TELECOMMUNICATIONS INFRASTRUCTURE CHANGES FOR SUSTAINABLE DEVELOPMENT OF RUSSIA

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Contents

Summary

The changes of the telecommunications system in Russia during the last 10 years are analyzed in connection with “perestroika”—the introduction of new market-oriented economies in the country. The current state of affairs of Russian telecommunications infrastructure is presented. The perspectives of the development of this infrastructure, both in social, and technological aspects are considered, and its integration into global telecommunications infrastructure is discussed as an important factor of sustainable development of Russia. Generally, the paper shows telecommunications as a very important part of the infrastructure of any society where changing together with economics, and in its turn influenced economic changes and modernization, contributes—by this—to the sustainable development of the whole country.

1. Introduction

Communication systems and, in particular, telecommunications (or electrical communications), are a vitally important component of the infrastructure of any state, providing it’s economic, industrial, informational, political, and social development. An effective telecommunications system is a determinative factor of the sustainable

development of a society.

In all civilized countries today telecommunications systems develop faster than all other fields of human activity. Today it is the most profitable business. By their nature telecommunications are principally international. In connection with formation of modern global economics based on international division of labor and exclusive mobility of the capital and technologies, the question of survival of any country is its integration into global telecommunications and informatization system. This question stays, of course, before Russia, which unfortunately switched into the "modern telecommunications race" relatively late, at the end of the 1980s to the beginning of the 1990s in the twentieth century, although pioneer works in the field of telecommunications have been made in the nineteenth century, also, in Russia.

2. Historical Survey

2.1. State of Affairs in the Field of Telecommunications in the USSR before 1991

As the beginning of electrical communications, or telecommunications it should be considered the invention of the first practically usable electric telegraph systems in 1832 in Russia by P. L. Shilling and in 1837 in USA by S. Morse, who also suggested the eponymous Morse code. The next key step was the invention of the telephone by A. Bell in 1876 and creation of the first telephone switching station in New Haven (USA). These telegraph and telephone systems used electrical wires.

On 25 April 1895 A. S. Popov in Russia demonstrated first transmission and reception of long and short signals (i.e. elements of Morse code) without wires with the help of electromagnetic waves on the distance about 60 meters. It was the beginning of the wireless telecommunications.

Popov''s publication about his experiments appeared in the journal of the Russian Physico-Chemical Society in January 1896. G. Markoni, who immediately applied for the Patent on wireless communications and received it in 1897, on 2 July 1896, demonstrated analogous experiment more than 1 year later, in England. In 1897 achievements of Popov and Marconi were more or less similar—wireless communications on a distances 5–7 km. But later, due to existence in Western Europe and America rather well developed market oriented economics principally having big demand for communications between enterprises and market participants, due to the invention of electronic tubes, diode and triode, and effective generators and receivers of electromagnetic signals, electrical communications in Europe and America started to develop very fast.

In the degree of telephonization Tsarist Russia at the beginning of the twentieth century more or less followed the developed western countries since due to economic reforms there also started fast growth of market-oriented economics. It is known that in market oriented economics the number of telephones is approximately proportional to GNP per capita. However, later due to two destructive world wars on Russian territory, creation in Russia after October 1917 (later in the USSR) the administrative-command economic system, not much interested in the wide developments of telecommunications and due

to various other reasons Russia started to retard in the field of telecommunications from other developed countries.

The USSR Administration during long period underestimated the necessity of developments of telecommunication systems. For example, if in USA during the period after Second World War the investments to telecommunications field relative to total capital investments were 8 percent, in Japan: 6 percent, in France: 5.3 percent, in FRG: 3.3 percent (up to 0.5 percent of GNP), and in the USSR these investments were less than 1 percent (about 0.15 percent of GNP).

As the result, to the beginning of new market reforms at the end of eighties—beginning of nineties the USSR (and, of course, Russia) by its telecommunications developments was much behind world developed countries both quantitatively and qualitatively. So, in 1990 the most important factor – number of telephones per 100 inhabitants—in the USSR was equal 13. For comparison, at the same time in USA this factor was 80, in France and FRG: 65, and in Japan: 50. By this factor the USSR was on 30th place in the world. Besides of this the telephone density was very non-uniform over the territory of the USSR: in Moscow, Leningrad, Kiev, Urals, and the Baltic regions there were 30–50 telephones per 100 inhabitants, but on huge Siberian and Middle Asian territories—less than 1. The qualitative state of the USSR telephone network was rather old fashioned. The switching stations were mainly electromechanical. About 50 percent of equipment has been working already 20 and more years. Electronic switching stations were just appearing, mainly in the inter-city lines, not more than 8 percent in 1990. Practically, all telephones were of analog type. The digital telephone network was in the embryonic state. Only in a few directions in big cities there were digital communication lines with speeds of 2 and 8 Mbit/s. Several lines for 34 and 140 Mbits/s were under construction. New telecommunication services like telefax, videotext, and electronic mail and cellular telephones in the USSR in 1990 were practically absent. There were no domestically manufactured telefax machines: all available fax apparatuses were to be connected to the international network only through the operator. A catastrophic shortage of personal computers (less than 1 million versus over 50 million in the USA) and an absence of corresponding modems didn't allow the development of electronic mail. Quite heavy equipment for radio telephones, which were used in trains, ships, planes, for communications with cars were in fact, radio stations and couldn't be by any means, used for cellular telephone systems.

In 1990 in the USSR there were about 325 million channel-kilometers of inter-city trunk lines (from them over 200 million channel-kilometers in Russia, forming more than 100 thousand channels), generally of cable and radio-relay type and only 1 thousand of international communication channels.

Fiber optic communication lines (FOCL) just started to develop. Here it should be noted than in the sixties and seventies of the twentieth century in Russia there have been performed several pioneer works in this field. The double hetero-junction semiconductor laser for C.W. room temperature operation, which is the main light source in FOCL, was invented first by Zh. Alferov and his coworkers in 1969 in Russia. Low loss optical fiber was obtained in the General Physics Institute and in the Institute of Radio engineers and Electronics of the Academy of Sciences of the USSR only two

months after Corning Glass and Sumitomo first produced this fiber. But in 1990, after 20 years of fiber optic applications, in the USSR there was only one long distance fiber optic line from Leningrad to Minsk (about 1200 km) with the capacity 140 Mbit/s, whence in Europe, America and Japan FOCLs were already the main trunk telecommunications lines.

For such a big country as the USSR (or Russia) there are very important satellite telecommunications lines. Being pioneer in launching the first artificial satellite, or sputnik, the Russian name commonly used, Russia in 1990 was much behind the USA in using sputniks for communications purposes. For communication to stationary objects only seven satellites of "Horizont" type were used; several satellites of "Molnija" type on elliptical orbits were used for TV and radio broadcasting. The park of the USA communications TV and broadcasting satellites was several times bigger and the quality of inside equipment was much better. Such a state of affairs of telecommunication systems in the country absolutely did not satisfy all participants of starting market-oriented reforms.

2.2. The Program of Telecommunications Developments in the USSR on the Period 1990–2005

In the mean time, "perestroika" and liberalization of Russian society started by Gorbachev Parliament in the USSR at 1989–1991, brought to life very well known in market world but new for that time in Russia kinds of enterprises, stock hold companies, joint ventures with foreign partners, various kinds of non-governmental associations and corporations, corresponding commercial banking system, stock markets, and regional and season fairs and so on. Already at the end of 1991 in Russia there were officially registered over 80 000 enterprises which vitally needed development of modern means of informatization. It is due to this reason that the industry of informatics and telecommunications occurred to be almost the only one, which had positive development derivative on the background of general drop down of all other industries.

In 1990 the Sub-committee on Communications and Informatics of the USSR Supreme Soviet Committee on Transport, Communications and Informatics together with Communications Ministry of the USSR produced the Concept and the Program of the USSR Informatization. During the nearest 10–15 years, and as part of it: the Program of Telecommunications Development in the USSR. This Program was based on four basic directions:

- Transition to a digital telephone network for the period 1990–2005 by both superimposing a digital network on the existing analogue network and by creating in clean (from telephones) regions of the "islands" of pure digital networks with succeeded merging of these "islands" into uniform all-union digital telephone network. The Program assumed the creation of 60 million telephones in 15 years at a rate 4 million a year, which was two times bigger than at that moment. So, by 2005 telephone density in the USSR were to be 30–35 telephones per 100 people, or each family supposed to have a telephone. On the basis of this digital telephone network it was proposed to develop services

such as electronic mail, telefax, telex, videotext, and data transmission, etc., i.e., transform it into Integrated Services Digital Network (ISDN). In future with the help of fiber optic communication systems with all optical switching this network should transform itself into wide-band ISDN (B-ISDN) with formation of multimedia services.

- Wide use of fiber optic communication lines (FOCLs) including intercity and international FOCLs, various local FOCLs, cable TV systems based on FOCLs, FOCLs for ships, planes and cars—up to supply of fiber optic cable to each personal telephone for performance of wide-band (B-ISDN) services.

As one of very important projects there was considered the building of trans-Siberian fiber optic trunk line from Europe to Japan with the length along Soviet territory over 14 000 km. This trunk line would increase the length of internal USSR trunk lines by about 120 million channel-kilometers and by estimates of information flow could bring profit over US$200 million per year.

3. Further development of sputnik telecommunications systems of all three types—for stationary objects, for moving objects, and for systems TV and broadband radio broadcasting. Having in mind Nordic geographical position of the USSR it was supposed to use besides of geo-stationary sputniks also satellites of “Mayak” type on high elliptical orbit with the highest point over the Soviet Union. Four satellites of this type can provide 24 hours communications over the whole territory of the USSR. Along the other project it was proposed to launch on geo-stationary orbit very big platform weighting 18 tons, which could carry the equipment and have energy potential enough to provide digital 64 kbit/s communication channels to 50 million people.

4. Special efforts were to be applied to creation and development of cellular radiotelephone systems, both for mobile objects and for personal use in cities and in rural areas. The point is that, for the USSR (and, hence, for Russia) radiotelephone systems are especially important. Besides the well known advantages of mobile radiotelephones providing the customer with reliable connections at work, in travel, at home etc., here in the USSR there were specific reasons why the use of mobile radiotelephones can be comparable in investments with the usual telephonization.

In the country there were (and are even now!) many old city houses and overwhelming majority of rural houses, which have no telephone cables. So create here cellular telephone zones may be cheaper than to put the posts with copper wires or underground cables. The same relates to newly built houses—the radio prolongations to each flat may well be used instead of cables and wires.

Big distances between cities and villages on the large portion of the USSR territory also were the arguments for the creation of cellular and personal radiotelephone systems along main transport routes.

These were the main directions of telecommunications developments in the USSR worked out in 1990. The life later showed that chosen directions were correct. Along these directions telecommunications system in Russia developed during last decade and this development continues even now.

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Biographical Sketch

Professor Yuri V. Gulyaev graduated from the Moscow Physics and Technology Institute, MPTI (1958) PhD (1962), D.Sci. (1970). Professor and Head of semiconductor electronics chair in MPTI (1971), corresponding member of Ac.Sci.USSR (1979), full member (academician) of Russian Academy of Sciences (RAS)(1984), Division of Informatics, Computer Sciences and Automation. From 1960 he worked in the Institute of Radio engineering and Electronics (IRE) Ac.Sci. USSR. Since 1988 he is the Director of IRE RAS. In 1992 Professor Yuri V. Gulyaev was elected as a Member of the Presidium of Russian Academy of Science. Professor Yuri V. Gulyaev is a specialist in the fields of solid-state physics, radio physics, electronics, computer sciences and telecommunications. Main scientific results obtained by Yuri V. Gulyaev are published in more than 400 scientific articles, 50 patents and 3 monographs.

In 1979 Professor Yuri V. Gulyaev was awarded the Hewlett-Packard Euro physics Prize of European Physical Society. Twice (in 1974 and 1984) he was awarded the State Prize of the USSR. In 1993 Yuri V. Gulyaev received State Prize of Russian Federation for his works on SAW- devices. In 1995 Yu.V.Gulyaev was awarded the A. S. Popov Gold Medal of the Russian Academy of Sciences for his contribution to electronics and telecommunications. Professor Yuri V.Gulyaev is the President of the

Russian A. S.Popov Scientific and Technical Society of Radio engineering, Electronics and Telecommunications. Being elected in 1989-91 People's Deputy of the USSR and Chairman of Subcommittee on Telecommunications and Informatics of Supreme Soviet of the USSR Yuri V. Gulyaev participated in working out the strategy of the development of telecommunications in USSR and in particular in Russia.