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INTERDISCIPLINARY APPLICATION OF TELECOMMUNICATIONS IN THE MODERN WORLD

ABSTRACT

Communications have become irreplaceable part of everyday activities. Mobile communication is gaining in importance due to the mobility of terminals and persons. Telecommunications, computer and media industry are getting connected and the chain of values shifts from components to overall solutions. Possibilities offered by information technology are limitless, and its application enables better working conditions since they keep humans away from dangerous working places and facilitate heavy tasks. The applications in the field of information and communication technology make it possible to drive from one end of the continent to another without needing any maps. The computer onboard a vehicle can choose the best direction and adapt to the travelling conditions.

KEY WORDS

generic technology, interdisciplinary character of information technology, telecommunications market, application in the field of information technology, technological development and changes

1. INTRODUCTION

Communications are becoming an increasingly significant element of economic growth and a driving force of the information society which is being created, and the access to communications is acknowledged as one of the main human rights. For those having access, communications have become an irreplaceable part of their everyday activities.

Telecommunications are a world system characterised by globality, diversity of information - media, communicating either stationary or in movement, and by the significant market of communication and information services.

Communications free of restrictions are provided by international standards, recommendations and agreements. The most important body whose task is to stimulate and create conditions for global transparency of telecommunications is the International Telecommunication Union - ITU, which operates within the United Nations, with two standardisation fields: telecommunication, ITU-T and radiocommunication, ITU-R.

2. BASIC CHARACTERISTICS OF TODAY'S COMMUNICATIONS

Regarding the form of information, that is the medium, it may include speech, sound, data, text, drawing, fixed or moving images, which are used for communication in the network connecting users, providing them with the possibility of complete telecommunication services or information exchange services. Regarding its range which is measured by the number of users compared to the whole population, coverage, and the dynamics of development, the most important are the public telephone network, ISDN - Integrated Services Digital Network, B-ISDN - Broadband ISDN, and Internet which are accessed via fixed (copper, optic fibre) or mobile (radio) ports.

Mobile communication is gaining significance. The mobility of terminals and persons is being solved. For the mobility of terminals special solutions for radio access in the cordless communication system and global system for mobile communications are being developed. In Europe, cordless communication which is used in a limited area (building, block of buildings), is based on the DECT system (Digital European Cordless Telephone). The digital global system for communication in movement is GSM - Global System for Mobile communications, and special solutions are achieved by satellite communications. The convergence of concepts and technologies of fixed and mobile networks results in establishment of UMTS - Universal Mobile Telecommunication System which is about to be commercially exploited in the countries of the European Union. This system will enable complete mobility of users providing them with the same possibilities of communicating on the fixed and mobile network connections.

Such development requires complex management of the network and its parts, as well as all the information and communication operations. The adaptability

of telecommunication network to the requirements of users and information traffic, and the creation and implementation of a comprehensive set of services offered to users is realised through the concept of intelligent network - IN, by introducing services with additional values, personal services adapted to each individual, telematics as a form of connecting telecommunications and information sciences, etc.

3. GLOBAL TELECOMMUNICATION MARKET

Telecommunication market, like the system itself, is global. It is liberalised and the manufacturers and operators take on new roles. Telecommunication, computer and media industries are being connected, and the chain of values shifts from components to complete solutions.

The overall development is reflected individually on the network itself, the technology and the market. Integration of different concepts is the basic trend in the field of networks. The network of the future, FUTURNET as some call it, will certainly stimulate even more the convergence of development concepts in order to achieve focusing on the end user.

Technological trends are obvious. The importance of program technologies appropriate for dynamic development of system efficiency is growing. Microelectronics is playing a great role, significantly influencing the growth of the system capacity. Radio connection as alternative to cord connection introduces additional flexibility. Broadband solutions open up new possibilities of using several media. Open standards stimulate production and at the same time protect the investments into communication systems. From this aspect, it is difficult to set borders between communication infrastructure and information infrastructure, between communication technologies and information technology. Anyway, this is not necessary in the environment of generic technologies which stimulate each other.

The market is best described by the fast growth of the number of users. In public telephone network there are 50,000,000 connections annually, the number of mobile users growing by 60% annually, and Internet has 10% more users every month. Annual revenue is 800 billion dollars, with investments ranging between 160 and 180 billion dollars annually. The telecommunications of the new era in the year 2000 are expected to have 1 billion telephone network users, half a billion mobile network users and the same number of Internet users. Unfortunately, practically all communication infrastructures will be available to the same billion people of the developed world. Many civilisation issues waiting to be solved in the next century will not pass by telecommunications either.

A number of targeted objectives are suggested in Table 1, which the world community should attempt to achieve by the year 2010. It seems that for all the developing countries 10 telephone connections per 100 inhabitants, with more than 50% of covered households, is a sensible objective for the year 2010. However, for the countries with low revenue (excluding China), the objective of 5 connections and 20% of covered households seems much more realistic. Regarding public telephone booths, a feasible objective would be one booth per 500 inhabitants in the developed countries and one per 1000 inhabitants in the countries with low revenue. The twentieth century is coming to a close, and there are still big differences in the world in the availability of telecommunications. The most frequently used method for describing the availability is the telephone density or the number of main telephone lines per 100 inhabitants. In 1996, telephone densities in the world ranged from 0.07 in Cambodia to 99 in Monaco, indicating the wide scope of telecommunication development worldwide.

In spite of great efforts invested by many countries in the improvement of telecommunication availability, there remain great differences between single countries and regions. The period of time required to achieve high level of telephone density is still relatively long. One fourth or the countries members of ITU still have telephone density of less than one. Until a country passes this threshold, it is impossible to foresee how long it will take for it to reach higher levels. After achieving the density of one telephone per 100

Table 1 - Objectives to increase availability of services

	Density		Distribution among households		Public phone booths per 1000 inhabitants	
	1996	2010	1996	2010	1996	2010
WORLD	12.80		34.4		1.55	
Developing	5.07	10	16.3	> 50%	0.84	2
Low revenue	2.44	5	8.5	>20%	0.57	1
Excluding China	1.22		4.1		0.21	
Developed	54.03		94.3		5.19	

inhabitants, it takes 50 years on the average to reach the density of 50 telephones per 100 inhabitants, which marks a high level of telecommunication development. The fact that some countries have experienced fast growth of telephone density is encouraging, showing thus that the required time may be shorter. Moreover, the increase in telephone density seems to result in shortening the number of years needed for achieving further higher levels. For example, whereas average time to reach density 10 from density 1 amounts to 21 years, it only takes 9 years to reach density 20 from density 10. On the other hand, this shows that telephone density in countries that had already been at a high level, increased more than in the countries at lower levels. This results then in a greater gap between the countries with high and those with low level of telephone density.

The backbone of the Croatian telecommunication network consists of the network of Croatian Telecommunications (Hrvatske telekomunikacije - HT). In Croatia, the functional networks are also used for the needs of Hrvatska elektroprivreda (Croatian Electrical Industry), Hrvatske željeznice (Croatian Railways) and other major users, as well as Hrvatska akademska i istraživačka mreža (Croatian Academic and Research Network - CARNet). Since HT is a public network, its structure, functions and services are best indicators of the level of development of telecommunications in Croatia.

The telephone network development indicators for the period between 1990 and 2000 are presented in Table 2. Telephone density expressed by the number of main telephone connections per 100 inhabitants has increased significantly with simultaneous re-structuring of the network by reducing the number of exchange subscribers and increasing the number of remote subscribers.

The users of HT telecommunication services are described in Table 2, and the revenue and investments with estimation for the year 2000 in Table 3.

Table 2 - Basic indicators of telephone network development level

Indicator/year	1990	1997	Plan 2000
Telephone exchange capacity (1000 subscr.)	990	2050	2200
Telephone density (GTP/100)	17.2	33.3	42
Number of access terminals	709	420	200
Number of remote subscriber levels	56	1200	1500
Km of optical cables	200	12000	18000

Table 3 - Users of HT telecommunication services

Indicator/year	1990	1997	Plan 2000
NETWORK SERVICES AND MOBILE COMMUNICATIONS			
Telephone connections (1000)	823	1500	1850
Analogue mobile network MOBITEL NMT	40	60000	120000
Digital mobile network CRONET (GSM)	0	55000	180000
CROAPAK package data transmission	130	850	1500
CROLINE digital leased cables	0	160	13000
ISDN (basic + primary access)	0	0	12000+600
ATM	0	0	700
TELEPHONE SERVICES WITH ADDITIONAL VALUE			
Free call	0	50	1000
Call with additional tariff	0	100	660
Single dialling code	0	6	120
Business group services	0	60	250
Card-paid call	0	0	640
TELEMATIC SERVICES WITH ADDITIONAL VALUE			
HT-INTERNET (PC+HOST)	0	25000+90	70000+5800

4. TECHNOLOGICAL DEVELOPMENT AND TECHNOLOGICAL CHANGES

The technological development also notices the increasingly important role of social and humanistic sciences in evaluating, assessing and rejecting or accepting new technological solutions. Negative experiences from the past, in which non-critical acceptance of certain techniques brought to dehumanisation of living and environmental destruction, tend to be used today to achieve a balanced comprehensively evaluated further so-called sustainable development.

Technological changes occur through constant improvement and innovations or replacement of production processes. According to the accepted classification the following can be distinguished:

- incremental innovations (which improve the existing groups of products, services and processes);
- radical innovations (which lead through major changes to newer types of products, services and processes in certain branches of industry);
- generic technologies (which create, using several incremental and radical innovations, new branches of industry);
- assertive generic technologies (which have such a strong influence that they act on almost all branches of industry).

Examples of assertive generic technologies in the past were the already mentioned uses of steam engines and electrical power. Today's most assertive generic technology is certainly information technology which, as a union of microelectronics, computers and telecommunications finds applications in every single branch of industry, all fields of sciences, all services, and serves as the basis for successful operation of all social and governmental structures. In particular, computer application has not only penetrated and will penetrate still more all the branches of industry, but it also appears in all the basic functions of entrepreneurship: research, development, design, production, administration, marketing.

After World War II some significant events happened that determined the information technology. First, the research and structures of computer devices, which had been kept as military secret, came public.

Then, at the end of the forties, the transistor was invented, a component which is small regarding dimensions, and designed by controlled contamination of pure crystal of germanium. Transistor proved that it could replace the electron tube at a substantially lower energy consumption being substantially more reliable. In further development germanium was replaced by silicon, and then production processes were improved which enabled that a small silicon board could accommodate a great number of transistors and other components sufficient to build whole electronic units, the so-called integrated circuits. Thus a new technological branch was created, which is called today microelectronics.

Beginning of the fifties saw the first computers on the market. These were devices composed mainly of electronic tubes, and occupying whole rooms, consuming hundreds of kWh of electricity daily.

Today, integrated microelectronic circuits are used to build all electronic devices, starting from the simplest radio devices to very complex systems, such as e.g. electronic telephone exchanges or systems for guiding and controlling spacecraft. Very quickly microelectronics started to be applied in building computers. In 1971, the first computer was composed of integrated electronic circuits, and during the next twenty years the development resulted in today's computers the size of the desktop, and of characteristics and capabilities multiply surpassing the first computers. Today's microelectronic circuits contain several hundreds of thousands, even millions of transistors each, located on a silicon board of several square centimetres. The production of microelectronic circuits and computer devices is today one of the biggest industrial branches in the most developed countries of the world.

Parallel with the development of microelectronics and computer technology was the development in the field of telecommunications. From simple telephone exchanges connected by wires and relatively isolated radio-diffuse systems of some twenty years ago, developed the today's world system for voice, image and text transmission. Also, the until recently isolated computers can be interconnected into so-called computer networks transmitting data from one computer to another at tremendous speeds. Thus, groups of computers can be interlinked into smaller or bigger, specific or public systems.

For the connection between microelectronics, computer technology and telecommunications a generic term information technology has been used recently. This technology has got its attributes by allowing receipt, storage, exchange and simple use of all types of information.

Best known today are different business applications of information technology. Its capabilities are limitless. Besides, the use of information technology allows better working conditions by making it possible for humans to stay away from dangerous work places and by facilitating tedious jobs.

The mentioned tasks of information technology show that it plays an important role in supporting the principles of sustainable development.

Furthermore, harmonious union between electronics and computers with other technologies improve the existing products or create new ones.

Information technology offers many devices and services to mass consumption. One might say that some innovations were first applied in mass consumption products and were then translated to some other applications.

Apart from industry and in infrastructure activities, the influence of information technology by its devices and processes penetrates into the contents and methodology of other professional and scientific disciplines. Cross-breeding with mathematics, natural sciences and technical sciences is understandable in itself. However, its role is becoming increasingly important in social and spiritual sciences. Computer-controlled preparation of data in linguistics or integration of computer data in economic sciences are valid examples for this statement.

5. INTERDISCIPLINARY CHARACTER OF INFORMATION TECHNOLOGY

Harmonious unification of electronic, computer and telecommunication devices and systems with other technologies improve the existing products or processes or create completely new ones. No doubt, today's solutions are the beginning of the process which leads towards the "world filled with computers". Information technology has today already reached such a level of maturity that only humans are becoming the limiting factor of further application development. In today's world there are simply not enough adequately qualified personnel who could act creatively in this field. Therefore, with timely recognition of some of the interesting applications and their successful implementation, there are serious possibilities to achieve business success even worldwide.

Business success of an undertaking depends primarily on the basic idea of a certain solution, but also on the method of its implementation. In the field of applying information technology, the realisation of artificial products depends significantly on the achieved quality of interdisciplinary activity. Every successful solution, namely, assumes teamwork by experts in the field of application and experts in the field of computer technology. The interdisciplinary character should be understood as the result of teamwork by experts from different fields, and not as interdisciplinary activity of individuals in all their working fields. Interdisciplinary activities of individuals, namely, lead very easily into superficiality in solving single implementation components. Successful realisation of single ideas depends therefore on the achieved level of co-operation between experts coming from the field of implementation and experts for information technology. Such approach should unify knowledge derived in different professional, and one might even say, cultural environments.

Applications from information and communication technology will allow driving from one end of the continent to the other end without the need of any maps. The computer on board a vehicle will be able to select the best direction and to adapt it to the conditions of travelling. For example, in case of traffic congestion in a European country, the navigation system on board a vehicle intending to pass through that country can obtain relevant information and undertake certain modifications in travelling direction. Therefore, a system is needed that would be integrated throughout Europe.

Applications of road telematics provide operators in road traffic with improved devices for controlling traffic flows, resulting in reduced road congestion. In a fully integrated European transport system the drivers will not have to stop their vehicles in order to pay toll, because it will be possible to automatically charge it from the smart-card located in a device on-board the vehicle. When driving along European motorways, the drivers will have available services assisting them in navigation, and traffic information offered by various operators.

Not so recently separated fields of Internet and telecommunications are coming closer together today. ETSI has begun a project TIPHON in co-operation with about 40 different companies in the field of information-communication technology for the development of standards that would insure continuous interoperability of the Internet telephony system. Along with the universal nature of IP networks, ETSI's objective is to achieve TIPHON defined standards.

6. CONCLUSION

The development of information technology and its previously described breakthrough into all aspects of industry and society worldwide cannot be stopped and is a process with no going back. The production of computer equipment, program equipment and telecommunication equipment is a special industrial branch with total annual revenue at the level of 1000 billions USD. The impact of breakthrough into other branches of industry cannot be precisely assessed, but it is assumed to be multiply greater. The improvement of the quality of living and reduction of adverse impact on the environment, which can be achieved by implementing information technology cannot be quantitatively estimated.

SAŽETAK

Komunikacije su postale nezamjenjivim dijelom svakodnevnih aktivnosti. Komuniciranje u pokretu dobiva na značenju pokretljivošću terminala i osoba. Povezuje se telekomunikacijska, računarska i medijska industrija, dok se lanac

vrijednosti pomiče od komponenata prema cjelokupnim rješenjima. Mogućnosti koje pruža informacijska tehnologija su neograničene, dok njena uporaba omogućava postizanje boljih uvjeta rada, jer udaljuju čovjeka od opasnih radnih mjesta i olakšavaju teške poslove. Aplikacije iz područja informacijske i komunikacijske tehnologije omogućavaju vožnju s jednog na drugi kraj kontinenta bez potrebe za velikim auto-kartama. Računalo u vozilu može izabrati najbolji smjer i prilagoditi ga uvjetima puta.

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