TELECOMMUNICATIONS IN RUSSIA

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Abstract

Eight years ago the article under the title “Telecommunications in Russia” was published in “IEEE Communications Magazine” [1]. In 1995 the feature topic "Telecom technology, systems, and services in Russia and the new republics" had continued the presentation of telecommunication development in Russia [2, 3]. The time passes. National telecommunications underwent significant changes. Some of them are described in this article.

Keywords: national telecommunication system, public networks, private networks, statistics, forecast.

Introduction

The main principles of national telecommunication system are described in the first item. At the beginning the milestones of the last years are considered. Afterwards, the structure of the Public Switched Telephone Network (PSTN), the basis of the national telecommunications, is presented.

The second item deals with statistics and forecasting. Two tables present the development of the main telecommunication networks. Third table allows to compare the telecommunication development in the republics of the former USSR. Three diagrams show the forecasting of the main indexes describing future telecommunications.

General evolution tendencies inherent to Russian telecommunications are described in the third item. The first paragraph of this item is dedicated to the new technologies and services. One example relating modern equipment application is described in the second paragraph. Last paragraph deals with liberalisation aspects of the Russian telecommunications.

Existing telecommunication system

Milestones of the last years

Radical transformations in the Russian economy have caused essential changes in the field of telecommunications. As a result, some customers had required the modern telecommunication services. Existing telecommunication networks were not able to

support increasing demands. Rapid modernisation of the national telecommunication system in the whole was impossible due to lack of the needed investment.

For provision of the modern telecommunication services, Operators began to build the Private Networks. Before that time, all telecommunication networks were state owned. Private Networks were based on the modern telecommunication equipment. So, quality of service was much higher. On the other hand, Private Networks were relatively small. In addition, in some cases, more than one Private Networks operates within one city. For these reasons, tariffs for services looked as unreal.

Nevertheless, customers of the Private Networks generated the main part of international and long-distance traffic. Modern services provided additional income for the Operators of the Private Networks. Operators of the Public Networks supported Plain Old Telephone Services (POTS) only. Figure 1 shows financial aspects of the relationship between Public Networks and Private ones.

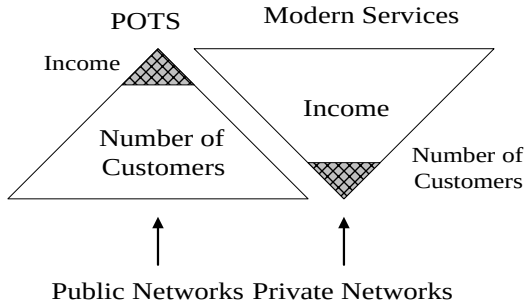

Figure 1. Relationship between Public and Private Networks

Creation of the Private Networks presents a classical example of bypass, the negative consequences of which are well known. Nevertheless, Private Networks still play important role in the development of the national telecommunications. First of all, these networks provide modern services for the limited subscriber group. Secondly, Operators of the Private Networks collect know-how, which is very important for the development of the national telecommunications.

So, creation of the Private Networks is the important tendency of the national telecommunications' development. Next basic tendency is introduction of the new types of switched networks. In the early 90s, there were two networks supported dialogue services. First network was the national PSTN. Second network was the telegraph one.

Business subscribers were interested in the mobile communications. Practically, there was no network for supporting needed services. As a result, plenty of cellular networks were created. Russian Telecommunication Administration has permitted to use equipment corresponding to three standards NMT, GSM, and AMPS. However, AMPS standard intends to so-called regional application. It means roaming is not regarded as an obligatory feature for AMPS cellular network. It should be noted that CDMA (Code Division Multiple Access) equipment is not permitted for the mobile

communication. At present, this technology may be used for fixed wireless access only.

Paging systems were introduced as well. This type of mobile communication is still popular. In large cities, plenty of Operators provide paging services. Nevertheless, this type of mobile communication is not cheaper than the classical one.

Wide use of personal computers began in the early 90s. Later on, Local Area Networks (LAN) were created in many enterprises. In the early 90s, there were no large-scale data transmission networks. Internet and communication between LAN stimulated the data transmission networks' creation. These networks are based on the different technologies. In the beginning, X.25 networks were mainly available. Later on, Frame Relay technology has emerged. Today numerous Operators are going to create a network based on Asynchronous Transfer Mode (ATM) technology.

So, second tendency of the national telecommunications' development is increasing of the networks' number. Nevertheless, PSTN still plays the vital role in the telecommunication system. Next paragraph presents the main characteristics of the Russian PSTN.

Public Switched Telephone Network

Russian PSTN has specific features. Some of them can be an obstacle for the further development of telecommunications. There are some distinctions between standards of International Telecommunication Union (ITU) and national norms. In addition, some solutions made many years ago generate now the new problems. These aspects of Russian PSTN may be found in [2, 3] but one example is given below. In this paragraph, PSTN structure is mainly described. Model of the Russian PSTN is shown in the Figure 2.

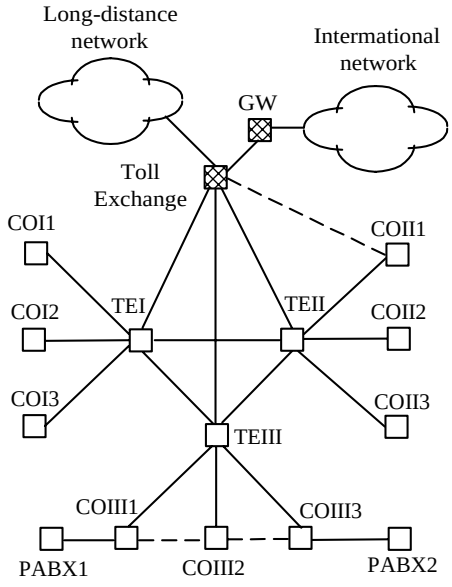

Figure 2. Model of the Russian PSTN

Lowest part of this model is example of the local network in the middle and large cities. Central Office (CO) is connected to the tandem exchange (TE). In some cases, COs are connected by the directly. Such possibility is shown by the dotted lines for three COs connected to the TEIII. COs may be directly connected with the Toll Exchange. This option is shown by the dotted line for the COII1. Automatic Branch Exchange (PABX) is served by the nearest CO.

All TEs are forming the meshed network. Up to 90s, TE was independent element of the local network. Operators did not use the equipment combined functions Tandem and Toll Exchanges. So, TE provided connections between COs of the local network, and access to the Toll Exchange. A function of the Toll Exchange is to establish connections for the long-distance and international calls. Last type of calls is served by the Gateway (GW).

Processing of the local calls is performed by the COs and TEs. If subscriber dials digit "8" (prefix of the long-distance connection in the national PSTN) all further processing of the call is a function of a Toll Exchange. Numbering plan for the cellular networks based on the Area Code (three digits) and number of mobile terminal (seven digits). In this case, Area Code defines the concrete cellular network.

Let us consider the call from fixed terminal to mobile phone. Calling subscriber dials digit "8". According to existing principles of the call processing, CO will establish switched connection to the Toll Exchange. The Toll Exchange will provide processing of the Area Code and number of called terminal. As a result, connection with Mobile Switching Centre (MSC) will be very long. In addition, capacity of trunk bundles to (from) Toll Exchange is not enough to pass additional traffic. The same problem will take place when Intelligent Network services will be introduced.

These problems are more simply for the Private Network. Typical structure of this network is shown in Figure 3. Let us assume that considered Private Network covers the city that has local telephone network shown in the lowest part of previous model.

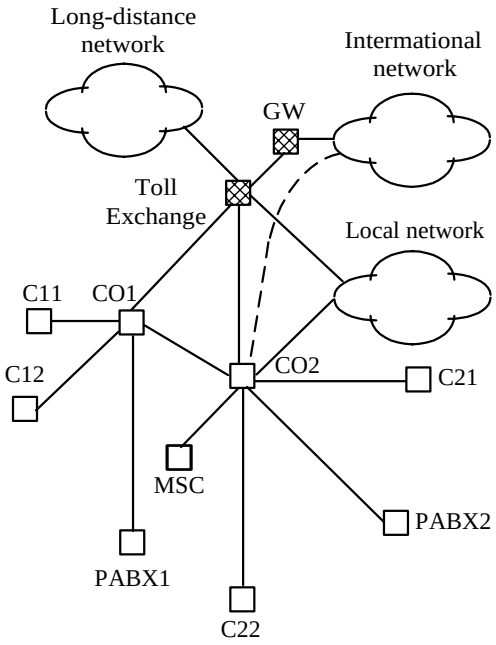

Figure 3. Typical structure of the Private Network

Private Network consists of the two CO. Usually these COs are high-quality digital equipment supporting all modern telecommunication services (Integrated Services Digital Network, Intelligent Network, etc.). Remote modules are widely used for the optimisation of the access network. Four concentrators (C11, C12, C21, and C22) and two PABXs are shown in considered model.

CO2 provides interworking functions with the local, long-distance, and international networks. In some cases, CO may provide additional functions. Dotted line denotes direct channels to the international network. Unconditionally, such possibilities have to be permitted by the licence issued by the National Telecommunication Administration.

One more effective solution is presented in Figure 3. The direct channels connect MSC and CO2. It is possible due to the functionality of these switching equipment.

Statistics and forecasting

Statistics of Russian telecommunications

The total area of Russia is 17.1 million square kilometres. About 148 million people live in Russia. Among them, about 76% are urban inhabitants and 24% are rural inhabitants. According to Constitution, Russia consists of 89 subjects of Federation (Republics, Territories, Provinces, etc.). Subjects of Federation are consolidated into 12 regions. In 1999, gross domestic product (GDP) per head was approximately $2,410 [4].

Table 1 presents the main telecommunication statistics. This table describes the quantitative tendencies in the national telecommunications.

Table 1

Number of:	1995	1996	1997	1998	1999
Trunk calls, millions	1436	1493	1570	1592	1620
International calls, millions	138.4	187.7	269.0	327.0	394.4
Domestic telegrams, millions	121	106	90	83	62
Capacity of the PSTN, millions	24.6	25.7	27.0	28.0	29.4
Capacity of the cellular networks, millions	0.09	0.22	0.48	0.74	1.35
Main lines per 100 inhabitants	16.6	17.4	18.4	19.0	20.0

These data show that telephone traffic permanently increases. Telegraph traffic is rapidly falling. This process takes place for both international and domestic telegrams. Finally, vast growth of the mobile communications should be noted. On the other hand, portion of Moscow and St. Petersburg is about 80% in the mentioned data.

The qualitative aspects of the telecommunications evolution are presented by the table 2. Data listed in this table help to understand the main tendencies in the Russian telecommunications. For this reason, each line of second table is briefly commented.

Table 2

Qualitative indices:	1995	1996	1997	1998	1999
Automatic trunk lines, %	80.8	83.8	84.8	88.7	91.5
Digital switches in cities, %	13.5	17.0	21.9	27.0	32.1
Digital switches in rural area, %	5.8	7.6	9.5	12.0	14.3
Length of digital trunk lines, %	4.9	9.1	35.3	47.6	56.3

Portion of automatic trunk lines is increasing. However, near 10% of these lines are served yet by operators. Digitalisation of the urban and rural networks is carried out rapidly. On the other hand, achieved level does not correspond to market demands. Digitalisation of the trunk lines is accelerated but this rate lags behind from installation of the modern Toll Exchanges.

Very important index of the telecommunication development is Internet penetration. In 1999 there were more than 300 Internet Services Providers (ISP). The main part of ISPs operates in Moscow and St. Petersburg. In the middle of 1999 there were near 1.3 millions of Internet users [5]. Internet users of the largest cities (Moscow, St. Petersburg, Ekaterinburg, and Nizhni Novgorod) are approximately 80% of the all customers.

In general, Moscow and St. Petersburg essentially differ from other subjects of Russian Federation. For example, telecommunications in St. Petersburg are characterised by the following data:
- about 2.1 millions subscribers connected to the local telephone network, that is approximately 44 main lines per 100 inhabitants;

- existing Private Networks providing modern telecommunication services up to ATM connections;
- roughly 220000 mobile subscribers of cellular networks created by three main Operators;
- more than 50 ISP.

It should be noted that these numbers relate to 1999 in contradistinction to information in both tables.

It is interesting to compare a telecommunication development in Russia and some republics of the former USSR. Telephone density is used as the main index. Corresponding figures are given in Table 3 for the countries located in Europe [6].

Table 3

Country	Main lines per 100 inhabitants (1998)	Place
Armenia	15,4	7
Azerbaijan	10,5	10
Byelorussia	24,6	4
Georgia	11,1	9
Estonia	35,1	1
Latvia	31,7	2
Lithuania	30,0	3
Moldova	15,3	8
Russia	19,0	5
Ukraine	18,3	6

Some forecasts

Important index of telecommunication development is the PSTN capacity. Undoubtedly, potential market on new lines is very large. Some forecasts of PSTN capacity carried out more than five years ago have estimated the PSTN capacity up to 2000 by values within 35 - 40 millions. However, fast growth of the national PSTN was restricted by the economical factors. Figure 4 present the forecast of PSTN capacity growth.

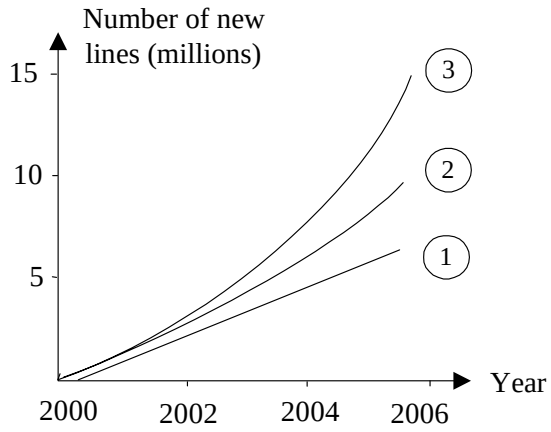

Figure 4. Forecast of the PSTN capacity growth

In this paragraph, three types of the prognostic curves will be shown. First curve is a pessimistic scenario of considered process. Behavior of this curve will take place under worst economical situation. Second curve corresponds to a pragmatic scenario. So, this curve is more realistic. Third curve presents an optimistic scenario. Only rapid economy growth will provide such behavior of prognostic curve.

Figure 4 presents quantitative aspects of the future telecommunication development. Next figure shows the growth of the ISDN (Integrated Services Digital Network) users. Corresponding curve presents qualitative aspects of the future telecommunication development. Number of users evaluates as part of PSTN subscribers.

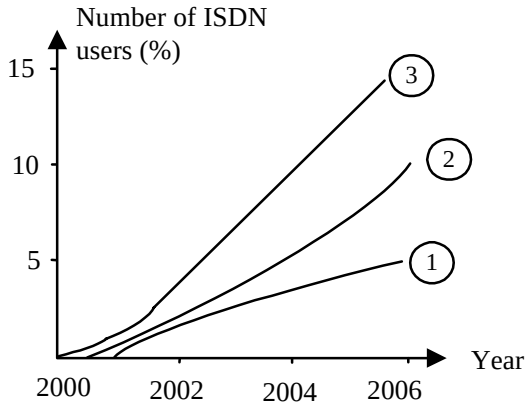

Figure 5. Forecast of the ISDN density

Obviously, number of mobile terminals will be rapidly increase. This process may be estimated as part of mobile terminals within PSTN capacity. Corresponding prognostic curves are shown in figure 6.

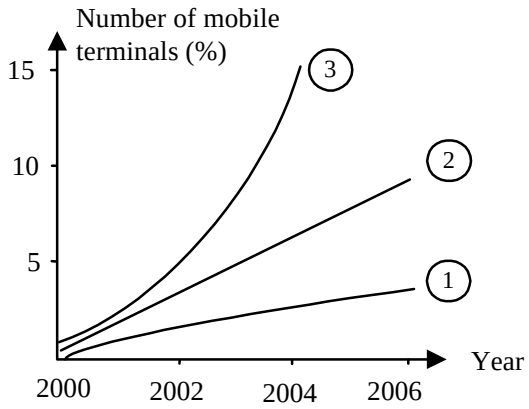

Figure 6. Forecast of the mobile terminals' density

General evolution tendencies

An important evolution tendency of the national telecommunications is an application of the equipment that corresponds to International and European standards. However, standard equipment application is not sufficient condition of the successful telecommunication development. It is needed to follow a generally accepted norms related to networks' creation and calls' processing. This problem has to be considered from the organisation, financial, and technical points of view.

New telecommunication technologies and services

On the whole, all Operators are going to use the telecommunication technologies adopted in developed countries. Operators of Private Networks apply these technologies at the same time when corresponding equipment and/or software are available. In this case, they are able to compete with other Operators. PSTN Operators introduce new telecommunication technologies as well. However, they start this process later on. In addition, replacement of old equipment elapses over a long period of time.

Synchronous Digital Hierarchy (SDH) is technology that today is widely used for all types of the transmission networks. Some Operators are going to apply Wavelength Division Multiplex (WDM) for throughput increase of the existing transmission networks. SDH equipment multiplies fiber-optic (FO) cables and microwave systems. These two types of transmission media are dominated in the new projects. In rural areas any wireless technologies have began to apply. Point-to-multipoint systems based on CDMA technology are widely used by Operators. In some specific cases, satellite communication is the only one possible solution for access to PSTN and other networks.

Ups to now, ISDN capabilities were interested for customers of the Private Networks only. In the nearest future, these services will be available for the PSTN subscribers connected to the digital exchanges.

Televoting was the first service of Intelligent Network (IN) effectively demonstrated in Russia. Some TV companies use televoting during discussion of topical problems. However, perspectives of the other IN services are still foggy. It is explained by the some reasons. Except Private Networks and some regional PSTN companies, local calls are still free of charge. Trade and Services are not ready for technologies like Freephone.

As a result, evolution towards an IN has specific features for Russian PSTN. In some cases, Operators introduce limited set of the IN services. If such services as televoting and telephone credit cards are needed, national equipment “PROTEI” based on the CORBA platform may be used.

Application of some new technologies was stipulated by Internet expansion. First Internet users installed ordinary modems. However modem cannot provide high rate access. Some users ask ISPs to install any Digital Subscriber Line (xDSL) equipment. Such access systems are used within Private Networks. To prevent the overload of switched networks, Internet traffic will be transferred via data networks. ATM technology is one of effective solution.

Operators of Public and Private networks consider some other new technologies for the future development of telecommunications as well.

Example of a modern equipment application

Internet is important part of the telecommunication market. Many Operators provide Internet services. A competition is very strong. For the progress, Operator has to have the high quality digital network. This network has to use the modern equipment. Network created METROCOM widely uses fiber-optic cables laid in underground tunnels of the metro.

In St. Petersburg, Operator METROCOM has created the “Internet Backbone”. Simplified model of this network is shown in figure 7. Routers and ATM switches are used to provide the Internet Services. Some E1 links are used for the connections with foreign Internet Services Providers. ATM switches are interconnected by the STM-1 links.

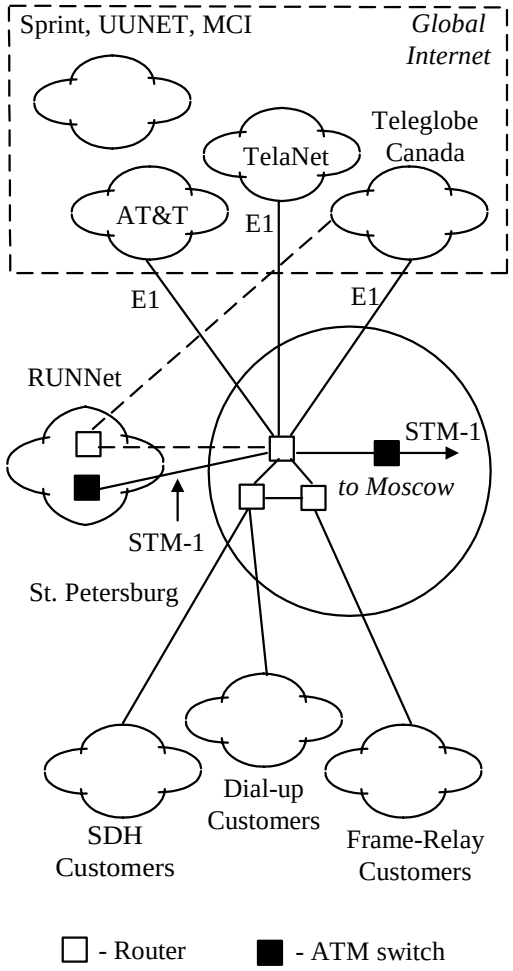

Figure 7. METROCOM Internet Backbone

Resources of the “Internet Backbone” support the all demands of different Customers. Three types of Customers are shown in figure 7. At present 1000Ethernet Customers can be served as well. “Internet Backbone” are naturally expanded to Moscow where similar Operator (MACOMNET) works.

Liberalisation aspects

In the former USSR there were not any Private telecommunication networks and systems. State Ministry of Communication had regulated the technical, financial, and organisational aspects of telecommunication development. There was not any competition in the field of telecommunication. So, liberalisation and deregulation have very short history in Russian telecommunications.

According to Russian legislation, the foreign capital may be used in the telecommunication market without any restrictions. Russia is going to enter to World Trade Organization. For this reason, some national lows will be defined more accurately. Currently, regulation in the field of telecommunications is based on the 11 state lows [7]. These lows and the main decrees of Russian Telecommunication Administration are a base for the telecommunication market liberalisation.

Liberalisation has to provide the normal condition for a competition. At present, there is competition between Operators of the Private Networks. So, competition takes place within some kinds of modern services. Examples of such services are mobile communication, paging, Cable TV, and Internet. Except a little part of business customers, telephone services are still the monopoly of the national PSTN. However, this situation may be changed in the nearest future.

Conclusions

In fact, national telecommunication system consists of the two main parts. Biggest part is PSTN and some other networks that provide ordinary telecommunication services. In some cases, quality of services does not correspond to the national standards. It should be noted that payment for the services is relatively small. For example, local calls in many local networks are still free of charge and monthly payment for PSTN connection is less than 3$.

The Private Networks represents second part of telecommunication system. These networks support telecommunication services that are available in the developed countries. However, payment for the services may be much more than analogue value in the developed countries. For example, month payment for simple digital pager in St. Petersburg is more than 10$.

Evidently, existing situation will be gradually changed. It will depend on the economical situation in Russia. For this reason, forecasting of the some indices has to be done for the optimistic, pragmatic and pessimistic scenarios. Undoubtedly, Russian telecommunication market in the next century will be very attractive for the potential providers of the equipment and services.

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