the building. Such measures can improve efficiency and reduce the payback period. However, even for houses built well, a satisfactory thermal behavior can only be achieved with proper and constant management. First, the heating, ventilation and air-conditioning worsen over time, often fail and lose their effectiveness. Secondly, the building is typically programmed to a certain lighting and air conditioning modes. However, tenants or employees of companies can change these modes for some substantial reasons, and then forget to bring them back to the previous state, which will lead to a breach of the optimum settings. That is why the ability to monitor energy systems and measure thermal parameters in real time is very important.

Such opportunities are provided by IBM Intelligent Building Management solution. Its pilot implementation in the corporate campus in Rochester (Minnesota) 8% is reduced by energy consumption.

IBM Intelligent Building Management provides a pre-integrated and configured software package that combines the building monitoring capabilities in real-time and event management. This enterprise-class solution is designed to help building owners, operators and managers analyze and reduce operating costs, energy consumption, improve overall resource management, reliability and consistency of service. The key architectural concepts include data collection, asset management, monitoring sensors, optimization based on centralized intelligence and distributed control [1].

Here is a brief overview of the solution architecture. Key levels include (in order of hierarchy) visualization, logic, relationship, as well as hardware and physical layer (Figure 12.3).

Each level provides an important aspect of the decision. Thus, the physical layer includes the installed equipment and the physical elements, which are subject to monitoring. The hardware level is provided by IBM Business Partners. It comprises a building management system that collects data from sensors and devices in real time, aggregates them into meaningful operational information. At this level, alarms are generated, based on established customers thresholds. relationship level has two sublevels. One uses open standards for the collection of the necessary metrics and alarms from different building management systems across the enterprise.

Another – aggregates data into a single normalized format. This level also provides integration between IBM products to perform analytics, management and operations through common dashboards. Logic Level IBM provides

products that perform and analytics, management and operational activities. Analysis transforms data into meaningful and easily understood information allowing you to make informed decisions. It also allows engineers to quickly identify problems and fix them, and managers take timely action in response to the disruption of the services. Finally, the imaging layer is cross-system information on a single dashboard. The combination of previously unrelated data received from multiple sources with business logic allows for a fresh look at the situation. With the help of the operator panel can run other applications required to perform the current operation.
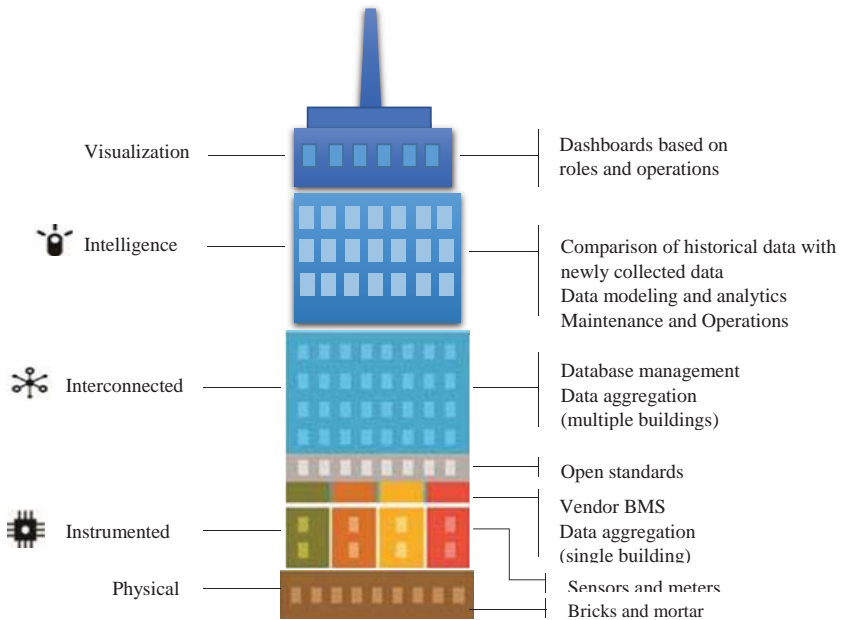


**Figure 12.3.** *Architectural elements of a decision*

Key areas of responsibility, including the administrator, managers on the use of energy and equipment, engineers are supported focused on the role of the instrument panel (Figure 12.4).

The equivalent tool for the data center is the IBM Tivoli Monitoring for Energy Management. Use it to collect data from the supported IBM servers and include additional data collection agents of the leading providers of data center and IT infrastructure. Agents can be built using IBM Tivoli Agent Builder and collect metrics from devices connected to the network, providing vital information. The generated reports help users identify areas where energy

efficiency can be improved, and allow better planning for power and cooling.

Graphical representation of metrics such as heat, power consumption, humidity and other parameters are provided by IBM Maximo Asset Management for Energy Optimization. The package allows you to schedule regular maintenance of buildings and sites, optimize the energy consumption within the scope of the entire infrastructure. As part of the overall solution for IBM Energy Management package is consistent with Tivoli Monitoring for Energy Management, that allows you to use data from a variety of different sites across the enterprise, including servers, heating, ventilation and air-conditioning, environmental sensors, and so on.



**Figure 12.4.** *The instrument panel administrator*

Finally, the area of management. Constant demands to reduce the cost and increasing the number of mobile workers confront administrators tasks such as reconfigureuring the occupied areas, the purchase of additional or unnecessary release area. IBM TRIRIGA facilities provide managers with a floor plan of the building visualization and helps to move, add, change and track resources. Integration with AutoCAD and MicroStation provides bi-directional communication and visual resources, people and organizations based on building information models and CAD-plan floors.

TRIRIGA Strategic Facility Planning defines the scripts best space planning to increase their utilization, distribute and compares the line occupied area of the company with their business objectives, the status quo, and so on. Managers can visually explore space planning scenarios with interactive

analysis of supply and demand, evaluate the effectiveness of new areas, and follow the completion of the renewal of the lease.

Thus, the granting of buildings "intelligence" has the following objectives:

• a holistic energy management, improving the efficiency of buildings and other assets;

• correcting deficiencies of building, the most appropriate and effective methods;

• unification of power management and assets in order to reduce operating costs.

Construction of smart homes can be considered one of the most important stages of creating smart cities, reduce the burden on the environment.

## 12.2 The concept of 'intelligent' city

Many countries have implemented ambitious projects for the development of modern urban infrastructure based on widespread use of the achievements of modern technology, especially ICT. This concept is called "smart city" (Smart City). Its main components can be identified the energy efficiency, environmental friendliness, safety, availability of different services and e-government, which provide comfortable accommodation in this city.

Such projects are related to infrastructure and a budget of tens billions of dollars as the construction of new smart cities from the ground up, and the modernization of existing urban systems. They are always at the initiative of governments or local authorities with the involvement of business partners such as IBM, Cisco and others. However, while you can only talk about pilot projects, before becoming mainstream, «smart city» is still far.

Currently unsatisfactory appearance ideas concept. Gathering held in the past, ideas, each of them reflect a narrow aspect of the organization of urban life, most often, economic. In the context of the dominant activity of the majority, IT-SMART-proposals bind only to the computerization of the city's infrastructure. Holistic ideas arise. The method of constructing of the concept resembles «brainstorming», based on an intellectual importance in the form of «analysis of best practices and case studies». The value of the concept of how the theory of «intelligent city» did not confess.

In these circumstances, the concept of SMART CITY conceptualization seems reasonable and interesting for those, who are responsible for urban development projects, and for the conceptual analysts. And since the «Smart City - is, above all, self-developing specific culture», it is difficult, and therefore interesting. There is a reason to start a scan of «development» theme with the application and the actual problem.

There was an understanding that the objective problems that must be resolved with the help of this concept are the following:

• The problem of obsolescence of municipal services (housing and other infrastructure). There is a problem with overly long existence of the city property compared with the rate of change of generations, requirements, technologies, and so forth;

• The problem of intensive poisoning habitat waste products;

• The problem of rapid complication streams that form the city, and the loss of controllability as it grows;

• The problem of the backlog of forms of support of individuals forming the urban population, the development of this rate in relation to the intensity of urban life;

• The problem of the backlog of social formation on the pace of urban life;

• The problem of public management processes of reflection backlog growth and development of the city on the speed of these processes;

• The problem of lagging the pace of development of urban life management mechanisms of the speed of change.

In response to it, there is a state of the domain any working versions of the concept of "smart city." When you run the business projects on construction of smart cities, these concepts can be deployed up to that limit the depth to which the technology capable of conceptual design.

## 12.3 'Smart' transport and logistics system (Smartlogistics), Managed ICT

Transport - a kind of binding element that is located between the units themselves of great logistics and much of the cargo delivery operations by using it. This led to the emergence of a separate branch in the system of logistics the so-called transport logistics – moving goods ordered in the required time, the best route to the desired point with minimal expense. Transport logistics generally covers three main areas: control over operations with goods arising route cargo, using various means of communication and new information technologies; organization and planning of delivery with minimal financial costs; providing the necessary information for the commodity. Transport, as an integral part of the logistics, consumes about fifty percent of all costs allocated to the logistics. It is involved in many logistical processes therefore requires coordination between all participants in the transport process. Let us look at the main transport logistics tasks: coordination of transport and storage process; creating employment goods transport systems; the desired type choice and mode of transport; determine the optimal time and cost of delivery routes of the goods; solve the above problems, it is necessary to observe the

basic principles of transport logistics: the desired quality needed slightest need to transport costs, and should he come to the customer at a set time and in the proper amount. With the development of the logistics system, the role of transport in this system varies considerably.

Nowadays transport service is determined by the optimal ratio of income and expenses according to the wishes of the sender and (or) recipient. Transportation can be internal and external, all depends on the variant of its use. These kinds of transport are linked to each other and form a common system of vehicle type.

Thus, transport becomes the main part of the transport of goods process. In this system of transport logistics functions of a successful process of storing and moving cargo. This process should be beneficial for both the temporary variant and economic. In the case of financial savings for re-loading and unloading cargo storage function is used when it is necessary to take into account the increase of time required for delivery of goods to the consumer. Isolation of transport in a separate area of logistics is contributed to the following factors: the presence of a huge number of forwarding companies, which plays the main role in the optimal delivery of the goods; the ability to create a sustainable transport, reliable and stable system of sale goods; high transportation price, which in some cases can be up to fifty percent of the total logical costs of cargo delivery; the solution of a large number of traffic problems.

Logistics is connected into one: the economy, technology and modern equipment. Transport logistics task is generally a separate complex process. Among the objectives and goals can be noted to ensure technological and economic nature. Technological unit is achieved through the use of a single transport technology. Economic unit is the construction of the tariff system on the results of market research. Technical unit implies consistency across all transport system characteristics as in interspecific reserve, and within species [2].

The basic principle of logistics is to minimize costs. In transport, savings can be achieved by the range and scale of the consignment. Savings of finance due to the range of the transported distance are achieved by the fact that with an increase in the cost of the route reduced, use of transportation when calculating per unit distance. For example, transportation of goods by 1 000 kilometers will be cheaper than transporting two goods (or goods of the same weight) per 500 kilometers. Saving money at the expense of the magnitude of the transported goods is achieved by the fact that the larger is the load, the lower the cost per unit of product (weight), or the use of powerful means of transport (water or rail), will be cheaper than the use of air or road transport. The above principles should be taken into account in the search for alternative forms of transportation. It is necessary to achieve maximum range and maximum load transport vehicles, taking into account all the wishes of the

customer. The optimality of transport costs should be such that the aggregate of all logistics costs are minimal. This can be achieved by establishing a balance between the quality of delivery and transportation costs. In drawing up a transport service model must take into account the schedule of delivery and route traffic.

Creating the optimal route will accurately calculate the number of vehicles that are necessary for the successful transportation of cargo. In determining and respecting delivery dates and selected routes, you can save the consumer stocks several times. This can be achieved the subject to such operations: preparation of placing consumer card; forecasting the required number of items and the volume of traffic; transmission of customer information; preparation of delivery schedules of goods on time; fictitious work; choice of rolling stock; preparation of optimal routes. The basis of transport logistics is just the vehicles, they must conform to the stated requirements and possess certain properties. Vehicles must have this ability: in accordance with small reserves user products, through small intervals of time need to carry consignments to set the distance. The most popular and the main criterion when choosing the type of transportation is considered the maximum use of their capacity and capacity, safety of goods, as well as a decrease in financial expenses for the transportation itself.

Logistical problems in one form or another have to solve the vast majority of companies. Even the company's IT sector, dealing with a totally intangible product that cannot be abstracted from the real world, since the functioning of the software need to «iron» the most diverse varieties and species it.

Companies as the «real» sector, in particular have its own fleet, faced with problems of logistics in its entirety. It is necessary to accept and process applications for transportation, plan routes, manage the delivery of goods, make correction «on the fly» from the inevitable failures of transportation, traffic problems, delays in cargo senders or recipients. In addition, the operational objectives need to be addressed and economic: reduce transport costs, improve the efficiency of the use of vehicles to analyze performance vehicle mileage, etc. Perform all of these operations manually in conditions of intensive business is very difficult. In addition to the high load on the employees, «hand» implementation functions inevitably leads to suboptimal results due to the difficulty of taking into account a large number of indicators in the planning of routes and loading of transport, problems with the delivery control, the inevitable errors in the execution of large amounts of manual operations and so forth. A natural way out the situation was the emergence of systems that automate the logistics – transport management system – TMS-systems (transportation management system).

TMS-systems provide operational accounting in the current automated

vehicle location (using data from the determinants of coordinates that are installed on vehicles) and road conditions, as well as data about delivery and shipment of the facts. This allows on-line to carry out route optimization and load vehicles, provide prompt and final reports on the implementation of logistics operations, generate indicators for assessing the effectiveness of operations and others.

One of the trends in the development of TMS-systems is their implementation of both of SaaS (SaaS (English software as a service) is one of the forms of cloud computing, a service model in which subscribers are provided with ready-made application software fully serviced by the provider) – solutions, making them accessible to the general medium and small companies often do not have the resources to purchase the «classic» corporate systems.

To give the appearance of TMS-system specific features, a few typical systems of this class could be considered.

ABM Rinkai TMS – system for the automation of logistics management in the B2B and B2C sectors for companies in various fields: production and distribution, transport companies, online stores and many others. One of the main functions of the system is planning of automatic transportation routes, taking into account available resources, vehicles, time-limited ranges of delivery, performance and cargo vehicles. Users of the system describe it as a system that improves the efficiency of logistics due to the following factors: the speed plan (the formation of the plan – no more than 5 minutes), the possibility of restructuring in order to unforeseen circumstances, the reduction in vehicle mileage and transportation costs (by 10-15% and 12%).

«Department of logistics» – also «cloud» implementation of TMS-system, providing «instant start» – these services do not require installation. The system algorithms form the best routes, taking into account the delivery time windows, some customers. In the formation of the routes is taken into account the current traffic conditions, allowing you to set a timetable for delivery with minimal tolerances. «The Department of Logistics» provides not only the rapid collection of information about the location of vehicles and during delivery, but also supports real-time information to drivers on the routes designed and developments. The system implemented by the API provides seamless integration with accounting and CRM systems. According to the calculations of economic efficiency of the introduction of the service, direct savings on transportation and related costs, some customers amount to 300 000 rubles. per month.

«2008 Courier service» system – a dedicated solution that has nonetheless very broad in scope. The system is aimed at the comprehensive automation of processes of delivery of goods from online stores, mail lists. the delivery of operations can be carried out not only locally, but also in long-distance and

international modes. The system provides through automation of the courier company's operations, has extensive integration with corporate accounting systems (via API or setting on the customer's request), a CMS online stores (ready-made solutions for Bitrix, OpenCart, PrestaShop, Shop-Script, etc..), with the CIS partners (SDEK, Boksberri, Pikpoynt, TopDeliveri et al.). The system enables integration with 1C-Accounting with bank-client systems, services, automated calls and SMS notifications, and many other services.

AlfaICT – process automation system of logistics in the shipping companies. The system applies more than 10 years for ordering activities logistics companies operating in national and international framework. AlfaICT program covers the accounting applications, customer information, billing, payment, monitoring, dispatch and ensure the return of the original acts of the work performed. Accounting documents are transferred to 1C facilitating the work of an accountant. Also it is available high-quality CRM unit. The program allows for multi-currency account, automates transportation with transshipment, multimodal transportation and delivery of cargoes. The system provides work of various departments-transporter companies in the general information field, providing employees with the operational information picture of their profile section. Company executives receive operational and financial information online.

## 12.4 Monitoring using «smart» devices (smart sensors, counters, etc.)

Information and communication technologies (ICTs) have become one of the fastest growing sectors of the economy in the past (especially pre-crisis) years, providing 16% of global GDP growth from 2002 to 2007. Therefore, on the one hand, an important theme is the "*greening*" of the industry. The so-called "green" ICT offers solutions for the use of computer technology and communication facilities with the least environmental damage and the maximum positive effect on the environment, including by reducing the specific energy consumption, ensuring a longer service life, features recycling and safe disposal of the individual devices and network components, as well as the transition to alternative energy sources for the operation of storage and data processing centers, and so forth.

On the other hand, that the potential contribution of ICT to the "green" economy is not limited. The widespread use of digital technology provides a unique opportunity for "greening" the economy in general.

The direct effect of ICT development that we are witnessing today *dematerialization* (and miniaturization), consumption and virtualization of many activities through the introduction of electronic document circulation, the development of electronic media and the market of e-books and music, the expansion of e-commerce and internet banking, use e-mail and video conferencing for meetings, the transition to the remote operation and so forth.

These trends continue, however, can still more important to be a stimulating effect of ICTs - improving the efficiency of energy and resource consumption in all other sectors by creating the conditions for the intellectual transformation of the transport and energy infrastructure, optimization and automation of production cycles and construction of "smart" homes and offices.

Source – SMART 2020: Enabling the low carbon economy in the information age; a report by The Climate Group on behalf of the Global Sustainability Initiative (GeSI), 2008. P. 30. http://gesi.org/portfolio/report/69

According to estimates of the Climate Group (The Climate Group), information and communication technologies (ICT) are able by 2020 to reduce global carbon emissions by 15% (7.8 billion tons of CO2-equivalent), and in monetary terms – save 1015800000000 dollars. United States, including US $ 872.3 billion. by reducing the consumption of electricity and fuel, and $ 143.5 billion. by reducing greenhouse gas emissions (when the world price of 20 euros per ton of carbon). This reduction in emissions of the economy in general is more than five times higher than the "carbon footprint" of the ICT sector [37, p. 51]. This single technology is certainly important, but the most promising direction is integrated by technology platforms, which bring together different approaches and innovation.

The greatest environmental impact from the introduction of ICT should be expected in the development of smart grid (smart grid): it is estimated that the Climate Group, in 2020, they can reduce global greenhouse gas emissions to 1.75 billion tons of CO2-equivalent. The basic idea of *Smart Grid* (The Economist magazine has introduced an alternative term – "energy Internet") – the fusion of information and energy technologies for optimizing the generation, storage, transmission, distribution and end-use energy consumption. One of the main advantages of such systems is the ability to integrate renewable energy into the overall scheme of distribution. Supply of electricity from solar and wind power plants is carried out by decentralized manner, and unevenly, but the monitor using the "smart" devices (smart sensors, counters, etc.) allows you to adjust the consumption via differentiated tariffs and adjust the load in the different segments of the network, depending on the availability of additional amounts of electricity. For example, the freezer compartment temperature can be adjusted automatically depending on the availability of "cheap electrons" in the network – to rise during peak loads, decreasing during the low energy demand in the network. In addition, consumers with their own generating units, are to supply surplus electricity to the grid and get compensated for it.

The practical implementation of this idea involves great financial and organizational costs in the traditionally sluggish in public services. To date, the level of investment in the development of such networks rank first the United

States, but it is expected that from 2016 the leadership will go to China. According to forecasts, by 2030 the US will spend on the development of US smart energy infrastructure to $ 60 billion, and China US $ 99 billion. Already, US and European standard-setters in the design of smart meters for electricity suppliers are oriented primarily to the Asian market. On the West pilot projects to create a "smart grid" goes not so smoothly. So, November 1, 2011 residents of Boulder voted in a referendum for the transfer of the local power grid in the city administration, as the executor of the project on introduction of «smart grid» technology company, Xcel Energy has not only significantly exceeded the project budget (more than 44, 8 million instead of US $ 15 million.), but failed to make full use of the existing capacity in the city for the development of solar and wind energy.

In the context of continuing economic instability to the fore again the problem of profitability includes innovative projects. To support the transition of the business to the "green" development strategies on the stock exchanges of the world created a special sector for trading financial instruments in the field of environment and energy – as an electronic platform for transactions (for example, trade quotas on CO2 emissions). In China alone, there are several platforms: China Beijing market for environmental transactions (China Beijing Environment Exchange, CBEEX), Shanghai Stock Exchange, on environmental and energy transactions (Shanghai Environment and Energy Exchange, SEEE) and Tianjin exchange on climate transactions (Tianjin Climate Exchange, TCE).

Thanks to modern means of communication, primarily the Internet offers opportunities for the development of innovative business strategies, implements the principle of trinity indicators of profitability, social and environmental responsibility (triple bottom line). Example: the so-called mesh-model based on shared platforms, allowing to abandon the personal property of many commodities. It is estimated that over the life of an electric service in the same family, it is used in only 15 minutes, and the rest of the time – gathering dust in the garage or closet. Each drill is used more efficiently and save money and storage space in your own home (as well as resources and energy to the production of extra tools), you can organize rental (leasing) tools – provided that potential users have access to the network and can at any time convenient for it borrow from the public workshop.

In the city of Santa Cruz, pcs. California, the idea of sharing economy (sharing economy) has gone beyond the business environment and spread to the non-profit sector. To date, the city has a number of projects operating on a similar principle, including the United States initiative to harvest the surplus collection with fruit trees in private gardens, repair and bike rental, car rental (annual fee of $ 75, gives the right to use any of the cars marked ZipCar1,

parked in special parking areas in different parts of the city) 3. In addition, various courses are becoming popular on mastering the skills of needlework and clothes repair, as well as the repair and development of computers. Such projects – a typical example of initiative from below, «from the roots», and benefit from them can receive the poorest segments of the population.

*ZipCar* – American company providing short-term rental of cars on the principle of self-service by the hour. The company was founded in 2000 in Cambridge, MA. Massachusetts. By the end of 2010, its fleet amounted to more than 9 thousand cars, car parks with the city in 28 US states and counties, as well as in the UK. According to company estimates, each municipal car replaces 15 private cars. At the same time 90% of users ZipCar pass less than 9 thousand km per year (for comparison, the average American motorist passing year more than 20 thousand. Km) than reduce annual oil consumption in the country of 32 million gallons (120 million liters) (ZipCar company data and US Department of transportation).

### 12.5 The Internet of Things

**The Internet of Things** (English Internet of Things, IoT.) is the concept of computer networks of physical objects ("things"), equipped with built-in technologies to communicate with each other or with the environment. The organization of such networks as a phenomenon that can rebuild the economic and social processes, are excluded from the actions and operations of the need for human intervention.

The concept formulated in 1999 as a reflection of wide application prospects of RFID tools for interaction of physical objects between themselves and with the external environment. Filling the concept of "The Internet of Things" diverse technological content and implementation of practical solutions to implement it since the 2010s is considered a stable trend in information technology, primarily due to the widespread dissemination of wireless networks, the emergence of cloud computing, the development of machine to machine technology, top active transition to IPv6 and the development of software-configureable network.

**Technologies**

**Means of identification**

Engaging in the "Internet of things" objects of the physical world are not necessarily equipped with the means to connect to data networks requires the identification of these items Technology ("things"). While the impetus for the emergence of the concept of RFID technology has become, but these technologies can be used all the means for automatic identification: the optically recognizable identifiers (barcodes, Data Matrix, QR-codes), means for determining the location in real time. When distributing a comprehensive "The Internet of

Things", the principle to provide unique identifiers for objects that, in turn, requires standardization.

For the objects directly connected to the Internet network, the traditional ID – MAC-address of the network adapter that allows you to identify the device on the data link layer, thus practically exhausted the range of available addresses (248 addresses in the space of the MAC-48), and the use of link-layer identifier is not too convenient for applications. More opportunities for identification of such devices make the IPv6 protocol, which provide a unique network layer addresses of at least 300 million units per inhabitant of the Earth.

**Measuring**

A special role is played in the Internet things measurement means for converting the external data into computer-readable data medium, thus filling the significant information computing environment. Use a wide class of measurement tools, from the elementary sensors (eg, temperature, pressure, light exposure), consumption metering devices (such as smart meters) to complex integrated measurement systems. As the part of the "Internet of Things" concept essentially pooling measurements in the network (such as wireless sensor networks, measuring systems), due to what is possible to build machine to machine systems.

As a particular practical problem of implementation of the "Internet of Things" notes the need to ensure maximum autonomy measurement means, above all, the problem of power supply sensors. Finding effective solutions that ensure self-powered sensors (use of solar cells, converting vibration energy of air flow, the use of wireless transmission of electricity), it allows you to scale sensor networks without increasing maintenance costs (in the form of changing the batteries or recharge the battery sensor).

**Data communication**

The range of possible data transmission technology covers all possible means of wireless and wired networks.

For wireless data transfer, particularly, the important role in the construction of "the Internet of things" is played by such qualities as efficacy at low speeds, resilience, adaptability, the ability to self-organization. The main interest in this quality standard is IEEE 802.15.4, defines the physical layer and access management for the organization of energy-efficient personal networks, and is the basis for protocols such as ZigBee, WirelessHart, MiWi, 6LoWPAN, LPWAN.

Among wireline technologies an important role in the penetration of «The Internet of things» played PLC solutions - technology of building powerline data transmission networks, since in many applications, there is an access to the power grid (eg, vending machines, ATMs, smart meters, lighting controllers initially connected to the network electricity). 6LoWPAN, implements

IPv6 layer over both the IEEE 802.15.4, and on the PLC, while an open protocol, the IETF being standardized, noted as particularly important for the development of the «Internet of Things»

**Practical use**

Technologies Related to the Internet of things are active application. Currently commercially advantageous use of technologies of the Internet of things is observed in the areas:

| The region's economy | An example of the application of the Internet of Things Technologies |
| --- | --- |
| Logistics | Automated identification at all levels of the supply chain |
| Agriculture | Monitoring the movement of cattle and his health status in real time |
| Marketing | Conducting marketing campaigns by bar-coding technologies, which can be recognized by your smartphone |
| Transport | Creation of automated transport systems (including «smart» car), monitoring the movement of vehicles |
| Tourism | Identification Technologies to provide information about monuments, attractions |
| Security | The control of arms trafficking and its application |
| Health | Control the spread of drugs |
| Production | Precise identification of each state of the production chain |
| Housing, Town Planning | Technological Solutions from the scope of «smart» homes and «smart» city |

The Internet of Things technologies are used in other areas.

**12.6 Big Data**

In the Russian-speaking environment is used as a term Big Data, and the concept of "Big Data." The term "Big Data" – a blueprint of English term. Big data does not have a strict definition. It is impossible to draw a clear line – 10 terabytes, or 10 megabytes? The name itself is very subjective. The word "great" – is as "one, two, many" among primitive tribes.

However, there are well-established views that the big data – a set of tech-

nologies that designed to perform three operations. Firstly, manipulate large in comparison with «standard» data volume scenarios. Secondly, to be able to work rapidly with the incoming data in a very large volume. That is not just a lot of data, and they are constantly becoming more and more. Thirdly, they should be able to work with structured and poorly structured data in parallel in different aspects. Large data suggest that the input stream is obtained algorithms and always structured information and that it can be extracted from more than one idea.

**Manage large sets of data**

A typical example of big data is information coming from a variety of physical experimental facilities – such as the *Large Hadron Collider*, which produces a huge amount of data and makes it permanent. Installing continuously produces large amounts of data, and scientists use them to solve a variety of tasks in parallel.

The advent of big data in the public space was due to the fact that these data are affected almost all people, not just the scientific community, where such problems are solved for a long time. In the public sphere *Big Data* technology came when it began to go on quite specific number – the number of inhabitants of the planet. 7 billion, gathering in social networks and other projects, which aggregate people, *YouTube, Facebook*, *VContact,* where the number of people is measured in billions, and the number of transactions that they perform at the same time. The data flow in this case – a user action. For example, data of the same *YouTube* are hosting that shimmer across the network in both directions. Under treatment is meant not only the interpretation but also the ability to properly handle each of these actions, that is, put it in the right place and make sure that these data are available to each user quickly as social networking sites do not tolerate waiting.

Much of the data that concerns large, approaches that are used for analysis, there is actually quite long. For example, processing of images from surveillance cameras, we are not talking about the same picture, but the data stream or navigation of robots. All of this exists for decades, just now data processing tasks are affected a number of people and ideas.

Many developers are accustomed to working with static objects and think conditions categories. In larger paradigm of other data. You should be able to work with a steady stream of data, and it is an interesting challenge. It affects more and more areas.

In our life more and more hardware and software are starting to generate a large amount of data – for example, "The Internet of things".

Things are already generating a huge flow of information. Police system "stream" sends information from all cameras and lets you find the machine according to these data. More and more are coming into fashion fitness bracelets, GPS-trackers and other things that serve human tasks and business.

Moscow Information Department is gaining a large amount of data analysts, because the statistics on people accumulate a lot and it is multi-criteria (i.e., for each person, collected statistics for a very large number of criteria for each group of people). In these data, it is necessary to find patterns and trends. Such tasks need Mathematics with IT-education. Because eventually the data is stored in a structured database, and we must be able to handle it and receive information.

Previously, there was not much data as a problem for the simple reason that there was no place to store them and there was no network for transmission. When these possibilities have emerged, the data is immediately filled the entire amount provided to them. But no matter how expanded bandwidth and capacity for data storage, there are always sources, for example, physical experiments, experiments on modeling, the wing aerodynamics, which will produce more information than we can convey. According to Moore's Law, the performance of modern parallel computing systems steadily increases, grows speed data networks. However, these need to be able to quickly store and retrieve from the media (hard disk, and other types of memory), and this is another problem in the processing of large data.

### 12.7 Artificial Intelligence
**Artificial intelligence** (AI English Artificial intelligence, AI.) –

1) Science and technology for creating intelligent machines, especially intelligent computer programs;

2) The property of intelligent systems to perform creative functions that are traditionally considered the prerogative of man.

AI is associated with a similar task of using computers to understand human intelligence, but not necessarily limited to biologically plausible methods.

Cited in the preamble to the definition of AI given by John McCarthy in 1956 at a conference at Dartmouth University, it is not directly related with the understanding of intelligence in humans. According to McCarthy, AI researchers are free to use methods that do not occur in people if it is needed to solve specific problems.

In explaining his determination, John McCarthy points out: "The problem is that while we cannot as a whole to determine which computational procedures we want to call intelligent. We understand some of the mechanisms of intelligence and do not understand the rest. Therefore, under the intelligence within that science refers only to the computational component of the ability to achieve goals in the world ".

At the same time, there is a point of view that the intelligence can only be the biological phenomenon.

As pointed out by the chairman of the St. Petersburg branch of the Russian

Association for Artificial Intelligence T.A. Gavrilova , in the English language artificial intelligence phrase does not have the slightly fantastic anthropomorphic coloring which it has acquired a rather unsuccessful Russian translation. The word intelligence means "the ability to talk intelligently", rather than "intelligence", for which there are English analogues of intellect.

Members of the Russian Association for Artificial Intelligence give the following definition of artificial intelligence:

1. Scientific direction in which are formulated and solved the problem hardware or software simulations of human activities that have traditionally been considered to be intelligent.

2. The property of intelligent systems to perform functions (creative), which are traditionally considered the prerogative of man. This intelligent system is a technical or a software system that can meet the challenges traditionally considered creative, belonging to a particular domain, knowledge of which is stored in the memory of such system, intellectual structure of the system consists of three main blocks – knowledge base, solver and intelligent interface that allows for communication with a computer without special software for data entry.

3. Science, entitled "Artificial Intelligence" is a set of computer science, and created on the basis of its technology to information technology. The objective of this science is the reconstruction with the help of computer systems and other intelligent devices artificial reasoning and actions.

One of the definitions of private intelligence, common to both humans and "machines" can be formulated as: "Intelligence is the ability to create a system in the course of self-study programs (primarily heuristic), solve a certain class of the complexity of problems and solve these problems".

### 12.8 Green Technology ICT

Innovations, which are based on the principles of sustainable development and re-use of resources.

A common approach involves reaching their main goal is to reduce the negative impact on the environment, for example, by reducing the amount of waste, energy efficiency, design improvements reduce the amount of resources consumed.

According to the classification of the Organization for Economic Cooperation and Development (OECD), green technologies cover the following areas:

– General environmental management (waste management, water pollution control, air, land restoration, etc.);

– Production of energy from renewable sources (solar energy, biofuels, etc.), Mitigation of climate change, reduction of harmful emissions into the

atmosphere, improving fuel efficiency, as well as energy efficiency in buildings and lighting fixtures.



In fact, green technologies cover all sectors of the economy: energy, industry, transport, construction, agriculture, etc. They are currently being implemented in the entire chain of companies, including, in addition to production, consumption, management and methods of production.

Green technology, as a rule, can significantly reduce the consumption of resources, increase the use of by-products. Thus, modern refrigerators consume 75% less power than their counterparts in 1975, with the 20% increase capacity, in particular due to an improved and more effective insulation of the cooling system. Air transport in developed countries uses 50-60% less energy per passenger compared to the beginning of the 1970s, and freight – at 10-25% less fuel per ton-kilometer.

A more effective it becomes oil and gas, if used associated gas was flared, but today it is widely used; advanced technologies allow for a long time to operate even old oil fields. The green building is not only reused building materials, but disposed of trash, used, new insulating materials and alternative energy sources, waste heat is used for heating the air and so forth.

Among the main areas of the development of green technologies is a key power. The main areas of its «greening» are energy efficiency and the development of new energy sources, especially renewable.

The most simple and effective ways to reduce energy consumption and other environmental issues are the use of technologies aimed at improving the insulation of buildings, the use of lighter materials in vehicles, reducing water leaks in municipal systems, as well as improved methods of storage of agricultural products.

### 12.9 Teleconferences

Teleconference (Forum) is an organized themed messaging between network users.

Messages are not sent to the private addresses of users, and address the conference call, i.e., the recipient is a server that provides access to the message received to other network users.

Teleconferences can be classified in several ways:

• The method of information exchange – Conference in delayed mode in real-time (newsgroups, mailing lists) and conference (via IRC servers - Internet Relay Chat);

• The process for teleconference management – moderated (managed) and unmoderated (unpadded);

• The level of access to the conference call – open and closed (for registered participants).


### 12.10 Telemedicine

**Telemedicine** is one of the areas of medicine, based on the use of modern communication technologies for remote medical care and timely advice.

From the history. For the first time the term "telemedicine" was introduced in 1974, but long before this practice of telemedicine consultations was implemented with the help of the first precursor telephone – telegraph. Later the phone was invented, then – radio, television, and finally – the computer. With the advent of computers humanity learned what the Internet, and then ceased to be a telemedicine technology from the category of fiction.

The first transcontinental medical videoconference was held back in 1965, during which a prominent heart surgeon Michael DeBakey advised course of surgery to replace the aortic valve in the artificial heart.

**Main directions of telemedicine**. Among the main areas of telemedicine should include: telemedicine consultations, tele-education, online broadcasting operations, remote biomonitoring and home telemedicine.

**Telemedicine consultations.** Telemedicine is remote consultation and diagnosis of patients are considered to be the most common and popular service. With the help of video conferencing systems between consultant and the patient is getting better full audiovisual contact. Thus, the patient and the doctor can not only see and hear each other, but also share graphics and text data (e.g., an X-ray snapshot of a patient or a physician license).

**Medical tele-education**. Medical seminars, conferences and lectures broadcast videoconferencing system enable professionals of a higher level to share their knowledge and skills not only in theory but also in practice. Thus, more experienced professionals can even remotely monitor the progress of operations and give practical advice to their colleagues.

**The online broadcast of surgeries.** The use of webcams to transmit over the Internet a variety of information, allows for broadcast operations. This area is also used by telemedicine for Tele-mentoring when a more experienced expert remotely controls the actions of their colleagues in the online mode. During the operation, one person can transmit different image medicine device (microscope, endoscope or an operating table), applied to digital video cameras. In addition, you can transfer telemetry information (about the patient's state of the pressure, the frequency of its pulse rate and many others).



**Remote biomonitoring.** Remote patient monitoring systems are used by health professionals to monitor their health. This requires a special telemedicine equipment with which the doctor can monitor your patient at a distance. It is often used in remote monitoring surveillance for the elderly who are unable to carry out all the necessary medical manipulations.

**Home telemedicine.** This area includes the provision of telemedicine physicians to care for patients undergoing treatment in the home. Specially designed for such purposes, telemedicine equipment transmits the collection of patient information directly from his home. It is realized as follows: the patient to the home PC is connected with special complexes containing sensors for the measurement of body temperature, blood pressure and other data necessary for medical professional. Thanks to videoconferencing systems all this information from the patient's home PC is automatically transmitted to the telemedicine center for further processing specialists. Particularly it is relevant home telemedicine for patients in need of regular, operational surveys (for example, people with heart disease).

**Control questions:**
1. List the advantages of using the SMART technology in education.
2. How do you identify the structure of intelligent networks and intelligent network?
3. What is meant by the expression «smart» building? List the positive aspects of the introduction of «intelligent» buildings.
4. List the need to develop the concept of «smart» city.
5. List the specific features of the TMS-systems.
6. How do you see the expression controlled by ICT?
7. How do you see the Internet of things?
8. What was the need for the creation of artificial intelligence?
9. List telemedicine.

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# CHAPTER 13. E-TECHNOLOGIES

## 13.1 E-business: basic models of e-business

There is a pure e-business model.

|  | State (G) | Business (B) | Citizen (C) |
|---|---|---|---|
| State | G2G coordination | G2B information and sale of illiquid assets | G2C |
| Business | B2G supply | B2B e-commerce | B2C e-commerce |
| Citizen | C2G taxes | C2B price comparison-price comparison | C2CAuctions |

*Business system for business* is an organization of complex information and trade cooperation between the two companies by means of electronic communications (the Internet, intranet, mobile and other communications). The main difference between B2B system is the automated data exchange between two interacting systems, which means that on both sides of the complex automated control systems (enterprise resource planning). The system of any B2B contractor has the ability to view the current needs of the company, immediately react to them, plan delivery schedules, delivery methods to determine, invoices, and all of this information in the enterprise resource planning system. First of all, B2B systems are designed to solve the problems of distribution and logistics. In addition, this system can reduce transaction costs and remove inefficient units of supply chains.

*Models of B2B:*

1) Aggregation Model (electronic trading platform) – a universal place for the procurement of logistics for the company. In one place, in the form of a single vendor catalogs represented on the groups of products and categories that are displayed in real time.

2) Shopping hub model is forming online trading community of buyers and sellers. The seller has a special place to advertise their products, and the buyer has the opportunity to receive information including product specifications and descriptions. This model can be horizontal, i.e. support of all buyers and sellers from different industries. Diagonal business model supports certain categories of buyers and sellers, and certain categories of goods. A feature of this model is that the auctions for the sale of large quantities of rare items or auctions for the integrated supply of small companies.

3) Bulletin Board is a structure where buyers and sellers can post something that may cause interest among buyers and sellers. Parties, finding each other react outside the structure. The purpose of this type of e-business is encourage industry to more standardized terminals.

4) Auction model buyers and sellers expose competing bid for contracts. This is an ideal model for the elimination of the surplus at the best price.

5) Brokerage site operates as an intermediary between buyer and seller, which exists for the purpose of obtaining an order via the Internet from one entity and placing it in another enterprise.

6) The corporate website of the company is for communication of the company with other partners, counterparties, existing and potential investors. The site contains information about the company, its management, as well as product catalogs and service descriptions.

7) Online shopping – this model can be integrated into the overall corporate website or exist separately.

8) The Procurement Service allows the company to carry out logistical support directly through your website. To do this, place their needs for material and technical resources in order to find the supplier and obtaining from him commercial offers.

*Advantages and disadvantages of B2B system are:*

1) system extends the coverage of the market;

2) online platform provides price reductions;

3) the activities of online brokers reduce the operating costs of customers of companies;

4) web-based system allows to identify the best ways of doing business.

Two groups of risks arising from B2B customers can be distinguished by:

1) Technological risk – poor quality service providers, hacking tools internal databases attack followed the leak of confidential information, the possibility of a denial of service;

2) Business risk – the risk of non-compliance the quality of supplied products, the risk of losing the buyer in the transaction of prepaid funds, the risk of non-payment or delay in payment, the risk reduction of profit margins for suppliers and buyers. A common shortcoming of B2B sites is the lack of settlement services, with the result that the transaction is split into two parts: electronic (buyer and seller agree on the terms) and traditional (the signing of documents, payment).

The movement of business on the Internet according to the analysis of experts, through the following stages in the process of development of the Internet is:

1) connection to the Internet with the possibility of companies actively use it - this phase is passive, but you cannot do without it;

2) creating a web-site, but it creates a marketing interactive information channel, create a positive image of the company, interaction with the environment and the promotion of goods and services;

3) procurement and sales through electronic communication channels;

4) use of the Internet to integrate with the company's internal management systems.

The contents of a web-site sections are associated with exposure to the different target groups in order to create a positive image of the company.

The first task Force – Information for the press is ready materials that journalists can use for thematic publications.

The second – general information about the company – that information, which the company describes itself audience. This shows transparency and its willingness to work with the community.

The third is information about products or catalog.

The principal of the company the following target groups: shareholders and investors, customers, media representatives (not only regional, but also at the federal level), the local community in which the company operates, professional society and other stakeholders.

B2B is a model in which e-commerce services to consumers, sellers and buyers - individuals.

Advantages for the buyer are:

1) the absence of a geographical point of attachment to the trade;

2) a comparison of information about products from different manufacturers and sellers;

3) the ability to save time.

B2C system takes place in the case of sale of the enterprise of their goods or services via the Internet directly to the consumer.

B2B system is the principle of a contract based on mutual profit.

B2C system – sale of goods is carried out on the basis of receipt of applications. An example embodiment of a B2C e-shopping, booking and ticket sales.

*Internet kiosks*

Business Development B2C is related to the overall development of the economy and increase the welfare of customers. Online trading can be developed only if the high quality of all its components is:

1) logistics – this part is not developed in Russia;

2) transport infrastructure;

3) e-mail system;

4) payment systems online stores.

Trading company working in the B2C system are the following structures:

1) Web-Showcases – placement in the network directory products or goods companies with means of ordering min;

2) Online Shop contains in addition, showcases all the necessary business infrastructure for managing e-commerce process;

3) Commercial Internet System (CIS) an online store and web-based office that is fully integrated with the company's business.

B2C organizationally and methodologically is simpler than the B2B system. For the customer online store – a showcase, where should be presented:

1) catalog;

2) interface elements to enter the registration information and the formation of the purchase order;

3) making payments via the Internet;

4) obtain information about the vendor;

5) the presence of on-line help. electronic storefront is located on the web server and is a web-site with active content.

The main stages of the buying process are:

product search → Choice of goods → payment → delivery ; registration,, form filling
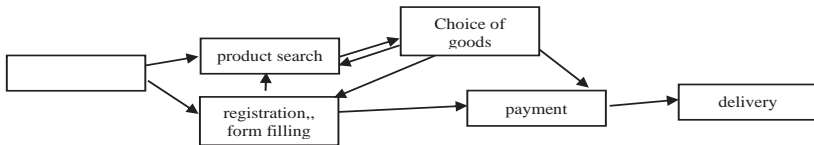
Information service of the buyer - the main purpose of an online store.

C / Client → Web server ; Business processes of the organization ; Payment system ; DBMS ; Application server
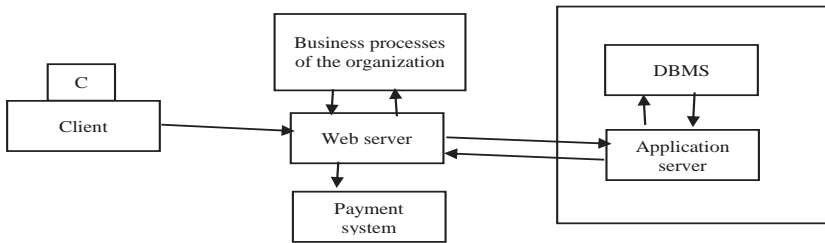
Web-server distributes incoming requests to the possible separation of access.

The application server controls the entire system and in particular the logistics business online store.

DBMS (database management system) provides data storage and processing.

For full integration with the company's business processes must be organized gateway for electronic data transmission between buyers and document of the company.

There are three main features of the B2C system:

1) the seller itself trades manually through their managers, rather than using the automated trading system;

2) private person or legal entity acting as the buyer is in a favorable position if the interface online store has no real connection with the enterprise;

3) features associated with the business process, as each business process

is automated with the help of some management system that can dock with your business system, thereby denying your access.

*C2C system* (buyer to buyer)

View e-commerce between buyer and seller. The site acts as an intermediary between buyer and seller. Consumers enter into a deal and expand its operations with the help of third persons – provider (it provides exchange services). Around the web-site develops an online community of people united by specific interests, their number is directly proportional to the efforts of the project participants and the organization of the necessary services. C2C direction allows to enter into transactions at any convenient point in time, reduce overhead costs and savings of the final consumer. The sector includes C2C online auctions where the sale takes place directly from one person to another within the framework of e-business, when there is a single seller and many buyers. To participate in the auction, the buyer or seller is enough to become a customer of one of the auction server and expose for sale a product or express a desire to purchase it through the Internet.

The Internet allows one person who became a client of the auction to participate simultaneously in multiple electronic trading and registration for the e-mail is enough to have a bank account. Banking structure is used the technology of electronic auctions for foreign exchange trading. Sale of goods for the highest possible price is called direct auction. In this structure there is one seller and buyers of two or more. Reverse Auctions – one buyer and several sellers – on the structure work all the auctions of government procurement.

Auctions implement natural pricing schemes, therefore are used for the study of market opportunities. Bidding on auctions are conducted as follows:

1) *Standard* or *English* auction. Use an open format offers when all customers are aware of each other's sentences. Seller assigns the starting price and the buyers indicate the price of a 3% increase proposed.

2) The *Dutch* auction – starting with obviously inflated prices, also uses an open form of proposals and continues as long as one of the buyers does not agree to accept it.

3) The *simultaneous* auction offers all at the same time buyers set prices and win the one who offer the most.

4) The *double* auction – when the proposal comes from the seller and the buyer at the same time. As a result, the equilibrium price is set – electronic exchanges operate on the principle of the electronic auction.

5) The auction *closed* sentences - when the buyer and the seller makes the closed (secret) proposals within the stipulated time. Winner buys the goods at the price, the previous maximum.

*On-line* auction is an information database, which contains the description of the goods admitted to trading. Auction is a system of ratings bidders.

It will conclude that the winner of the auction and the seller put up with each other evaluations, reflecting their attitude to the counterparty, established in the course of interaction. This setting assessment is mandatory. The Internet Exchange allows active mode operation with financial assets. Exchange – a marketplace, where product price is determined by supply and demand. At the stock exchange the goods must be standard, as trade anonymity and the buyer cannot see the goods before buying it. Revenues internet exchanges entirely of commission for the deal.

### 13.2 Information infrastructure of e-business

Modern companies with an efficient IT-infrastructure receive a significant competitive advantage strategic level. Moreover, the constant growth of requirements on the part of the business, such as the expansion of the branch network, access to new markets, the increasing complexity of processes entails increasingly complex software and hardware companies, so the need for rational management of IT, especially for large companies is coming to the fore.

Any of the office computers are no longer used only as a typewriter and a multifunctional calculator accountant. The ubiquity of telecommunications networks including personal computers in the business process workflow. Moreover, it happens in companies of any size and ownership. E-mail and web services successfully replace in-person meetings, courier and even banking. Therefore, if in the IT-infrastructure will a failure, there is a risk of irreparable harm to the whole business [1].

Leaders of absolutely all companies now fully realize the importance of effective and trouble-free operation, use of information systems. So even there has been some shift in the requirements for the service sector of IT-infrastructure. If earlier it was enough to know that all computers are in order and the staff does not idle, now comes to the fore the question of the speed of the entire disaster recovery information system. And the most important thing – you need to decide who will carry out this support. And in order to understand what are the differences between outsourcing and IT-supported information networks on their own, it is best to look at the problem through the eyes of the leaders of companies of various sizes.

**IT-infrastructure for small businesses**

In small companies it often applied the practice of the system administrator involvement only as a problem. This allows a much reduced by maintaining an information network costs in working condition, but is fraught with very long latency specialist in case of urgent need for it. The system administrator often employs only as part-time work, and before the appearance of his spare time restores the system, and there is no way. And the attitude to work, in this case too is appropriate.

Outsourcing also looks more attractive. Specialists such firms operate on clearly spelled out in the contract specifications on the reaction time and correct the problem. They are also very interested in the quality of their work, to the number of accidents could be reduced to a minimum, because for most outsourcing company any failure in performance of the customer equipment is sputtering own strength, even if it was embedded in the concept of the business.

**IT-infrastructure for average business**

For mid-level companies, already in the state is characterized by the presence of at least one IT-specialist. But here you can observe the distinct advantage of IT-outsourcing, which is expressed in the level of training. Medium-sized businesses take the staff of highly paid, but perfectly are prepared by the system administrator, which is not profitable, as to provide him with daily classes like elementary. So you have to settle for inexpensive human services with an average level of training, which in the case of serious problems in the IT-infrastructure is not always able to respond adequately.

In providing services IT-outsourcing firms approach to staff is somewhat different. It has a crucial role which is played by professionalism. This is to ensure that the customer can be serviced as soon as possible and with the highest possible quality that the shortage of special education and experience is unattainable. In addition, the involvement of experts from the outsourcing company solves the problem with the audit of IT-infrastructure, which often do not have time. As a result, the entire information system loses its stability, its development occurs randomly, and no documentation in this case is more often than not carried out at all. Practitioners are also quite reasonable scruples and demands for order in all IT-outsourcing affairs firms begin their work with a new client just to bring its information systems in an ordered state, at the same time increasing their efficiency [2].

**IT infrastructure for large businesses.**

Large companies usually employ skilled IT specialists, but this does not exclude the use of IT-outsourcing as a Supplement to their IT Department. The motivation here is the desire to get the really reliable and effective information infrastructure.

**13.3 E-learning: architecture, structure and platform**

Over the past two decades in the field of the Internet education is dominated by LMS (Learning Management Systems) – learning management system. However, in its traditional form, they are not able to support all the new features of the Internet technology and use the potential of all communication within social networks. Taking into account the existing technological nuances and possibilities of modern platforms has helped the emergence of

such systems as E-Learning Framework (ELF), IMS Abstract Framework and the Open Knowledge Initiative (OKI) that determined the first steps towards creating a service of e-learning platforms.

However, in its traditional form, they are not able to support all the new features of Internet-technologies and the potential use of all means of inter-action within social networks. Consider available technological nuances and possibilities of modern platforms, help the emergence of systems such as E-Learning Framework (ELF), IMS Abstract Framework and Open Knowledge Initiative (OKI), which are identified the first steps towards the creation of an e-learning service platforms. The next generation of distance learning systems will be based on the service architecture.

The Internet-technologies are becoming an integral part of everyday life, people are closer to the realization of new possibilities of communication and one of the possibilities - e-learning (e-learning). more dynamic platform cre-ated in this area, that are replacing traditional «passive». An active e-learning is used by a wide range of Internet-technologies such as personalization, mo-bility and simulation that enables you to implement inaccessible to traditional types of teaching methods. There is a growing demand for modular and per-sonalized e-learning platform, the traditional platforms do not have sufficient flexibility due to its monolithic internal structure. Manufacturers of e-learning systems are trying to meet this demand by offering tools that support the set-ting or to modify the source code of such systems in accordance with the terms of the various licenses for open source software. This suggests an emerging trend of denial of universal solutions to specialized. The new e-learning plat-form will provide interoperable architecture for existing and newly created services. These requirements include federated sharing between services (in-formation and management), different levels of interoperability (intra-domain and inter-domain) and composition of services (organization and manage-ment). However, the implementation of a new generation of platforms, has a lot of problems in a variety of research areas, such as Semantic Web, adaptive hypermedia, dynamic services and federated simulation.

*The e-learning platform*

Traditional e-learning platform, or learning management system consti-tute the environment for the delivery of training courses and management. They offer packages of tools that support the creation of online courses, their facilities and provision, means the registration of students and management of work with them, the administration of the process of learning and reporting about the success of students. All the LMS system can be divided into two main categories:

• freely distributable initiatives, which include Moodle (*www.moodle. org*),

Sakai (*www.sakaiproject.org*), ATutor (*www.atutor.ca*) and Whiteboard (*whiteboard.sourceforge.net*);

• proprietary solutions, including WebCT/Black board (*www.blackboard.com*),

Gradepoint (*www.gradepoint.net*), Desire2Learn (*www.desire2learn.com*) and Learn.com (*www.learn.com*).

Free software solutions are generally created through extensible wrappers that enable you to conFigure and modify the learning system in accordance with the specific requirements. Despite the fact that in the category of proprietary systems, this approach has not found wide application, it arose in the framework of initiatives such as in WebCT PowerLinks and Blackboard Building Blocks in providing means for the connection of third-party software vendors with LMS.

The e-learning platform of *the first generation*, which appeared in 1993, in fact, represents the "black boxes". In most cases these systems are used by internal formats for direct control of the courses. As a rule, between systems and courses there was one – correspondence with a very limited control over users. Priority requirement in establishing these platforms has been the provision and interoperability of specific content designed for a specific course. At the same time, there is a range of standards – Dublin Core (*www.dublincore.org*), IMS Learning Resource Metadata (*www.imsglobal.org/specifications.html*), IEEE Learning Object Metadata (*ltsc.ieee.org/wg12/*) and a number of others that are still in use today. These standards describe the content that satisfy the LMS, they could be exchanged at the resource level, however, this practice is not widespread. Instead, standards provide interoperability between different systems at the level of content through communication channels such as AICC Computer Managed Instruction (CMI; *www.aicc.org/pages/aicc_ts.htm*). AICC describes common communication protocols for working with the learning content. In particular, provided notification is sent to the LMS and indicates the start and end of the academic content. The platform of the first generation is provided a further evolution, as supported share the content. Examples of such e-learning platforms can be called the first versions of WebCT and Blackboard.

**The second generation**

The e-learning platform of the second or current generation (they began to appear about 1999) has developed a success of their predecessors and began to fix their mistakes. Such platforms include WebCT/Blackboard, Moodle and Sakai. From the point of view of the evolution of e-learning, they ensured the transition to implementing a modular architecture and have shown the need for semantic exchange. They were founded based on the exchange of not only content, but also the learning objects, their sequences and information about the

students. At this time, standards and specifications such as Shareable Content Object Reference Model (SCORM; *www.adlnet.gov*), IMS Content Packaging и IMS Learning Design (*www.imsglobal.org/specifications.html*), IMS Tool Interoperability has set the guidelines for the interoperability of instruments between different LMS systems. Another important aspect consisted in the fact that the platform of the second generation began to support the principle of "services", opening the outside access to certain aspects of its functionality. Increasing the level of modularity of the structure became easier to integrate in the platform the new feature. In some cases, for example in Sakai, created Web services provide access to a limited set of features: the LMS community has increasingly sought to separate content from the tools and pay special attention to information about students. However, these systems were not yet fully focused on the student: they remain largely focused on administration of training, i.e. management courses.

*Evolution* opens the door to e-learning platforms of the next generation, which essentially involves the use of service skins the modular architecture platforms. The division of the functionality of the system and learning content management LMS (Learning Content Management System, LCMS) will support greater interoperability, where systems can conflict-free and dynamic exchange of not only content and learning scenarios, but also the tools, functionality, semantics, and control facilities. This also applies to a much broader range of information (user data, context, programming, job flow and management), which services can use and analyze the e-learning platforms. This will allow you to create a custom platform from a wide range of services to support specific tasks, dynamically solved in a certain time. Traditional LMS manufacturers will sell not monolithic, universal solutions, as interoperable platforms and a variety of e-learning by providing users the ability to choose their desired combination of services.

The new generation of e-learning platforms raises several key issues relating to support interoperability at the information level, partly because of the transition to the exchange of semantics. You need to be able not only to import and export information, but also sharing in heterogeneous environments. Modern e-learning platform, for example, can send user information (level of knowledge, skills, and preferences) or information about the content (metadata about the subject, technical content, etc.) between environments. However, there is no possibility to "understand" the semantics of such information, to Figure out how to analyze or how it can be used by different environment. For this level of interoperability of the environment should share information syntax and its semantics. This is impossible to achieve with the help of what is called "shared" semantics, that is, using a single, global semantic model. In fact, people (the main component of information systems) completely diffe-

rent ways to describe objects, so flexible solutions should identify and support dynamic semantic matching in order to ensure true semantic interoperability.

Another key aspect of semantic exchange is associated with the control. It cannot be assumed that e-learning is just "flat" content. They have its own internal representation, flow of control and, in some cases, tracking mechanisms. Thus, future e-learning platform must support the exchange of control between the interacting services.

Another difficulty associated with providing higher levels of interoperability, for example, requires the creation of wrappers and standards to support connectivity of new systems and capabilities. The solution of this problem has already dedicated to numerous initiatives, and is actively involved in standardization organizations. Composition of services will enable such e-learning platforms to dynamically discover and compose the services in order to achieve particular goals, which puts each individual user. In this case, it will be necessary to organize the services ("orchestration") and management services ("choreography"). We have taken a number of research initiatives dedicated to solving the mentioned problems, but most of the work is still at an early stage.

*Standards and technology*

Some standards and processes support the requirement for interoperability of next-generation e-learning platforms. Existing and emerging methodologies evolve based on modularization and separation of spheres of influence, which essentially means allocation of functionality to modules, which you can then combine in order to form an integrated e-learning platform. Service architecture (Service-Oriented Architecture, SOA) describes an architectural concept that defines the processes and logic as individual services. These services, in turn, give other services the opportunity the standard way to use elements of its functionality.

On the other hand, component-oriented architectures (Component-Oriented Architecture, SOA) is designed for lower level and more closely related than SOA. Changes to individual components typically impact on the software to which these components are accessed, that is why SOA is more flexible and extensible than COA. A component-oriented architecture in the first place is related to a local component, its properties and methods.

In architectures based on the use of instrumentation middleware (middleware), interoperability between applications or services supported at the software level, allow us to provide such services as identification, authentication, authorization, information exchange and security. Software middleware specifically is designed for modern knowledge systems, based on XML, SOAP and SOA. Indeed, this software is often called "plumbing system" that unites Web services.

Organization for standardization for a number of years studies different

shell, specifications and principles of service e-learning platforms. IMS Abstract Framework (*www.imsglobal.org/specifications.html*) identifies and presents the main components and interfaces for e-learning systems. E-Learning Framework (ELF; *www.elframework.org*) illustrates the overall functionality of e-learning systems. Open Knowledge Initiative (OKI; *www.okiproject.org*) determines the levels of services for the development of e-learning platforms. The General approach underlying these newly created standards is the modularization of functionality, as a rule, defining the following groups:

- the application sets (level LMS);
- application services (low level services, such as surveys and modelling, with which the user interacts directly).
- educational services (usually relating to the administration of learning, such as the management of courses and course schedule);
- shared services (important functionality to which the user has access, e.g., authentication, file sharing, registration and database management);
- infrastructure (base services, including HTTP, SOAP and XML).

Sheath, specifications and principles of the organization, in turn, determine the level-by-level approaches to creating e-learning systems of these sets previously defined services. These specifications define the presentation of individual and group information (IMS Enterprise), the student's profile and learning history (IMS Learner Information Package and e-Portfolio), assessment (IMS Question and Test Interface) group study of content (IMS Content Package and SCORM), dynamic programming content (IMS Simple Sequencing), competence of the student (IMS Reusable Definition for Competence and Educational Objectives), operations, learning (IMS Learning Design), search in federated databases (IMS Digital Repositories Interoperability) and associating different e-learning tools. At a low level, these standards and specifications describe the syntax that the various services should implement for the external representation of information. However, the loss of a critical component of interoperability is the ability to dynamically use the content information. In this direction serious work is performed by the Semantic Web community.

The key assumption for a read machine information and services is that services can interact and negotiate on the fly. Developments in the Semantic Web began with RDF and DAML+OIL, and since then moved up to the ontology language OWL (Web Ontology Language, www.w3.org/TR/owl-features/), which recently became a W3C standard. The OWL language can be used to describe the «ontology» – knowledge bases of concepts, have access to the services and requests for information. In particular, ontologies help to create new knowledge in which a conclusion may be formed in the knowledge base with the target, regardless of information directly enter by the Creator of

the ontology. This ability extends to the world of Web services using a subset of the ontology language – OWL for Services (OWL-S).

At a low level, developers can use Web Service Description Language (WSDL), W3C proposed for describing functionality of Web services in terms of «input», «output», «predetermined conditions» and «effects» (inputs, outputs, preconditions, effects – IOPE). WSDL provides a syntax through which a calling system or service can access the outdoor functionality without considering its internal implementation.

Adaptive hypermedia system form a second group of technologies support interaction in learning systems. Here we use a different approach, because, as a rule, an adaptive system is an open information system with almost unlimited access to the available knowledge on a particular subject area. This means that external sources are relatively easy to add new information when referring to this system and that a small amount of additional data can lead to large productivity gains. Adaptive services using OWL-S in addition to core OWL, provide opportunities for interactive services.

The basic relationship between the Semantic Web and adaptive hypermedia is the composition and the Web services technology. Technologies SOAP and REST support remote systems in order to use the Web-based communication to create complex systems from atomic services.

*Services e-learning*

E-learning can cover any technical aspect of distance learning, and initiatives such as ELF, IMS Abstract Framework and OKI define a wide range of high-level functionality, which is able to provide services of e-learning. Such services include traditional functionality (authentication, tracking, management, courses, schedules, operations, tools and evaluation), as well as new opportunities – presentations, resource gathering, context management, federated exchange, simulation, games, wiki, blogs, podcasting, etc. Thus, to ensure genuine flexibility e-learning platform must support an ever-expanding range of new high-level and low-level services. The complexity and variation in the standards of the second generation will result in a wider variety of implementations than make a content-related standard of the first generation. In addition, the e-learning platform must be able to support loose coupling, thereby ensuring the interoperability of semantic services.

Interoperability of services requires conflict-free creation, deployment, use and management of Web services. The bulk of research in this area is devoted to interoperability at the syntax level, i.e., the ability to create a service on any platform in any environment and interact with it from other platforms and environments. Using these specifications, like the OKI, the community of e-learning describes a common API on the basis of the membranes for specific applications. However, these APIs provide support only tightly coupled col-

lections of services, grouped by functionality. In the future, more weak ties have greater potential for interoperability and flexibility, and IMS Tool Interoperability was a positive step in this direction. Instead to describe the API for communications in the common syntax, the developers will focus on the exchange of semantics and managing the flow of commands between services.

*Services, taking into account the context*. The basis of the studies of "pervasive" computer systems, is based on two basic concepts: ubiquitous computing (pervasive computing) and background calculation (calm computing), which allow users to simplify management of their complex information profiles. E-learning, using the context, aims to reduce the information load on learners and allow them to focus on other tasks of learning.

As a rule, modern systems form the context based on physical properties such as location. Next-generation systems will be able to effectively use information sources, access to which will be possible due to a service approach. The services will provide much more information about students and their activities, including metadata to describe the information. This richer information space allows the system to obtain more data, the bulk of which is detected during operation.

One approach involves integrating adaptive systems with semantically described services by using the semantic overlapping of the network to create links between knowledge, placed in the external services, and the application of e-learning. Environment, context-aware can use these links to convert the information held by external services in the application of e-learning taking into account the situation and requirements of users (i.e., their context).

## 13.4 Electronic textbooks and intelligent tutoring systems

Electronic book – learning tool, which is a computer program that contains educational material and interactive tests. Modern approaches and tendencies in the development of different models of educational systems show that nowadays it is a world where science and high technologies play a fundamental role in the harmonious development of the future of the younger generation and largely determine the quality of the educational process in General.

The need for computerization of educational institutions is increasing every day. The massive spread of computer technology in the 90-ies of XX century brought into the field of education not only new technical and didactic possibilities, among the main advantages of computers, their accessibility, simplicity, interaction, graphics and other features.

The application of computer technologies in educational process allows to increase the speed of transmission of information to the learner and to increase the intensity of her understanding, promotes the development of personal qualities as intuition, professional flair, imaginative and creative thinking of students.

Over the past 20 years, we have developed a large number of computer systems for educational purposes, aimed at different types of information and telecommunication.

Analysis of the literature shows that the development and use of e-learning tools have evolved in two main directions. In the first direction are being developed and operated automated training systems for different academic disciplines. The core of automated learning systems is so-called copyright system that allows teachers to enter their training materials in database and programming with the help of specialized tools, algorithms study.

Electronic textbooks are created with the aim of enhancing performance, development and deepening of existing knowledge, provides trainees, listeners to additional information and is designed to provide in-depth study of the discipline. To general professional, special and in-depth study of the system disciplines of continuous education associated with the intensive development of science and technology and the rapid aging of knowledge, short-run is developed by electronic educational literature.

The electronic textbook is the main educational electronic edition, created at a high scientific and methodological level, fully complies disciplined educational standards of specialties and areas determined by the didactic units of the standard and programme to ensure the continuity and completeness of the didactic cycle of the learning process subject to the implementation of interactive feedback. Electronic textbook cannot be reduced to paper without losing didactic properties.

The analysis of the literature concerning the Association of the electronic and print textbooks, identified that the textbook both electronic and print have both common features and distinctive.

Common signs include:

1. the learning material is presented from a particular field of knowledge;

2. the training material covered at the present level of science, engineering and technology;

3. teaching material in textbooks systematically, i.e. it is a whole complete work composed of many elements that have semantic relations and ties that ensure the integrity of the textbook.

Distinctive features of the electronic textbook from print are:

1. every printed textbook is designed for a certain initial level of preparation of students and assumes the final level of training. Electronic textbook on a specific academic subject can contain the material of several levels of difficulty. All of them will be placed on the same disk, contain illustrations and animations to text, multimedia, multiple-choice tasks to test knowledge in interactive mode;

2. visibility in the electronic textbook is much higher than in print. The

visibility is also provided by the use of when creating e-books multimedia: animation, sound, hyperlinks, videos, etc.;

3. electronic textbook provides a variety of testing tasks, tests. The electronic textbook allows all tasks and tests to give in an interactive and learning mode;

4. when creating electronic textbooks, and distribution of fall stage of printing. Electronic textbooks are the structure of open systems. They can add, adjust, modify in the process of operation;

5. availability of the electronic textbook is higher than that of the printing. When demand for an electronic textbook, it is easy to increase its circulation, which can be sent over the network.

It should be noted that in any textbooks (electronic and print) are two main parts: substantive and procedural. In the electronic textbook, two parts: control and diagnostic. The content of the tutorial includes the following components: cognitive, demo; the procedural part consists of the components: modeling, control, perpetuate.

The cognitive component is aimed at the transfer of knowledge to the learner. This is usually textual information. The demonstration component supports and reveals substantial; modeling component allows you to apply knowledge to the solution of practical tasks to simulate the studied phenomena, processes. Control and anchorage component determines the degree of students assimilation of the studied material. The control part is a software of the electronic textbook capable of ensuring the relationship between its parts and components. The diagnostic part is to store static information about working with specific programs.

Development and practical application of electronic textbooks in the system of secondary special and vocational education contributes to a better correspondence of the level of preparedness of the trainees to the requirements of the state standard. Based on these requirements, and taking into account the possible are used of e-textbooks on special disciplines curricula, programs, methods of conducting various classes on special subjects studied in educational institution.

**Control questions:**
1. What is some e-business?
2. Types of e-business.
3. What are the e-auctions?
4. What is electronic banking?
5. What is e-commerce?
6. What is an electronic research and development work?
7. What are the e-pointers?

8. What is e-learning?
9. What is email?
10. What is email marketing?
11. E-learning.
12. The need for E-learning.
13. List of e-learning tools.
14. List the technologies underlying distance learning.
15. Electronic textbooks and intelligent tutoring systems
16. E-government concept.
17. Three main components in the system of «electronic government».
18. List the approximate range of e-government services.
19. The structure of the Government.
20. The formats of e-government in the developed countries.

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# CHAPTER 14. INFORMATION TECHNOLOGY IN THE PROFESSIONAL FIELD. INDUSTRIAL ICT

**14.1** Software for solving problems of specialized professional sphere

**Applied software**

Application software is a set of programs for applications (user tasks). It is a part of the computer software.

Classification of application software is:

```
        ┌─────────────────────┐
        │  Applied software   │
        └─────────────────────┘
           ╱              ╲
┌──────────────────┐   ┌──────────────────────────┐
│  for general     │   │  for special (professional) │
│  appointment     │   │  appointment                │
└──────────────────┘   └──────────────────────────┘
```
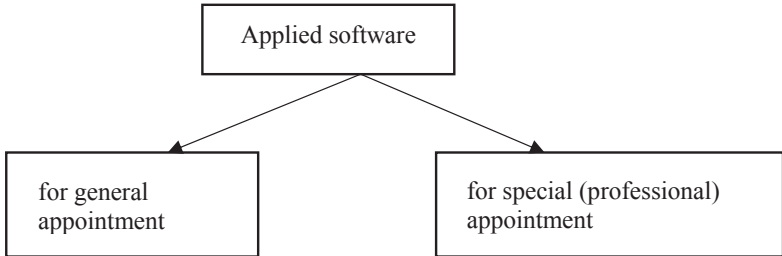
**Application software of general purpose** is a set of programs to address the general purpose tasks. These programs are used by most computer users.

| № | Types of general-purpose application software | Assignment | Sample programs |
|---|---|---|---|
| 1 | Text editors | Creating and editing text, without any registration | Notepad (included with OS MS Windows), TextPad |
| 2 | Word processors | Creating and editing text (fonts task, size, text color, alignment, etc.) and with the introduction of tables, graphs and formulas | MS Word, WordPad (included in OS MS Windows) |
| 3 | Spreadsheets | Processing data in table form | MS Excel |
| 4 | Graphic editor: | or creating and editing images | |
|   | - raster | Working with bitmaps | MS Paint (included in OC MS Windows), Adobe Photoshop |
|   | -vector | For work with vector images | CorelDRAW, Adobe Illustrator |

| 5 | «Viewers» | View universal file formats | |
|---|---|---|---|
| 5.1 | «Viewers» images | Image viewer | CDSee, FastStone Image Viewer, FastPictureViewer |
| 5.2 | «Viewers» the HTML-pages (browsers, web browsers) | View websites pages | MS Internet Explorer, Mozila Firefox, Google Chrome, Opera, Safari |
| 5.3 | «Viewers» media content (media players, media players): | Playing media content | |
| | -audiopleery | Playing audio files | AIMP, Foobar2000, Spider player, MusicBee, Media Monkey |
| | -multimedia centers | Playing video and audio files | Windows Media Player (WMP, included in OC MS Windows), QuickTime Player(included in OC Mac OS X), Winamp, VLC media player, Media Player Classic |
| 5.4 | «Viewers» flash-content (Flash-Player) | Playing video and audio files on websites for games online | Adobe Flash Player |
| 5.5 | «Viewer» pdf-files | View and print pdf-files | Adobe Reader |
| 6 | Database management systems (DBMS) table (file-server) | Control the creation and operation of database | MS Access, Paradox |
| 7 | Computer games | Entertainment or training | 3D-shooter, «Leopold the Cat. Learn English» |
| 8 | Translators | | |
| | -Electronic dictionaries | Translate individual words | ABBYY Lingvo, MultiLex |
| | -Translator texts | Translate text | PROMT |

**Application software purpose (professional)** is a set of programs to address more specific goals and objectives of the various professional domains (architecture, construction, music and film industry).

| № | Types of general-purpose application software | Assignment | Users | Sample programs |
|---|---|---|---|---|
| 1 | Desktop publishing | Electronic typesetting of newspapers, magazines, books, booklets (drawing pages of a certain size of the text and illustrations for the printed form) | Employees of publishing houses, editorial offices of newspapers and magazines, publishing houses, as well as employees of advertising agencies | QuarkXPress, Adobe InDesign, Adobe Frame-Maker, Corel Ventura, MS Publisher |
| 2 | Electronic encyclopedias, textbooks, dictionaries, reference books | Gain knowledge in a particular field | Pupils, students, scientists, specialists in various fields | «Encyclopedia of modern construction technology», «Directory master builder», «Music Dictionary», an interactive multimedia textbook «Organic Chemistry» |
| 3 | Computer-aided translation (CAT tools) | Translation of professional texts using knowledge bases of subject areas | Professional translators | Trados, Deja Vu, Star Transit |
| 4 | Server DBMS (client / server) | Manage the creation and working with databases information systems | Database administrators | mySQL, MS SQL Server, Sybase Adaptive Server Enteprise, Oracle Database |
| 5 | The editors, three-dimensional (3D) graphics | Creating and editing three-dimensional graphics | 3D artists | Autodesk 3ds Max(ранее 3D Studio MAX), Autodesk Maya, Blender, Cinema 4D, ZBrush |
| 6 | Video editors (video editing system) | Processing video-material | | |
| | -professional | The installation of movies, TV shows | Workers of cinema and television | Adobe Premiere Pro, Grass Valley Ediu, Sony Vegas Pro |
| | -»home» | Mounting movies | Amateurs | Windows Movie Maker (входит в ОС MS Windows), Corel VideoStudio Pro, Pinnacle Studio |

| 7 | Audio editor program (system audiomontage) | Processing audio | | |
|---|---|---|---|---|
| | -professional | Recording of musical compositions, the preparation of soundtracks for radio, sound movies, computer games, the restoration of old phonograms by | Sound engineers for radio, recording studios, film | Adobe Audition, Steinberg WaveLab, Sony Sound Forge. Audacity |
| | -»home" | Record an Amateur music compositions to create their own ringtones for mobile phones and others. | Amateurs | CyberPower Audio Editing Lab, Akram Audio Editor |
| 8 | Music notation editors | Creating and editing sheet music text design and for playing text | The staff of music publishers, music schools, musical theaters, Philharmonic, composers, arrangers, conductors | Finale, Encore, Cakewalk Overture, Sibelius,MuseScore |
| 9 | Expert system | Solving problems of some subject areas (replaces specialist-expert) | Workers involved in the diagnosis, design, planning, management | Medicine: MYCIN; Military: ACES; Electronic: ACE; Informatics: CODES, Chemistry: DENDRAL; Geology: PROSPECTOR Trade: PEMOPAMA |
| 10 | Computer-aided design (CAD, CAD/CAM/CAE) | Develop the computer drawings, diagrams, 3D models, design and technological documentation | Design engineers, architects trade | Compass, AutoCAD, ZwCAD, nanoCAD Электро, BtoCAD, Стройэкспертиза BASE |
| 11 | **Geographic information system (GIS):** | | | |

| | | | | |
|---|---|---|---|---|
| | Universal and specialized | Creating, editing, and analysis of electronic maps, search for information about map features: cities, roads, buildings, streets, rivers, relief , mean annual temperature | GIS professionals, GIS operators, engineers, cartographers, geologists, surveyors, hydrologists, meteorologists | MapInfo, CREDO_DAT, ArcGIS, Arcview, GeoServer, GRASS, gvSIG, Argo, Polygon, View, GIS Meteo |
| | -information and referral | View maps of the city and the surrounding area, to search for associations of transport routes, search for travel in the city | Amateurs | 2GIS |
| 12 | Total systems for various companies and organizations: | | | |
| | Integrated case management system | Support full document lifecycle in the organization: creation of documents (documentation), organization of movement and accounting of documents (document management), document storage (archiving) | Clerks (employees who are responsible for maintaining documentation of the organization) | Business, LanDocs, Cinderella, Gran Dock |
| | -accounting system | Book keeping and tax accounting | Accountants | 1C: Accounting |
| | -financial analytics system | Conduct analytical accounting of financial and economic activities of the organization (systematization of information, calculation of analytical indicators and reporting) | Financial analysts | Alt – Finance, Audit Expert, INEK – Analitik, Finacials module for MS Office Excel «Excel Financial Analysis» |

### 14.2 Modern IT trends in the professional field

Problem-oriented PPP for industrial areas should meet the following requirements:

First, they must not only plan the advanced production techniques (integrated production schedule, material requirements, capacity), monitor the implementation of the work plan (inventory management, customer orders, orders-clothes, purchase orders, etc.), make a routing to govern the financial and human resources, but also implement a number of «non-productive» functions – control of service, distribution of finished products and marketing.

Second, they should be focused on the architecture of client-server, based on a multitasking and multiuser operating systems (like UNIX) and relational databases to be developed on the basis of CASE-technologies and have a graphical user interface.

Thirdly, a modern system capable of supporting different types of production: production «in reserve», developing and manufacturing products to order, Assembly to order, small and large scale production, with continuous production cycle, as well as mixed type.

The Western market of automation systems production and economic activities has hundreds of integrated PPP. They can be divided into four groups:

1. Comprehensive PPP integrated general-purpose applications automate all the activities of large or medium-sized enterprise (Corporation). These include multifunctional products in the highest price class: R/3 (SAP), Oracle, Mac-RAS Open (A. Andersen). typically, these products support production of various types. Russian PPP in this class note system «Galaxy» (the New Atlanta).

2. The second group includes the sets of applications to production management of a certain type. Among them they include: Genesic Manufacturing Suite (Edwards) – build to order, Trilior1(Vaap) – various forms of discrete manufacturing, PRISM (Macam) – manufacture with a continuous cycle.

3. The specialized products are: MMPS, MES (Fast System), allowing to make production more flexible, accelerate its adaptation to market demands, to implement dynamic scheduling of material requirements, production capacities and drafting flexible production schedule, monitoring the work of departments.

4. PPP management of the entire chain of processes of production, from design details of the product and ending with the moment of receiving finished product by the consumer: ERP system (Manugistics Numetrix), etc.

The cost of most comprehensive problem-oriented PPP high (sometimes over $ 1 million), but most Western companies to automate their activities still go towards the use of integrated problem-oriented PPP.

Bank of PPP in large measure depends on the chosen functional decom-

position of the information system and usually consist of a set of packages, which is a multi-module system working in interactive mode, real-time, a crucial task of financial operations and management of the Bank as a whole and its individual units based on a centralized, integrated database. The technical basis for the implementation of a comprehensive Bank of PPP is multi-machine computing network with different topology, connections to global computer networks of SWIFT, Reuters, Sprint, Internet etc. Among complex Bank PPP should be allocated to packages developed by following (usually American) companies:

• IBM together with a number of manufacturers of software products: AS IBIS, Midas ABS;

• the firm DEC – the concept of DBS. (Digital Banking System), implemented in PROFILE, FMS – Financial Management System PROFILE/IBS – Integrated Banking System, IBS-90 – integrated system;

• firm NCR, which implements the concept of «open collaborative data processing» and its architecture in the field of banking (NCR Bank View) in complex PPP-type DBS Bank;

• the firm Hewlett-Packard, proposed the concept HAI Bank (together with the firm Diagram) implemented as sets of software modules;

• firm UNISYS – FSA, Financial Finesse Branch Automation system (automate the functions of banking institutions);

• by Siemens-Nixdorf (Germany) – dialog system «KORDOBA» (complex automation of Bank activity);

• firm Olivetti (Italy) – banking platform (Platform for Banking) for automated Bank (a complex IFR banking activities);

• the firm Bull (France) – ICBS system for complex automation of banks activity.

Available integrated PPP Russian Bank note system «Diasoft-BANK» (ZAO Diasoft), RS-BANK (R-Style), «all-START» (FORCE), as well as comprehensive PPP firms Programmbank, Inversion, Center of financial technologies.

PPP accounting (PPS BU). Despite the fact that there are more than a thousand replicated accounting packages of different capacity and cost, Russian entrepreneurs prefer local packages, more suitable for the transition economy and fast change of legal acts regulating the order of accounting. Most of these packages running under the Windows operating system and is designed for operation in local networks. New SPT BU, as a rule, have built in tools of development and fully compatible with other software tools of the company-developer, providing further expansion and development of the system. An example of such a PPP can be called PPP BU «Office» that combines the 1S and Microsoft, allowing not only to automate the functions of an accountant,

but also organize all the paperwork of the company in the form of «electronic office».

PPP financial management (IFR FM) appeared in connection with the necessity of financial planning and analysis activities of firms. Today the Russian market of PPP FM presents mainly two classes of programs: financial analysis of a company and assess the effectiveness of the investment.

Program financial analysis of the company's focuses on a comprehensive assessment of past and current activities and provides estimation of overall financial status, including assessment of financial stability, liquidity, efficient use of capital, property valuation etc.

Source of information to solve such kind of problems the accounting documents that are prepared on a single form regardless of the type of property and include the actual accounting balance sheet, report on financial results and their use, a report on the condition of the property, the presence and movement of funds.

Among the SPT of this class can allocate OEDIPUS (Centrinos Software), And Finance (Viola), Financial analysis (Infosoft).

Another class of PPP FM is focused on evaluating the effectiveness of capital investment and real investment. Most famous in this class, the SPT received Project Expert(PRO-Invest Consulting), Al-invest (Viola), FOCCAL (TSentrInvest Soft) [1].

For analysts of banks and investment funds are important, first and foremost, making decisions about the prospects of investment and comparative investment analysis. For financial managers an important tool for the detailed analysis of past and future activities is the enterprises for decision-making on the implementation of specific investment project.

**PPP legal reference systems** represent an effective tool for working with huge amount of legislative information in a continuous flow.

Modern mobile devices use powerful hardware components that allow you to run games originally developed for PC, watch movies in HD, edit photos and run applications, perform work tasks in different fields.

When this mobile phone is very different from other electronic devices people use every day. Here are a few examples: we always carry the phone with us, phone is a personal device used by a particular person, the main purpose of the telephone is interaction with other people.

The development of mobile Internet has increased the potential of mobile devices as the primary means of communication at times.

To understand the basic trends in the market of mobile applications, we start with the analysis of the used devices and the use of mobile Internet.

According to IDC, the report IDC Worldwide Mobile Phone Tracker

2013, a leader among platforms is the Android OS. The device on this OS is for 78.6% market share of all mobile phones. IOS devices speak a little more than 15% of the market, and Windows Phone 3.3%, see table 14.1). The situation should not change dramatically, although many analysts predict a rise in the share of Windows Phone.

Of course, do not forget about the young players of the mobile OS market, which include Tizen, Sailfish OS, Firefox OS and UbuntuMobile. At the heart of these systems are based on open platforms, operating time, taking from such well-known systems like Bada, MeeGo, Qt etc. These systems are just beginning to develop and can not yet seriously compete with the leaders, but each of these systems may find their fans.

If you look at the tablet market, the situation is about the same. Leadership also hold the device on the Android OS(62,3% of market), in the second place the iPad in different versions (32,7% of the market), devices running Windows take 4.8% of the market, showing growth of 0.5% of the market at the beginning of 2013.5.

**Table 14.1.** *Report Data, IDC worldwide mobile phone tracker 2013*

| Operating System | 2013 Shipment Volumes | 2013 Market Share | 2012 Shipment Volumes | 2012 Market Share | Year-Over-Year Change |
|---|---|---|---|---|---|
| Android | 793.6 | 78.6% | 500.1 | 69.0% | 58.7% |
| iOS | 153.4 | 15.2% | 135.9 | 18.7% | 12.9% |
| Windows Phone | 33.4 | 3.3% | 17.5 | 2.4% | 90.9% |
| BlackBerry | 19.2 | 1.9% | 32.5 | 4.5% | -40.9 |
| Others | 10 | 1.0% | 39.3 | 5.4% | -74.6% |
| Total | 1009.6 | 100% | 725.3 | 100% | 39.2% |

Here we can distinguish three patterns:

• the leading position of Android in the segment of smartphones and tablets can be linked with the activity of a large number of suppliers (usually Chinese and Korean), producing models of primary and secondary level in the low price category;

• Apple competes on the market just two devices – the iPhone and iPad, which limits its ability in capturing the market of mobile platforms;

• a small number of Windows devices is associated with a small number of mobile apps for this platform.

Look at the first lines in the statistics of application usage, which we have quoted above:

- Social network
- Photo
- The messengers
- Game.

**The social network**. In this trend we can distinguish two directions: applications that integrate with existing social networks, and the creation of new social networks.

Applications that interact with already existing social networks are applications that add different formats of social network activity. Many people are not happy with the standard mobile clients from known networks, they want to use other instant messengers to send your content in a network of their own, to aggregate news and contacts from different networks.

On the other hand, the mobile phone has already become an independent device and began to appear mobile social networks, i.e. social networks without representation on the normal Internet, but using only the mobile app on various mobile platforms.

A vivid example of such network is Instagram, which allow users to apply their various photo filters and share new photos with your friends. Instagram was first launched on the iPhone app in October 2010. A version for Android OS has appeared only in April 2012, and a full desktop version of the site the company launched in February 2013, when the number of active users was approaching 100 million.

Before the advent of Facebook, there were several small by today's standards of social networking, then Facebook began to develop, appear a lot of clones, but they could not compete and further developed mainly Facebook. Now this is not a site for friends, classmates, and information portal with plenty of news, posts, etc. However, the system of laws has led to and began to appear small network, focused on a small group of people. Under the system refers to laws General laws of development of complex technical and social systems, which are similar to the laws of evolution, and this gives reason to do forecasts on the basis of existing knowledge in another area. The emergence of smaller networks was thus a natural stage of evolution. They began to appear on smartphones, as with the advent of mobile Internet direct access to users by mobile platform.

The most striking example of a successful photo app was Instagram, which was acquired by Facebook in April 2012 for a record at the time the amount of the transaction amounted to approximately $ 1 billion, and the sums were transmitted in the form of shares of the company Facebook.

The trends in the field of photo applications include the following:
• applications for Selfy shots of himself;
• applications that use both front and rear camera of the phone;

• applications with a variety of filters to photos.

**Messengers.** The communication function remains the most important function of smartphones and the proliferation of Wi-Fi networks and affordable mobile Internet enabled smartphone owners to communicate, using not only the services of mobile operators.

A pioneer in this field was Skype, which came on a mobile platform with a PC. Now there are many applications for communication, here are the most popular of them:

- Viber;
- WhatsApp;
- Line;
- WeChat;
- CacaoTalk;
- SnapChat.

Generalizing the functionality of these applications, you can select the following:

- allow you to exchange text messages, emoticons, MMS;
- allows to make voice and video calls;
- analyze your contacts on your phone and automatically add people who have already installed a similar application.

**Games.** Everything is simple and complicated at the same time in this area. In order to create a popular game, you need an interesting story, and thinking outside the box. The most popular arcade is casual games that do not have many levels. Of course, the example of the most popular games is the Angry Birds from Rovio. On the other hand, constantly appear a variety of games, for example, Flappy Bird, which are included in the top applications.

**Mobile Banking.** This trend developed in 2013 and continues to grow in 2014.11. People want to monitor the movement of their money and do so not only through SMS-informing. Many banks have already got mobile clients. In Russia, the most popular is the mobile client of Alfa Bank. The challenge for startups is that the banks are currently developing applications or hire companies to develop their applications, so for young startups path remains the same: create an interesting application in the financial sector (taking into account budget, loan calculator, etc.), and when it attains popularity among bankers to look for a partner or completely sell the solution to any bank. It should also be remembered that in this area competition.

**Geolocation.** This is a global trend and it is associated with all previous. Previously, startups tried to create separate applications and geolocation example of this is AlterGeo (2008 onwards) and Foursquare (2009 year). Currently, geolocation itself is not interesting, but it has penetrated into the other categories of applications, namely social networking and dating-services.

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An interesting example of the social new dating service using the geo-location service is the Highlight, which allows you to chat with your friends from the social networks that are near you.

It should be noted in mobile trends several promising areas. Firstly, it is SmartTV. We can smartphones and tablets to view and IP TV control your TV and other multimedia devices. Secondly, they are office applications. More and more people use their own tablets and smartphones in the workplace or for business purposes, instead of desktop computers. Third, they are wearable gadgets. In 2013, there were some "smart" watches, including from companies such as Sony and Samsung. The number of such devices will only grow, and they also require applications for work and communication with the smart-phone.

**Trends in the market of cloud services**

The idea of cloud computing came along with the Internet. The gist of it was simple: each person having access to the network should receive all the necessary resources – information, software, computing power, and use them at its discretion, at any place and any time. However, the technology that existed at the time, and the low level of their distribution is not allowed these ideas and concepts to develop into something more. At the end of the twenti-eth century, the rapid growth in the rate of data transmission networks and the rapid expansion of coverage of the Internet has led to the fact of the ideas of the 1970s. They began to become reality.

The term "cloud computing" was formed of the symbol IT structures in the diagrams in the form of clouds, with an understanding of the required functionality of the cloud, but without a precise knowledge of what and how within that cloud works, what is the infrastructure and what software is used.

One of the industry's pioneers, who used the concept of SaaS (Software-as-a-Service), based on the principle of cloud storage, have become a resource www.salesforce.com, which appeared in 1999. Today it is used by a huge number of organizations whose offices and employees scattered around the world. The next step was the creation in 2006 Amazon Web Service from the same company, which launched its commercial operation for any, even the smallest companies.

In 2013, 60% of medium-sized and small companies using cloud servi-ces, 66% of companies plan to continue using cloud services. 72% of small and medium enterprises use virtualization technology; while 80% plan to switch to a virtual server technology. Cloud computing is on the rise and one of the trends in the IT industry [2].

Now consider directly the trends in cloud computing.

First, we should talk about the spread of hybrid clouds. **Hybrid cloud** – a combination of at least one private cloud and a public cloud infrastructure,

creating an environment that provides access to the cloud and can dynamically grow to manage an uneven load. The purpose of the hybrid cloud is the union of two main qualities: security private cloud and public cloud capacity.

The second trend can be called the development of the Internet of Things. The term "The Internet of Things" (The Internet of Things) was proposed by Kevin Ashton in 1999. Internet of Things – a network formed by a variety of devices with the Internet access combines the real and virtual objects. Now a lot of devices around us have access to the Internet: printers, televisions, refrigerators, watches, electrical outlets. They actively develop and augmented reality - all are looking forward to enter the mass market of Google Glass glasses. It is clear that all of these devices will communicate with each other and the man through a cloud-based infrastructure, which has its own set of protocols.

The development of cloud storage and web services use the cloud. Now almost everyone has an online store. The most popular of these are the iCloud, SkyDrive, Dropbox and Google Drive. Every year storage is offering users more and more space for their data. In 2013 the service was launched Mega, who immediately offered to users 50 GB of storage space for files. With the ever-growing number of cloud storage of personal data can be withdrawn startups implement various aggregators and integrators for cloud services. For web services, the use of cloud technologies is the key to quickly and painlessly scale. Bring Your Own Device – Bring your device.

Trends in Medical Technology in 2016 are "cloud" data, gamification and applications for doctors.

**The development of the Internet of things**

The main driver of the market growth in medical technology - mobile, the Internet of Things. In 2014, the volume of mobile health market reached $10.5 billion. And in the next five years, according to the company Allied Market Research, it will grow on average by 33.5% per year.

The future of the Internet of things in the field of medicine is not only new gadgets that are monitoring certain parameters of the human body. There are also so-called food scanners, with which you can see how useful that is in the plate.

Actively being developed in the field of "smart clothes" was established tissue implanted with microchips (Fibertronics). Google and Levi's have agreed to cooperate in the creation of materials that can interact with electronic devices.

The ability to create a "connected home", which is related with each other gadgets, looks more and more real – and when the concept was introduced, it seemed quite fantastic.

**Storing data in the "cloud"**

New gadgets and applications allow you to collect a huge amount of data

on the various systems of the body. To store them use the "cloud": so access to the information received not only the patient but also a doctor. He can study health indicators and receive alerts if there are any deviations.

In addition, the "cloud" data can be generalized, for example, to keep track with the help of their epidemics. So, the creators of the project developed Kinsa electronic thermometer that connects to your phone and transmits data on body temperature to the server. Then, the user using the app learns the average temperature in your area or country - a useful feature during a flu epidemic.

For storing and transmitting sensitive data such as health information, security is important. Carelessness is not valid, or it can cause the situation like the one that occurred in a hospital in Los Angeles. Hackers seized control of its IT infrastructure and cut off and regain access to the equipment it was possible only after payment of a ransom of more than $ 17 thousand. Otherwise, the attackers threatened to be removed from the hospital computer information on the health of patients.

**Facilitating the work of doctors**

New technologies help not only patients but also doctors. We have already mentioned the fact that they can receive confidential access to the "cloud" data on human health. In addition, for doctors are special versions of mobile applications: the information collected in them which is presented as best facilitate its analysis.

They are used in medicine and technology of a virtual or augmented reality: VR-helmets have been used directly in operations. In addition, virtual reality is used for research - for example, aimed at finding a cure for cancer.

Holographic computers like Microsoft HoloLens can also be used in the training of doctors: so, with the help of the hologram can study the structure of the human body.

Special application for the physician is, for example, the heart monitor CardioQVARK:



Or «smart» stethoscope 3M Littmann:

**Socialization and gamification**

Owners of fitness gadgets already got used that these products actively use game mechanics and stake on socialization. Daily hundreds and thousands of users share results of the trainings on social networks, comparing indexes to friends and strangers.

These tools are added to the arsenal gradually by creators of medical gadgets. For example, owners of the "smart" Kolibree toothbrush (it issues recommendations whether the thicket and what zones of an oral cavity should brush teeth to pay more attention) can share information on quality of toothbrushing with other users of the device. The competitive spirit helps to attract children: usually they not really like to brush teeth, and similar approach changes the attitude towards health from an early age.

**Apple in the market of health care**

In 2015 Apple and IBM created on the basis of the products a number of tools for doctors and health workers. By means of an iPhone and Apple Watch experts can look what patients arrive and are written out, to communicate with other doctors and even set tasks to laboratory assistants and low medics.

For example, by means of the Hospital MD application the doctor can view indexes of health of wards, and approaching chamber – to see the clinical record of the necessary patient on the screen. The iBeacon technology is used for this purpose.

On the recent presentation of new products of Apple is provided a new framework for development of medical applications of CareKit. It is possible to create applications for check of the state of health, monitor accomplishment of medical recommendations, in time take the necessary medicine and learn about diseases when there are corresponding symptoms.

The CareKit applications will be able to transfer information to doctors, medics and members of the family of the user. According to the statement of Apple, the CareKit platform will be available in April, 2016 as a framework with an open source code.



The technology 5G will shortly allow to unite various technological devices and services (with the speed of the Internet of more than 100 megabytes).

Use of sensors and far off the working medical devices will provide to patients in the remote regions access to the advanced medical services. Development of videoconferences and telemedicine, remote diagnostics and remote surgery will allow not only overcoming a geographical gap in provision of medical services, increase efficiency of delivery of health care in emergency situations, but also to reduce the cost of services for patients. Medical devices, integrated with the help of the high-speed Internet will be able to collect and transfer data on patients at distance for only a few seconds.

Increase in a usability of medical devices, use of big data is capable to increase the accuracy of medical diagnoses to reduce quantity of medical mistakes because of human factor.

Next-to-skin measuring devices became a part of the life of many patients already today. Use of opportunities of a telemedicine and application of robotics in medicine of the future will allow to perform, for example, surgeries to the patients who are in difficult available regions, in conflict zones where there is no access to medical institutions.

One of examples of successful application of a telemedicine today – the Boston program of the Partners Healthcare organization in the USA which helped more than three thousand patients with diseases of heart to use home devices for measurement of weight, pressure and other physical indicators, automatically sending these data to doctors. The specially formulated software

considerably facilitated life of patients and doctors, having reduced the number of personal acceptances of patients at the doctor by 44% that as a result allowed hospital to save 10 million dollars.

According to the research of the consulting agency McKinsey conducted in 2015 use of analytics of big data will allow a health care system of the USA to save from 350 to 450 billion dollars, optimizing expenses on use of the medical equipment, working hours of doctors and purposes of pharmacological medicines. It will allow to cut expenses on medical attendance for patients give them the chance to get advice from the best doctors and the advanced medical attendance in those regions where there are no hospitals with the high-technology equipment yet.

The size of the market of mobile technologies and applications for medical diagnostics, by the estimates of the American experts published in the Trends in Biotechnology magazine last year, will reach 27,6 billion US dollars by 2018.

In the middle of July in the Washington Institute of Brookings there the panel discussion about problems 5G the Internet of things and future medicine was studied in which representatives of state institutions, business, science and health care took part.

Participants of a discussion tried to find answers to questions: how the Internet of things will affect the future of medicine? Whether the quantity of medical mistakes will allow to reduce use of the medical equipment, more perfect, united in smart network, and increase efficiency of medical services?

Opinions of the state regulators and representatives of business on what shall be the future of technologies in medicine differed.

If entrepreneurs, innovators and the innovative companies first of all are interested in technical progress and an opportunity to earn on it, then regulators potential hazards and risks for the state, for example, safety issues and confidentiality of the personal data collected by means of technologies and a possibility of their control concern more.

Bob Rogers, the director of the center Big Data Solution, Intel considers that technologies of the Internet of things considerably will increase timeliness of rendering medical services. «Patients will be able to receive medical care when it is necessary to them and where it is necessary to them, – he says, – receive the help in real time. In more connected world the medicine will become more perfect. The analysis of data during an era 5G will make each device smarter as they are connected in one general network. Doctors will be able to get access to more exact and complete information about each patient».

Rob Havasy, the director and the vice-president of medical alliance Personally Connected does not agree with him: «When everything becomes integrated, there is always a risk that each device can be used for any purpose.

We have to remember importance of safety of personal data of patients, the nobility who and when gets access to them and. Identification is a key aspect in use of personal data. During an era when technologies develop so quickly, regulation becomes fast too».

Information technology in the energy sector was in Moscow, March 31, 2016 The III Industrial Conference «IT in the energy sector: time efficiency.» The organizer was the company infor-media Russia. The event was held with the participation of the Russian Energy Agency (REA), the Russian Energy Ministry, expert support, and IT ENERGY Association ASTRA strategic outsourcing. Conference partners are companies RAD, Schneider Electric, DIS Group, CIO International Limited, Interactive Group, Forrester, Accenture and OS Group.

«Smart grids - this is our future» - began by Catherine Okisheva (Center for Energy Efficiency INTER RAO UES). According to experts, the gradual intellectualization power system automation begins with: «Automation of the control modes of the consumers and the generation in distribution networks, automation of warning, detection and localization of the emergency operation with the broad participation of consumers with their distributed generation create a single information technology space». The speaker stressed that the intellectual energy is to use a combination of technological features and elements of economic principles in any of the states of the regime, in Vol. H. The reaction to the occurrence of accidents with disaster recovery normal operation of the system is increasing the level of automation of decision-making. Examples of solutions have led Catherine automated energy management system (AEMS) the hybrid instrument accounting of electric power transmission and provision of communication services.

**Information Technology in Education**

The main means of ICT for information environment of any education system is a personal computer, the possibilities of which are determined by software installed on it.

In today's education systems are widely used generic office applications and ICT tools: word processors, spreadsheets, presentations, training programs, database management systems, organizers, graphics packages, etc.

With the advent of computer networks, and other, similar ones ICT education has acquired a new quality associated primarily with the possibility to receive information from any point of the globe. Through the global computer network the Internet is possible with instant access to global information resources (electronic libraries, databases, file storage, etc.). The most popular Internet resource – the World Wide Web WWW published about two billion multimedia documents.

The network is available, and other common means of ICT, which include

e-mail, mailing lists, newsgroups, chat. There are special programs for communication in real-time so that when you establish communication to transmit the text input from the keyboard, as well as sound, images and any files. These programs allow you to collaborate with the program of remote users running on the local computer.

With the advent of new available for data compression algorithms for computer network audio quality significantly improved and it became closer to the sound quality of conventional telephone networks. As a consequence, very actively began to develop a relatively new means of ICT the Internet telephony. With the help of special equipment and software over the Internet can be carried out audio and video conferencing.

Using the networking tools of ICT it is possible to access to educational and methodical and scientific information, the organization of operational advice, modeling research activities, conduct virtual training sessions (seminars, lectures) in real time.

There are several main classes of information and telecommunication technologies. Some of these technologies are video and television. Videotape and relevant ICT tools allow a huge number of students to listen to lectures of the best professors. Video tapes with lectures can be used in special video classes and at home.

Television is one of the most common ICT, which plays an important role in people's lives. Educational television programs are widely used around the world and are a prime example of distance learning. Thanks to television, there is an opportunity to broadcast the lectures for the general public in order to enhance the overall development of the audience without further control the assimilation of knowledge and the ability to subsequently verify the knowledge by means of special tests and examinations.

Powerful technology to store and transmit the bulk of the material being studied, are educational electronic publications as distributed computer networks, and recorded on CD-ROM. Individual work with them gives a profound assimilation and understanding of the material. These technologies make it possible, with appropriate refinement, to adapt existing courses to individual usage, provide opportunities for self-learning and self-acquired knowledge. Unlike traditional books and educational journals allow to submit material in a dynamic graphic form.

The main purpose of global computer networks is to provide a convenient, reliable user access to geographically distribute network-wide resources, databases, messages, etc. Transfer to organize e-mail, newsgroups, bulletin board, ensuring privacy of information transmitted in a variety of global computer networks, standard (in these networks) software packages.

Under the influence of informatization change the social order on the

competence of future specialists of any sphere of activity in the field of information and telecommunication technologies. A distinctive feature of the current stage of development of education is increasing attention to the use in the educational process of telecommunication technologies.

The content of training ICT traditionally identified a number of crosscutting lines, reflecting the separate areas of automation of information processing. One of the most advanced areas of computer science content is its section on *telecommunications technology*. For teachers it is of particular importance in relation to total informatization of education, development of the Internet and its services, accommodation in a telecommunications network a huge number of new teaching materials, enhancing training almost all academic disciplines.

*Newsgroups* are one of the most used and effective telecommunication technologies in education, implying the active form of learning. They allow students to form their own opinion on current events, realize many of the phenomena and explore them from different points of view, solve the problems together, ask each other a variety of questions, share ideas, etc. One of the most effective telecommunication technologies are rightly teleconference. Their use in education over the years becomes systemic. Teleconference always implies active creative form of training, increases motivation for learning, allows participants to form their own opinion on current events, realizes many of the phenomena and explore them from different points of view, solve the problem. Teleconference is learning when carry it out consciously training formed a task that defines all received technical, technological and organizational solutions. Training teleconference meaningful and technically should be tied to academic discipline, in the framework of education which they are held. In connection with this change should not only learn content, review methods of training to information technologies of the future teachers. We need to develop a theoretical and practical framework for the design, implementation and evaluation of the effectiveness of teleconferencing.

## 14.3 Using the search engines and electronic resources for professional purposes

All search engines have in common that they are located in a specially-selected high-end servers and linked to effective communication channels. Bots are also called information retrieval systems (IPS). The number of concurrent users of the most popular systems reaches many thousands. The most famous service is millions of customers a day. In cases where the search system is based on a directory, called a directory. It is based on the work of the moderators. At the heart of the IRS with full-text search is automatic collection of information. It is carried out special programs. These programs periodically

examine the contents of all the Internet resources. For this, they are moved or said to creep, according to various resources. Accordingly, such programs are called robots. There are other names as WWW – an abbreviation of the expression World Wide Web, then this program is naturally called spider England. – Spider. Recently, other names are used: automatic index or directory. All these programs are examined and "download" information from different URL-addresses. Programs of this type is visited each resource over time. No search engine is not able to index the entire Internet. Therefore, the databases in which addresses are indexed resources collected from different search engines. Nevertheless, many of them seek, if possible, include in their work the entire space of the global web. This is a versatile system.

So, search engine operation is provided by three components:

• «robot» program (spider). It analyzes the resources and produces their indexing.

• indexes search engine. They form created their own search engine database.

• the program, which is in accordance with the user's request, prepares a response based on an analysis of indices, i.e., their own databases.

The user really has to do only with the last of these three components.

Powerful search of a universal type system is designed to work on all the main languages of the world. Each country tries to create at least one own search engine. Let us get acquainted with the main domestic and foreign search engines.

**Yandex** (http://www.yandex.ru) – at present is the most popular domestic search engine. That was started in 1997. It contains more than 33 million documents, maintains its own directory of the Internet resources. Also is the best search engine to identify the illustrations. The English-language version of the guide is provided with the Internet resources. It has expanded the system of formation of the request. In particular, it may be entered as search instructions in natural language - in this case, all necessary extensions are made automatically. A more detailed inquiry can be made using the mode "Advanced Search" (plus sign), which uses a multi-menu system.

Yandex – Russia's only search engine that indexes documents in PDF, DOC, RTF, SWF, PPT and XLS. Update of database on a weekly basis.

Rambler (http://www.rambler.ru) – one of the first Russian IPS, opened in 1996. In late 2002, radical modernization was carried out, after which the Rambler again joined the group Web search leader. Currently, the volume index is around 150 million documents. For the preparation of complex queries it is recommended to use the "Advanced Query" mode, which provides opportunities for drawing up the search requirements by using menu items.

**APORT** (http://www.aport.ru) to date – the volume of its base of more

than 20 million documents. The system has a wide range of search options. APORT has a built-in function of translation, it allows the user to formulate queries, both in Russian and English languages. In addition, APORT has special modes for finding illustrations and audio files.

**Mail.ru** is searching engine company began to work in 2007. Volume index file the spring of 2009 was more than 1.5 billion pages, located on Russian servers. In addition to the texts of searching, the system searches for illustrations and video clips posted on the specialized "itself refillable" Russian servers: Photo@Mail.Ru, Flamber.Ru, 35 Photo.ru, PhotoForum.ru, Video@Mail.Ru, RuTube, Loadup, Rambler Vision and the like. Gogo.ru allows you to limit your search sites, commercial orientation, informational sites, as well as forums and blogs. Shape "Advanced Search" also gives you the opportunity of finding restrict certain file types (PDF, DOC, XLS, PPT), place the desired position of words in a document or a particular domain.

The most popular foreign search engines are Google, Alta Vista, Scirus.

**Google** (http://www.google.com) – one of the most complete foreign IPA. The volume of its base of more is than 560 million documents. A distinctive feature of Google IPS technology is determining the degree of relevance of a document by analyzing the references to other sources of this resource. The more links to any page available on the other pages, the higher isits ranking in Google IPS.

**AltaVista** (http://www.altavista.com) – one of the oldest search engines, the first places in terms of the documents – more than 350 million. AltaVista allows for simple and advanced search. «Help» allows even untrained users to correctly make simple and complex queries.

**The main types of searches**

Finding information is a component of human activity. On the Internet, every day a huge amount of resources comes and goes. You must be able to navigate to them. To effectively perform a search, you need to skillfully make a request to the search engine. If the answer is sought in the directory, there are no special difficulties at work here. Directory creators and moderators attend to the creation of the directory partition. The user only has to clearly define the subject of the search, and then use the structure that he proposed.

At the heart of a full-text search is the ability to successfully create a search query. Other things being equal conditions should be chosen to find the most narrowed little common word. At the same time, it may happen that the search term is too narrow fails. Then we move on to a broader term.

If the search term does not narrow the results, it is necessary to gradually expand the search term, or move on to the allied terms.

Search for the best possible is conducted by a few words, their combinations, and sometimes on specific phrases.

During the search and evaluation of its outcomes is necessary to remember:

• blind trust in the results posted on the Web, error-prone.

• beware of anonymous information, t. To. Their source is very difficult to establish.

• if in doubt, do not be lazy to check the information request found on the web reviews and opinions about the found information.

• suddenly appears and then quickly disappearing resources are not reliable.

• in cases of doubt, must be handled in such trusted source, such as network encyclopedias, reference books and special training sites.

• avoid "sensational" of data results from overly high accuracy, purely polemical, advertising and biased materials.

Getting to the surf, you enter one or more keywords, select the type of search and press the Enter key. In response, issued a list of addresses (URL) - a list of all indexed pages that contain any of the keywords. Often, the number of matches is in such huge search. However, if the search engine sorts are good results by category, then the desired page can be found at the top of the list. Search for any word can be useful when the user is not sure of the keywords.

It should be borne in mind that the search engines are different words. These IRS as "Yandex" is meant the word in all its grammatical forms and with this in mind will look for it. They know the morphology of Russian language, t.e. If the request and write "person" and "people", the answer is the same.

Searching for the following logical operators are used on the Internet:

– The AND – and (and this and that – the two terms together);

– OR – or the (or one term or one);

– NOT – do not (do not need such term).

Using the icon *, you can broaden the search to all words that contain the part. For example, if you enter Electrotechnical * in the search results will be pages that contain electrical equipment and so on. N. Sign truncation * can be substituted in the right key, the left and inside. In Yandex you can request a particular form of words when searching (excluding other word forms) with an "!" Sign in front of it.

All these search engines allow keywords, subject headings, and even individual letters quickly find a network, for example, all or nearly all the texts in which these words appear. In this case the user the website address where the R & D results are always present. However, none of them has an overwhelming advantage over the other. To conduct a reliable search for complex queries, experts recommend to use series or parallel (simultaneously) various IPS.

Full-text search engine indexes are all the words of the user-visible text.

Availability morphology makes it possible to find the search terms in all declensions or conjugations. In addition, the language HTML tags exist that also can be processed by a search engine (headers, links, and captions to images, etc.). Some machines are able to search for words or phrases on a given distance, it is often important to get a reasonable result.

Although the general principles of the search engines are different subjects, their scope, classification and interfaces. For ease of movement (navigation) on available on search engines to share some of them use the special section "Map".

Often, the user needs to text and map information simultaneously. In 80-ies of XX century experiments to address this issue we have started in Canada were first geographic information system (GIS) – computer systems to effectively work with spatially-distributed map information. GIS – a natural extension of the concept of a database that complements their clarity of presentation and the ability to solve problems of spatial analysis. They are used for land management, resource control, environmental protection, municipal administration, transportation, economy, solution of social problems and others. Up to 80-90% of all information, which usually deals users, can be represented in a GIS. GIS – a stage of transition to a paperless information processing technology.

During the search engines usually is use the data stored in web pages in the metadata tags: (title), (meta name = "keywords"), and (meta name = "description"). Shaping your page should be reflected in these tags, information about the purpose of the site and to its subjects.

It should be known that the smaller number of keywords included in these tags, the greater is the frequency they can occur in the text pages, and hence is the higher their relevance. The optimal frequency of such words is not more than 5%. Keywords should not be very much; they increasingly have to consist of one or two words, forming the most used terms. The more relevant keywords are, the more competitive they attach documents from the point of view of search engines.

The completeness and accuracy of the response a user receives depending on the accuracy of the request formulated by him. As a result of research it is usually given much more information than it needs, some of which may not be relevant to the generated request. It is easy to notice that a lot depend not only on well-formulated request, but also on the search engine capabilities. Information technologies in the energy sector. It is sufficient pronounced "forest syndrome" (from the forest cannot see the wood), which consists in the fact that you can skip the main, the necessary information in the data. Obviously, no measures are not exhaustive in terms of constant expansion of the environment and the emergence of new variety of R & D, which confirms the

difficulty of finding in the WWW. Simple queries as separate rather common terms lead to the recovery of thousands (hundreds of thousands) of documents, the vast majority of which the user is not required (information noise). An important aspect is also the possibility of such systems to support multiple languages, that is, the ability to handle requests for different languages. The users are offered bilingual dictionaries, electronic translator, and others. In addition, the system appeared, carrying instant ( "on the fly") translation of information resources is found by the user on the Internet and copied onto his computer. Topical is the use of machine-readable thesauri. Electronic Thesaurus - Dictionary for analyzing text and information retrieval, which includes a wide range of semantic relations between its constituent terms, create systems that allow you to search the full-text database effectively. They are based on the use of technologies of syntactic and morphological analysis of text (split into elements recognized program) and the expeditious processing of texts in natural languages.

The developers of search engines are trying to adapt them to beginners and «average» Internet users, whose number is steadily growing. In the Canadian system (www.web-help.com), users are asked a set of links, prepared by the staff of the online company. On user request the employee in real-time locates and connects to the user's screen the appropriate (in his opinion) web-site. Method is useful for finding specific facts, statistics, etc., which in other ways is not easy to find.

When the same query on different search engines it is possible to obtain various content and outreach materials. The art of building a query requires knowledge of the characteristics of each specific search engines and the availability of experience with the Internet in General. Some search engines offer quasiintellectual tools, allowing less experienced user, traditionally asking questions in natural language to obtain enough relevant data [3].

Usually search in full-text database is done using morphological analyzers (as a rule, Russian and English), allowing you to automatically discover existing word forms for the word fragment, word, phrase, even if the query contains some typos. Use meta search engine that provides search result obtaining aggregate data from a dozen search engines, but the volume of information can be quite significant. Partially this problem is solved by provision of a common list at the beginning which will be the data most relevant to the query. Another way to meet the needs of users was the creation of thematically focused search engines web portal sites. The importance of the problem of information retrieval on the Internet has spawned an entire industry whose job is to help the user in his navigation in cyberspace. Make this industry special search tools. Conditionally they can be divided into search tools reference type, or just the directories (directories) and search engines in its pure form (search engines).

**14.4.   Security in industrial information and communication technologies**

The main concern in the field of ensuring international information security is related to the ability of ICTs for purposes inconsistent with the objectives of maintaining international stability and security. The main threat here may be noted the hostile use of ICTs at the level of States against information infrastructures in the political, including war criminal and terrorist activities in cyberspace.

The turn of XX – XXI centuries was a period of changing forms of interstate conflict: using ICT attacks and aggression can be carried out of transboundary, without the involvement of army units and the use of traditional arms and military equipment, with the help of non-state actors. Destabilization of the economy, undermining the sovereignty and foundations of government, disrupting the normal operation of infrastructures can be achieved through the use of media. That is why the effective provision of national and international security is impossible without the strengthening of international information security (IIS), primarily due to a decline in threats of hostile use of ICTs.

Questions IIB was devoted to analytical seminars, in particular, under the auspices of the UN Institute for disarmament and the International Committee of the Red Cross. At the initiative of Russia, the issue of the IIB was considered at a high political level and a multilateral basis in the group of eight, the Shanghai cooperation organization (SCO), by the Plenipotentiary conference of the International telecommunication Union (ITU), world summit on the information society in the CIS and Regional Commonwealth in the field of communications (RCC). In the relevant outcome documents was enshrined provisions on threats to the IIB and the need for cooperation in order to reduce their level.

The first step in the direction of organization of efficient international cooperation in the field of the IIB was the proposal made by Washington in 1998, to sign on the level of heads of state joint statement on the issues of international information security. The draft document noted that in the present situation of the information sphere, on the one hand, there is the potential of human development through the global information-technological revolution, on the other – present threat of the use of new technologies to undermine international stability.

It was stressed that the new threats require the adoption of preventive measures, which may include:

• harmonization of the views of the international community on the problem of possible use of information technologies for military purposes;

• basic concepts («information weapons», «the information war»);

• identify opportunities to use information technologies for improvement of existing and creation of new weapons systems;

in considering whether it is expedient to create an international system of monitoring of information security threats;

• introduction the question of global information security to the UN and other leading international fora;

• creation of an international legal regime banning the development, production and use of especially dangerous types of information weapons;

• to develop multilateral Treaty to combat information terrorism and criminality.

According to the Russian side, such a joint statement could contribute to a specific, comprehensive and focused discussion of emerging issues. As a result, the discussion of this proposal, the idea of the application via the MIB has not been implemented. However, concerns about emerging threats in this area are reflected in the Joint - Russia statement on common security challenges at the turn of the XXI century, signed by presidents of Russia and the United States for the Moscow summit on 2 September, 1998.

The negative consequences of the destructive use of information technology by criminals and terrorists and individual States to resolve political and military objectives may affect the interests of many countries, purchasing a global scale. Such ICT use can cause disaster on the destructive consequences with the result of the use of weapons of mass destruction. In this context, the heads of the SCO member States have agreed on the possibility of joint action to address information threats in compliance with international law.

In October 2006, it was the inaugural meeting of the group experts of member States of SCO on international information security. The meeting was attended by representatives of the Republic of Kazakhstan, people's Republic of China, the Kyrgyz Republic, the Russian Federation, the Republic of Tajikistan and Republic of Uzbekistan. The expert group was mandated to develop the SCO summit 2007: action plan and identify possible solutions to the problem IIB in the framework of the competence of the member countries organization. The Chairman of the group, by consensus, was elected to the Russian expert.

**Control questions:**

1. List the classification and characteristics of software for solving problems in the professional sphere.

2. Kinds of software utility.

3. The types of application software.

4. The total system for various enterprises and organizations.

5. Problem-oriented PPP for the industrial sector.

6. Bank of PPP.

7. PPP accounting.

8. PPP legal reference systems.

9. The use of cloud computing.

10. The development of the Internet of things.

11. Applications to facilitate the work of doctors.

12. Information technology in the energy sector.

13. Information technology in education.

14. Known information retrieval system (IRS).

15. Principal search.

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# CHAPTER 15. PROSPECTS FOR THE DEVELOPMENT OF ICT

## 15.1 Development prospects in the IT sectors of the market: the development of free software

With the growth and development of the ICT industry received considerable development of open source software.

*Open source software* is software with open source. That is, the source code of such programs available for viewing, study and modify, which allows you to help in the finalization of the most open programs, and use code to create new programs and fixes errors in them. It should be noted that "open" license does not always require to open source software (the software) free of charge.

Open source software has great promise for our country as a whole. One of the main benefits, in the case of the introduction of open source software in government and budget organizations, is a significant leap forward in ensuring national security and technological independence in the field of information technology. You should also consider the considerable savings of public funds due to the lower cost of ownership open systems.

In some areas, open source software (OSS) is the undisputed leader, or just has a large share of the market (for example, among web servers, operating systems supporting the web servers, etc.); in some free software poorly represented (e.g., in accounting). Question in what areas it makes sense to develop a new OSS and to refine existing interest to many developers, entrepreneurs and investors.

According to the recently published annual study of the North Bridge "The Future of open source-2010"a significant increase in the market share of OSS expected in the coming years in three main sectors software:
• WCM/CMS/"social" software;
• DBMS;
• Operating systems.

The first point – WCM/CMS/"social" can be considered obvious. Now available CMS is widely used to create Internet sites abroad, in Russia and in Kazakhstan. For example, on the website GovWeb.ru (http://govweb.ru/site/cms/) among CMS-based sites of Russian governmental bodies, lead with roughly the same number-based websites Drupal (free CMS) Bitrix (commercial) and Joomla (free).

Available databases are also used widely. According to a study Cnews "Database Market 2010", available databases are increasingly being used in Russia, mainly in servers, primary and secondary levels. Thus, the greatest benefit from the available databases get companies with qualified technicians and non-standard requirements – for example, the need for additional

functionality (the latter may well be virtually impossible for organizations using proprietary software). Cnews as the researchers note, the free database often prefers an innovative company focused on rapid growth, as well as companies who need to solve non-traditional tasks of data management. Among them – the company Yahoo, Hadoop is based on its world's largest data warehouse; and Skype, works on the basis of PostgreSQL. As for the operating system market, the use of Linux on servers is growing, and on the Linux workstation in the world takes a while only about 1-2%. The Russian government policy in support of OSS is to make real changes in the segment of operating systems. But for radical movements it requires joint efforts, coordinated work and the consolidation of all the representatives of the Russian OSS market.

Note the tasks relevant for the Russian market. It is obvious that we should like to take part in the development of international free software (GNU / Linux operating system free database, server products, office suite OpenOffice.org and others.) For an adequate development of open source software development industry in Russia Russian programmers and application software have to create using free software products. At the same time, the development of certain areas of the free software support required state, by virtue of the specificity problems. For example, such problems include infrastructure use digital signatures to GNU / Linux. Currently, convenient infrastructure for developers of EDS in systems of electronic government services, e-government portals and systems legally significant document exists only under Microsoft Windows. This leads to the fact that any performer of the state order, which is developing the portal of electronic government services, forced to create it using Microsoft products.

The sectors least susceptible to change in connection with the implementation of SPO in the next five years, according to a study by North Bridge are:
• security and data protection;
• office software, office "Toolkit";
• ERP/CRM.

What to common predictions, many participants in the global it community agree that in 2011 and in subsequent years, the principles of free software (transparency, community participation and joint development) will become fundamental in the it segment. Against this background, there is an even more public API – as in the segment of Internet services (like Google APIs, Google Wave APIs, My World@Mail.Ru API or YouTube API) and social networking (like Facebook API, Vkontakte API) and in the segment of specialized solutions (like Doublegis API), cloud computing (like OpenCloud API) and a number of other areas.

**Examples of the implementation of open source software**.

Currently, worldwide there is a tendency for the transition to an open free software. Governments and government agencies of many countries already use it actively. Some of them even declared on state support of open source and prefer open source to use in state bodies.

Among them – China, France, UK, Germany, Netherlands, Japan and others.

The European Commission is the main governing body of the European Union (EU) issued a recommendation on the transition to free software in the governmental structures of the EU. The use of open source software in the European Union reaches 50%.

In the USA, the Alliance of Open Source for America (OSA), which promotes open source in the public sphere.

The Ministry of defence of the neighbouring Russia already uses its operating system based on GNU/Linux.

Education is a critical sector where there is a tolerance of the user to the different systems. The introduction of a package of free software in education in Russia actively began in 2008 in three pilot regions – Tatarstan, Perm Krai and Tomsk oblast. In the future, subject to successful pilot phase, open plan to install in all Russian schools.

## 15.2 The formation of the IT ecosystem of entrepreneurship and support for small startups

The information technology ecosystem should be understood as a set of services, devices, other products of the same company, which are inextricably linked in a single network.

Every Business, whether he knows it or not, today is a part of the Business Ecosystem. Is it possible to learn how to benefit from the Ecosystem and to make the company rise to new business ideas, products and services to market needs with minimum costs?

There are five types of Business Ecosystems in which company they live. Not every Ecosystem is able to make you an innovative company, but you have the right to choose what ecosystem your company will be able to maximize their potential.

The business model companies like Apple, Amazon, Google show how important to success is the task of building the Ecosystem. General Electric for many years, remaining one of the most popular business cases for the study of strategy and management at business schools worldwide, sees its future in model ecosystems «Industrial Internet.» Uber and Airbnb are Prime examples of the modern digital ecosystem. The impression that ecosystems are all around us [1].

There are five key trends that stimulate the formation and development of the ecosystems:

1. The development of new products and services based on the combination of an increasing number of technologies and innovations;

2. The development of the Internet of Things makes available the physical world;

3. Organizations focus on their core competencies and need to collaborate for innovation;

4. The growing number of platform business models and «Everything-as-a-Service» stimulate the partnership between the companies;

5. The development of Algorithms leads to new business models of cooperation.

Business Ecosystems have become the basis of the business model of company development and a key element of the business strategy of most organizations.

In the new Digital World, companies can participate in 5 ecosystem types:

1. Ecosystem of Platforms;
2. Innovation Ecosystem;
3. The Ecosystem of Interest;
4. The Ecosystem of Commerce;
5. Ecosystem Things.

***Ecosystem Platforms***

At the heart of this ecosystem is the software platform that serves as the basis for interaction among all participants.
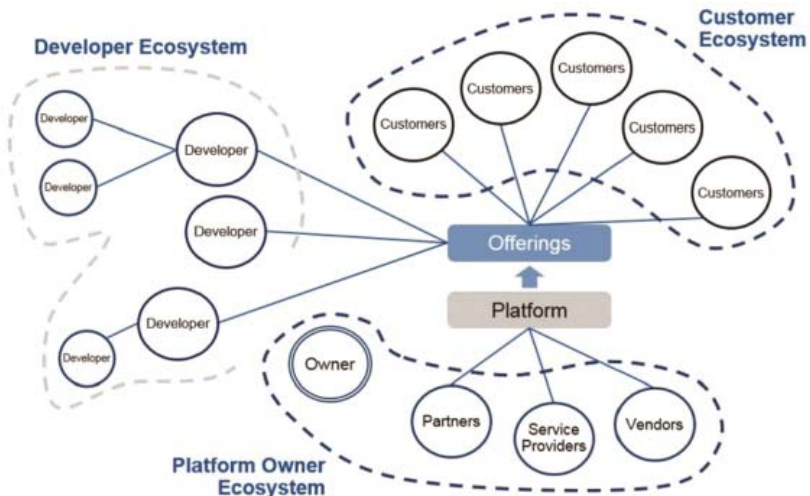
Each type of participants building their own ecosystem:
• The ecosystem of the owner of the platform;
• The ecosystem of developers;
• Ecosystem customers.

The success of this business model depends on growth in the number of services (Offerings) that are offered by the platform. Than more and more services start to use the client, the more Platform-dependent, they are becoming increasingly difficult to switch to other services outside of the platform. One of the reasons for the failure of the company BlackBerry was a limited number of application developers and as a consequence the smaller the number of services on the platform.

Examples of Business Ecosystems Platforms – Apple, Google, Facebook, Dropbox, Airbnb, Uber, General Electric.

***Innovation Ecosystem***

The solution of complex problems stimulates cooperation. Accelerating the world of technology gives companies the chance to have time to develop products and services based on knowledge within the company.

Today there are more options for cooperation between companies in the framework of the concept of "Open Innovation" (Open innovation).

Ecosystem of Innovations are formed for the following purposes:
• Accelerate the development of new products and services;
• Reduction in time to market for new products and services;
• Increased number of successful new products and services;
• Reduction of costs for research.



| Closed-Innovation Model | Open-Innovation Model |
| --- | --- |
| Innovation ideas progress inside the organization | Innovation leverages the business ecosystem for ideas, complementary capabilities and resources |
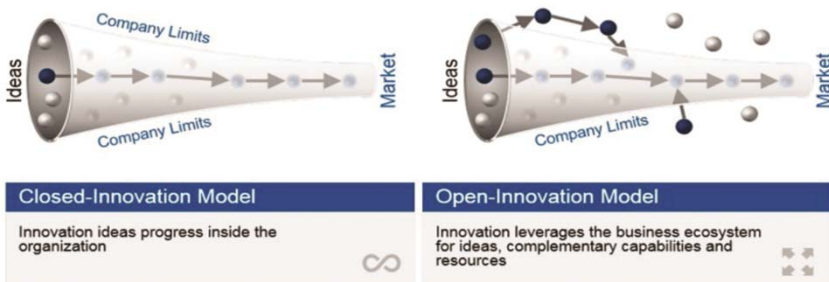
Open Innovation is the Use of targeted incoming and outgoing flows of knowledge to, respectively, accelerate internal innovation and expand external use of innovation (***Henry Chesbrough***)*the founder of Open Innovation*

The Open Innovation model is quite flexible and can be used by companies for a variety of tasks:
• The inclusion of external ideas in the innovation process. The initia-

tive of Procter & Gamble "connect and develop", one of the most striking examples where 50% of the company's innovations are born out of its walls.

• Exchange of Innovation – as well as any other Exchanges allow providers to connect ideas with those who need it.

• Crowdsourcing for innovation companies collaborate with communities of developers and young researchers. There are many sites (Topcoder, Kaggle), where companies place their tasks, and developers compete with each other offering the best possible solutions.

• Collaborative Innovation For the production of the Dreamliner, Boeing worked with more than 50 design firms.

One of the clearest examples of ecosystems at the scale of the industry is the approach to innovation in Banks from building their own centers of innovation, to deployment open API and attract startups in the Fintech industry.

Examples of Ecosystems of Innovation - P&G "Connect and Develop", Kraft Foods, GE Open Innovation, Samsung, River simple.

***Ecosystem Interests***

The development of social networks and mobile Internet has led to the emergence of many communities of interest, from units to millions of participants.
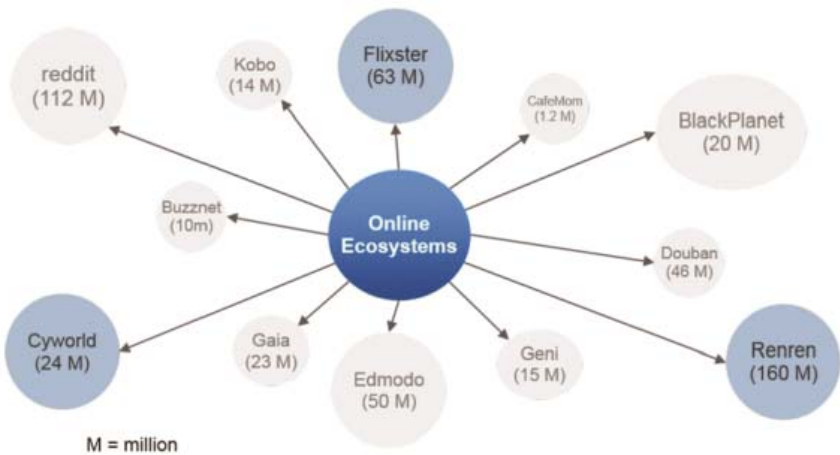


Companies are building work with ecosystems primarily to promote their products and services. But communities can also serve as tools for the development of innovation, as are the direct channel for obtaining feedback from consumers and a source of suggestions for improving client experience.

Examples of the Ecosystems of interest – Reddit, Renren, Edmodo, Myspace.

### Ecosystem Commerce

A classic example of an ecosystem is the supply chain. If we consider the supply chain of values from producer to consumer, the participants in this chain are the elements of the ecosystem. In this case, innovation will be born in the new business models.

A key feature of the Ecosystem Commerce is the task of optimization of the relationship between the parties, and not optimization of the whole ecosystem in General. The result of such an Ecosystem is very slow to react to any changes and disruptive innovation.
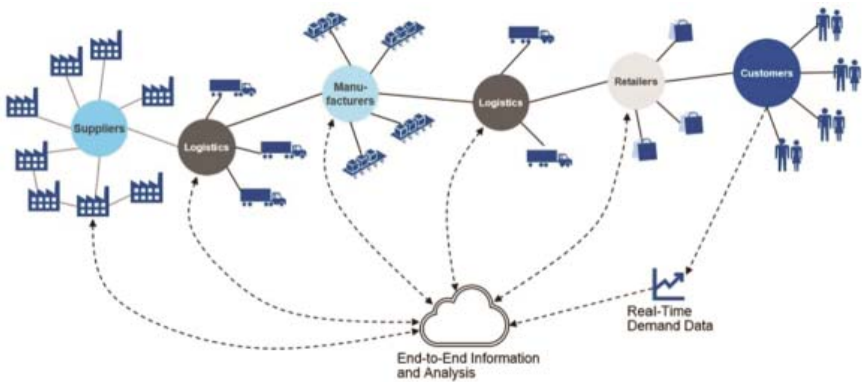


The goal of ecosystem orchestration – coordination of participants to achieve individual or collective effectiveness. The effectiveness can be measured in different ways – cost, flexibility, speed and etc.

Examples – supply chains, it market (consultants, integrators, vendor and etc.)

### Ecosystem Things

Ecosystem of devices there the first year is as a part of operating management systems. The reduced cost of the device, the development of the Internet, mobile technology and the trend of recent years – the Internet of Things (IoT) give companies a new basis for thinking about new business models and improve business efficiency [2].

Without going into the details of the IoT, which has plenty of information, it is necessary to highlight three key trends of further development of the Ecosystem of Things:

• The emergence of new business models through access to real-time usage information products and services (for example, the cost of insurance depending on driving style);

• Cost of sensors, sensors that are connected to the Internet today is negligible, which removes the barriers to their widespread;

• Big Data and Analytics can show itself in all its glory and it is due to enormous amounts of information from "things".



Examples of the industrial Internet, logistics supply chain, healthcare.

In the Digital World, every company is a part of the *Digital Ecosystem*. But not every company is able to form their own ecosystems.

Business Ecosystems are formed at the intersection of technology, open standards and architecture. Any company involved in a particular ecosystem – agree with it or not. The only question is, how the company is able to make the most of this ecosystem. Does ecosystem development company and promoting innovation and new business ideas.

And it needs to include the Ecosystem as a mandatory element of the Business Strategy and Business Architecture and to become a *Business Ecosystem*-Oriented company.

*Startup* is acompany with a short history of operating activities. As a rule, such companies are recently created, under development or research prospective markets. It should also be noted that although the term could be applied to all areas but mostly it was spread in the field of IT and Internet projects.

### 15.3 Program acceleration and incubation

Incubators and accelerators are one of the key elements of the start-up ecosystem. These organizations are involved in the development of projects at an early stage, turning them into a business that can be sold at market value rather than cost. In the world incubators and accelerators operate with a large flow of projects, sharing their investors' risks, but success in this area reached only a few. In Kazakhstan, incubation and acceleration is only gaining their strength, trying to copy foreign models.

In the classic sense of the accelerator - an organization that is engaged in growing businesses from the ideas of enterprising people who want to become entrepreneurs.

The most successful accelerators in the world perform six key functions, such as Attracting, Hunting, Selection, Training, Support and Investment. Looks simple, however, many can misunderstand this statement. All your work as the accelerator, is that in the end you got a stake in successful companies. At public institutions, educational and other institutions of the same goal – to «grow» as many large, successful companies that make everyone richer, which in turn is the basis of the reproduction business. You [as accelerator] just looking at the same goal from a different point of view.

The incubator differs from the accelerator because it operates on the «cultivation» has already been formed businesses before investment.

And the incubator, and the accelerator is passed during its existence, hundreds of startups, in exchange for the services rendered in the share capital of these companies.

This is carried out strict screening of projects that can further the development of their business (the faults of the team, legal issues, strategic issues and so on) that defines a certain percentage of the graduates of such organizations. So, abroad from accelerators usually goes no more than 75% of start-UPS and incubators no more than 25-33%. This does not mean that the remaining start-UPS do not always work and closed, but it becomes more difficult to participate in the search for investment without a change in its development strategy.

**15.4 The development of the necessary infrastructure of electronic payments and logistics. Prospects for the development of E-technologies**

The beginning of the third Millennium is a period of analysis of the enormous capabilities of information and communication technologies for mankind and their use in various fields of Economics and international business. Recent advances in the development of the global information and communication technologies (Internet technologies) have led to rapid growth of economic activities, called "electronic trade (Commerce)".

E-commerce is not just a trade, based on the use of new information and communication technologies on the Internet. It is a very big part of various business operations. With the help of E-Commerce provided the achievement of economic and financial goals of the company's mission.

E-Commerce in Kazakhstan was not yet sufficiently widespread form of committing acts of sale and conclusion of business transactions via the Internet. Currently Kazakhstan lags behind developed countries in the development and use of elements of infrastructure of E-Commerce system.

According to the speaker, there are about 500 online stores in Kazakh-

stan, the largest of which are Air-Astana, "Kazakhtelecom", Kazakhstan Temir Zholy Kcell. The turnover of the first approached $35 million, at the same time, KTZ reported 1 million tickets sold online, and a 6-fold increase in a year. It was also noted that in the near future, this market segment expects output of such major players as hotel chains, payment aggregators.

For the development of electronic Commerce in July 2011, a law was passed, introducing changes to some legislative acts on issues of electronic money. An electronic trading platform for participation in public procurement operates in the Republic of Kazakhstan: http://goszakup.gov.kz.

In may 2012, the system of electronic money was launched (www.ekzt. kz). This is the first domestic system to make instant online payments using electronic money, the nominal value of which is equivalent to the national currency is tenge. Today, the rules of law work, and Kazakhstan launched the first domestic e-money system designed to service trade operations on the Internet.

To fully work the Law Republic of Kazakhstan «On electronic document and electronic digital signature», created the necessary infrastructure for use of digital signature in the key sectors of the economy. A major step in the development of E-Commerce may be the introduction and transition to use of electronic invoices. Currently, this question is studied by competent state bodies. The phased introduction of electronic invoices is expected, starting in 2014.

At the initiative of the Ministry of economic development and trade in the current year was developed a draft law «On amendments and additions to some legislative acts of Kazakhstan on issues of improvement of legislation in the field of electronic Commerce», designed to regulate the implementation of E-Commerce and to introduce the legal provisions necessary to protect the interests of consumers in transactions on the Network. Currently, however, there is still a debate on this bill and on the need to develop a separate branch of the law on electronic Commerce.

Great importance for the industry development of E-Commerce has a solution to the problem of fast and reliable delivery of goods across the country. The problem waiting to be solved and require a lot of effort to build a modern infrastructure for the delivery of goods and logistics, to adequately meet the needs of market participants and covering all regions of Kazakhstan. The solution to all of these issues will have a positive impact on the development of E-Commerce.

For Kazakhstan, given its features (vast territory, low population density) E-Commerce could become a viable alternative to the traditional trade.

Especially from the point of view of accessibility of goods and services to people in remote areas.

At the regional level it is expedient to establish the public logistics structures for the coordination of product distribution.

The main functions of these structures should be:

• forecasting the development of distribution systems at the regional level and coordination of activities to build macrologistical systems;

• motivation and initiation of the introduction of new technologies in the field of logistics in the region;

• support of subjects of logistics, directly involved in the process of regional information systems, integrated in interregional, interstate database system;

• normative activities in the field of regulation of goods movement;

• development of guidelines and recommendations for optimizing regional transport flows and the application and use of rational schemes of organization of traffic;

• motivation rationalization of regional traffic flows through the system of flexible tariffs for transportations;

• the formation of investment and innovative policy in the field of regional logistics;

• territorial and sectoral coordination of the activities of trade and intermediary businesses and organizations, transport and storage terminals and other entities of the regional logistics;

• funding priority from the point of view of the region of research projects in the field of logistics;

• organize jointly with educational institutions and centers of preparation and retraining of personnel for the regional structures of logistics.

Currently, the processes of implementing e-services most rapidly are in the financial sector. Today, Kazakhstan services Internet banking provides 18 banks of the second level. Using «personal profile» in Internet banking, you can pay a wide range of services and to perform other operations. The popularity of this channel in recent years has increased markedly.

*Marketing researches of the market of electronic payments in Kazakhstan*

In recent years, the market of electronic payment cards in Kazakhstan demonstrates steady growth. Improving the infrastructure of the banking office and the trend among consumers to use electronic maps contribute to the implementation and development of new technologies that offer fast and secure payment of goods and services.

The number of payment cards in Kazakhstan has increased from 7.2 million in 2008 to 11.9 million in 2012. This means that the compound annual growth rate was 13.98%.

Marketing research indicates that by 2017 in Kazakhstan the total number of electronic payment cards will reach 17.9 million. Thus, the average annual growth in the number of cards used will be about 6.55%.

It should be noted that simultaneously with the increase in the number of

electronic payment instruments increased average transaction value made using electronic cards. The average annual growth of 25.43 percent.

According to forecasts, the total amount of payments using electronic cards in 2013 will amount to 719 268 million tenge (47 700 million USD). Research suggests that this Figure may reach 1 064 577 million tenge in 2017 (70 600 million U.S. dollars). This means that the average annual growth to 2017 will be of 10.28 %.

During the reporting period, the largest increase was increase in the number of outstanding credit cards. Average annual growth rate of e-cards made up 49,51%.

During the reporting period, there is a cumulative annual growth rate of payments using payment cards on average 25,43%. In 2012 it reached $ 5.7 trillion tenge (US $ 38900 million).

The expansion of the Internet services market in Kazakhstan and the increase in consumer income and spending has led to an increase in online retail sales in the country. By the end of 2012 the total amount of purchases in e-shops amounted to 58.5 billion tenge (US$398.4 million).

For the development of E-Commerce will be the following:

• will develop proposals on creation of industrial marketplaces;

• will consider the reporting of transactions (number and volume), made in online stores;

• will be implemented to encourage Internet merchants tax and customs preferences and participation in science and technology parks;

• work will be undertaken to improve legislation and law enforcement practice in the field of electronic Commerce;

• will support conferences, seminars and round tables on the development of the Internet environment in General and online business in particular and the holding of infotainment work on the use of electronic payment instruments on the Internet.

This question attracts the attention of businessmen, representatives of ministries, lawyers, etc. In this regard, we can pay attention to the article "Development of E-Commerce in Kazakhstan: barriers and solutions". In it to splash down aging discuss the matter.

May 17, Club of Institute of political decisions (KIPR) on the initiative of the Internet Association of Kazakhstan (IAK) has discussed prospects of development of electronic Commerce in the country.

Without questioning the potential of the industry as a whole, the experts tried to focus on particulars, to determine how quality will be tomorrow's breakthrough, and that this should be done today. Including at the legislative level, and especially emphasize how members of the industry, in terms of taxation.

After reading designed (by the Ministry of economic development and

trade) amendments to the legislative acts in the field of electronic Commerce, the participants voiced their proposals on the development of the sphere.

*Aidar KAZYBAEV, Chairman of the trade Committee of the Ministry of economic development and Republic of Kazakhstan, the speaker:*

E-Commerce of all retail formats the most dynamically developing sphere today, the future of Internet trading, and in this aspect, it is important to create a legal framework regulating relations in the field of Internet sales and purchasing.

Will briefly acquaint you with the law, initiated last year and used primarily for business.

Without law the market segment is growing quite well, but there is a bias towards services (the largest players on the Internet market is air Astana and GSM Kazakhstan), the share of consumer goods is not so high. Also, in General, the level of development the Internet-trade characterizes the level of connectedness. Therefore, all developed countries have a huge share of Internet sales in the retail[4] sector, yet it is extremely low.

The bill involves amendments to several legislative acts.

*Criminal Code*. It is clear that the online trading we do not see who is selling us the product, it is likely that this sector generates scam sector, and this activity is punishable. Second, information hacking. When we buy goods, in any case we form a database online stores, in this context, unauthorized access to the same is declared a criminal offense. The following applies to counterfeit payment cards. electronic money system in Kazakhstan for today practically does not work, in this regard, the main shopping means of payment are payment cards.

*The code of administrative offences*. There are issues of responsibility of private business entities for the supply of goods and advertising of products with erotic content, illegal content, prohibited goods.

*Tax code*. The question is not solved, because according to a number of government agencies, the tax burden in Kazakhstan is quite low so, in that regard, there is a single VAT rate, and there is no need in General to address the issue of taxation. But we deal with the following: it is necessary that when you purchase large quantities of goods via the Internet recognized stores electronic invoices. Also, the turnover on payment cards it is proposed to levy VAT at the rate of 10%.

*The law "On regulation of commercial activities"*. In 2007, regulations were adopted for electronic Commerce, but they, as many say, practically do not work. There is no liability for violation of these rules, terms and concepts are not reflected in the legislation and, thirdly, the system went forward, and

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[4] *Retail – distributive trades, trade. Shop – selling goods and services to the end user. The literal translation of the English retail – retail. In a broader sense, retail should be considered not only any point of sale, and the principle of the organization of trade.*

these rules are simply out of use. In this context, we introduce the concept of "electronic Commerce", the criteria and procedure for Internet sales, want this law to reflect the mechanism of the sale and delivery of goods.

*The law "On protection of consumer rights*," - a mechanism of consumer protection extends to E-Commerce.

*The law "On advertising"* – introduces liability for the accuracy of advertisements on the Internet sites.

*The law "On the rights of the child"* – restrictions on dissemination of information of erotic nature in electronic Commerce.

In addition, this year the Ministry of transport and communications is developing amendments to the *Law "On Informatization"* – there will be considered issues of liability, procedure of issue and validity of the digital signature.

As for the "Kazpost", now the system of goods delivery working, it now goes to the modern delivery formats.

Here is a brief the provisions of the act, in June we should submit it to the Ministry of justice in the fall to Parliament.

*Baghlan AIDAROV, head of information-analytical Department of the Internet Association of Kazakhstan, the speaker:*

Focus on the advantages of E-Commerce in General, its status and importance for Kazakhstan. For companies, this global presence, increase competitiveness, personalization sales, quick response to demand and cost reduction. For buyers and Internet users E-Commerce is certainly the time savings, delivery, no queues, anytime access, detailed examination of the goods, saving money, anonymity when buying.

It is important that in the development of E-Commerce decreases the share of the shadow economy, because all payments are "white".

As for the market the past two years, online sales are much faster than other sales channels – in stores, vending machines, TV-shops, catalogs. The country is on the path of strong growth of E-Commerce and CNP forecast, by 2015 the market volume will exceed $3 billion.

In General, the factors are contributing to the development of E-Commerce. This degree of accessibility of the Internet and the experience of use, confidence in Internet shopping, security of personal data, the availability of convenient means of payments, adequate legislative base, convenient and inexpensive delivery infrastructure products. Today we see that in the market of Kazakhstan there are about 170 online stores (most of them are limited, either they are inactive), the main payment instrument is a Bank card, the legal framework is being improved, and the infrastructure is at an early stage of development.

*Konstantin GOROZHANKIN, Director OF the public Foundation "national Internet award AWARD.KZ":*

Let me mention the main two points that, in our (JAMES) opinion, should hard enough to change our field of electronic Commerce.

This electronic *invoice*, which will greatly facilitate life to businessmen, because it is not needed after release of goods and services to arrive to the buyer and to put a stamp on the paper.

And even more interesting change it seems to us the abolition of VAT in the case of the provision of services via the Internet. We are not inventing the Bicycle, there are studies showing that such a rule is used in the US since 1997 and an American e-commerce market in connection with this very cool moves. We are not saying that the rate should be reduced forever, offer to do it for a certain period, say, three years, and see how it will affect our e-Commerce.

*Shavkat SABIROV, President, Internet Association of Kazakhstan, member of the Presidium of National economic chamber of Kazakhstan "Atameken":*

I would like to make a small remark about the cash register receipt when payment is made to online merchants are not afraid of this because we in the tax laws there is such a thing as fiscalization of information systems. That is, if you have a information system will fiscalization the tax authority, you can issue a receipt electronically.

From the above it follows that the electronic payments infrastructure is developed, perfected and expanded.

The basic tool to solve the problem of increasing the efficiency and attractiveness of transport industry in Kazakhstan should be the introduction of intelligent transport system. This complex of interrelated automated systems, solving the problems of traffic management, monitoring and control of all types of transport (individual, public, cargo). It should inform citizens and enterprises about the organization of transport services on the territory of the region of the country. Its aimed at three main objectives: safety, mobility, and environmental protection.

An important element in the construction of ITS is a global navigation satellite system (here in after – NSS). On the basis of this system solution improves the efficiency of not only land transport complex, but also actively applied in the aviation, navy, railway sector, are used for the synchronization of transmission lines and transportand etc.

The formation and implementation of ITS will enhance management efficiency in transportation, reduce non-production costs for cargo transportation, passenger, speed up the development of transport and communications infrastructure, will provide a favorable climate for the introduction of services on the basis of existing satellite navigation systems.

Integrated information system will be implemented "Smart stop" that takes into account the needs of persons with disabilities and aims to ensure that:

1. informing passengers about the arrival time of the passenger transport at a stop in real time;

2. informing passengers about the numbers of routes and modes of public transport plying on this line;

3. passenger information about public transport:

• changes in schedules;

• changes of traffic routes;

• change of tariffs for journey payment;

• the emergence of criminal and emergency situations;

• will be introduced system of video surveillance on public transport and at stops, with the possibility of the call to the operator of the situational center and emergency response services using the panic button;

• implemented a fare collection system, ticket booking via mobile devices (tickets will be equipped with bar codes and bar-codes, which gives the opportunity to show your ticket electronically on your mobile phone, and the inspectors or conductors to check tickets special readers).

The next task of the future development of E-technologies for improving the quality of services in the field of housing and energy efficiency through the introduction of ICT.

To achieve the goals following measures will be realized.

Introduction of automated control systems of technological processes in systems of water supply, wastewater, gas, heat supply and power supply, for the decision of tasks:

• improve the reliability of drainage systems, water, heat, gas, electricity;

• increase service life of equipment;

• reduce maintenance costs;

• reduce energy consumption;

• monitoring users in real time of consumption of municipal resources and expenses for their payment;

• exclude unauthorized connection to the water supply, sewerage and heat supply;

• condition monitoring of engineering networks and identify leaks in real time.

The introduction of ICT into the health system will bring a new level of quality medical care. ICT will play a vital role in the provision and delivery of health care. E-health technologies allow us to monitor patients at a distance, to better disseminate information to patients, improve access to health care, especially in remote areas, for disabled and elderly.

Today in the field of informatization health care has already implemented a number of projects. In 2011, in the framework of creation of Unified information system of health of the Republic of Kazakhstan (Unified information

system of procurement) have been completed of a pilot zone UISP. For the purposes of the implementation of the UISP is operating the portal "hospitalization Bureau", "register of the attached population", "Formation accounts registries" ("Electronic register of patients"), "Incentive component to health care".

However, there remains the problem of excessive bureaucratization, which in turn affects the quality of patient care. From year to year there is an increase queues in the medical clinics, patients have little alternatives when choosing a doctor, and one can quickly plan a visit to him. Data problems in health care may be overcome by a wide introduction of ICT, the transition to "e-health", which will improve the accessibility of health services for the population, to ensure the timeliness and accuracy of diagnosis and treatment of patients, to reduce the time for paperwork and, therefore, use it directly for patient care.

Improving the availability and quality of medical services to the population through ICT in the health sector envisages the implementation of the following measures:

• connect to UISP all medical institutions in the country to exchange and access information;

• translation of all primary paper medical records into electronic form (this will be provided a uniform format for medical documents);

• the establishment of a secure unified network of health care allowing, where appropriate, organize teleconferences, consultations with leading industry professionals;

• development and implementation of a unified integration platform and connect all information systems and databases, medical organization and healthcare organizations store all necessary information on the activities of the agencies, specialists, schedules, patients ensuring the population's access to medical databases via the Internet or mobile telephony, and the introduction of monitoring devices, health condition of patients transmit data in real time in an electronic card of the patient and the doctor through the electronic (mobile) patient-protected, containing information about visits, health examinations, diagnostic examinations, outpatient and inpatient care with the opportunity of operative access through the Internet;

• establishing a database of scientific and medical information, including publications, reports, studies, information about epidemics and outbreaks of diseases, information about diseases, their prevention and treatment;

• create a single public database of drugs, which is registered in the Republic of Kazakhstan, and their presence in pharmacy chains;

• creating a system of electronic medical prescriptions and recipes, allowing you to quickly obtain access to the archive of appointments of patients;

the introduction of a telemedicine bracelets monitoring the health status of older and single people (over 60 years);

• automation of ambulance services;

• creation the system of training and refresher training of health workers on ICT and information security.

The future of education – education is mixed, that is a symbiosis of full-time training, and network forms with varying degrees of involvement in the educational process. Currently practiced blended learning (traditional and e-learning) in the world. According to international studies (Watson, John, 2008) in the future, a mixed form of training will be dominant in secondary education. Taking into account all the new ICT development trends in the field of education and their application in the educational process, will help to bring the country's education to a new level.

For global implementation of ICT in secondary education in 2011 launched the project of implementation of information system of electronic learning (e-Learning) in schools and technical and vocational education (further – TaVE). However, this project requires the solution of a large number of related tasks such as standardization of digital educational content, providing free or subsidized broadband access (SBA) education institutions, provision of subsidized Internet students and teachers.

Full-scale implementation of ICT in education and increasing access to quality education through ICT will be implemented the following measures:

• made proposals for systematic development of digital scientific and educational resources with the use of multimedia technologies;

standards in education will be harmonized with international standards;

• made proposals for the development of the concept of formation of information culture in pre-school education;

• made proposals for the creation of resources for monitoring and management of activity of children of preschool age.

The introduction of ICT in the educational process of secondary schools includes:

• ensuring the preparation and training of teachers for the operation of the e-learning system and administrators of e-learning system;

• ensuring disabled children equipment and software.

The introduction of ICT in the educational process of higher educational institutions includes:

• consideration of proposals on creation of laboratories at Universities equipped with the necessary resources for the implementation of students ' scientific works;

• will include the translation of educational processes in the electronic format: the dissemination of materials, publication of news, communication

between students, individual communication between students and teachers in all educational institutions, as primary and Supreme;

• implementation issues will be worked out in the educational process of training courses the practical use of the latest software solutions and applications for specific professional specialization by activity (for example economics student - modern software solutions in the field of economics).

**Control questions:**
1. Give a definition of open source software.
2. Give examples of the introduction of open source software.
3. What is the ACT?
4. List the types of Business Ecosystem.
5. Give the characteristics of the ecosystem.
6. What is the acceleration and incubation?
7. Give the definition of e-commerce.
8. How is E-Commerce developed in Kazakhstan?
9. What are the results of marketing research of electronic payments?
10. Give the analysis of the prospects of E-Commerce development in Kazakhstan.

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| By the mid-70s, along with mainframes are widely used mini-computers | By the mid-70s, along with mainframes mini-computers were widely used | 63 |
| The most wide-spread OS for mobile devices is the following: | The most wide-spread OS for mobile devices are the following: | 76 |
| Symbian OS – the Mobile OS which is most extended now developed by | Symbian OS – the Mobile OS which is the most extended now developed by | 77 |
| Decided to allocate in expert systems three main modules: | It is decided to allocate in expert systems three main modules: | 83 |
| Let us to list some examples of DM applications, main goal of which is | Let us list some examples of DM applications, main goal of which is | 133 |
| this approach will be illustrated using simple Database example and | This approach will be illustrated using simple Database example and | 140 |
| For example, it to transform the result | For example, if to transform the result | 143 |

| | | |
|---|---|---|
| of DT solution into form of | of DT solution into form of | |
| Actually, these formulas are the same which used for definition logical | Actually, these formulas are the same which were used for definition logical | 151 |
| However, as it cad be seen, some classification techniques | However, as it can be seen, some classification techniques | 151 |
| Multimedia term around time interval appeared. | Multimedia term also appeared around that time interval | 285 |
| A huge mass of technologies. Appear CDROMs, blasters and other types of technology are appeared and there is the Internet and microelectronics. | A huge mass of technologies such as CDROMs, blasters and other types of technology appeared and along with them the Internet and microelectronics. | 285 |
| Three dimensional graphics (3D-graphics) is engaged in the creation of | Three dimensional graphics (3D-graphics) are engaged in the creation of | 289 |
| With their help, created frame first object, then its surface is coated with materials that | With their help, frame first object is created, then its surface is coated with materials that | 289 |
| After all this, used light effects, gravity, atmospheric properties, other parameters of the space in which the object can be located. | After all this, light effects, gravity, atmospheric properties, other parameters of the space are used in which the object can be located. | 290 |
| it means that we must programming. | it means that we must do programming. | 290 |
| To build a fractal pattern you want to use an algorithm that is based on | To build a fractal pattern you will want to use an algorithm that is based on | 290 |
| in the formula and the modification of the image. Using fractal graphic saves | in the formula and the modification of the image by using fractal graphic saves | 290 |
| Its size is horizontal (width) and vertical (height), they are measured in | It's sizes are horizontal (width) and vertical (height), they are measured in | 291 |
| Its simplicity and clarity makes it used frequently. | Its simplicity and clarity makes it being used frequently. | 293 |
| Typically, print illustrations. | Typically, prints illustrations. | 294 |
| TIFF (Tagged Image File Format). Commonly used in the areas where | TIFF (Tagged Image File Format) is commonly used in the areas where | 295 |
| It commonly used in the printing and | It is commonly used in the printing and | 295 |
| It often used for storage sets | It is often used for storage sets | 295 |
| It is pessible to find out how many frames per second are running. | It is possible to find out how many frames per second are running. | 300 |
| MPEG-2 The previous standard, planned for a high | MPEG-2-The previous standard, planned for a high | 302 |
| This the MPEG-2 is not suitable for storing high-defi-nition video | That is why the MPEG-2 is not suitable for storing high-definition video | 302 |
| along signal transmission is usually implemented with the loss of some of | Along signal transmission is usually implemented with the loss of some of | 307 |
| A more effective it becomes oil and gas, if used associated gas was flared, | A more effective become oil and gas, if used associated gas was flared, | 337 |

| | | |
|---|---|---|
| In today's education systems are widely used generic office applications and ICT tools: word processors, spreadsheets, presentations, training programs, database management systems, organizers, graphics packages, etc. | Generic office applications and ICT tools: word processors, spreadsheets, presentations, training programs, database management systems, organizers, graphics packages, etc. are widely used in today's education systems. | 375 |
| All search engines have in common that they are located in a specially-selected | The common feature of all search engine is that they are located in a specially-selected | 377 |
| The most famous service is millions of customers a day. | The most famous service has millions of customers per day. | 377 |