THE SOVIET TELECOMMUNICATIONS SYSTEM

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CHAPTER 1

INTRODUCTION AND SUMMARY

The telecommunications sector is a vital infrastructure for the information revolution. Soviet progress in exploiting the potential of the computer will depend in part on the capabilities and technical level of the telecommunications sector. In addition, telecommunications is an information technology in its own right. There are huge information transfers, in addition to data transfer between computers, for which a well developed telecommunications system is essential. Its own technical progress is closely tied up with the information revolution, depending as it does on extensive use of computers and advances in information coding, processing, and storage.

In thinking about the information revolution and the Soviet Union, Western analysts have given a great deal of thought and research to the computer, but much less to the telecommunications infrastructure. There is no general systematic study of the telecommunications sector in the Western literature on the Soviet Union. But even limited acquaintance with Soviet telecommunications makes it clear that it is today inadequate for a society that has aspirations to be an industrial superpower. It is technologically backward, it has too little capacity to meet the telecommunications needs of a modern society, and is too thin to tie the society and the economy together. It is not capable of handling extensive data transfer. This condition has grown out of a long history of neglect, but these defects of the telecommunications system are today fully recognized by the Soviet leadership, which is trying to propagate a new attitude toward the functions it must perform and the priority to be given to it. In the 12th Five Year

Plan, Soviet planners have established ambitious goals for expanding and modernizing the technical base of this sector. In the general reform of the Soviet system being attempted by the Gorbachev leadership, telecommunications is to be both an instrument for reform and a beneficiary of reform. How quickly the telecoms sector gets modernized will depend on how successful reform is, and the progress of economic reform and perestroika will be governed in part by how effectively the telecommunications system can be transformed. Many policies of the past, which have led to neglect of the sector and which underlie its poor record of performance, are undergoing change. It will be an important actor/client in many of the policy areas that are now being shaken up, such as pricing, R and D management, reweighting of civilian/military priorities, the attitude toward technology transfer, and the Soviet interaction with Eastern Europe. This is accordingly not the time to attempt dogmatic assessments as to whether telecommunications will become a driver for the information revolution, or one of those "braking mechanisms" which the Gorbachev reformers are trying to overcome.

What can be done at the present time is to develop a more complete background study that will enable us to understand the baseline from which the Soviet leaders are starting. A survey of how the industry is organized, what its current technological level is, what its record in a number of areas of economic choice and innovation has been, and what aspects of its structure and environment limit the effectiveness of its performance, will provide perspective on how far it has to go, and a background against which to evaluate change. This report is a first draft of a book-length study intended to fulfill that purpose. In its present form, as a report on work

done under the Hudson Institute project on "The Implications of the Information Revolution for Soviet Society", it is an intermediate step toward the ultimate study, which presents a) an inventory of major issues, some fully researched, others less so; b) a collection of basic data on the dimensions, growth, and structure of the sector; c) some tentative assessments of its present performance and its capabilities for modernizing itself to cope with the demands of the information revolution, d) an effort to relate telecommunications to a more general understanding of how information and communication fit into society, and how the information revolution, technological change, and system change interact with each other.

Chapter 2 is a general overview of the sector, describing its organization, size, network structure, some aspects of its technology, problems of quality of service, the current plans for its modernization and so on. Many of the issues laid out there are taken up in more detail in succeeding chapters.

Chapter 3 develops a framework for interpreting how the organization of the telecommunications function in the USSR affects its performance. There is a familiar argument in the West as to whether the telecommunications system, as an entity that is highly integrated technically, can best be managed by a centralized authority, or given the extremely rapid pace of technical change, is likely to advance faster in an environment of fragmentation and competition. In the recent past policy in the advanced industrial countries has been strongly influenced by the latter view, and rapid technical advance in telecommunications has been closely connected with deregulation and organizational change. But the issue remains

controversial. The USSR, where the communications sector is highly monopolized and centrally controlled by a single organization, is an example at the opposite extreme of the spectrum. But for Soviet telecommunications the structure/performance question arises in a distinctive context — one in which the Soviet telecommunications ministry is a monopoly operating in a "world of monopolies." Chapter 3 attempts to recast the issues of market power, structure, customer/client interfaces, etc, familiar in Western analyses of the sector into the Soviet context.

The work done so far dramatizes the unsurprising proposition that one of the most important ingredients in the technical capacities of the sector is the kind of inputs of R and D and equipment available to it. Chapters 4 and 5 are devoted to these two topics. Minsviaz — the Soviet Ma Bell — has suffered from an inadequate in-house base in these areas, and has been at a serious disadvantage in having to depend for these inputs on the military-industrial ministries of the USSR economy. Those ministries have as their main responsibility serving the procurement demands of the Soviet military, and there is abundant evidence that the ability of Minsviaz to do its job has been severely handicapped by its weak bargaining position as a procurer of telecommunications equipment. There is enough information on the development of some particular types and models of equipment to do case histories illuminating the organizational and technical constraints that limit innovational effectiveness. It turns out that Soviet telecoms has also relied extensively on Eastern Europe for both R and D and for production of equipment.

One approach to assessing more concretely the goals, choices and performance of Soviet telecommunications and how they are affected by the

structure and organization of the sector is case studies of specific applications. Chapter 6 deals with three such cases. The Russians have created an extensive system for transmitting newspaper images by facsimile for decentralized printing of the central press. This turns out to be especially useful because we have close analogues in Western countries that show interesting differences and similarities. The Russians have put a great deal of resources into a communications satellite system, and have given it a major role in TV distribution. But they have made very little use of comsats for telephony, and their failure to do so creates an intriguing area for second-guessing their policies and choices. The telecommunications application that is most closely tied to the computer-based elements of the information revolution is the Minsviaz role in providing utility services for data transfer and computer networking. It turns out that there is not much activity to report in this area, but what there is reveals a great deal about the current technical state of the system, and the interaction between Minsviaz and the clients for such services.

Though most of the book is concerned with the point-to-point switched forms of telecommunications, Chapter 7 examines radio and television broadcasting. This component of the telecommunications system has been much less neglected in the USSR than has the telephone system, and provides a lot of interesting material for understanding the attitude the regime takes toward the forms of information dissemination and control of information flows.

The Hudson project as a whole is driven by the dilemma that most observers of the Soviet system see between the desire of the regime to obtain the benefits that the revolution in information technologies

promises, and the incompatibility of those new technologies and their applications with Soviet institutions and the forms of information handling that have characterized Soviet society. Chapter 8 approaches this topic by examining more systematically the role that information and communication play in the functioning of society, and how the traditional Soviet society has structured these information processing and transmission processes. The heart of the question that concerns us is the interaction between rapid advance in the potentials of information technologies and possible change in societal structure. To what extent is technical change an autonomous force that will force changes in society? Or is such change improbable given the possibility that the structural imperatives of the Soviet-type system may inhibit, shape, and exploit the new information and communication technologies without having to alter its basic institutions in the process? This is, of course, a very complex issue, and the approach of the chapter is exploratory, the conclusions far from definitive. But as with the rest of the book, the treatment is in the form of a set of hypotheses, tentative conclusions, examination of the issue in the light of the detailed picture of the sector that begins to emerge in the rest of the book.

As a basis for the larger study it seemed useful to build as systematic a collection as possible of basic statistics on Soviet telecommunications. Given the preliminary status of this report, and the hope that it can be the basis for additional work by others, it seemed appropriate to present this data base rather fully in the form of a statistical appendix. That picture is a bit sketchy. For the fifties and sixties there was fairly complete and consistent publication of the data collected by the state statistical organs in a specialized handbook on communications and in the handbooks on

transport and communication, but in recent years the flow of information has been thinner. The prospect now is for release of a great deal more data and the appendix is a kind of skeleton that other researchers can keep up to date on their own.

This report is unmistakably a first draft that still needs a great deal of filling in. There are numerous areas where further digging will replicate examples to permit a more definitive ultimate assessment. I have looked at the R and D history of half a dozen specific innovations, for example, but have found a number of others that can be worked up in the same way. The material I have surveyed has been surprisingly uninformative on economic issues -- pricing, financial relationships, resource magnitudes and the like. But I suspect that a much fuller picture will emerge from the patient accumulation of detail. Doing a report like this is almost a prerequisite for beginning work on the ultimate study. It takes a while to build a reasonable understanding of the technology, to know what the interesting issues are, to acquire a sense of what information to take at face value, what to question. So this work has a twofold function -- in addition to providing a full enough treatment of some central points to be useful in itself, it also lays the basis for, and I hope will stimulate, additional future work.

CHAPTER 2

OVERVIEW OF THE SOVIET TELECOMMUNICATIONS SYSTEM

The telecommunications sector is a vital infrastructure for the information revolution. Any judgement as to the ability of the Soviet system to realize the potential of this revolution must rest on an understanding of the capabilities and technical level of the telecommunications sector, and its ability to absorb the innovations involved in information transfer, such as those required for high speed data exchange and computer networking. In addition, telecommunications is an information technology in its own right. There are huge information transfers for it to handle that do not involve computers. In the reverse direction, its own technical progress depends heavily on the information revolution via use of computers and advances in information coding, processing, and storage.

Equally important for the purposes of our study, the telecommunications sector is a revealing case study of the interaction between systemic features and innovation in information technologies. Studying it in depth will help us understand how the institutional features of the Soviet system interact with the problem of introducing new technologies, especially the big-system, multiple-interface, institution-jostling, kinds of technology associated with the information revolution.

It comes as something of a surprise to find that despite all the work done on the Soviet economy over the years, the telecommunications sector has been scarcely investigated by Western analysts. There is one dissertation

with a few associated publications.[1] This is all the more surprising considering that there is an informative Soviet literature on the industry, dealing with both technology and economic policy issues. This might be explained by the fact that compared to other sectors, it is perhaps unusually difficult to understand the economic issues and choices for this sector without a solid understanding of its technical basis. Unfortunately, economists studying the Soviet economy have been reluctant to become engaged with the study of technology.

ADMINISTRATION OF THE TELECOMMUNICATIONS SYSTEM

Telecommunications in the USSR is administered by the Ministry of Communications, usually abbreviated in Soviet discussions as Minsviaz.[2] In addition to telecommunications proper, the ministry also has the postal service under its wing, and the latter includes distribution of printed publications through the Soiuzpechat agency. The reach of Minsviaz also exceeds that of telecommunications entities in most other countries in that it also builds, maintains, and operates facilities for television and radiobroadcasting. This study is concerned with telecommunications proper, i.e. communication involving electronic signals, and will not cover the post office operations of Minsviaz.

Figure 1 shows the Minsviaz organization chart. The ministry is

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[1] See J. Patrick Lewis, "Communications Output in the USSR: A Study of The Soviet Telephone Systems," Soviet Studies, July 1976, pp. 406-17.

[2] For simplicity, in several of the common names and terms important to this subject omit the soft sign that would be shown with a comma in proper transliterations.

organized as a Union-Republican ministry -- in addition to the Union-level Ministry of Communications (Minsviaz SSSR), a similar ministry exists in each Union republic, dually subordinated both to Minsviaz SSSR, and to the Council of Ministers of the corresponding republic. The all-Union ministry has responsibility for management of the structure as a whole, and for direct conduct of activities that overlap republic boundaries. The most important of these are operation of the national net for long-distance telephone service and operation of the national network of radio and TV broadcast services, an important component of which is comsat operations. Minsviaz also has general oversight responsibility for telecommunications operations and facilities in other branches of the economy. However, since the Communications Law which gives these responsibilities to Minsviaz does not apply to the Ministry of Defense, the KGB, and the Ministry of Internal Affairs, I assume that Minsviaz has no oversight responsibilities for their telecommunications activities.[3] The internal organization of Minsviaz follows the usual pattern of Soviet ministries. It has a collegium, a scientific-technical council, and a number of "chief administrations" (glavnye upravleniia or glavki). Several of the latter worth noting here

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[3] See the Ustav Sviazi, in Sobranie Postanovlenii SSSR, 1971, Moscow, 1971, p. 83.

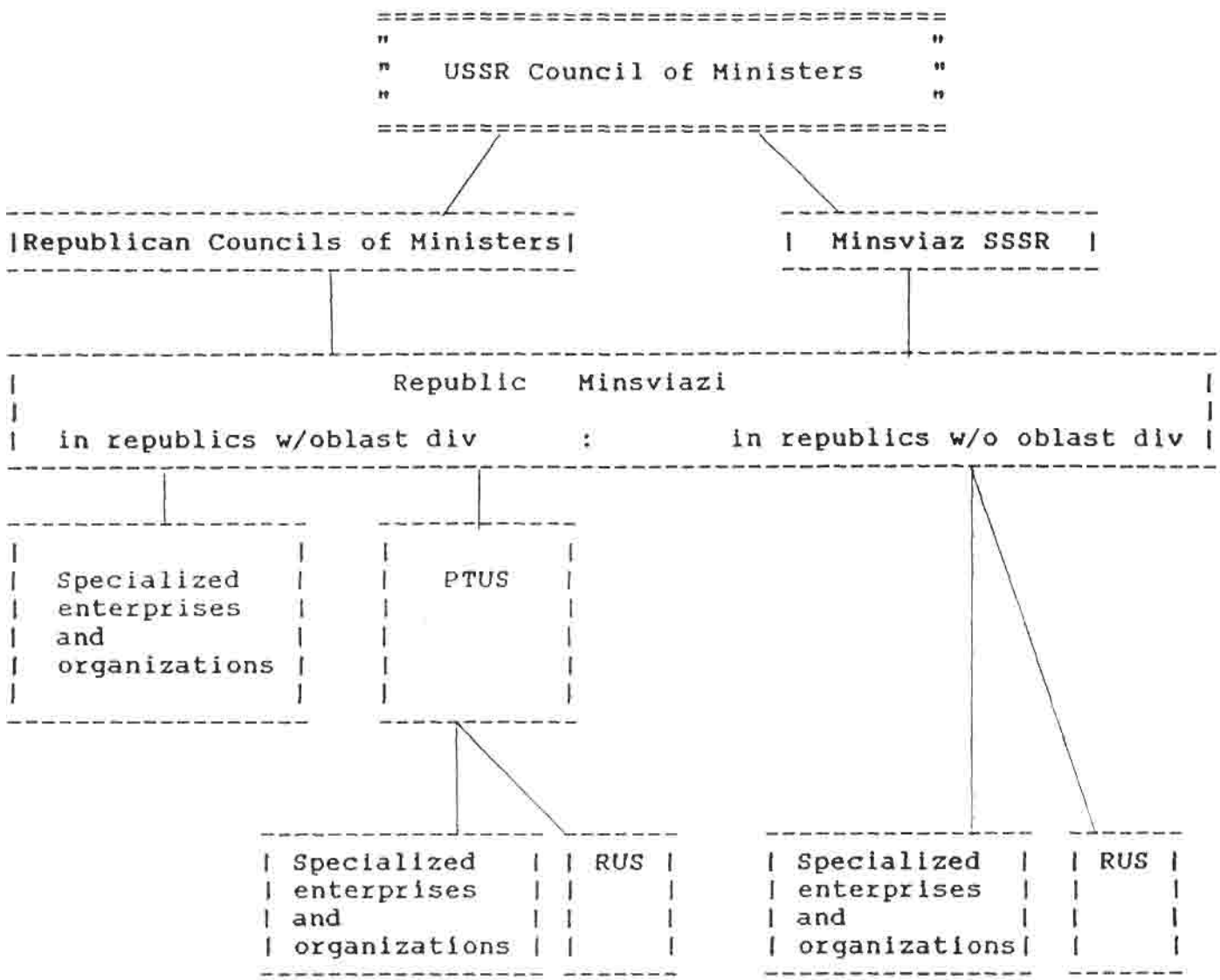

Figure 1. Minsviaz Organization Chart.

since we will be discussing them later include GUPP, the Chief Administration for Industrial Enterprises, GNTU, the Chief Administration for Science and Technology, and GKRU, The Chief Administration for Satellite and Radiobroadcasting.[4]

The Union-republic ministries have analogous, though simpler, structures, through which they administer the facilities in their territory. In republics containing the territorial subdivisions known as oblasti, (or krais or ASSRs) they do so through an oblast level khozraschet organ (the PTUS or proizvodstvenno-territorial'noe upravlenie sviazi). At the bottom of the hierarchy are the khozraschet production enterprises (the RUS or rabochoe upravlenie sviazi) that provide communications services -- the post offices, the telegraph offices, the city telephone networks, and so on. Of the total number of enterprises in the system, these lower level enterprises under the PTUS constitute "more than half".[5] In republics without internal divisions (i.e. Armenia, Turkmenia, Estonia, Latvia, Lithuania, and Moldavia) the production enterprises are directly controlled by the republic ministry. The republic ministries also usually administer the facilities in the republic capital (except in the case of the USSR, where Minsviaz SSSR

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[4] The other branch chief administrations are: chief administration for the postal service (GUPS); chief administration for long distance cable-line and radio-relay installations (GUMTS); chief administration for urban and rural telephone communication (GUTS); chief administration for telegraphy (GTU); chief administration for distribution of the press; chief administration for construction of communications enterprises. There are also numerous functional administrations, which I will not list here. See O. S. Srapionov, Spravochnik ekonomista predpriiatii sviazi, Moscow, 1983, pp. 11-24.

[5] Spravochnik ekonomista predpriiatiia sviazi, p. 16.

runs the Moscow system, leaving Minsviaz RSFSR to run the Leningrad system.[6]

Internally, Minsviaz is run on the principle of khozraschet, or economic accountability, under which individual enterprises have their own bank account, do their own accounting, and are more or less financially independent. The system is, however, necessarily distinguished by a high degree of redistribution of incomes among units. Many do not deal with the public, and earn no revenue directly. But a system of output indicators has been devised for the various kinds of units, and intrabranch prices for these activity indicators are used to channel income to them. In fact this redistribution is very crude, and in 1987, 1215 of the 7000 khozraschet enterprises of the ministry were planned to lose money. The effective management of this huge conglomerate raises many issues, which will be taken up in the following chapter.

CURRENT STATUS OF THE TELECOMMUNICATIONS NETWORK

The Soviet telecommunications system is inadequate for a society that wants to function as an industrial superpower. In addition to being technologically backward, it has too little capacity to meet the telecommunications needs of a modern society, and is too thin to tie the society and the economy together. The component of the system that is of most interest to the Hudson information project is the network of switched voice, documentary, and data facilities. The bulk of the work of this net is

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[6] Apparently there has not always been a Minsviaz RSFSR. According to an early seventies source, "in the RSFSR the all-union ministry performs the role of the republican ministry." (M. G. Kozlov, Ekonomika sviazi, Moscow, 1971, p. 27). I do not know when the change was made to the present arrangement.

telephonic communication, but the distinction between telephony and other point-to-point switched communications functions is today becoming increasingly blurred, and in what follows "telephone network" will be used as shorthand for the broader system described above. Special attention will be given, however, to the telegraph system.

Television and radio distribution are the other major tasks of the telecommunications system, and those systems are better developed in the USSR than is the telephone system. They will be discussed separately in a later chapter.

The Telephone Network

The judgments offered above concerning the underdevelopment of the Soviet telephone system are easily demonstrated by a few comparisons with the United States. The data base I have been able to put together[7] leaves a number of issues and dimensions unsettled, but some things are clear enough. In the US in the early eighties there were over 180 million telephone instruments connected to the utility network.[8] In the USSR, at the beginning of 1980, the number of telephones installed was 29.1 million, of which about 23.7 million were connected to the public network. By the end of 1985 the situation was somewhat improved, with 37.2 million telephones installed, and 31.1 million connected to the utility network. To put this six-fold difference in perspective, one should remember that the GNP of the US is perhaps only half again as large as that of the USSR. The number of intercity calls made in the US was about 45 billion, and in the USSR about

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[7] See the statistical appendix.

[8] International Telecommunications Union, Yearbook of Common Carrier Telecommunication Statistics.

1.7 billion. The volume of international traffic, though it reflects Soviet policies and the character of Soviet society as much as it does technical capabilities, is especially insignificant. In 1982, the USSR originated 2.13 million international calls, the US 310.8 million.[9]

The telephone network is strongly oriented toward serving official and institutional rather than household needs. Of the 31.1 million public network telephones in place at the end of 1985, 17.1 million or 55 per cent were residential. This was a significant rise in the share over the FYP period, since it had been only 50 per cent at the end of 1980. In the US, the share of households is much higher -- about 84 percent of all subscriber lines are residential.[10] As a corollary of this relative neglect of the household sector only 23 per cent of urban households have telephones, and only 7 per cent of rural households. Of all intercity telephone calls in 1980, 43.8 per cent were initiated by households, 38.5 per cent by organizations in the production sector, 17.7 per cent in the nonproductive sector.[11] That is a gain for households compared to 1958, when they accounted for only 30.7 percent of intercity calls.[12] I have seen no breakdown for local telephone calls, but their distribution is no doubt similarly lopsided.

It is not that there is any shortage of demand. With 12 million households on the waiting list, there are almost as many households waiting

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[9] Ibid.

[10] Ibid.

[11] O.S. Srapionov, Ekonomika sviazi, Moscow, 1982, p. 130.

[12] I. A. Podgorodetskii, Ekonomicheskii analiz deiatel'nosti predpriiatii sviazi, Moscow, 1961, pp. 81-82.

for telephones as with telephones already installed. Getting a telephone involves a wait of many years. In one source it is said with pride that in some districts in Moscow the waiting list has now been cut to only one year! Nor is the population well served with pay telephones. In the whole country in 1970 there were only 3 thousand pay telephones from which one could dial outside the local exchange, and though the number has increased since, 35 thousand at the end of 1986 makes them pretty thin on the ground. There are also pay phones from which only local calls can be made, but for some reason the Russians are notably hesitant to reveal this number. In Moscow, however, we know that there are 3.3 pay phones per thousand inhabitants. The quality and usability of pay phones is extremely bad. Only a small fraction can be used for intercity calls, and a large fraction are out of service. In 1985, in a campaign to improve the status of the pay phone network, one of the newspapers encouraged its readers to check what fraction were not working, and it was often half or more.

There is a great deal of diversity in availability of telephone service and in its general quality as between regions, urban and rural areas, administrative centers versus other kinds of cities, and so on. The Baltic republics have more sophisticated systems and higher densities, as does also Armenia. Other republics, especially those in Central Asia, are very poorly served. The highest density is in Latvia with 221 telephones per thousand persons, and the lowest in Uzbekistan with 48 telephones per thousand. The number of telephones per person is three times higher among the urban population than among the rural population. Moscow with 3 per cent of the country's population has 11 per cent of all Minsviaz telephones, and considering the concentration of institutions and administrative offices in

the capital probably a still higher share of all telephones.

The telephone system is technologically old-fashioned. As recently as 1970, 14 per cent of the phones were connected to manually switched local offices, though that share has fallen fast and is now down to 2 per cent. Automatic switching equipment is still basically electro-mechanical, with about half of the exchange capacity in Strowger-type exchanges, and half in crossbar exchanges. Switching control in crossbar offices is still almost exclusively electromechanical, and the effort to introduce switches based on ferreed switching elements and stored program control is only beginning. There was only a handful of such exchanges at the end of 1985, and of the 12.1 million numbers of additional exchange capacity to be installed in the 12th FYP only 2 million are to be in "quasi-electronic" (stored program control) and electronic exchanges.[13] I have seen little data on the pace of introduction of the more modern systems in 1986-88, but what little there is suggests that these goals are unlikely to be met. The supply situation for modern exchanges will be discussed further in a subsequent chapter. Intercity calls still depend heavily on operator assistance. In 1985, 66 per cent of intercity calls were dialled direct, an improvement over the corresponding figure for 1980 which was 42.3 per cent.[14] But significant progress is being made in automating intercity traffic. In the decade of the seventies while traffic tripled, the number of operators was reduced by 75

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[13] Vestnik sviazi, 1986:7, p. 2.

[14] Elektrosviaz', 1982:1 and 1986:2. I am not sure that this number means what it seems to say — other sources refer to intercity traffic using "automated and semi-automated" dialing.

thousand.[15]

Network Architecture

As shown in Figure 1, there are three main levels to the Soviet telephone network. The bottom layer of the hierarchy, which I will call the primary level, consists of local exchanges, i.e city and rural exchanges. The simpler of these (rural systems) may operate through a single exchange, but a city network will more often consist of a number of exchanges, tied together by direct trunks or through tandem exchanges. The next level of the network, which I will call the secondary level, consists of "zonal networks", generally coincident with the Soviet administrative subdivisions called oblasts, krais, and ASSRs. The zonal systems are the basis for the Soviet area code numbering plan. There are cases where a large oblast contains more than one zonal network, and where a republic lacks oblast divisions, the zone may coincide with the republic. One source indicates that there are some 178 zonal systems.[16] Since I count 149 oblasts, krais, and ASSRs, there must be numerous cases where large territories are split into more than one zonal network. Each zonal system has a transit exchange (the Russians call these UAK or uzly avtomaticheskoi kommutatsii when they are automatically switched, UK when manually switched), usually in the oblast center. These UAK and UK tie together the primary exchanges of the zonal system, and connect the zonal system upward to some 15 interregional transit offices, which I will call the tertiary level of the switching hierarchy. These tertiary-level exchanges are tied together to constitute

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[15] Vestnik sviazi, 1987:4, p. 2.

[16] Analysis of the Soviet Ministry of Communications' Public Network and Facilities, prepared by Duyck Van Gorder, GTE Communications, 1983.

the national, or tertiary network. (The Russian call it the "trunk network" — magistral'naia set' — but since "trunk" is usually used in English to denote other ideas I prefer to call it the national network). I do not know just how the tertiary UAKs are connected to form the national network. One would assume that tertiary exchanges would also have downward links to some zonal transit exchanges subordinated to other tertiary centers. I have not however, seen specific information on that point. One of these tertiary centers is in Moscow, where the international gateway, equipped with an ARM-20 exchange, is also located.[17] The Moscow UAK should perhaps be considered a fourth level switching center, as it may be the only transit exchange connected to all the other 14 tertiary transit exchanges. Apparently the tertiary offices all use foreign equipment -- mostly the ARM or MT-20 exchanges. How thoroughly this hierarchical conception has actually been filled in with either the transit exchanges or the various trunk lines it implies, I do not know, but I think it is still far from complete.

In addition to serving as the international gateway for telephone communications, Moscow also serves as the gateway for the telegraph and telex international connections. The communications

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[17] Vestnik sviazi, 1986:5, p. 5. This is the first of this imported exchange installed in the country.

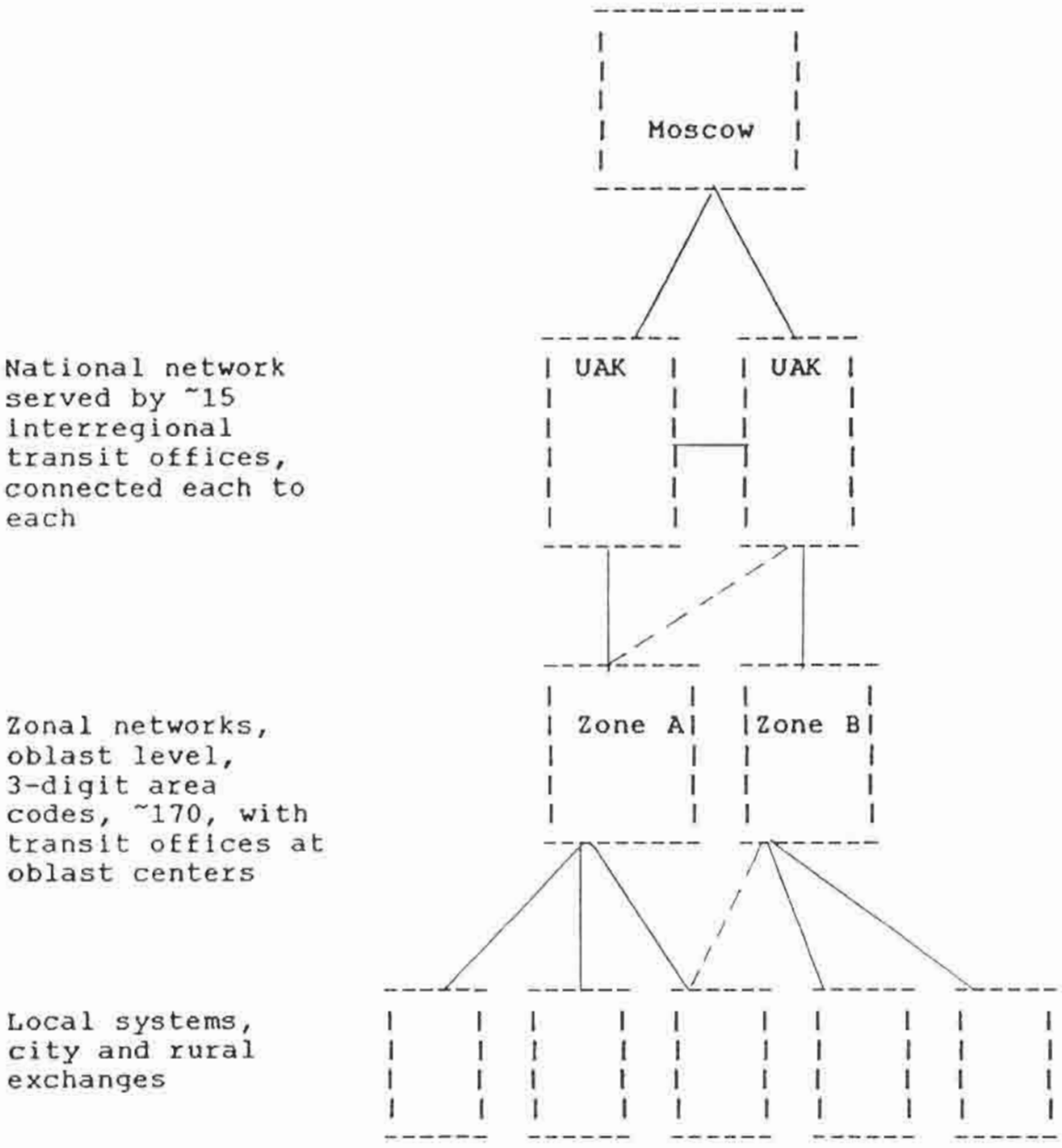

Figure 2. Hierarchical Structure of the Soviet Telephone Network.

satellite system is similarly tied in with the outside world through international gateways, but there are more of these. The Soviet Intersputnik station is located in Moscow, and there are stations at Moscow, Vladimir and L'vov connecting with Intelsat satellites.

The Soviet telephone network was originally conceived and in fact developed as congeries of local systems, far from integrated even at the zonal level. Any long-distance intercity connection was primarily to Moscow. It was very late in developing the interregional lines, or the hierarchical structure of switching nodes described above that could tie it together. It still shows very weak intercity and interregional connectivity. As one measure, the number of intercity telephone calls per telephone in the USSR is only about 50 per year, versus 280 in the US. A large share of these intercity calls are within-zone calls, rather than really long-distance. As another measure, we might expect intercity channel-kilometers to be more or less proportional to the number of telephones, and to some number a little larger than the square root of the area.[18] Applying the appropriate adjustments to the 1,579 million channel-km of the US network in 1980[19], we would expect the Soviet Union to have had about 338 million channel-km, but in fact it had more like 136 million. I would have expected an even greater disparity, but one offsetting factor is that the Russians get very poor utilization of intercity circuits, having expanded transmission capacity faster than they modernized the exchange facilities needed to connect these

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[18] The argument is that the longest route in a rectangle would be along the diagonal, but that many routes would be parallel to the rectangular dimensions rather than the diagonal.

[19] U.S. Statistical Abstract, 1986 -- these are facilities operated by Bell system companies, which probably included the most trunk line at that point.

lines to instruments[20]. As still another measure, in 1985 only 65 per cent of public network telephones had direct-dial long-distance access. That should not be interpreted as meaning that all those phones had long distance access to each other. Because of the weak interconnectivity mentioned above, any given phone on the network could only reach a fraction of the rest of the 65 per cent. Trunk-line blockages or bottlenecks at operator controlled exchanges also limit interconnectivity. A 1985 source says that there were then 78 automatic zonal transit exchanges.[21] Since as stated above there are about 178 oblast-level zonal networks, in the majority of zones both intrazonal and interzonal calls had to go through an operator. These are probably zones with smaller numbers of subscribers, but this figure gives us an idea of the limited geographic spread of direct dialing. Today 83 per cent of intercity circuits are automatically switched compared to about 50 per cent at the end of 1982.[22] Though the share of intercity calls requiring operator assistance is falling (see statistical appendix) it is still about one-third in 1986.

Though I have not found the actual data, there must be a large differential unfavorable to households in long distance access. For calls not direct dialed, one must schedule a call in advance or wait for several hours for a request to be fulfilled. For anyone without a telephone, in the

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[20] This point is made in an article in Ekonomicheskaia Gazeta, 1981:37, p. 2, which adds that because of bottlenecks in terminal equipment, many telephone trunk circuits are used only 15-20 minutes per hour. In the Eleventh Five Year Plan the plan for additions to circuit capacity were fulfilled, but the goal of 2.1 billion intercity calls was far underfulfilled at 1.7 billion.

[21] Izvestiia, 29 March 1985.

[22] Elektrosviaz', 1983:4, p. 2.

absence of pay phones one must go to the local telephone office.

Another feature of the system is that many residential subscribers are on party lines — some 20 per cent of residential phones according to one source.[23]

The rural economy is poorly connected internally and to the rest of the economy. The major goal in the sixties was to get all state and collective farms connected to the oblast centers, a process essentially completed in the seventies. The current goal in agriculture is the creation of intra-farm systems that combine dispatcher phones for intra-unit production management with access for some of the phones to the utility network.

To some extent all these contrasts with the US merely reflect the peculiar character of telecommunications demand flowing from the peculiar structure of Soviet society, rather than failure of the telecommunications system to meet the demands placed on it. Telephone service to households has shared the low priority of consumption and services generally. The lack of integration and connectivity in the telephone system probably reflects a hierarchical communication structure and the compartmentalization of the economy and society as much as faulty design of the telephone system. In correspondence with its level of development the USSR relied more on telegraphy than on telephony. At the present time, however, it is clear that the amount of telephone traffic is supply-constrained. The telecommunications infrastructure has become a significant bottleneck, both in relation to household desires, and in relation to the communication needs of the state sector. And in relation to the dynamics of demand for communication as incomes rise, and as the technical potential increases for

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[23] BBC, Summary of World Broadcast, Section B.

harnessing telecommunications to an information revolution, the defects of the telecommunications infrastructure have become intolerable.

Network Equipment

There are three main elements to this network, i.e. subscriber loops and the terminal equipment located on the subscriber's premises, switching facilities, and the transmission equipment and channels that tie the exchanges together. Since the mid-seventies customer equipment has been owned by the subscriber. This equipment includes a very large variety of telephone instruments, mostly rotary dial phones, which have been supplied from many sources. There may be a few touch-tone phones. Another form of customer equipment is the private branch exchange (PBX or PABX if it is an automatic exchange). I have not yet been able to find a way to estimate how many of these there are, but I think the system employs far too few PBX's. PBX's, too, are owned by the customer. The USSR has long produced domestically a cross-bar PBX but more recently a quasi-electronic model, the KVANT, has also been developed, and is being produced in significant quantities. I don't know how dependent the USSR is on foreign suppliers for this equipment.

The switching equipment at exchanges is of several generations. The oldest consists of step-by-step, or Strowger, exchanges, which are noisy, expensive, unreliable, and costly to maintain and operate. The Russians were still producing these exchanges in 1988, though that was to be the last year of production.[24] In the mid-eighties probably not much less than half of the numbers were still in such exchanges. The rest of the switching equipment is mostly second-generation technology, i.e. cross bar equipment, of both

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[24] A.A. Aleshin in Elektrosviaz', 1987:4, p. 2.

domestic and foreign manufacture. An interesting feature of the system is that it incorporates a great variety of switching equipment, differing both in terms of technology, generation and origin, making network integration difficult. Stored program control exchanges, which in the Soviet literature are called quasi-electronic and electronic switches, are just beginning to enter the system. The latter are again both imported and domestically manufactured. The major models in use are the MT-20 (imported from France or produced domestically on the basis of a French license), the Finnish model EATS-200, and the Metaconta or 10C, produced in Yugoslavia on the basis of a Western license. Their own entries are the Kvarts and the Istok. The USSR produces an electronic PABX, the Kvant, which is also being pressed into service as a rural exchange. More will be said about the characteristics of these models, and the problems experienced in developing this equipment in the chapters on R and D and equipment sources.

Trunk lines are a mixture of radio relay lines, cable, and comsats. Microwave radio relay lines accounted for about 25 per cent of the telephone channels in the mid eighties.[25] This is a very different mix from that in the US, where microwave has long predominated in the trunk network. There is only minimal use of comsats for telephonic communications, though this medium has been heavily exploited for television distribution. I conclude that almost three-fourths of the transmission network is cable, mostly buried, and mostly co-axial. In the earlier years the carrier systems available were capable of putting a relatively limited number of circuits on

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[25] Elektrosviaz', 1987:12, p. 2. Another source says that more than one-fifth of the circuits in the primary network use radio relay links. (Elektrosviaz', 1986:2, p. 5). The length of radio-relay lines at the end of 1980 was 116 thousand km. In the early years they put few circuits on these lines and later modernized them to get many more circuits.

a cable or radio-relay channel, but these lines have since been modernized to provide many more channels per kilometer. For all three categories of station equipment Soviet domestic producers have supplied some, but the USSR is heavily dependent on East European suppliers. A later chapter will deal with this point more fully.

I find contradictory evidence regarding the share of different kinds of traffic on the system. One source says that of the total number of channels in the network, three fourths are used for intercity telephone traffic.[26] But an alternative statement is that "at the present time more than 90 per cent of the existing telecommunications circuits are used for telephone communications," [27] which is consistent with the corresponding share in the US. The remainder would include telegraph circuits, no doubt, but it must not include TV distribution channels. According to an article in the BSE the TV system uses terrestrial lines totalling 90 to 100 thousand million km. Multiplied by the equivalent number of telephone channels, that far exceeds ten per cent of total circuit-kilometers.

Branch systems

In addition to the "public" network, there are a number of departmental systems only partially connected to the utility system. Major departmental systems exist in the pipeline industry, the railroads, and the electric power industry. These systems have their own exchanges, and in some cases their own transmission lines, though they also use lines leased from Minsviaz. At the end of 1986 these systems had 6.5 million telephones not connected to the public network. In the early eighties, departmental systems

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[26] Elektrosviaz', 1982:1, p. 1.

[27] Deputy Minister Kudriavtsev in Vestnik sviazi, 1985:6, p. 3.

operated about 18 per cent of all intercity channel-kilometers in the system, and the capacity of their exchanges was about 20 per cent of that in exchanges owned by Minsviaz.[28] Only about 40 per cent of these departmentally owned phones have access to the utility network.

Quality of service

The quality of service is bad in numerous dimensions. Network bottlenecks cause a high rate of blockages. There are extensive line outages both planned and accidental, due in part to the continued widespread use of tube equipment in transmission systems, and in part due to construction damage. Old fashioned and worn out switching equipment results in bad connections. In Belorussia, for example, there are still 80,000 lines served by ATS-47 exchanges (the step-by-step model first produced right after the Second World War) which give terrible service and generate most of the complaints.[29]

There is a standard genre of telephone horror story in the Soviet press in which one cannot get the long-distance operator, or the operator is rude and unhelpful, or that a call placed by the operator does not go through, or that the operators never place the requested call. The wait for a long distance connection through an operator is at least an hour, and many calls never get completed. In the Minsviaz complaint inventory, more than half are for uncompleted or delayed calls, another 9 per cent for bad connections.[30] As a measure of the inadequacy of circuit availability, on 45 per cent of the automatic trunks, the blocking rate is 3 per cent or more. Another

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[28] Elektrosviaz', 1982:11, p. 27.

[29] Vestnik sviazi, 1988:3, p. 8.

[30] Elektrosviaz', 1986:2, p. 9.

indicator is the ratio of attempts to completed calls. In intercity transit offices of the ARM type (this is their best, imported, equipment) there are 3.1 attempts per completed call.[31] For the flavor of the frustrations of long distance telephony, see an account in Izvestiia, 2 January 1987, in which the author describes an all day effort to make a few long distance calls. But this was still a better day than most, he says.

The Telegraph Network

In developing a telecommunications system, the Russians relied heavily on the telegraph as an alternative to the telephone system.. The volume of telegraphic traffic is very large, though it has now begun to shrink. It not only exceeds that of any other country, but at over 500 million in the early eighties appears to have been larger than that of all the industrialized countries taken together. The telegraph network was originally started as two rather separate systems. One was the utility system in which one sends a telegram from a telegraph office for physical delivery at the receiving end. The other is a telex-type system in which subscribers use equipment on their own premises to dial up and communicate with other customers (what the Russians call the abonentskii telegraf). The telex system is circuit switched, the utility system operates with both circuit switching and message switching, with storage (usually on paper tape) at intermediate nodes. The two networks are gradually being integrated.

THE EASS FRAMEWORK

The technical and economic framework for Soviet planning of the

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[31] Elektrosviaz', 1982:1, pp. 2,6.

telecommunication system is the EASS, or Unified Automated System of Telecommunication. The idea of this system is to serve separate traffic networks through the use of an integrated facilities network. Specialized functions -- radio and TV distribution, telephony, telex, and data exchange (described in the Soviet literature as "secondary networks") will share a common network of switching and transmission facilities (described as the "primary network"). The gains from integration will be enhanced interconnectivity between telecom modes, and economies of scale from sharing switching nodes, transmission equipment, and transmission lines.

This idea was first advanced in the sixties and mandated at the 23rd Party Congress for the 1966-70 Plan. Actually, very little traffic integration has taken place so far; as nearly as I can tell the telegraph, telephone, radio and TV distribution, and data transfer networks use common facilities to a very limited extent. The comsat system is separate from the other telephone, TV and radio distribution nets. Two separate telegraph systems are only partially integrated with each other even now. The PD-200 data transfer system may share some switching and transmission equipment with the telegraph system, but it scarcely exists. Digital exchanges and channels are only beginning to appear in the network. One element in the EASS concept is eventual conversion of all facilities to digital form, offering economic advantages in reliability, cost, capacity, compatibility with fiber-optic technology, and suitability for a extensive data transfer traffic. The ultimate form of the EASS is thus seen as an integrated services digital network, or ISDN to use the Western acronym.

Some commentators take the Soviet EASS vision very seriously, and believe the centralized structure of the Soviet system provides favorable

conditions for realizing it.[32] My own view at this point is that the Soviet system will face obstacles in realizing this goal at least as serious as those we are likely to experience in the West. Actually, it is far from fully accepted in the US that ISDN is the way to go. No one can think of a good rationale for why everyone should have access to all the services an ISDN would provide, at the corresponding high cost. As the Russians begin to introduce digital components on a large scale, and begin to give their network an adequate degree of interconnectedness, there will be the same intertwining of technical uncertainty, debates over where to place a function, and how private advantage relates to network efficiency, that are currently so disputed and controversial in the US. During the first couple of decades since the EASS vision was proclaimed, the gap between it and what Minsviaz was actually doing was so great that Minsviaz policy-makers did not need to think seriously about it.

As the Russians get closer they are now beginning to think seriously about the many issues involved, such as the relative advantages of circuit switching, packet switching, and message switching, and how integrated the various services need to be. Arguments are now being raised against putting all functions into one integrated system, as in a recent statement that "it may be more economical to construct not a single integrated system with integration of services, but a limited number of separate systems, each of which could integrate a particular kind of service."[33]

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[32] See, for example, Ivan Selin, "Communications and Computers in the Soviet Union," Signal, December 1986, pp. 91-95. Selin concludes "...the Soviet Union will probably achieve its plan for an integrated, centralized, mostly digital, telephone network by the end of the century."

[33] V.M. Dmitrachenko, "Postroenie tsifrovykh setei sviazi," Elektrosviaz', 1986:7, pp. 6-8.

One approach is to create islands of digital facilities as in individual zonal networks, which will finally coalesce into a country-wide ISDN. A plan to create a 10-oblast digital zone has been announced.[34] The other approach is to go for laying special-service digital networks country-wide on the general network (the principle of the "superposed network" or nalazhennaia set'). As all the individual services become digitized they could merge into an ISDN. Since this debate is only beginning in the USSR, there is not a lot that we can say at this point about what may happen. But the fate of ISDN as the system evolves will be a good test of Soviet technical performance and economic sophistication.

SOVIET PLANS AND POLICIES

A much more serious priority for telecommunications in leadership intentions has been emerging since the seventies, and there has recently been a sharp upturn in the attention it is receiving. In the Ninth and Tenth Five Year Plans the goals for building a modern telecommunications system were more declaratory than real. Then, as not much happened in the way of modernization, the attitude of the leadership became more and more impatient. A significant upward step in priority was embodied in the goals of the 11th FYP. The number of telephones connected to rural exchanges was to be increased by 43 per cent and to urban exchanges by 33 per cent. A large share of new installations was to go to households. Those quantitative goals were more or less achieved, but progress on technological upgrading was much less impressive. An especially important turning point came in

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[34] Elektrosviaz', 1987:5, p. 4.

1984-85, in a series of decrees of the Council of Ministers and Central Committee. The most significant of these was a decree of January 23, 1985 which set goals that have been incorporated in the 12th FYP.[35] The goals include expanding the capacity of exchanges by 12.1 million numbers (a 42 per cent increase), making a radical shift to "quasi-electronic" exchanges with stored program control (an achievement of the 1960s in the US), beginning the introduction of fiber-optic technology, and a significant expansion of digitization. Another goal is to increase the use of comsats for telecommunications by moving to the Ku band (12-14 GHz).

An important feature of these decrees was specific instruction to Minradioprom, Minelektronprom and Minpromsredsviaz to produce the equipment needed to carry out this upgrading. These ministries are part of the defense industrial complex under the military industrial commission or VPK, and have been primarily oriented to producing for the military. These decrees were one of the first moves in what has become a broad shift in priorities under Gorbachev to redirect the attention of the VPK ministries to producing civilian consumer and producer durables.

So far, virtually nothing seems to have been accomplished on the fiber-optic goal. There is one experimental installation in the Leningrad city network, and some development effort, but nothing is happening in the way of getting ready for introduction on a large scale. This will be discussed further in the chapter on R and D.

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[35] An abridged version of this decree of January 1985 is available in Resheniia partii i pravitel'stva po khoziaistvennym voprosam, volume 15, pp 183-188, Moscow, 1986. General provisions are summarized in the Current Digest of the Soviet Press. There was another Politburo review of measures to achieve these goals at its 11 September 1986 meeting. One in August 1984 had outlined measures for improving TV.

The most recent indication of governmental priorities was a renewed attack on Minsviaz itself for failure to respond to the challenge of these decrees and of perestroika, and an institutional shakeup in its R and D effort. This, too, will be gone into more fully in the chapter on R and D.

An interesting feature of the plans for the telecommunications sector is the emphasis on providing telephone service to households. The telephone is an income-elastic personal convenience that has been neglected in the USSR, as evidenced by the waiting lists mentioned earlier. The 12th FYP specified that 75 percent of all new telephones installed were to be residential, and it is intended that by the year 2,000, 80 per cent of all households will have telephones. The priority of serving households has been raised still further since the approval of that plan. In 1987 85 per cent of new installations were in apartments, and the original goal of 8.3 million installations in apartments during the 12th FYP has been raised by 2 million.[36] By 1990 34 per cent of urban households and 13.5 per cent of rural households are to be supplied with telephones.[37]

This is an interesting indicator of leadership attitudes about the information revolution. One of the uncertainties in Western assessments of Soviet ability to exploit the information revolution is how the leaders will react to the conflict between the desire to raise productivity by introducing new information technologies and the fear that these technologies may undermine control by enhancing information flow. The high priority the government is giving to providing telephone service to households seems an important bit of evidence that they are willing to risk

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[36] Shamshin in Vestnik sviazi, 1988:3, p. 2.

[37] Vestnik sviazi, 1986:8, p. 38.

decentralizing some of the instruments for gaining access to information.

Another indication of altered priorities is a campaign to take telephone lines and numbers away from industrial and institutional subscribers, and to reassign them to households. In the process telephone officials are supposed to give priority to invalids and veterans. Another interesting experiment was to let enterprises use the numbers and lines during the day, but switch them over to households at night. The drive to add party lines has also intensified.

ECONOMIC DIMENSIONS OF THE INDUSTRY

The economics of telecommunications is a broad and weighty topic. Subsections include issues of optimal choice in design of the system, its impact on the effectiveness of the rest of the economy, questions of demand elasticity, cost allocation, and cross subsidization among its clients. Indeed telecommunications represents a major area in the application of microeconomics -- at one point AT&T had a large economics effort and even sponsored a major economics journal. But when one examines the Soviet literature on telecommunications to see how those issues have been thought about and dealt with, it turns out to be pretty thin gruel. What follows is intended as an introduction to a few major aspects of the economics of Soviet telecommunications. Full treatment of the economics of Soviet telecommunications must await more research.

Economic Priority

Telecommunications has long been a neglected sector in the Soviet economy, in part because of a Soviet prejudice against "nonproductive"

activities. This has been a recurring complaint of the economists who speak for the branch, and who have had a discouraging time trying to demonstrate the payoff to expansion of telecommunications.[38] The telecommunications sector seems to have been badly undernourished as regards investment. And another reflection of its low status is that its employees, since they are workers in a nonproductive sector, are at the lower end of the Soviet wage distribution.

Investment

Statistics on investment in telecommunications proper, omitting Minsviaz's postal work, are sketchy, as indicated in the data appendix. But it is clear that in the USSR the share of telecommunications in all investment has been well under one per cent[39], compared to several per cent in other developed countries. There is also an institutional anomaly in that much of the Minsviaz investment program is covered by funds that come via other sources rather than from an allocation directly to Minsviaz. These include local budgets, industrial enterprises and even collective farms. Such agencies often see contributions to the Minsviaz investment program as a diversion away from higher priority goals.[40] Minsviaz investment also seems to depend

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[38] Examples are I.A. Podgorodetskii, "Problemy dal'neishego razvitiia sviazi v SSSR," Planovoe khoziaistvo, 1960:12, pp. 24-31, and a series of pieces by M.A. Gorelik in journals and books.

[39] M.A. Gorelik, et al. "Sviaz' i proizvodstvo," EKO, 1981:1, p. 102.

[40] "The basic source for financing construction of automatic telephone exchanges is money allocated by the local soviet. And these funds are so inadequate that the annual allocation is not enough to build even a single building in three years' time. A number of ministries were advised to contribute, on a pro rata basis, 1.65 million rubles for the development of communications in Krasnodar in 1978-1985. But the Ministry of the Chemical Industry held up the transfer of its 100,000 rubles for a year. The USSR Ministry of Light Industry failed to transfer 200,000 rubles to the city in 1980 and is making no promises about doing it this year. The Ministry of the

heavily on bank credit, rather than outright investment grants. In the Soviet system, moreover, it is not enough to have funds available. As will be discussed later, Minsviaz has a hard time getting the equipment it has been promised. Minsviaz's own construction base is too small to perform all its own investment and its clout for getting its construction work included in the plan of outside construction organizations is limited. All these pressures have limited its access to capital.

More recently telecommunications has benefitted from the new awareness that has emerged in the USSR of the importance of infrastructure. Total investment in the communications sector as a whole in the 12th FYP is to run at about 2 BR per year versus 1.2 billion rubles in the 11th FYP.[41] At 2 BR per year, this is getting close to 2 per cent of all investment. Its wage level disadvantage will also be eliminated. Minsviaz employees are being given the status of workers in productive sectors, and will receive wage increases -- 20-25 per cent for production workers, and 30-35 per cent for white collar and professional workers.[42]

Machine Tool and Tool Building Industry was to have allocated 100,000 rubles this year, but it has now announced that the transfer has been postponed until next year." Pravda, 14 July 1981.

Departmental systems and PBX's connected to the general network, are paid for from the capital allocations to the ministries and departments rather than by Minsviaz (Elektrosviaz', 1985:4, p. 1). That enterprises would as soon avoid this cost, and have all their phones connected to the Minsviaz exchange is indicated by a decree passed in the seventies requiring that any enterprise having more than 50 phones would have to have its own PBX.

41 Planovoe khoziaistvo, 1986:6, pp. 25-26.

42 Elektrosviaz' 1987:5.

Tariffs and rates

The Soviet telecommunications system operates basically on the Soviet khozraschet principle, paying its costs out of its revenues. Overall, its service output seems to be priced high enough to cover costs, and to generate a profit (see data appendix).

Information on Soviet charges for telecommunication services is incomplete. There are tariff handbooks, but these mostly talk about principles, and those I have seen are out of date.[43] Despite the absence of a systematic collection of prices, the little we know about rates makes them seem high. Installation of a phone costs 100 rubles, which implies a high ruble dollar ratio for a labor intensive activity. A standard dial telephone intended for apartment use is priced at 20 rubles, and a pushbutton phone with redial capability at 95 rubles.[44] I have seen speakers for wired systems advertised for 25-49 rubles, which seems high. The cost of leasing a line (see section on data transfer) also implies a high ruble/dollar ratio. On the whole, telecommunications seems to be a relatively high cost activity in the USSR. As an exception, the monthly charge for residential phone service at 2.50 rubles is low compared to the $15.83 which Indiana Bell charges me.

There is significant cross subsidization, with large losses in the rural network. Individual articles describe this, and one source shows that for the rural network as a whole, in 1980 the loss was 73.9 per cent of

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[43] Ministerstvo Sviazi SSSR, Tekhnicheskoe Upravlenie, Tarify na uslugi sviazi, Moscow, 1965.

[44] G.M. Belousov, Sredstva orgtekhniki, Moscow, 1985, pp. 83-85. A comparable western telephone at $15-20 gives a ruble/dollar ratio over 1, which is high compared to ruble/dollar ratios generally.

cost.[45]

The most recent change in rates was worked out in 1980, and enacted as part of the price reform of 1982.[46] I have seen only sketchy discussions of what happened in the reform but one commentator's interpretation is that the 1982 tariffs were an attempt to relate price to cost. Berenyi says that for a long time Minsviaz seemed to have no commercial sense at all. A new price list was published in 1986, but I have not been able to obtain it, and so do not know whether it included any changes in tariffs.

Telephones used to be owned by Minsviaz, and the subscriber paid a rental. Now, apparently, a household buys the phone itself. When a person moves, the phone stays with the apartment and becomes the property of the new occupant, who pays the former owner for it. This makes sense in the Soviet situation, because it is not just the phone, it is also the connection that is important — it would not make sense to take the phone to a new dwelling where likely as not there may be no connection to the exchange. It has been claimed that household customers use the telephone too heavily, overburdening the lines. Metered service has been suggested as a solution. This idea goes back at least to the mid-seventies.[47] Lack of equipment, no doubt, made that difficult, and the first experiments seem to have begun only in 1988 in the Baltic republics and in one Moscow district. One intriguing article suggests the measuring equipment is not working properly, and generates huge bills for some customers.

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[45] Spravochnik ekonomista predpriiatiia sviazi, Moscow, Radio i sviaz', 1983, p. 128.

[46] Spravochnik ekonomista predpriiatiia sviazi, Moscow, 1983, p. 111.

[47] Deputy Minister Glinka in Elektrosviaz', 1976:3, p. 5.

Network Optimization

The design of telephone networks and their components involves choices that have a large impact on the cost of constructing and operating the network. The economics of system design is one of the central issues engaging the attention of any telephone utility company.

A major aspect is optimizing the network architecture, i.e. the hierarchical system portrayed in Figure 2. Suppose one tries to build direct lateral links connecting each of the secondary (zonal) systems to all the rest. To achieve a low blockage rate in such a system, it would be necessary to provide capacities approximating peak traffic needs. In this case the lines would have low utilization. Moreover, in such a system traffic on some zone-to-zone links is too small to achieve the economies of scale available in transmission. The rationale for creating a hierarchy like that in Figure 2 is to make it possible to provide less-than-peak capacity on lateral links and handle excess demand by routing it through the next higher level. It may make sense in some cases to thread in lines between tertiary transit centers and secondary transit stations that are primarily subordinated to other tertiary centers (as shown by dashed lines in Figure 2). The larger the network, the more likely it will make sense to add another level. (The US system has five levels). Such a system has rules about routing, in which a call attempt is made through an established hierarchy of routes until a free pathway is found. Efficient design chooses the hierarchical structure, the location of links in the structure, and their capacity, to optimize the trade-off between cost and quality as measured by the blockage rate.

The quality of design decisions obviously depends on the quality of traffic forecasting and planning. It is my impression that the Russians have

not done a particularly good job in these areas. The few discussions I have seen of traffic forecasting seem to be rather haphazard, and the actual information base available to the planners seems thin. It is claimed that the design of the system of tertiary stations and their trunk lines was optimized using a model in which the objective was to minimize capital.[48] But a look at outcomes suggests that the design decisions have in fact been far from optimal. One source says that "the use of direct routes for automatic and semiautomatic connections has led to a lowering of the effectiveness of use of channels, which as is known, are the most expensive element of the system." The system does exhibit low utilization of intercity channels; a recent article says that the average utilization on intercity circuits is 18 thousand conversations per year per circuit, which works out at about 2.5 conversations per circuit per hour.[49] I don't know what it is in the US, but it must be much higher than that. Another discussion adds that the absence of alternative routes via a tertiary level is one of the explanations for the high blockage rate. There is also a problem in matching transit office capacity to line capacity. Again we have only hints, but apparently the capacity of the secondary exchanges is greatly underutilized — utilization is reported as 46 per cent in a 1985 source.[50]

It was intended to correct the situation in the 11th FYP by giving more

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[48] Elektrosviaz', 1985:12, p. 2.

[49] Gorelik in Elektrosviaz', 1987:11, p. 16.

[50] Izvestiia, 29 March 1985.

attention to indirect routing through higher levels of the hierarchy.[51] Progress may well have been made during the 11th FYP, but I have found no evidence on that. There is simply very little systematic information or analysis of utilization of the intercity network.

Another important area of economic optimization is the design of the subscriber loop portion of the plant. A high per cent of the total value of the plant is located here, as is also most of the copper. One of the major problems Minsviaz has is getting cable for the development of the subscriber loop part of the network. As a result much exchange capacity is unutilized -- in the early eighties, capacity of rural exchanges was utilized to the extent of only 70 per cent. And at 90 per cent, utilization is not great on the urban networks, either, with a target of 92-93 per cent by the end of the 12th FYP.[52]

Conclusion

To conclude, I have made little progress in evaluating economic behavior in the sector, partly because telecoms officials, not having thought about it much do not write about it much. But I believe there is a great deal of badly designed and badly utilized capacity in the system. I think the planners have not had the incentive, the kind of demand relationship with their clients, or any effective outside rate regulation to make them think seriously about economic issues. The new conditions emerging under economic reform may make them do so. It is intriguing to see how the pressure of new conditions has led Shamshin to comment that "the multi-

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[51] Elektrosviaz', 1983:4, p. 2, and 1986:2, p. 6. The Russians call such indirect routings obkhody.

[52] Elektrosviaz', 1984:4, p. 3.

branch character of telecommunications and the world trend toward integration of networks and services demands a further clarification of general system issues, but there is here a major shortage of ideas and development."[53]

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[53] Elektrosviaz', 1987:5.

CHAPTER 3

ISSUES IN STRUCTURE, MANAGEMENT AND CONTROL

The task of this chapter is to elaborate on the brief description in the preceding chapter of the organization of the telecommunications sector in the Soviet economy. I want to provide more detail, offer a framework for interpreting organizational issues, and consider how the organization of the sector may affect its performance. This will also set the stage for a couple of later chapters. The chapter should also help us link changes in telecommunications to Gorbachev's reform efforts.

The guiding question for the chapter is "what is the telecommunications function and how should it be controlled and managed, internally, and in its relations with the rest of the economy?" In the American context we might pose the question as "what is the nature of the telephone company, and what kind of regulatory approach, if any, should we take toward it? There is a difference of context in that the USSR follows the European tradition of combining the telephone mission with other telecommunications missions and with the postal function in one organization. But as will be explained below, I think that the tie between the telephone function and others is rather slight in Minsviaz, and in fact we will generally be focusing on the narrower question of how best to run the telephone company. In the US we see the question as a problem of market power and regulation versus deregulation, in an environment that is basically a market one. Minsviaz operates in a totally different kind of environment in which the

administration of the telephone company is embedded in an administrative process that covers the whole economy. But despite the exotic appearance of the Minsviaz setting we will find that there are functional equivalents in that economy for all the basic policy issues and economic consequences that are familiar in our own.

THE NATURE OF THE TELEPHONE COMPANY

The function of the telephone company is to put people (and machines) in touch with others over long distances in real-time or close-to-real-time interaction cycles. An important distinction is whether the communicants are engaged in two-way interactive, or only passive, connection. Telegraphy is less real-time interactive than telephony, though the telephone answering machine can blur that difference, and data transfer connections may cover the whole spectrum. My interest is in the more urgent and interactive forms, and so the center of my attention is the point-to-point switched network involving telephonic and telegraphic communication. (The postal service and TV and radiobroadcasting are of less interest here.) Since general interconnectedness is the essence of this kind of network, there is some presumption that technically it ought to be integrated in a single system and should perhaps be supervised by a single management entity. That the telephone company has usually been thought of in the US as a natural monopoly illustrates the idea that the telephone system has a natural unity.

It is widely appreciated today that this function of putting machines and people in touch with each other is very fuzzy around the edges. It is difficult to draw the line between it and many associated activities.

Telecommunications is sometimes described as a "market without boundaries". At what point should the network-subscriber interface be located — for example should the customer or the telephone company run various aspects of the switching function? In "putting people at a distance in touch with each other," are some forms of this activity so specialized and distinct in terms of clientele or technology that they should be handled by a separate company? An example would be the distinction between telegraphy and telephony. Is there any reason to have the system of television and radiobroadcasting integrated with switched, two-way, telecommunications under a single management? Might private telecom networks exist outside the telephone company? Often there is little need for interconnection with the general system, though here and there access to the rest of the system may be essential. Specifically, business data traffic often involves a small circle of interactors, and requires minimal access to the general utility network. In terms of associated technologies and functions, such as R and D or the manufacturing of equipment, where should the line be drawn between telecommunications firms and other firms? In the West we see telecommunications companies adding computer development capabilities and computer companies trying to get into the telecommunications business.

US policy has focused mostly on breaking up the sector into competing entities, both laterally and vertically, and public attention is not strongly drawn to the internal structure of the resulting units. But telecommunications in the Soviet Union has not been subject to such a dissolution, and the issue of internal organization of the sector remains. What is involved here is well stated in a view expressed by V.A. Shamshin, USSR Minister of Communications — he sees "the multibranch communications

sector as a flexible organism, working under conditions of close cooperation, organically incorporating scientific design organizations, production plants, construction units and operating enterprises."[54] The question is how well it does in fact achieve some kind of organic cooperation of these activities to meet society's communications needs.

The economist has at hand a lot of ideas for thinking about these problems in either context. One approach is to focus on the issue of economies of scale versus specialization of function. Another is Oliver Williamson's notion that whether some transaction should take place within a firm, or should go across a market border to another firm is basically a question of transaction costs. In a market setting, firm size and market structure will be strongly influenced by the effort to minimize transactions costs. Transactions costs will depend among other things on homogeneity versus heterogeneity across lower level units, stability of the phenomena involved (is information changing or constant?) etc.

In the West, the market structure that emerges is not purely natural, but may also be affected by regulatory intervention. The telephone business was long thought to be a natural monopoly, requiring regulation rather than the stimulation of competition. This idea was eventually challenged and replaced by a view that some aspects of this monopoly could be broken out to create competition in certain functions. But even after the breakup there are still monopolistic units, and a high degree of regulation remains. So we have a market structure that is partly natural, partly determined by outside regulation and there is a continuing dispute about whether those imposed borders represent the right degree of intrusiveness, and are drawn in the

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[54] Elektrosviaz', 1982:12, p. 3.

right places.

In the USSR all the interactions that underlie our view on how to deal with the telephone company exist within a centrally administered system. If we want to coordinate efficiency and bargaining power in that system, we have to talk not about where to allow market interactions, and where to replace market interfaces with regulation, but about adjusting the whole administrative structure.

My approach to the Soviet case also draws on ideas developed in other contexts for analyzing hierarchical structures in economic management.[55] We can think of administration as a problem of coordinating three structures.

1) The first is the real-world process or set of interactions one is seeking to control. In this instance we are talking about the network of physical facilities that make interconnection possible, as it exists or might exist, as it is used or might be used. Compared to other sectors, the interactions to be controlled in telecommunications have a more mechanical, "hard-wired" character, than in many other sectors, but the process also involves an important human element in the people who operate this machine, and who keep it in working order, expand and adapt it. This real world structure has a hierarchical character in which the phones scattered over space are agglomerated into a network through a hierarchical system of switching and physical links as suggested in the preceding chapter.

2) The second is a management structure — an organization chart indicating subordination and authority relations, communication links, etc., among the people involved in operating the facilities. In this managerial

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[55] Robert W. Campbell, "On the Theory of Economic Administration," in Henry Rosovsky, Industrialization in Two Systems. New York: John Wiley and Sons, 1966, pp. 186-203.

hierarchy the upper levels view the system as whole, while lower levels look at functionally or territorially specialized elements in it. There are also intermediate levels in this hierarchy.

3) The third structure is a hierarchical set of images or models corresponding to each of the levels, about the structure and relationships in the real-world process, on the basis of which the managers monitor and control the activities they supervise. The model is a way of seeing as a whole, inevitably in a simplified way, the interactions in the real-world system at the level of management involved, with identification of some control instruments and some notion of an objective to guide choices in operating the system. The models at the different levels represent an aggregation (looking up) or a partitioning (looking downward), and their function is to integrate the local view with the topmost view via a system of evaluation and incentives so that the lower level actors are guided to work for the goals set at the top of the hierarchy.

The organizational problem may be thought of as one of achieving a reasonable isomorphism among these three structures. A local decision-maker must have a model that tells him how the various actions he takes will affect outcomes (i.e., he has to have a notion of how the local zone network works) and he must be steered by a set of incentives that lead him there. And the upper levels must see how the actions in one area (in repair, for example) influence the outcome of others (blockage rates, routing potentials) so that they can coordinate them to attain the optimum for the system as a whole.

The internal isomorphism issue interacts with the external borders issue since outcomes depend on dealing with outsiders on such matters as

construction, repair, maintenance, R and D, training, and subscriber wishes. Whether an entity negotiates across a bureaucratic interface or at arms length through a market, bargaining power depends on knowledge (information) and on the existence of alternatives. In the West, firms fear having to buy equipment from a firm that it may be competing with in another aspect. AT&T doesn't want to be dependent on IBM for computers, IBM doesn't want to be dependent on AT&T for telecoms services. The Baby Bells have a similar position vis-a-vis their clients and suppliers of value added services. The value added service suppliers don't want to depend on connection via the Baby Bells in a situation where the Baby Bells are allowed to also offer those services, and might use their power to freeze out the other VAN suppliers. In the East, power depends less on arms-length lateral bargaining than on patronage, i.e. ability to evoke power from some superior agency to modify the behavior of your partner.

Although at first glance "the problem of the telephone company" might seem a rather different animal in the USSR and the US, a closer look reveals more or less the same issues, subject to interpretation in the same underlying fundamental terms, as those just outlined. So I want to look at a number of issues in the "organization of the telephone company" in the USSR, both external in relation to the rest of the economy, and internal to itself.

EXTERNAL INTERFACES

The Border between Telecoms and Other Services

The broad question here is how far various kinds of services should be

integrated, either in management terms or in network terms. Is there any cogent reason why it is desirable for the postoffice and the telephone company to be run by the same outfit? Is there any reason why the Ministry of Communications should handle the radio and television broadcast function? Does it make sense to serve many kinds of traffic via an integrated digital services network? The issue here turns on whether the interactions in the real world are really that important, requiring oversight by someone who sees them whole, and whether there are potential savings through economies of scale, or output synergies through better coordination.

What strikes one is the broad responsibility given to Minsviaz. Its charter gives it responsibility for postal services, TV and radiobroadcasting, and newspaper delivery as well as telecoms, and in addition gives it legal responsibility for overseeing the telecommunications activities of all the rest of the society (except for the military).[56] I have to say that I don't think the case is proved for having Minsviaz handle all those non-telecom functions. That is just a tradition. That conclusion seems all the more valid at the local level. There are some interactions -- i.e. the telephone company and telegraph agency can work together in sharing the transmission network, and in having the local telegraph office find the phone number of a recipient and call the message to him. But it might be more to the point to develop an information service that would enable the sender to find the telephone number and call the message himself! Other examples will appear in later chapters (for example,

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[56] It is an interesting asymmetry that although Minsviaz does not control the military side, it is supposed to develop the public network in a way that will satisfy the needs of defense. (Spravochnik ekonomista predpriiatiia sviazi, Moscow, 1983, p. 11).

facsimile delivery of newspaper copy for remote printing). But few of these combinations seem to really involve much saving or productivity enhancement, and the fact that I don't find much evidence of nodes in the administrative structure to oversee them reinforces that idea.

The Company-Subscriber Interface in Telephony

As indicated in Chapter 2, the telecommunications system was for a long time fragmented, and there has been a long struggle to unify it under the concept of the "unified automatic system of communications," overseen by Minsviaz. In the early post-war years individual ministries and departments created their own systems, following their own conceptions and their own standards. In the fifties and early sixties Minsviaz phones accounted for only a little over half of all phones, and a little over sixty per cent of phones with access to the public network. Today the corresponding figures are 73 per cent and 87 per cent. Minsviaz received a new charter in 1968 that gave it responsibility for the whole system, and rights to check branch systems for economic justification, conformity to Minsviaz standards and compatibility for connection to the utility network. Branch systems were expected, where possible, to lease lines from Minsviaz, or where appropriate links did not exist, to finance them cooperatively with Minsviaz and other ministries, with ownership going to Minsviaz. This process has always involved a great deal of conflict, and coordination is still rather incomplete. The Minsviaz case stresses the advantages of universal access, standardization, compatibility and cost saving. Minsviaz argues that the trunks in branch system are ineffectively used -- one source says that they are half as heavily used as Minsviaz lines -- and do not meet quality

standards.[57] The client ministries believe that their needs are different, that Minsviaz does not serve them effectively, that they can do the job better than Minsviaz. The jurisdictional battles are fought out in an interdepartmental coordinating council, and it is not surprising that some of the bureaucratically powerful ministries manage to get their plans approved. Minenergo, Mingaz, Minneft and the railroads, all of which can argue special circumstances, maintain substantial independent systems. For example, the oil and gas ministries have extensive operations in areas where the Minsviaz network was not developed. Minenergo has a far flung network of facilities that it has to keep coordinated in real time. The railroads have a long tradition of operating their own telegraph and telephone system and a distinctive combination of signalling, telegraphic, and telephonic communication to handle. In all these cases, the non-Minsviaz agencies sometimes make their own equipment, order it from a domestic supplier in competition with Minsviaz, or import it. For the BAM, the railroad ministry was able to acquire a special communication system, built by a foreign firm.[58]

This jurisdictional issue remains a troubled one. In addition to the major mavericks already mentioned, other bodies have had some success as well, and stories in the press suggest that ministries still manage to evade

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[57] Elektrosviaz, 1982:11, p. 27. It is interesting to find that the Soviet economist V.K. Fal'tsman, who has been one of the main critics of Soviet investment policy and statistics, cites poorly utilized telecommunications equipment as an example of wasted investment (EKO, 1985:12, p. 6).

[58] Antonio Macorig, "Soviet BAM Telecommunication System Rides First Class Across Siberia," Telephony, 22 March 1982, pp. 75-77. The story makes clear that Minsviaz set the specifications for the line and supervised its construction, but I imagine it is owned and operated by the railroad ministry.

the authority of Minsviaz and build their own systems. A statement made in the sixties "the problem of cooperating and coordinating construction and use of telecommunication facilities between various branches and Minsviaz awaits its solution"[59] is echoed in similar statements today. V.A. Shamshin, Minister of Communications, says in his 1983 review that the quality of departmental lines is not up to standard and that Minsviaz organs do not offer enough help in getting the departmental lines built and operated.[60] And at a high level meeting in April 1985 at which the Minsviaz leadership was assembled to be told what Gorbachev expected of them, one of the issues discussed was the unsatisfactory relationship of the departmental systems to the EASS.[61]

A second point at which the border issue arises is the decision over whether a firm should have its own PBX. From a systems point of view it is often more economical for an enterprise with a large number of phones to have its own local exchange. The rationale is to take advantage of a natural concentration of telephones to reduce the number of subscriber loops to the central exchange (which are expensive), and to economize on switching by the principle of concentration. If tariffs, equipment prices, and so on are rational, then both sides would find the most economical solution acceptable. In the past, apparently, enterprises often preferred to avoid the investment cost and to have all their phones connected as main lines to the central exchange, which implies that prices allocated costs between the

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[59] I.A. Podgorodetskii, "Problemy dal'neishego razvitiia sviazi v SSSR," Planovoe khoziaistvo, 1960:12, p. 27.

[60] Vestnik sviazi, 1983:3, p. 3.

[61] Elektrosviaz', 1986:6, p. 2. Minsviaz officials have again returned to the theme in an article in Vestnik sviazi, 1988:4.

firms and Minsviaz incorrectly. But it is interesting to me that I have never seen a Soviet discussion explaining these arguments or analyzing them in these terms. Rather the policy-makers have tried to settle them by administrative regulation. The January, 1985 decree that set guidelines for the 12th FYP required that any subscriber with 50 or more phones install a branch exchange at its own expense. As nearly as I can tell, little progress has been made in this direction. Shamshin says that installing more PBX's would free more lines in Minsviaz exchanges for households (which seems to be the motivation for the decree), but that plans for PBX installations are being only half fulfilled.[62] The parties, interests and stakes in this decision are different in the USSR from what they are in the US, but this is an example of functionally parallel policy issues in the two countries where the outcomes may differ as a result of differences in institutional arrangements. Though I have not been able to find the numbers to prove my hypothesis, I suspect that the Soviet network uses too few branch exchanges.

A third issue is who should own the terminal equipment. At one point Minsviaz owned most terminal equipment and had full responsibility for it. I know this was true for telephones; teletype machines could be owned by either the subscriber or Minsviaz; the few indications I have seen seem to suggest that Minsviaz owns the facsimile machines. In 1976, however, Minsviaz was ordered to transfer gratis to state, cooperative, or public organization subscribers the telephones equipment installed on their premises. The new communications charter issued in 1978 indicates that

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[62] Vestnik sviazi, 1983:3, p. 4.

households, too, are to own their own phones.[63] This is interesting in relation to the similar US experience a bit later. As in the US, when ownership of instruments passed to households there was dissatisfaction about responsibility for repair. I have seen too little discussion of the Soviet situation to come to any firm conclusions about what motivated the transfer or whether the results have been generally favorable or not. An official of the Belorussian Minsviaz complains that customers are irresponsible about keeping their phones in order, which makes it costly for the company. Since the customer has no way to get the phone repaired, the job falls to the company.[64] This official takes a Ma Bell kind of attitude; "Minsviaz loses official control over the instrument from the moment when the subscriber receives the right to buy and attach it to the network, despite the frequently bad audibility and the presence of defective elements in the instrument." When Minsviaz transferred the phones to the subscribers, it was supposed to arrange a contract with the equipment producers for repair by them within the guaranteed period. But this seems not to have worked out. In the US the change in ownership provided significant gains for subscribers in terms of cost, variety, and capabilities, but in the USSR that was hardly the case inasmuch as all the equipment comes from the same source anyway.

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[63] For institutions, see the decree of August 1976, in Sobranie Postanovlenii, 1976, and for households, the new Ustav Sviazi, in Sobranie Postanovlenii, 1978. I have seen no statements as to whether households had to pay for the phones or got them free. They do have to buy phones for new installations. I am not sure that the shift of ownership of household phones actually took place with the introduction of the new Ustav. It might have been initiated at the same time as the earlier decree and may have taken some time to be carried out.

[64] Elektrosviaz', 1987:11, pp. 4-5.

The R and D Interface

Telecommunications has been one of the great beneficiaries of technological progress in microelectronics, with its attendant cheapening of computer applications, smart equipment of various kinds, reductions in cost, and so on. Much of the ferment in telecommunications policies in the advanced industrial countries has come about because of a desire to enhance the motivation to develop and implement these technologies. Many of the advances have come from within the telecommunications sector itself — indeed the Bell laboratories are the source of the original breakthrough that led to all the rest, i.e. the transistor. But much of the research and development of equipment embodying these advances now comes from outside telecommunications firms proper. Important in telecommunications policy debates are arguments about what kind of regulatory structures will stimulate the R and D that is necessary to continue technical advance, and about how much R and D should remain within the telecommunications companies. In the US the argument that Ma Bell was not dynamic enough was a major reason for deregulation. Though the issues have not been posed in the same way in the USSR, the question of where R and D responsibility for telecoms should be located ought to be equally important there.

This is an important enough problem that I will not try to settle it here, but will devote a later chapter to it. The work I have done so far suggests that in the USSR the interface has been drawn in a way that leaves Minsviaz with too little internal capability and excessive dependence on outsiders. It is probably correct to conclude also that the correct allocation probably differs in the USSR from what it would be in the United States. In the West there is plenty of pressure for technical advance from

outsiders willing to do the R and D and to raise the huge sums required for current advances. This is not the case in the USSR, and it is fatal to leave the R and D task to outsiders when the outsiders are monopolists themselves, with little interest in serving telecommunications needs.

The Equipment Supply Interface

To what extent should the telephone company produce its own equipment? There is a pattern in the West in which telecommunications entities have had a great deal of control over equipment supply. In the US AT&T used its Western Electric subsidiary to control quality and standardization and from the other side required all other Bell companies to use Western Electric equipment. In other countries a kind of cozy monopoly relationship between a national body administering the Post Telegraph and Telephone (PTT) and the national telecom equipment company provided something similar. The Western view on this relationship has shifted from an emphasis on the advantage of having control over quality and standards to one that emphasizes the technological dynamism that comes from giving free rein to competition from outside suppliers. In the USSR the ministry has some internal equipment producing resources but on the whole has been dependent on outside sources. Paradoxically, this has been disastrous in conditions of a seller's market, no competition, and bureaucratic weakness on the part of Minsviaz. This, too, is a crucial interface for the USSR, meriting extended discussion in a separate chapter.

Relationship with Space Operations

Another interaction is with the agencies who run the space program. Here Minsviaz is the weak partner, I would think. Minsviaz controls all its comsat operations through SUR-9, one of its "Union Centers for Radio and TV

Broadcasting." The three divisions of that office are concerned with domestic operations, Intersputnik operations and overall system control. Minsviaz owns and operates all the different kinds of ground stations, perhaps with the exception of some Moskva or Ekran stations which operate in isolation, unconnected to any retransmitting network. The operation of the satellites is under the control of a command center in the space program, and I would suppose that the relationship between Minsviaz and the space agency might be along the following lines. The military-space people launch the satellites, control their orbits and positioning, monitor power supplies, and probably turn on and off the various systems on the satellite. The Minsviaz people would be presented with a set of transponder capacities on various satellites, ready for operation, and they then direct the various kinds of traffic through those transponders.

But at some point Minsviaz has to play a role in the discussions of the new kinds of equipment. Again, the situation is not clear, though we know that Minsviaz probably does most of the design work for the ground segment, and probably has a strong voice in decision-making for the satellites. In an interesting interview the deputy chairman of Gosteleradio says that they want to be careful in the design of the new system, lest they make a mistake as they did with Ekran. "They gave the designers specifications: design the sputnik so that it covers as much territory as possible. They did so and everyone was satisfied. But later it became clear that when a satellite broadcasts simultaneously to 8 time zones it is difficult to arrange a sensible program, and viewers see the good night-sign off in the West at

dinnertime and in the east after midnight."[65] Despite the vagueness as to who "they" is, there is a hint here that the users did have an input, even if it was not too well thought out, and that they will have a chance to do the same in the STU-12 system. But I don't want to read too much power into that expression of interest, and I suspect that the input of either Minsviaz or of Gosteleradio is less extensive and less interactive than it ought to be. Similarly, we can only speculate about the financial arrangements, specifically to what extent Minsviaz pays for the production and launch costs of the satellites or whether it owns either them or the transponders. Some satellites, like the Gorizont carry other transponders besides those used by Minsviaz. I have seen no reference that would indicate that Minsviaz owns the transponders. In the light of statements made recently that the military does not pay for procurement out of its budget, it would not be surprising if procurement and operation of the rockets that launch civilian satellites and of the satellites themselves likewise went on some special budget. But it has recently been revealed that Gosteleradio pays Minsviaz for the use of transponders for TV distribution, which may imply that Minsviaz has to pay the space agency people. Whatever the arrangements have been, it is quite likely that under reform, some changes in the direction of self-financing will take place. That would probably enhance Minsviaz's influence in making the satellites meet more commercial tests.

The Military-Civilian Interface

The question of the civil-military relationship is interesting in a broader sense. There has traditionally been a tight connection — the

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[65] G. Iushkiavichiius, "Progamma na XXI vek," Nove Vremia, 1988:11, p. 41. Iushkiavichiius is deputy chairman of Gosteleradio.

leaders have always thought of communication systems as serving defense needs as well as civilian communication needs. N.D Psurtsev, who was the Minister for a long time, came to the position from an earlier experience in military communications. On the other hand, it seems to me that Minsviaz is today civilian, and there is a distinct line between Minsviaz as an agency serving the needs of the civilian economy and the military as an agency with its own special communications requirements. The military does have a separate set of communications facilities. In the early handbooks it is stated that the telephone numbers published there, even including those in the branch systems, exclude military phones. The military also has its own separate comsat system — three of them in fact. I doubt that the responsibility of Minsviaz for providing technical leadership applies to the military. As explained in the preceding chapter,there is an express provision that the general law on communications does not apply to the MVD, the KGB, or the Ministry of Defense. We know too little about the situation to draw any hard conclusions, but I would suspect that this interaction in the Soviet Union is not so different from what it might be in other societies.

Construction

In addition to equipment supplies, expansion of the telecommunications system requires extensive construction and installation work, mostly of a highly specialized nature. Straight construction is overshadowed by such tasks as installing complicated equipment, building specialized facilities like radio relay stations, laying cable, and so on. I have not yet gotten very far in understanding this aspect of Minsviaz's operations or in judging how it compares with Western companies, but have seen enough to believe that

there may be an interface problem here.

Minsviaz itself has a significant amount of construction and installation capacity in-house. There is a chief administration for construction of communications structures, to which numerous specialized trusts are subordinated. Much of that capacity seems to be at the Union level, though the lower levels of the hierarchy also control such organizations. I have not uncovered any information on the share of the Minsviaz construction and installation program that is performed by its own organizations. But we do see occasional mention in the decrees of assignments to outside organizations to carry out telecommunications investment. The accounts of what is delaying the introduction of new capacity in local exchanges often refer to construction organizations outside the ministry. I suspect the construction problem may reflect internal organization defects in and the problems in coordination of central and local activities more than it does the external interface.

Though far from exhausting the subject of external interfaces, this short inventory demonstrates the nature of the problem and shows that questions over where to draw the boundary of responsibilities involve the same kind of issues one encounters in the West. Additional examples will appear in subsequent chapters, such as the interfaces with Gosteleradio, with the newspapers in the facsimile printing operation, and with clients in data exchange operations. The wired radio distribution systems, like telephone systems, are split between Minsviaz and other institutions. The hypothesis I am tempted to form on the basis of what I have seen so far is that on the whole, Minsviaz is weak vis a vis other ministries in several important respects -- the boundary has been drawn to leave too many

functions outside it. This is an important reason for the poor performance of the telephone company. Minsviaz in many ways operates in the Ma Bell tradition but monopoly status means less in a world of monopolies than it would in a market environment.

INTERNAL LINES OF AUTHORITY

The basic matrix for the internal structure of the Soviet communications ministry is the administrative-territorial structure of the USSR. This is easy to understand in the light of a development history in which telephone service was seen as a local function serving cities and other local agglomerations. And to the extent that a demand emerged to use the telephone to serve national purposes, expansion followed the top-down, "star" pattern of power and authority, which also underlies the territorial administrative structure. The emerging national network has thus fit reasonably well the administrative and information structure that has existed in the past in the USSR, though it may become inappropriate as the nature of the Soviet system changes, a topic to be discussed more fully in Chapter 8.

On the basis of general considerations one might question whether the network structure and the ministerial structure of a general telephone system should copy slavishly the territorial-administrative structure. The Soviet view of the rationale of their administrative structure is that it follows lines of cultural, economic, and ethnic homogeneity. This would indeed seem to generate the clustering of communication flows that a telephone system is supposed to serve. The territorial administrative

structure of the USSR probably does conform to such a rationale more than the US structure, where agglomerations like the mid-Atlantic megalopolis make state borders irrelevant for service areas. But there is some dispute as to whether Soviet administrative units do meet the stated criteria. One can cite cases like the Donbass where economic units spreads across the republic boundary. There must be a lot of natural interconnections involving rural regions and small towns across oblast borders that are stultified by the principle of zonal systems. Leningrad would probably have tighter connections with the Baltic states than with most of the rest of the USSR. More generally, the European USSR has a strong cultural and economic interrelatedness compared to its tenuous link with the East that would be a better basis for an oversight node than the republic areas that break it up and that, in the case of the RSFSR, extend outside it. The principle of cross-zonal integration is taken care of by Minsviaz-level bodies that handle what is in effect a long-lines division (i.e. the "territorial administrations of intercity communications"). But there is abundant evidence that this perspective has been slighted, as explained in the previous chapter. It is also striking that most stories about the opening of new exchanges mention a few cities which one may now call, but by implication underline that others that would seem equally important are not reachable. One wonders to what extent the Armenians of the Armenian SSR and those of Nagorno-Karabakh in the Azerbaidzhan SSR have been able to talk with each other. One of the arguments the railroad people make for their own branch system is that their communication flows must follow the geography of the railroad, which by its nature ignores territorial divisions. One can imagine that it would indeed be a nightmare for railroad personnel to have

to communicate over a system dominated by the territorial-hierarchy principle.

As indicated earlier, a major administrative unit in the Minsviaz structure is the PTUS at the oblast level, which runs the zonal telephone system, the post office, the wired radio network, the telegraph offices, and so on. Given the oblast base of the zonal systems, that makes sense for the telephone system, but there seems little in the way of agglomeration economies or synergies from grouping it with the post office at that level.

I have several hypotheses about the defects and possible improvements of the territorial administrative model for the telephone system. First, one can't help thinking that many of these units are too small and involve excessive overhead and duplication of function. We see some vindication of this idea in the current reform. Under Gorbachev, there is great pressure to simplify the administrative structure. For instance, Minsviaz is shifting from a four-tiered to a three-tiered administrative system. Moreover, many units are being consolidated — there will be a drastic reduction in the number of "firms" from about 7000 to 975 by turning 5000 former enterprises into structural units and abolishing another 1100.[66]

Second, one of the main reasons for the oblast-level agglomerations has been to transfer income from revenue producing to nonrevenue producing activities, and to subsidize loss-making units of a given kind from the profits of their counterparts, i.e. between rural and urban telephone systems or between small and large post offices. Without having much specific evidence to demonstrate the adverse effects of such subsidies, we know that, in general, cross subsidization is a bad principle that undercuts

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[66] Vestnik sviazi, 1987:112, pp. 2-3.

khozraschet and weakens the pressure to take account of real costs in tariff setting. Here too, the recognition of self-financing as a principle of the current reform validates this suspicion and may remove the crutch of bad organization as a substitute for more sensible pricing.

In construction, I suspect that the downward fragmentation is a major cause of the poor coordination achieved between the various components in network expansion, i.e. new instruments, new cabling, new buildings, switching equipment, and new trunk connections outside the zone. In all these areas there are delays in having exchange equipment installed because buildings are not ready, line capacity in exchanges that can't be used because cable for subscriber loops is not available, etc. I am interested here specifically in the construction aspect. I have an impression that despite the fact that Minsviaz as a whole has construction capacity, it is mostly devoted to all-Union projects and local officials have to depend on outside organizations to get work done on the local level.

There can be advantages to letting local units have more power and responsibility. If the telephone organization has priority and sympathy on the local level, it can get funds, cooperation in pressing its claims for construction contracts, and so on. I am sure that is one reason the Baltic regions have developed telephone systems that are so much better than those elsewhere in the USSR. As will be evident again and again in later chapters, what they have accomplished in data transfer, in introduction of modern exchanges, and in variety and quality of service offered probably could not have been accomplished by Minsviaz working from Moscow.

But localism has weaknesses as well. This Union republic organization must weaken the sector as a whole vis-a-vis the rest of the economy. The

lower levels have to go through the corresponding lower level economic planning bodies to get resources; Minsviaz does not bargain for and procure equipment for the whole network and then allocate it in accordance with some overall national priorities. The request for, and the authorization to purchase, new equipment for an exchange in the Uzbek SSR must go through the Gosplan of the Uzbek SSR. The process is similar for financing, construction, getting cable, and everything else. Minsviaz sits somewhat outside this process. Its power to speak for the whole system in the operational struggle for resources is diluted by being fragmented and expressed at the local level. Though this may seem paradoxical, considering the widely held view that the Soviet system is overcentralized, I see it as highly likely that the element of local control and responsibility has too heavy a weight vis a vis control, planning, and oversight from the center.

ECONOMIC REFORM AND STRUCTURE

Finally we should not leave the subject without noting that the kind of system change that may be beginning in the USSR may have an ambiguous relationship to issues of structure and organization. It is too early to say anything definitive yet; this is mostly to make the point that as the environment changes it may solve some problems but, depending on the direction it takes, may worsen others. As lateral interaction strengthens, the territorial-administrative cast to the physical structure and to the managerial structure will become increasingly inappropriate. Self-financing might have mixed effects. The attention it focuses on better costing, pricing, and responsiveness to consumer demands will be all to the good. On

the other hand, the Soviet self-financing concept also implies meeting investment out of revenues. Telecoms is probably a textbook example where financial transfers among sectors are appropriate. Imagine an economy-wide return on capital of 6 per cent, but the desirability of expanding the capital stock of the telecoms sector rapidly to make up for its backward state, say at 10 per cent. It would be a mistake to generate this capital flow by pricing communications above cost -- after all one reason we want to expand the sector is because its services at cost are a cheap way to enhance productivity! If foreign trade becomes more open, there are more alternatives to the recalcitrant domestic suppliers of equipment and R and D. The Western world is eager to sell to the USSR -- the Telefonica deal to produce telephone instruments was one of the first joint ventures in the new climate and lots of other companies are very excited about the prospects for sales in the USSR. If foreign exchange goes preferentially to those who earn it, as the reform has now arranged matters, Minsviaz may well be at a disadvantage in pressing its arguments for the high payoff to technology imports. The possible openings for cooperative and private ventures would seem to be of little relevance to telecoms because of the kind of equipment it needs. But one of the most interesting current proposals is that one way for Minsviaz to enhance revenue and serve the consumer better is to introduce paid services; there is now a concrete plan to set up a legal and health service, by telephone, enlisting cooperatives to provide the service.

CHAPTER 4

R AND D FOR TELECOMMUNICATIONS

Approaching Soviet telecommunications against the background of the current technological ferment in the West, the importance of the R and D function is obvious and one wonders how the Russians handle this function. In the history of AT&T, technological progress has been a crucial goal and achievement, and its scientific arm — Bell Labs — is one of the premier scientific facilities of the world. Jeremy Bernstein has a wonderful book about Bell Labs, and the kind of creativity it fostered.[67] Moreover, it appears that the unique working climate and high scientific productivity of this institution has survived divestiture.[68]

Minsviaz has its own pallid version of the Bell Labs, but I think that the Minsviaz R and D in-house base is extremely weak, and that the R and D function, for civilian telecoms at least, is served very poorly even in the system as a whole. This chapter describes the R and D establishment, and seeks to evaluate its performance by looking at particular cases.

THE R AND D ESTABLISHMENT FOR TELECOMMUNICATIONS

The Ministerial Network

The R and D system within Minsviaz consists of four main elements, coordinated at the top by a chief administration usually referred to by the

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[67] Jeremy Bernstein, Three Degrees Above Zero; Bell Labs in the Information Age, (New York: Mentor Books, 1984).

[68] See New York Times, 9 March, 1987.

acronym GNTU (Glavnoe nauchno-tekhnicheskoe upravlenie), and advised by a Scientific-Technical Council (Nauchno-tekhnicheskii sovet).[69]

Scientific Research Institutes (NIIs)

In the Soviet economy, the institutional form used for performing basic research is the "scientific research institute" (nauchno-issledovatel'skii institut, or NII). So far as I can tell, there are only two significant NII's within Minsviaz, i.e. TsNIIS (Tsentral'nyi Nauchno-issledovatel'skii Institut Sviazi), and NIIR (Nauchno-issledovatel'skii Institut Radio). The head of TsNIIS is L. E. Varakin and that of NIIR is V. P. Minashin. The Minister of Communications, V.A. Shamshin, describes TsNIIS and NIIR as "our largest collectives" doing R and D.[70] In 1981 he praises them for having performed excellent work and mentions numerous accomplishments. These include the development of the Ekran system, the Moskva system, and the Orbita-RV system for facsimile transmission of newspaper pages.[71] An important inference is that Minsviaz apparently now does all its own comsat system R and D.

TsNIIS has done the R and D work for important elements of the telephone network. It developed the main transmission equipment for channel forming, e.g. a new channel-forming apparatus K-420-C for intra-zonal transmission lines. An article by a researcher retiring from the Institute says he was in charge of developing the B-3, B-12, K-122, K-1920, and K-300 multiplexing systems.

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[69] The chief of the GNTU is currently Iu. M. Fomin. (Elektrosviaz', 1986:2, p. 2).

[70] Vestnik sviazi, 1983:3, p. 5.

[71] Elektrosviaz, 1982:4, p. 2.

TsNIIS has a territorial structure, consisting of a number of divisions (otdeleniia), located in Moscow, Leningrad, Kiev, Odessa, and Erevan. I have also found one reference to a Riga division of NIIS, which was the Soviet member of the team that developed the Istok exchange.[72] Since references to it are infrequent in Minsviaz publications, it may possibly have a special relationship to the important VEF telecommunications plant in Riga, and to its parent ministry Minpromsviaz. Perhaps it has a kind of dual subordination and acts as a kind of bridge between Minsviaz and Minpromsviaz. The divisions all have names on the model of LONIIS (Leningrad Otdelenie of NIIS). It is my impression that this system may represent an example of the famous "dispersion of resources", against which critics of Soviet R and D policies often rail, and that the divisions do not focus on important tasks. Apparently MONISS was liquidated sometime in the recent past.[73] When Boris Yel'tsin took over as the Moscow party boss, he engaged in an extensive housecleaning job on Moscow NII's, eliminating many, and this may have been part of that housecleaning.

NIIR is perhaps a stronger institute. It did the development work for the Orbita-2 comsat receiving station.[74] Like TsNIIS, NIIR has a territorial structure, but for some reason its territorial units are called branches (filialy). I have seen references to branches in Kiev, and a number of other places, but am not sure I have the complete list. In the process of restructuring the R and D establishment in Minsviaz in 1987, NIIR was reorganized and was apparently turned into a scientific-industrial

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[72] Elektrosviaz', 1987:11, p. 32.

[73] Vestnik sviazi, 1987:8, p. 4.

[74] Elektrosviaz', 1973:1, inside front cover.

association (NPO) called "Radio". V.P. Minashin was moved up to be head of "Radio', and M.I. Krivosheev has been made the head of its scientific department.[75] The interesting question is what production or experimental production facilities may have been given to this NPO. I have seen no mention of that so far.

Design bureaus

The actual engineering work for new equipment and systems is the responsibility of various kinds of design bureaus (konstruktorskoe biuro). The major KB in Minsviaz is the Central Design Bureau (TsKB, or Tsentral'noe konstruktorskoe biuro) in Moscow. TsKB has a long history. It started out as the KB sviazi subordinated to Plant No. 5, but subsequently as TsKB grew, it was made independent, and Plant No. 5 became its experimental production plant (opytnyi zavod). This organization also has some regional branches (finialy), such as a Khar'kov branch, which I see mentioned as being formed in 1965, and a Sverdlovsk branch.[76]

There are also design organizations within some of the production plants, but it is my impression that they are small and weak. The republic ministries also have some design bureaus under their own control. An example is the production-design bureau (proizvodstvenno-konstruktorskoe biuro) of the Estonian Minsviaz, which has designed and produced various kinds of station equipment.[77]

The organizations charged with designing facilities in the USSR are

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[75] Elektrosviaz'. 1987:9, p. 1.

[76] Elektrosviaz', 1987:12, p. 30.

[77] Elektrosviaz', 1986:7, p. 2.

generally called State Design Bureaus (Gipros), and I know of three in Minsviaz — Giprosviaz in Moscow, Giprosviaz-2 in Leningrad, and Glavsviazproekt (Glavnoe upravlenie po proektirovaniiu ob'ektov sviazi), location unknown. Giprosviaz, at least, also has a territorial network of divisions (I have seen a Novosibirsk division mentioned).

There are apparently some such units in the construction side of the ministry. One article mentions the "spetsializirovannyi konstruktorsko-tekhnologicheskoe biuro stroitel'noi tekhniki" though doesn't say where in the hierarchy it is located.

Another important organization in the scientific-technical establishment serving telecoms is the professional association to which engineers with electronics and communications specialties belong, i.e. NTORES (Nauchno-tekhnicheskoe obshchestov radio i elektrichekoi sviazi imeni A.S. Popova). This is an important agency for dissemination of technical knowledge, and may do so even across the military-civilian barrier.

Higher Educational Institutions

A third element in this system is a network of seven higher educational institutions (Vysshee uchebnoe zavedenie or VUZ).[78] All are subordinated to Minsviaz, rather than to the Ministry of Higher and Specialized Secondary Education (MVSSO), which until its recent abolition supervised most higher education institutions. The Minsviaz body responsible for them is the chief administration for personnel and training institutions (GUKUZ or glavnoe upravlenie kadrov i uchebnykh zavedenii).[79] These VUZy all have names analogous to the Leningrad Electrotechnical Institute of Communication

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[78] That there are seven we know from Elektrosviaz' 1987:5.

[79] Vestnik sviazi, 1986:10, p. 37.

(Leningradskii elektrotekhnicheskii institut sviazi, or LIES). The other VUZy are located in Moscow, Tashkent, Novosibirsk (imeni N.D. Psurtsev), Kuibyshev, and Odessa. One operates solely as a correspondence institution (the All-Union zaochnyi elektrotekhnicheskii institut sviazi in Moscow).

The main function of the VUZy is training and, in keeping with the common pattern for Soviet higher education institutions, they tend not to be significant R and D performers. They do have some R and D capabilities, supervised in each institution according to the usual pattern by a "scientific research sector." Their resources of scientific manpower are significant. One story reports that their staffs include 120 doctors, and more than 1300 candidates, of science.

I think that the Leningrad institute, LEIS imeni Bonch-Bruevich, is the longest established and strongest of the VUZy, and it has made some important contributions to the development of Soviet telecommunications technology. MEIS also does a significant amount of R and D work through a number of branch laboratories. In 1973 there were four and two more were in the process of being formed. These laboratories may have some significant capabilities. I have seen a statement that MEIS was to develop a microprocessor control for the ISTOK exchange (one of the joint projects with the East Germans under the 1971 agreement for ESSATs) which would give it more flexibility.[80] The Odessa Institute in the 11th FYP did 91 contract projects and 45 budget-financed projects for a total of about 15 million rubles.[81] Shamshin on numerous occasions has noted their existence and their contributions toward Minsviaz R and D problems and says, from time to time,

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[80] The effort is described in Elektrosviaz', 1986:8, pp. 2-9.

[81] Vestnik sviazi, 1985:10, p. 2.

that it is important to take advantage of the capacities of the VUZy.[82] Not surprisingly, it is thought that the path to getting their designs produced is even more thorny than that faced by the NII and KB.[83]

Some VUZy outside Minsviaz may play a role in telecommunications technology research. MGU, for example, helped with the development of the original Orbita satellite receiving station.

The Ministry also administers a system of tekhnikums but, as they train low level technicians, they are of little interest in the R and D connection.

RESEARCH AND DEVELOPMENT ESTABLISHMENTS OUTSIDE MINSVIAZ

Much of the R and D capability for telecommunications lies outside Minsviaz. Two NII's in the Academy of Sciences of the USSR (AN SSSR) are relevant. The Institute for Problems of Information Transfer (Institut po problemam peredachi informatsii) does theoretical work on traffic and on systems for communication between computers. It is obvious from its publications that it does some of kinds of work that would be useful. But it strikes me that I have never seen a reference to it or its works in any Minsviaz publication. Another is the Institute of Microelectronics (Institut mikroelektroniki) about which I don't know much and which again has very little interaction with Minsviaz. The Institute of Cybernetics in the Ukrainian Academy (Institut kibernetiki AN UkrSSR) helped in the development

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82 Elektrosviaz, 1982:4, p. 2.

83 Elektrosviaz', 1987:5, p. 4.

of the Kvarts semi-electronic exchange.[84]

There are also research and design organizations within the ministries that supply equipment to Minsviaz or in the enterprises under them. But in keeping with the general secretiveness about the VPK ministries, not much is said about them, with the exception of those associated with VEF in Riga.

There are also some NII's for television technology. The all-Union Research Institute for Television (VNII televideniia) in Leningrad is described as the head institute for TV. Another is MNITI (Moskovskii nauchno-issledovatel'skii televizionnyi institut), which designs transmitting equipment. I do not know the subordination of either, but believe they must be in a VPK ministry. Another institute, under Gosteleradio, is VNIITR (VNII televideniia i radioveshchaniia).[85]

SIZE OF EFFORT

We know a little about the size of the establishment in Minsviaz. It is said to include "10 thousand scientific workers and designers" including 23 doctors of Science and 500 candidates of Science.[86] I gather that TsNIIS must be the larger -- it has 13 of the doctors, and 324 of the candidates.[87] I have seen no data on the size of Minsviaz expenditure for NIOKR.

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[84] Elektrosviaz', 1983:4, p. 4.

[85] Pravda, June 10, 1986. This is a very good article. It makes the point very strongly that the supplying ministries, acting through a commission made up of deputy ministers, give short shrift to Gosteleradio's requirements.

[86] Vestnik sviazi, 1987:8, p. 2.

[87] Varakin, nachal'nik, in Vestnik sviazi, 1987:8, p. 4.

One good way to evaluate the performance of the R and D institutes, and to understand the peculiarities of their environment and operations, is to examine the development histories of particular innovations. This is possible for a number of equipment items, but I have selected here only a few on which I have so far been able to find information.

The Istok Telephone Exchange

The Istok is a combined digital and analog exchange, intended to be used in local rural networks but capable of being connected to the general network. Its capacity is 4,000 numbers. It took ten years to develop it (1975-1985) and it is now being produced serially. As of mid-1987 thirty-five had been produced. At that date there were 20 in operation, with an aggregate capacity of about 100 thousand numbers. This is an especially interesting case because we have a recapitulation and evaluation of its development history by a man who seems to be one of the developers. Much of what follows is based on his account.[88]

The program was a joint USSR-GDR effort, in which the development work was handled by the Riga division of TsNIIS and the responsibility for production of the equipment assigned to the GDR. (The German partners were Nachrichtenteknik and Robotron). The author cites a classic list of conditions in the Soviet R and D environment that were hostile to effective

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88 L. Ia. Misulovin, "Itogi razrabotki, vnedreniia i puti sovershenstvovaniia sistemy 'Istok'," Elektrosviaz', 1987:11, p. 32. Misulovin is the chief (nachal'nik) of RONISS (Vestnik sviazi, 1987:8, p. 26).

development work: "the absence in practice of any mechanism for the selection of the best decisions; a striving in the administrative system for minimizing risk; departmental chauvinism; dominance of prestige motivations over economic criteria; hegemony of the producer over the consumer". In retrospect the developers operated on some mistaken assumptions: a) that the cost of such electronic equipment would fail to make it competitive with alternative kinds of equipment (he implies that this has not happened, and that the Istok station is not necessarily cost-effective); b) a mistaken forecast of its market slot — a major feature of the design was the combination of master and slave stations, but it turns out that in a major intended application of the small slave station — rural exchanges — most installations require the capacity of a full station rather than merely a slave station. Some technical miscalculations were also made regarding the best common channel signalling system. One of the biggest troubles in development and in the process the Russians call naladka — actually getting the equipment to operate — was with software. They started out by working in machine code without a way to automate the writing of software. (I think he means they did not have a compiler or assembler.) Also they did not appreciate the need for test facilities to check hardware and software and, as a result, the software provided to the customer often did not work. Complaints in the journals corroborate this difficulty — it appears that RONIIS is still developing some of the software.[89]

The author is also clear in asserting that Soviet industry was incapable of producing the hardware the developers created. "Without the

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[89] Vestnik sviazi, 1987:8, p. 26.

participation of East German industry it would have been impossible to bring the Istok system to successful commercialization within any realistic time."[90] Apparently some units have been produced in the USSR, but not on a series basis. I have seen no definitive information as to what factory was the domestic producer. The author presents data showing that the Soviet produced stations are decidedly inferior in reliability to the East German versions. He implies that there is a current proposal to have the exchange produced in plants of Minpromsviaz and the problem may be more the unwillingness of Minpromsviaz to take on a civilian task than its lack of technical capability to produce the equipment.

The author ends with some interesting observations on the task of "achieving world standards" in producing telecommunications equipment, one of the buzzwords of Gorbachev's modernization program. This slogan is too vague to serve as a guide to decisions. R and D plans must take into account Soviet scientific and production capabilities. In choosing the type and level of world technology to emulate, Soviet planners should be guided by the criterion of what will be of most help under actual Soviet conditions at the time the innovation is introduced. In particular he says it will be impossible to achieve world standards without creating new switching elements "using new materials and physical principles." The Istok uses ferreed switching elements (gezakony),[91] which have been superseded in Western switch technology by solid state devices, and I imagine that it is improvements in this area which he has in mind. That will be expensive, he suggests, but an investment worth making given the planned expansion of the

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[90] Elektrosviaz', 1987:11, p. 32.

[91] Elektrosviaz', 1986:2, p. 11.

telecommunications network over the period to the year 2000.

Private Branch Exchanges

A second case is the most advanced PABX which the Russians have developed and produced domestically, the Kvant. The developer was VEF.[92] This exchange was developed as a PABX. As of 1988 none were being used on the Minsviaz network itself. It has a maximum capacity of 2048 lines and is designed for .15 erlangs/line. Like the Istok, the Kvant uses ferreeds. The most extensive use has been in Minenergo and the Ministry of Civil Aviation.[93] We get some confirmation of that from a statement by the Minenergo minister (P. S. Neporozhnyi) indicating they plan to use it extensively on the Minenergo system.[94] I wonder if this may not have been a system that was pushed or even initiated by the branch customers as they tried to bypass Minsviaz. Neporozhnyi characterizes it as a domestically produced item, and one wonders if they may not have justified it on the argument that this is the kind of switch the domestic industry could produce. If there is anything in this, it would be an interesting commentary on the relative power of different ministries to press their claims for VPK attention. I would not be surprised to find that Minenergo and the Ministry of the Aviation Industry would have more clout than Minsviaz.

In an interesting reversal, the planners are now talking about using the Kvant as an exchange in rural networks. It apparently has a limited number of outside ("interstation") lines, which I suppose would limit its

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92 Elektrosviaz', 1981:4, p 3.

93 Vestnik sviazi, 1987:9, p. 45.

94 P.S. Neporozhnyi, Tekhnicheskii progress energetiki SSSR, Moscow, 1986, p. 135.

application as an exchange on the regular network.[95] As of 1987, it was being used only as a PABX and was still being redesigned to function as a rural exchange.[96] But a special version Kvant-S (I believe the S indicates adapted for use as a rural exchange) is to be produced by VEF. This source claims Kvant is being produced by industry in large numbers.[97]

The Interchat Multiple Access System

Another case is the development of equipment for multi-station access to communication satellites for telephony. Information about this case is incomplete; it is presented here more for the intriguing issues it raises than for any clear-cut conclusions.

The Russians apparently developed the first such equipment on their own — the Gradient N. It was a frequency-division system, using the single-carrier-per-channel principle and analogue signals, and was designed for a relatively small number of channels. It was used on the Molniya-2/Orbita-2 network for telephony and also on the Intersputnik telephone network. According to a Soviet source, its performance was unsatisfactory because of "low capacity, instability of parameters, and strong intermodulation interference."[98] Perhaps that is one reason the Russians have been slow to expand telephony on comsats. In any case, for an improved second generation

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[95] Elektrosviaz', 1982:6, p. 50.

[96] Vestnik sviazi, 1987:1, p. 5.

[97] A. A. Aleshin in Elektrosviaz', 1987:4, p. 3. Aleshin uses the term VEF RPO, which I assume may mean the VEF production association in Riga. An official of VEF said in 1984 that they had begun quantity production of Kvant exchanges, though I suppose his statement refers to the PABX version. (Soviet Export, 1984:2, p. 38).

[98] L.A. Kantor et al, "'Interchat'—kanaloobrazyvaiushchaia apparatura sistemy sputnikovoi sviazi 'Intersputnik'," Elektrosviaz', 1986:5, p. 2.

system they enlisted the help of the Hungarians. The Interchat system was developed by a joint R and D effort of NIIR and the Hungarian TKI institute. This, too, is a single-channel-per-carrier system, but uses pulse-code and adaptive-delta modulation. It will apparently also have larger capacity — individual ground stations will handle 64 circuits versus the 24 of Gradient N. It was tested and said to be satisfactory,[99] and the Hungarians exhibited it at the Sviaz-86 show in Moscow.[100]

The Russians have also worked on a time-division multiple-access system, intended for use on denser pathways. This has been mentioned from early on in the comsat telephony program. But its status has always been ambiguous and I have never seen the kind of clear-cut statements that led me to believe it had gone beyond the development stage to become an operational system. This impression is reinforced by the fact that a version with a definite name, the MDVU-40, was exhibited at Sviaz-86, suggesting that it was only then taking definitive form. E. Pervyshin, the Promsviaz minister in his review of the exhibition says that it is to be used on Intersputnik, raising the question whether it is an alternative or a supplement to the Interchat system.

I hope we can find out more about this case, since it seems to embrace several issues — the slow pace of Soviet development, dependence on East European help in R and D, possible conflicts over the payoff to joint development, and backing and filling on a decision about which technological route to take in the process of system design.

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[99] Elektrosviaz', 1987:11, pp. 39, 43.

[100] Vestnik sviazi, 1986:8, p. 8.

The Kvarts Quasi-electronic Exchange

The Kvarts is a relatively large "quasi-electronic" exchange (with a capacity of 8,000 lines (or 10,000 lines in its city exchange version). It was the first attempt to develop a stored-program control exchange domestically, rather than producing a foreign model under license as they have done with other such exchanges. The transit exchange version was a joint project of TsNIIS and the KB of VEF, the Institute of Cybernetics of AN UkrSSR, and the East German firm Robotron. The developer of the city exchange version was the Krasnaia Zaria NPO in Leningrad, which I assume is in Minpromsviaz.[101] Software for the system was developed in Moscow at TsNIIS. The control computer (called Neva-1), was developed "jointly by specialists of the USSR and GDR" but is manufactured by Robotron. The Riga VEF plant manufactured the switching equipment which uses ferreeds as switching elements.[102] Kvarts can be used as a transit exchange in the tertiary or in the secondary intercity network, or as an ordinary station in the zonal network. According to one source, the prototype model was installed in Leningrad and experimental operation begun in July 1980. According to another statement, however, the first domestically produced Kvarts was installed in Vilnius and went into operation in 1984.[103] The Leningrad one may have been an experimental prototype produced by the East Germans. There is a claim in 1983 that series production (in the USSR, I presume) has begun,[104] though other evidence suggests to me that this is an

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101 Elektrosviaz', 1986:4, p. 3.

102 SWB SU/W1455/B/1, 21 August, 1987.

103 Elektrosviaz', 1986:6.

104 Elektrosviaz', 1983:4, p. 5.

exaggeration. The only reference I have seen to additional Kvarts exchanges being put into operation since the Vilnius example is an assertion that one has gone into operation in Cheliabinsk and that one is nearing completion in Ashkhabad. But "there is still a great deal to be done before the Kvarts station [in Cheliabinsk] reaches design capacity."[105]

At one point the intention was that the Kvarts would be the principal exchange for expanding the intercity net.[106] At a conference in 1987 on experience with introducing quasi-electronic stations, the Kvarts station was not discussed "because the station was being reconstructed".[107] That might refer only to the original installation in Leningrad, but I suspect that none of these exchanges are in routine service because they cannot be made to work right. The report on the testing of the Leningrad station, when it was used for a relatively few hours each day, indicated that it exhibited many problems in operation.[108] In its original form it lacked equipment for automatic connection to many of the existing kinds of stations.[109] A 1988 report on the Kvarts exchange in Vilnius said that it could not handle more than 62 per cent of its designed line capacity without breaking down.[110]

The Kvarts was originally developed as an intercity transit exchange, and in that form it lacked equipment that would permit it to be tied into

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105 SW/1455/B/2, 21 July, 1987 and SW/1451/B/2, 24 July, 1987.

106 Elektrosviaz', 1986:2, p. 7.

107 Vestnik Sviazi, 1987:1, p. 5.

108 Elektrosviaz', 1983:4.

109 Elektrosviaz', 1986:2, p. 8.

110 Vestnik sviazi, 1988:3, p. 9.

zonal networks, or to work with nonautomatic systems.[111] I am coming to the conclusion that they have not yet gotten the bugs out of it. A.A. Aleshin says in 1987 that they are engaged in an adaptation of the Kvarts for use as city exchange.[112] Since an early account said that at the beginning of the development process this task was assigned to the Krasnia Zaria NPO (which I am certain is in a VPK ministry), this may be another example of the neglect of civilian telecoms assignments in the VPK.

Fiber-optic Technology

An interesting insight into the problems of doing R and D across the civil-military interface -- the "wall" — is provided in a story of what happened to "Svetovod," the MNTK founded in 1986 to develop fiber-optic technology.[113] Svetovod was under the control of AN SSSR, but apparently Minelektrotekhprom was an important partner, presumably on the rationale that it has responsibility for producing telephone cable. The reporter reminds his readers that in contrast to very rapid and extensive introduction of fiber-optic lines in the West, virtually nothing has been accomplished in the USSR. Despite numerous statements about experimental installations in various places, the author says straightforwardly that there is only one experimental installation in operation in Leningrad, though there are others in the planning stage.[114] Svetovod was to seek a

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[111] Elektrosviaz', 1986:;2, p. 7.

[112] Elektrosviaz', 1986:2, p. 11.

[113] Pravda, 26 February, 1988.

[114] Actually there now seem to be three short lines in operation in Leningrad--two connecting telephone exchanges, one being used for data transfer (Ekonomicheskaia Gazeta, 1986:42). A report on the experimental effort to install a fiber-optic line in Moscow suggests that it was a total failure. The cable was defective and the laser signaling equipment broke

breakthrough in the interbranch problem underlying this failure and was to do the development work for producing fiber-optic cable. He describes Svetovod's inability to obtain cooperation from the related ministries, and says that by February, 1988, it is ready to pull down the flag. A crucial difficulty was developing equipment to draw the glass fibers, which required sensing and control equipment more precise than any currently produced. Svetovod discovered that earlier, "when everyone was solving the fiber-optic technology problem on his own," a KB in Minelektronprom had successfully developed such equipment. That KB has since gone on to other tasks but its staff more than once indicated its "readiness to deal with this task on a statewide scale." But the MNTK has been unable to enlist the efforts of the KB, since "in that departmental fence there is no gate." This is just one more case illustrating that the capability to deal with telecommunications technology has been located in the VPK ministries, and that Minsviaz has had very limited access to it.[115] Despite the efforts under Gorbachev to breach that departmental wall and to redirect the energies of the VPK ministries to serving the needs of civilian technological progress, the wall has continued to exist in the form of an informal priority system that is as strong as ever.

Pulse-Code Modulation Transmission Equipment

Another case on which I have found enough information to make me think

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down. (Vestnik sviazi, 1986:11, p. 15.)

[115] I cannot but believe that fiber optic technology has been produced for the military. A. P. Alexandrov more or less confirms the implication that this is the case in his speech to the General Meeting of the AN SSSR in 1985 in which he said that "several institutes and several branches of industry have organized production of this equipment for their own needs.." (Vestnik AN SSSR, 1986:5, p. 5)

it could be developed and which would be revealing is the IKM line of digital transmission equipment.

CONCLUSIONS ON R AND D PERFORMANCE

I believe that Minsviaz has been severely handicapped in having a weak and fragmented R and D base. Certainly the current Soviet leadership is dissatisfied with its performance, as is made clear in a scathing criticism delivered by I.F. Trofimov in 1987, the deputy head of the Central Committee's department of transport and communications [116] and in subsequent self-criticism sessions in the institutes. It is said to exhibit all the classic weaknesses of the general Soviet R and D establishment. It is staffed by aging officials with old ideas; administrators hang on too long (the average age of heads of departments was 57 years); there is too little turnover and the talented people leave for other institutes. TsNIIS and NIIR do not actually produce innovations (their productivity output as measured by authors' certificates is one-third of the all-union indicator). Training of researchers for higher degrees (aspirantura) is on the verge of being shut down because of the low quality of graduate work — VAK has rejected many of the candidate dissertations.

These defects are acknowledged by the R and D personnel themselves. The head of TsNIIS, L. E. Varakin, says in a samokritika article responding to these charges that the internal philosophy motivating the work of the institutes is defective — TsNIIS staff do not see themselves as developers

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[116] I.F. Trofimov, "Vnesti dostoinyi vklad," Vestnik sviazi, 1987:8, pp. 2-3.

of new equipment. TsNIIS is tasked by Minsviaz with numerous responsibilities that could just as well be handled by the operating units. The Institute has become overburdened with producing technical documentation for equipment produced by others and has forgotten its primary mission of developing equipment itself. In particular, there are poor incentives for coordination between R and D organizations, and the designers, and the producers.[117]

One of the problems is that the system is too dominated by paltry, regional, tasks. It seems to me that the dispersal of resources among all these branches keeps them from being focused on large scale development tasks. As indicated in Chapter 3, I think the Minsviaz structure has suffered from too little central control from the top, too limited a horizon at the bottom, and I think this has spilled over to its R and D effort.

One consequence of not having an adequate independent scientific capability of its own is that Minsviaz cannot be effective in acquiring good equipment. An interesting story asserts that thirty percent of the telegraph equipment Minsviaz received from Minpromsviaz in a recent year is not usable. Minsviaz did not establish the specifications (TZ or tekhnicheskie zadaniia) with sufficient care. As a result the equipment delivered is unsuitable for use in the system. Minsviaz may have the technical knowledge (it knows what it gets doesn't work) but that knowledge is not mobilized and focussed in a way to enable it to act as a demanding customer.

Given the general dependence on Minpromsviaz for equipment, Minsviaz is necessarily dependent on Minpromsviaz enterprises for R and D assistance as well. Coordinating across the Minsviaz-VPK-ministry interface seems to be

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[117] L.E. Varakin, "Dolg uchenykh," Vestnik sviazi, 1987:8, pp. 3-4.

an insuperable problem. Trofimov faults the unit within TsNIIS responsible for fiber-optic technology for not "establishing good contacts with the related enterprises of Minpromsviaz and Minelektronprom."[118] Varakin, in trying to defend his institute falls back on the obvious — it is indeed difficult to coordinate the activities of the customer for new equipment (Minsviaz), the R and D organization (TsNIIS), and the prototype producer (a plant in Minpromsviaz).[119] As another commentator says, these failures surely depend as much on the "bol'shaia promyshlennost,'' which produces and supplies telecommunications equipment, as on Minsviaz, .[120] But the problem is not exclusively the unequal bargaining power between a civilian and a defense industrial ministry — Varakin confirms that TsNIIS does practically no significant joint work with AN institutes or VUZ institutes.

Minsviaz is really under the gun to improve and Shamshin is apparently a minister who is willing to try to change rather than lose his job. An extensive reorganization of R and D was begun in 1987. NIIR and TsNIIS went onto khozraschet and self-financing. They received more authority to set their own research plans (templany). Minsviaz is restructuring the forms of cooperation with neighboring (smezhnye) ministries "to achieve an acceleration in all stages of the science-development-production-implantation cycle."[121] Minsviaz institutes have begun to interact more with the labs and plants in the VPK ministries. For example, they have acquired some experience in working with plants of Minelektronprom (on the IKM-12 and

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[118] Vestnik sviazi, 1987:8, p. 2.

[119] Vestnik sviazi, 1987:8, p. 3.

[120] Elektrosviaz', 1987:9, p. 2.

[121] Elektrosviaz', 1986:2, p.1.

15, and some other systems) and are engaged in joint work with the KB's of Minpromsviaz.[122] It is fascinating that these actions are mentioned as if no such cooperation had ever existed before. Shamshin has further elaborated on this. Some 20 "temporary task forces" (one of the Gorbachevian efforts to break down departmental barriers) have been set up focussed on particular development problems. One of these "includes collectives of Minpribor and Minpromsviaz" — which seems pretty minimal to me! An NPO "Radio" has been created and two others — "Sviaz and "Elektrosviaz — are in the process of being formed. The tematika of the NIIs has been severely cut to weed out minor projects and focus more effort on urgent tasks. The NIIs have been put on the nariad-zakaz system, i.e. shifted from institutional to project funding. How much all this will affect performance is, of course, moot. Shamshin himself admits that most of the workers in the NII and KB "are not ready to work in the new way" and that "under the guise of introducing khozraschet the directors of the NII try to preserve the old method of financing work."

It has been interesting to me to find so many cases where the USSR is dependent on Eastern Europe not only to produce equipment but to do the R and D work on it as well. The Kvarts, Istok and Interchat cases are far from the only ones. There is a program for the development of the equipment for a unified telecommunications network, within which the Istok case is only one element. The importance of telecoms in the CMEA program for cooperation to the year 2000 was re-emphasized at the CMEA executive committee meeting in May 1988.[123] The technology transfer relationship between the USSR and the

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[122] Elektrosviaz', 1987:9, p. 2.

[123] Ekonomicheskaia Gazeta, 1988:2, p. 3.

other countries needs much more work. It is a topic capable of being researched and I believe it will be revealing.

CHAPTER 5

EQUIPMENT AND EQUIPMENT SUPPLY

One of the crucial interfaces that conditions Minsviaz performance is that with equipment suppliers. Again the example of the West provides a suggestive point of departure. One of the explanations given for the effectiveness of the telephone system in the US, as it evolved under AT&T, was the control AT&T exercised over the quality of equipment through its manufacturing subsidiary, Western Electric. This relationship gave AT&T a big advantage in getting equipment developed and produced to meet standards consistent with network design. It also had the advantage of being able to require all its associated companies to use Western Electric equipment. In many other countries as well national suppliers have grown up in close connection with the monopoly company. That arrangement is now being broken up, of course, and a fierce scramble is taking place internationally to get in on the business of supplying equipment in a more open market.

What is the source of equipment for Minsviaz? Minsviaz has its own version of Western Electric — a kind of Eastern Electric — in the collection of plants under its chief administration for industrial output (glavnoe upravlenie promyshlennogo proizvodstva, or GUPP). As we will see below, that is a very weak production base, with limited capabilities for producing complex telecoms equipment. Most of the major equipment needed for the telephone system, especially the more complex and technically demanding types, must be obtained from the Ministry of the Industry of Communications

Equipment (Minpromsviaz). This is one of the defense industrial ministries under the supervision of the Military Industrial Commission (VPK). These sources are insufficient to meet its total needs, however, and a large share of the equipment used in the Soviet telecommunications system must be imported, primarily from Eastern Europe.

SUPPLIERS UNDER MINSVIAZ CONTROL

The equipment producers within Minsviaz constitute a rather small industrial base, with limited abilities to handle high technology. Moreover, these plants are charged with producing not only telecommunications equipment, but also equipment for Minsviaz's postal operations and its construction organizations. I know of no general Soviet treatment of this sector but a description of it can be pieced together from scattered sources. The list of the plants I have seen mentioned, with some idea of what they do, is as follows:

1. The Akhtyrskii "Promsviaz" plant. I have seen a reference to production of postal equipment by this plant and it may not produce telecommunications equipment at all.[124] Most plants explicitly identified as under GUPP seem to carry the generic "Promsviaz" name. My working hypothesis is that any plant so called may be presumed to be in GUPP.

2. The "Armpromsviaz" plant in Erevan. This is described as an experimental production plant (opytnoe proizvodstvennoe tekhnichekoe ob'edinenie).

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[124] Vestnik sviazi, 1987:8, p. 13, and Elektrosviaz', 1982:3. p. 5.

3. The Barabinskii plant. Its subordination to GUPP is explicitly confirmed, but I have seen no statements as to what kind of equipment it produces.

4. The Kiev "Promsviaz" plant. This is explicitly identified as under GUPP, but I have seen no statements as to what kind of equipment it produces.

5. The "Promsviaz" experimental plant in Minsk. There is also a reference to a Minskii zavod "Promsviaz", which I assume is the same.

6. The Kaunas "Promsviaz" plant. This plant is mentioned in several sources as a producer of pay phones.

7. The Navlinskii "Promsviaz"plant.

8. The Perm "Promsviaz" plant. This plant produces the Spektr 101 telephone.[125] Since according to other information the Spektr phones originated with VEF, it is possible that this plant is in Minpromsviaz rather than in Minsviaz.

9. The Sverdlovsk "Promsviaz" experimental plant. This is probably the experimental plant of the Sverdlovsk branch of TsKB. As an experimental plant it must not be very large. It is reported to be engaged in series production of the AZTS-E electronic automatic zonal exchange.[126] Another story says this plant produced the K-1020 channel-forming device on a series basis.

10. The Taldom plant. This is explicitly identified as in GUPP, but I have no information on its product line.

11. The Tashkent plant. It is explicitly identified as under GUPP, but

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[125] Ekonomicheskaia Gazeta, 1986:42, p. 18.

[126] Elektrosviaz', 19878:12, p. 30.

there are indications that it may produce postal rather than telecommunications equipment.[127]

12. The Ufa "Promsviaz" plant.

13. The "production and design bureau" (proizvodstvennoe konstruktorskoe biuro) under the Estonian Minsviaz. It is said to have developed and produced some equipment. This example of a small-scale production facility under local control (not unique) suggests that local authorities often have to solve an equipment supply problem on their own; I would imagine that what they develop may not meet ministry-wide standards.

There are many indications that "Eastern Electric" is not a very powerful source of equipment for the telephone system. Most references to the plants in this group suggest that they are relatively small and produce equipment other than the complex high-technology items required for network modernization. Most reports mentioning them refer to such items as channel-forming equipment for telegraph exchanges,[128] housing for remote telephone stations, supplementary equipment for exchanges, post office equipment, equipment for construction organizations, and relatively minor auxiliary kinds of equipment. One exception is the Ufa plant. It is said to have mastered production of the "Elektronika-sviaz-6" radio-relay system.[129] I also understand that the plant is trying to develop a modern exchange under a technology transfer agreement with the Finns (see below), though it is having trouble mastering this transferred technology.

These plants are not well equipped and Minsviaz lacks the bureaucratic

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[127] Vestnik sviazi, 1987:6, p. 34.

[128] Elektrosviaz', 1982:10, p. 36.

[129] Elektrosviaz', 1987:11.

clout to upgrade them. One interesting account complains that Gosplan will not allocate GUPP plants the equipment they need to fulfill their production assignments and fobs off secondhand equipment on them.[130] Some effort is being made to upgrade the GUPP plants. Some are getting ready to operate under gospriemka and, in preparation, are strengthening their production base.[131] A recent decree authorized them to undertake investment to expand their facilities.

OTHER INDUSTRIAL MINISTRIES

Minpromsviaz and other VPK ministries

It is quite clear that most of the important equipment for telecommunications has to come from outside sources -- there are frequent acknowledgements that Minsviaz can deal with the modernization problem only through the cooperation of "big industry" (bol'shaia promyshlennost), which I presume is a euphemism for VPK ministry sources. The primary producer of telecommunications equipment is Minpromsviaz, set up in 1975 on the basis of enterprises from the Ministry of the Radio Industry.[132] There is relatively sparse information concerning what plants in Minpromsviaz produce civilian telecommunications equipment. The Russians have tended to be very circumspect even in referring to VPK ministries,let alone divulging information about enterprise names and subordination for enterprises of the VPK ministries. But there are some hints as to the major sources. One of the

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130 Vestnik Sviazi, 1987:9, p.6.

131 Elektrosviaz', 1987:5.

132 Sobranie Postanovlenii SSSR, 1976.

most important suppliers is the VEF plant in Riga, Latvia. This is a large and long-established firm pre-dating Soviet occupation, with a distinguished history, a broad product line and a reputation for high quality. When Gorbachev made a trip to Latvia, this is the plant he visited as a matter of course. Another that may be under Minpromsviaz is the Perm telephone plant Permskii telefonnyi zavod).[133] A Kaunas zavod sredstv sviazi mentioned occasionally may be different from the Kaunas Promsviaz plant mentioned above. Another is the Zavod avtomaticheskoi telefonnykh stantsii which appears in an announcement for a new office telephone system.[134] Since no location or name is given, I presume this plant is under a VPK ministry. This advertisement probably reflects the new situation under Gorbachev's polices in which there is pressure on VPK plants to produce civilian goods. There is said to be Stuchka Telephone Works in Vilnius and the Sigma NPO is said to be experimenting with PABXs in its Panevezys, Taurage, and Pabrade plants.[135]

Minpromsviaz has responsibility for the whole range of civilian telecommunications equipment. I have seen mentioned in various contexts telephones, telephone exchanges and other station equipment, television studio and broadcast equipment, television sets and other electronic consumer durables, the Ekran and Moskva satellite terminals, and equipment for the Orbita stations. (I have seen no reference that would indicate who might produce the satellite payloads for comsats).

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133 Ekonomicheskaia Gazeta, 1986:42, p. 18.

134 Ekonomicheskaia Gazeta, 1988:1.

135 Ivan Berenyi, "The constraints of a giant: the USSR struggles with modern telecommunications," Telephony, 22 July, 1985.

I have been unable to discover much about the internal organization of Minpromsviaz. The VPK ministries generally have somewhat distinct specialized sectors producing civilian output. There are occasional references to chief administrations for civilian output within VPK ministries and to deputy chairmen whose portfolio includes civilian production. That may also be the case for Minpromsviaz, though I have not seen such a person or such a unit mentioned, and there is an interesting statement to the effect that there is no explicitly organized subbranch for civilian equipment within Minpromsviaz with which Minsviaz can deal. One commentary recommended that a special body for development and initial production (a science-production association or NPO) be set up within Minpromsviaz to handle Minsviaz and Gosteleradio needs for new equipment.[136]

Minpromsvaiz is not the only military-industrial supplier of equipment for telecommunications. Electronic and electrical equipment production capabilities are scattered through several VPK ministries. Although most television sets are produced in Minpromsviaz, three other VPK ministries are also involved. The IKM-15 pulse-code transmission system is produced in Minelektronprom, for example. At the Sviaz-86 exhibition of telecommunications equipment, seventeen ministries and departments of the Soviet economy were represented. The January 1985 decree outlining the new plans for telecommunications obligated Minelektronprom and Minradioprom as well as Minpromsviaz to guarantee the production in 1986-90 of the equipment to carry out the decree.[137]

Basic to my interpretation Minsviaz's poor record in realizing the

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[136] Pravda, 21 February 1987.

[137] Elektrosviaz', 1985:4, pp. 1-2.

goals for improving the technical level of the telecommunications sector in the seventies and the first half of the eighties is a conviction that Minsviaz is a weak player in the bureaucratic game of getting the VPK ministries to meet its needs. Statements attesting to the low priority treatment Minsviaz and Gosteleradio receive at the hands of Minpromsviaz and the other VPK ministries are ubiquitous in the commentary on the sector. Varbanskii, chief of the comsat and radio administration of the ministry says that Minpromsviaz will not fulfill the plans for Moskva satellite terminals or the equipment to complete the data transfer network.[138] One of the interesting examples is the Gazeta-3 facsimile system. This will be discussed more fully in a later chapter; here the relevant aspect is the attitude of Minpromsviaz. The machine was developed to upgrade the system of local printing of the central press, a high priority function in leadership priorities. A prototype was delivered and, after testing, it was decided further improvements were needed. But Pravda has gotten no cooperation from Minpromsviaz and the prototype has sat in the facsimile transmission center for a couple of years. In the Central Committee's critique of R and D in the communications sector (see preceding chapter), Trofimuk said that "the system of relations with Minpromsviaz remains a very sore point. It delivers equipment in inadequate amounts and of low quality, in a context of liberalism and permissiveness on the part of Minsviaz".[139] The last point about the failure of Minsviaz to act as a demanding client is made in several places. My inclination would be to put the blame on the VPK suppliers as unresponsive, but it may be that Minsviaz after years of being

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[138] Radio, 1987:5, pp. 2-3.

[139] Elektrosviaz', 1987:9, p. 2.

rebuffed may have been thoroughly cowed.

Minelektrotekhprom

In addition to telephone equipment, cable is an indispensable element in expanding telephone service. The shortage of cable, and probably especially for subscriber loops, is one of the most serious obstacles to expanding telephone service — many exchanges have excess line capacity, which they cannot offer to subscribers because of the unavailability of cable. Minsviaz's complaint refers to low quality as well as insufficient quantity.[140] Apparently Minsviaz has no independent production capacity of its own for cable and is at the mercy of Minelektrotekhprom. Cable production is supervised by the Glavelektrokabel chief administration. The cable-producing plants are identifiable, as they are not subject to the same prohibitions about disclosure as are those in VPK ministries.[141] Minelektrotekhprom also apparently has a development organization for cable products, the NPO VNIIKP.[142]

EAST EUROPEAN SOURCES

It has apparently been a deliberate Soviet policy to rely heavily on

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[140] Elektrosviaz', 1986:1, p. 3.

[141] The list as I have identified it so far is: Belaruskabel; Sredazkabel ; Odesskabel (this was to be the one to produce optical fiber); Amurkabel; Elektrokabel; Tashkentkabel; Kuibyshevkabel; Sevkabel; Moskabel; Kamokabel; and Azovkabel.

[142] Elektrosviaz', 1987:10. p. 60.

Eastern Europe as a source for telecommunications equipment.[143] This dependency applies to all the major kinds of equipment -- telephone instruments, exchanges, transmission systems, and radio and TV broadcast equipment. The USSR also imports significant amounts of telephone cable, mostly from East Germany, Finland, and Yugoslavia. Supplying the Soviet Union accounts for an important part of the market for the telecommunications equipment industries in the East European countries.

The policy of relying on Eastern Europe has been in effect for a couple of decades or more. Some data on imports of exchanges and telephones from Eastern Europe for the mid-sixties[144] suggest that almost all the equipment being installed on the telephone network at that time was imported. In 1965 shipments of telephones to the USSR numbered 590 thousand, while the stock data in the statistical appendix show for that year an increment of 642 thousand telephones installed. Similarly for exchanges, in 1965 ATS-54 exchanges with an aggregate capacity of 590 thousand lines were imported, while the increment in capacity was 530 thousand numbers. It will continue in the future. The Russians count on digital carrier equipment from East Germany, Bulgaria, Hungary and Poland to expand the network in the 12th FYP.

Unfortunately we cannot follow the question of import dependence systematically in Soviet trade statistics, since information on trade in telecommunications equipment is omitted from the Soviet foreign trade handbooks.[145] But the picture can be filled in to some extent from the East

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[143] As an institutional footnote, the Soviet FTO responsible for importing telephone equipment is apparently Mashpriborintorg.

[144] N.D. Psurtsev, p. 367.

[145] Mention Kostinsky

European side and I will review what we know from East European sources.

The Bulgarians export large numbers of telephone handsets to the USSR. Bulgarian production grew from 326 thousand to 1.150 million units in 1985 and in the latter year 627 thousand, or 54 per cent, were exported to the USSR. In earlier years the Soviet Union had taken an even larger share. I am not completely certain who the Bulgarian telephone producer is but believe it is probably the Sofia Telecommunications Plant, with which the Russians have an agreement. More than 16 per cent of that enterprise's output is exported to the USSR. In 1981, it began specializing in the production of large capacity telephone exchanges for the USSR. I would guess that it is an old fashioned crossbar exchange.

The Czechs, at one point at least, were a significant supplier of exchanges. They began by supplying the ATS-54 (step-by-step) exchange and later shifted to the ATS-K (i.e.the crossbar model). I do not know what plant or plants are involved. They also supplied telephones and in 1976 delivered the 2 millionth telephone instrument to the USSR.[146] The plan for 1976-80 envisaged delivery of 1 million telephones.[147] If they in fact supplied that number, and something similar in the 11th, then by 1985 they would have sent 4 million instruments, accounting for 13 per cent of the 31 million instruments installed on the Soviet utility network at the end of 1985.

East Germany, too, is a large-scale supplier of telephones and

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146 P. Bagil, "Vazhnyi vklad v razvitie radiotekhnicheskoi i elektronnoi promyshlennosti," Ekonomicheskoe sotrudnichestvo stran-chlen SEV, 1979:6. p. 59.

147 "KOVO Foreign Trade Corporation on the Soviet Market," Czechoslovak Foreign Trade, vol 17, #10/11, 1977, p. 51.

exchanges. The East German partner is the Nachrichten elektronik kombinat. By 1974 German-made ATS-54 switches serving 2 million subscribers were operating in the Soviet network. By 1981, there were 4 million subscribers served by East German ATS-K and ATS-K4 exchanges. The combined total of 6 million amounted to a fifth of all subscribers.

The East Germans play a crucial role in the Soviet effort to move to a new generation of switching equipment. The Russians signed an agreement with them in 1971 to develop the EESATs (edinaia sistema sviaz' dlia analogovoi i tsifrovoi kommutatsii), an exchange which goes under several names, but is called the Istok by the Russians. It is one of the main exchanges to which the Soviet telecommunications planners look for expanding and modernizing the Soviet network. The Russians apparently intended (and tried) to produce this switch themselves as well, but seemingly have given up that idea and are now resigned to relying on German supplies. In addition to telephones and exchanges, there are references to imports of East German carrier systems for cable links and East German telegraph instruments.[148]

The Hungarians have a rather large export-oriented telecommunications equipment industry that is a significant supplier for the USSR. Hungary is said to export 2/3 to 3/4 of its telecommunications output and its most important customer is the USSR, taking in recent years over half of Hungarian exports. Most of the rest goes to other Comecon countries and to LDC's. Hungarian production is apparently based in part on imported components (perhaps including Western components) and some Hungarian equipment seems to be based on licenses from Ericsson. This foreign-licensed equipment is described as including the ARM, ARF, and ARK models of

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[148] Elektrosviaz', 1986:2, p. 3.

telephone exchanges.[149]

Hungary supplies a wide variety of telecommunications equipment to the USSR, especially exchanges and transmission equipment. I have seen no reference to telephone instruments, however. The Russians have depended on Hungarian supplies for a long time — the Hungarians developed one of the earliest radio-relay systems the Russians introduced, the Druzhba.

A major source is the Budavox firm. I have also seen a reference to the EHG, a Budapest telecommunications equipment manufacturer. It is modernizing its factory to produce digital telephone equipment. I have also seen a reference to a Plant named for Beloyanis, which is supposed to do "quasi-electronic" (i.e. some kind of stored program control) substations. I also have seen a reference to a co-production agreement between VEF and a Hungarian plant Hiradastechnikai Vallalat.

In 1960-1985, Budavox shipped equipment to the USSR worth 1.6 ER (in settlement rubles, I presume). That is a significant amount if one thinks of total annual investment in Minsviaz at about 1ER. As another measure, Hungarian-produced ATS-K exchanges serve 1.5 million (out of the 25-30 million or so) subscribers in the USSR (I think this refers to the mid-80s).

I find less information about shipments of Polish equipment to the USSR. There is a "Telekom" plant at Radom, 100 km south of Warsaw, and a plant in Warsaw that produces PBX's. The Polish statistical handbook shows the output of telephone instruments and exchanges, but I cannot find data on physical amounts of Polish exports to the USSR.

The Poles made an agreement to produce the Pentaconta automatic

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[149] Elektrosviaz', 1982:6, p. 53.

exchange under a license from the French. It is a crossbar exchange, first developed in the fifties, described in a Soviet source as a registrovy exchange, which I think means it is not computer controlled. This exchange is also described in Soviet sources as the PC-1000S. I don't know how many Poland was to produce, but this exchange seems not to have been an important element in deliveries to the Soviet Union from Eastern Europe. The first one introduced in the USSR went into operation in 1970 with 10,000 subscriber numbers. That one was being introduced only lately and they were having trouble with it.

One can discern a general pattern in the Soviet-East European relationship. The Russians design the equipment, or it might be more accurate to say they develop the specifications and manufacture small amounts, and then rely on Eastern European industry to produce it. This also happens at the level of components. The Leningrad branch of TsNIIS developed the design of the ferreeds used in most current switches (the so-called gezakony), but the relays are produced by the East Germans.[150] The Bulgarian foreign trade statistics note large numbers of relays exported to the USSR. My interpretation is that the Russians just did not think of telephone equipment as an evolving, high-tech field in which they needed to stay modern. They had low aspirations for their telephone system and farming out the production job to Eastern Europe enabled them to reserve their own development and production potential in telecommunications for military needs.

But to some extent telecoms equipment may be a line of production whose technology the Russians have difficulty mastering. Certainly that has been

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[150] Vestnik sviazi, 1979:5, pp. 19-20.

true as their aspirations have moved upward and as the technical level has risen. An example is the Istok exchange. This model is produced both in USSR and in East Germany. A Soviet review of experience with this exchange provides data on the failures of the two types, which are much higher for the Russian exchanges. One reason offered to explain the difference is that the German plant fully tests the exchange before shipping it and subjects all the dissassembleable equipment to a 100 per cent burn. [151] As another example, Minelektromprom cannot meet the demand for the IKM-15 transmission system and so "Minsviaz SSSR has been obliged to purchase this kind of equipment from Czechoslovakia and Hungary." It is possible, of course, that this reflects Minelektron's priorities more than its technical capabilities.

YUGOSLAVIA

The Yugoslavs have supplied some equipment to the USSR. One of the sources is the Nikola Tesla plant. There is also a joint venture between GTE and Elektronska Industrija of Nis, known as GTE-Pupin. The Pupin factory is in Belgrade. The idea of this venture was to produce computer controlled PABX's and then to move into producing full scale exchanges. Another source is the Iskra plant, which also has tech-transfer agreements with Western firms, specifically with ITT and with AMI/American microsystems. They may supply some telephones to the USSR — there is an ad in Ekonomicheskaia Gazeta, 1986:41 for a telephone instrument produced by this plant. Iskra also produces digital telephone exchanges — 12 in 1985, with plans to

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[151] Elektrosviaz', 1987:11, pp. 29-30.

produce 35 in 1986 — and apparently intends to sell some of these to the USSR. I think that these are PABXs, specifically the ones the Russians call the Metakonta.

The GTE-Pupin organization's switch is a quasi-electronic PABX, known as the Metakonta, or often labeled in Soviet sources as the MS-10.[152] Some of these have been installed on the Soviet network, including one at the Ministry of Civil Aviation,[153] but I do not know how many. The USSR is probably expecting to continue importing Yugoslav telephone equipment as a high priority. On his visit to Yugoslavia in spring 1988, Gorbachev was accompanied by I. S. Silaev, head of the Biuro for machinebuilding that is central to Soviet plans for re-equipping Soviet firms, and one of their stops was the Iskra plant.

WESTERN SUPPLIERS

Western firms have not been important as suppliers of equipment but have played an important role in supplying licenses and technical assistance. The most important Western supplier seems to be Finland.

The Finnish source is the Nokia group. They exhibited equipment in the USSR at the Sviaz-81 exhibition. Apparently both are produced under license from the French firm CIT-Alcatel, but they have one they developed themselves that is quasi-electronic. I have also seen a note that Telefonno, "associated with the Nokia group," has supplied a crossbar

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[152] Elektrosviaz', 1982:6, p. 53.

[153] Ivan Berenyi, "The constraints of a giant: the USSR struggles with modern telecommunications," Telephony, 22 July, 1985, p. 65.

exchange with a capacity of 10,000 subscribers, to be delivered in 1980.[154] They apparently received a subsequent order for a series of exchanges to be delivered in 1981 -- apparently small exchanges of 1,000 lines each -- to be used in Leningrad.

Nokia has also helped with cable production. It provided equipment for several cable factories -- e.g Elektrokabel, Odesskabel, Amurkabel, and Tashkentkabel.[155] Finally, Nokia also seems to be a partner for development of other kinds of equipment. One such is a pulse-code modulator,[156] supposedly with a plant under Minsviaz, and is to involve some co-production, with counter-deliveries to Finland.

Another Finnish company, Standard Electric Puhelinteollissuus, which is a subsidiary of ITT US, was supposed to deliver three 6,000-line electronic exchanges in 1980 to be installed in Leningrad.[157] Another source mentions a contract they won to supply "a series" of exchanges to be delivered in 1981, with capacities of 10,000 lines each.[158] The source is ambiguous as to what the character of these exchanges may be, but they seem to be crossbar switches. Ericsson Finland (a subsidiary of the Swedish firm) is said to have an order for a computerized telephone exchange for Zaporozh'e, to be delivered in December 1983.[159] Another source identifies this as the

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154 Business Eastern Europe, June 27, 1980, p. 208.

155 Business Eastern Europe, July 18, 1980, p. 232.

156 Business Eastern Europe, Dec 5, 1980, p. 392.

157 Business Eastern Europe, June 27, 1980, p. 208.

158 Business Eastern Europe, July 17, 1981, p. 232.

159 Business Eastern Europe, February 27, 1981, p. 72.

Ericsson AXE exchange.

France has been the other major Western source of technical assistance. The Thomson CSF firm made an agreement to deliver a complete set of equipment for a factory to produce electronic telephone exchanges of the MT-20 type.[160] I have not yet been able to identify the Soviet partner plant. A Soviet source speaks of the MT20/25 exchange as being "produced by our industry under license from Thomson-CSF."[161] The annual target for this plant was to produce equipment capable of handling 1 million telephone lines but it has achieved nothing like that target. Certainly the number of M20 exchanges mentioned in Soviet sources as having been installed is very small.

Finally, the USSR recently arranged a deal with the Spanish firm Telefonica to produce telephone instruments, and later, pay telephones.[162]

EQUIPMENT FOR RADIO AND TELEVISION

Much the same kind of story emerges for radio and television equipment. The effort to meet plans in this area has been much hindered by the inability to get from the VPK ministries the equipment needed and to get technology upgraded on a reasonable timetable. Most of this equipment, whether for broadcasting or for reception, comes out of the military industries and orders for it have taken a back seat compared to military orders. I will reserve fuller discussion of that for a later chapter.

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160 Business Eastern Europe, Nov 23, 1984, p. 376.

161 Vestnik sviazi, 1986:8, p. 4.

162 NYT, 27 October, 1987.

CHAPTER 6

SPECIAL APPLICATIONS — CASE STUDIES

One of the best ways to understand Soviet accomplishments and limitations in telecommunications is to look at individual cases. That is especially interesting to the extent we can find cases to compare Soviet and Western performance decisions on some policy or technological issue. Three cases on which I want to report in this chapter are 1) the use of comsats for telephonic links, 2) facsimile transmission of newspaper pages for regional publication of the central press, and because it has a special connection with the other parts of the report, 3) links for data exchange and computer networking.

USE OF COMSATS IN THE TELECOMMUNICATIONS NETWORK

One component of the telecommunications system on which I have earlier worked is the communication satellite system, used primarily for TV distribution. Having published a fairly lengthy piece on the topic[163] I need not recapitulate it here, though it may be appropriate to cite its conclusions evaluating R and D performance in comsat development.[164] The

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163 "Satellite Communications in the USSR," Soviet Economy, Volume 1, No. 4, October-December, 1986, pp. 313-339.

164 Though "operating a space program is a great technical achievement in itself, Soviet exploitation of this technology for commercial ends has been half-hearted if not feckless. Soviet efforts have not produced a technically sophisticated, high productivity, communication system. For the resources invested, the payoff is unimpressive. Telecommunications is an area where technology is advancing rapidly on a broad front and aggressive innovation

concern here is to investigate further how comsats have been employed in the point-to-point, two-way telephonic network.

Considering the huge expanse of the country, and the lack of pre-existing network, the Russians have made surprisingly small use of communication satellites for the telephone network. Soviet planners originally ignored telephony almost completely as a potential task for the satellite system. Soviet authors say explicitly that the design of the Orbita system (choice of antenna diameter, satellite power, etc.) was optimized for TV distribution, not for two-way communication. And, given its major assignment of TV distribution, Orbita stations were located largely in remote areas generating little TT traffic, rather than in regional centers that could become gathering nodes for long distance telephony.

Nevertheless, the Russians have had a program for using comsats as part of the telephone network. This began with the Molniia-2 generation of satellites, the first of which was launched in November, 1971. Molniia-2 used higher frequencies than had Molniia-1 and required the introduction of modified ground stations (the Orbita-2), some of which were equipped to send and receive telephony. Molniia-2's single transponder could be used for telephony only when it was not committed to its main purposes of TV distribution. The frequency notification submitted to the ITU when Molniia-2 was to be introduced showed 12 Orbita stations to be included in the

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is required to keep up with the possibilities. The level of technology achieved, and the pace of Soviet development of this application, seem to confirm our ideas about technological weakness and the flabbiness of innovative drive...this case study shows how the system finds it difficult to change course and to adapt. The Soviet decision-makers... did exhibit vision...Still, the vision is often narrow, and once committed to some effort, the system is slow in adjusting the vision and commitment to changing knowledge and circumstances."

telephony network through Molniia-2.[165] Multi-station access was achieved by frequency division and each frequency pair assigned to a station was to carry 8-12 circuits.[166] The small stations working through Molniia-2 were assigned two frequency bands each to create pathways whose capacity did not exceed 24 circuits. I have seen no evidence that they ever really did any significant telephone communication through Molniia-2. By the end of 1975, Molniia-2 had been replaced by the three-transponder Molniia-3 satellites. I imagine that it was at this point that the network first began to have significant use.

When the geosynchronous six-transponder Raduga satellite entered the system at the end of 1975, it provided enough additional capacity to expand the telephonic network. The notification of Raduga to the ITU indicated that it would work with a second set of 12 ground stations, which overlapped with the previous set at Moscow, Novosibirsk, and Komsomol'sk-na-Amure.[167]

This second system also used a frequency division approach to multi-station access, but at some point the Russians began experimenting with

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[165] The stations were those at Moscow, Arkhangel'sk, Dudinka, Komsomol'sk-na-Amure, Magadan, Murmansk, Novosibirsk, Petropavlovsk-Kamchatskii, Salekhard, Surgut, Syktyvkar, and Zaiarsk.

[166] Telecommunications Journal, Oct. 1978, p. 547.

[167] This network included (in addition to Moscow, Novosibirsk, and Komsomol'sk-na-Amure) Ashkhabad, Chita, Frunze, Iakutsk, Irkutsk, Iuzhno-Sakhalinsk, Kemerovo, Khabarovsk, and Ulan Ude. It is remarkable how little correspondence this and the previously described network show with the 15 tertiary centers of the telephone network, or even with the network of secondary nodes, as reconstructed in the study, Analysis of the Soviet Ministry of Communications' Public Network and Facilities, prepared by Duyck Van Gorder, GTE Communications, 1983. Of the 21 locations in the two networks, only three Orbita locations--Moscow, Ashkhabad and Iuzhno-Sakhalinsk--are located at tertiary switching centers. The main function of these comsat links has been to link some remote primary centers (such as Dudinka, Murmansk, or Novosibirsk) with the closest secondary or tertiary center, or with Moscow.

digital time-division equipment for pathways between stations with larger traffic demands. An installation for multi-station access using time division was first introduced in 1977 and had a capacity of 120 telephone circuits, i.e. two 60-circuit groups combined by time compression.[168]

Although the evidence regarding capacity and use of the telephone links through comsats is very sketchy, it appears that the planners were very slow in equipping existing earth stations for two-way traffic and in getting traffic onto the system. The 1980 edition of the ITU list of stations operating in the space telecommunications service omits 4 of the stations listed above, leaving only 17 in the network as a whole. V.A. Shamshin said in October, 1982, that Moscow maintained TT links with "dozens" of stations through comsat links,[169] but I would interpret that as meaning no more than the essentially two dozen we know about.

The only solid quantitative evidence I have found is a statement that "at the beginning of the 1980s there were 480 duplex circuits on comsats, totalling 2.5 million channel kilometers in terms of the terrestrial equivalent."[170] That is out of a total system of about 136 million channel-km of intercity trunk line in the system at that time. Though capacity was planned to grow significantly in the 11th FYP according to E. Pervyshin, (Minister of Minpromsviaz), and V.A. Shamshin,[171] the only claims I have seen is that a million circuit kilometers of TT links through comsats were added in 1981 and 1982 and that by the end of 1982, the total was "several

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168 Minashin, p. 16, and Vestnik sviazi, 1978:8, p. 7.

169 Izvestiia, 4 October, 1982.

170 Kosmonavtika: Entsiklopediia, Moscow, 1985, article on "Orbita," p. 277.

171 See Radio, 1981:5, p. 11, and Radiotekhnika, 1981:9, pp. 3-4, respectively.

million" circuit kilometers.[172] Those statements may be merely saying the same thing. Most of the growth in the eighties was achieved by adding circuits on existing pathways rather than by adding new pathways. Until 1987 (see below) I saw no indication that any new Orbita stations beyond those originally mentioned in ITU notifications were added to the network.

Delay in getting telephony onto satellites may have been caused by failures in producing digital time-division multiple access equipment for effective use of band width. For the frequency division systems they have used the Gradient-N channel-forming apparatus, which in reference to its international applications (on the Intersputnik) system is said to have had "small capacity, instability of parameters, and strong intermodulation interference."[173] I am beginning to suspect that the 1977 use of such equipment was experimental only and did not turn out to be a success. As indicated in the chapter on R and D, the Soviet comsat R and D people enlisted the cooperation of the Hungarians to develop the "Interchat" digital time-division system, which was first used on one of the telephone transponders of the Intersputnik system in 1984.[174] As mentioned in the R and D chapter, a new domestically manufactured time-division multiple-access system, called the MDVU-40 is intended for use on the Orbita-2 system.[175]

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[172] Vestnik sviazi, 1983:3, and 1983:4, p. 4.

[173]. There are contradictory statements about the multiple-access systems. In one place it is stated that the Gradient system is intended for digital time division transmissions over a 51.2 bit/second 36MHz channel (Elektrosviaz', 1982:8, pp. 37,40), though as indicated in the discussion in the R and D chapter, most statements are definite in identifying it as a single channel per carrier system.

[174] L.Ia. Kantor, et al, in Elektrosviaz', 1986:5.

[175] Elektrosviaz', 1986:11.

The implication of this story is that they have not in fact been using time-division multiple-access communications on Raduga.

Leadership pronouncements about improving the telephone system stress expanded use of comsats. This is to be a major task for the next generation system that will use the Ku band. Most accounts of the Ku band experiments are extremely cautious about hinting at a date when the new systems will be ready for introduction and extremely vague as to their capacity, technical shape, and specific applications.

In the meantime, however, there will be some additional use for telephony of Orbita stations, which are abandoning their TV reception role either because of the dropping of Molniia broadcasts or because they can be replaced with Ekran or Moskva stations. A recent report describes the conversion of Orbita stations to serve the needs of zonal telephone networks.[176] The author claims that one such conversion has been made in the Far East, probably in a group of stations centered on the Iuzhno-Sakhalinsk Orbita station. Since he mentions as the kind of equipment to be used that which was used in the original one-channel-per-carrier system, this is something different from whatever they are planning for the Ku band. There is another reference to this zonal network, indicating a link between Sakhalin and the Kuril islands, [177] (in both of which locations there are Orbita stations). Apparently that link will be used part time for a few

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[176] Vestnik sviazi, 1988:1. There is another mention of a Far East satellite connection in SU/W1455/B/1, 21 August 1987. This reference suggests that the satellite is used to tie the zonal network to other cities. The adaptation of Molniya-Orbita to provide links for zonal systems has been mentioned as planned for some time.

[177] SU/W1451/B/2, 24 July, 1987.

hours a week to send programs around Sakhalin.[178] What is most remarkable in the story is the statements that individual pathways between outlying stations and the zonal center will have a capacity of only 8 telephone circuits. This re-emphasizes the problem that many of the Orbita stations are in locations which can generate virtually no traffic.

If history so far is of any use as a predictor, I think we should be skeptical that Minsviaz will succeed in getting much telephone traffic onto satellites via either introduction of Ku band satellites or conversion of Molniia-Orbita.

FACSIMILE TRANSMISSION OF NEWSPAPER PAGES

One feature of the highly centralized character of the Soviet information system is heavy emphasis on the "central press" as the main source of official, homogenized, information for the whole nation. Given the size of the USSR, timely delivery of the central newspapers presents a difficult problem. It has been a long standing ambition to combine the central production of newspaper material with local printing and distribution. In the early years this was done by delivery of newspaper mats from the center to the localities by air. This approach was unreliable, expensive, and lacked reach. Beginning before the Second World War, the concept emerged of developing a cheaper and more reliable system using facsimile transmissions.

The USSR began the creation of a facsimile system for sending copies of the central press to outlying printing plants in 1961. In the first stages

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[178] SU/W1437/B/1, 17 April, 1987.

they experimented with their own domestic equipment (the Gazeta-1 system) and with equipment imported from England, Japan, and West Germany. The first experiments involved transmissions to Leningrad beginning in 1964 on equipment purchased in England. The first installation using Gazeta-1 began operation in Novosibirsk in January 1965, followed by installations in Irkutsk and Khabarovsk in December 1966. All these installations used a slow transmission rate, though I haven't yet been able to find out what it was. The Japanese and German equipment, purchased in 1965, apparently had higher rates of transmission (it is described as having the capability for "skorostnaia peredacha" or "rapid transmission"), but I have not found information on the actual transmission rate. It was used to send facsimiles to Khar'kov, Kiev, Minsk, Rostov-na-Donu, Sverdlovsk, Krasnodar, Kuibyshev, and Tashkent. The Leningrad operation was converted to the new higher speed equipment in 1968. It is not clear what kind of channels were used for this equipment but I imagine it was lines of the telegraph network.

In 1966-70, development work was begun on a second generation domestic system, the Gazeta-2, which was first produced in 1969.[179] It is not clear whether this was an evolution from the Soviet Gazeta-1 design or was reverse engineered from the imported Japanese and German equipment. But there are no claims about independent development and I would imagine that it was the latter. Gazeta-2 was designed to transmit at higher rates, using a group of 60 telephone channels, for which appropriate channel forming equipment had to be created. The Gazeta-2 was first put into operation in 1970 to Alma-Ata and Saratov, and then to Volgograd and Cheliabinsk in 1971, Kazan', Perm,

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[179] S.O Mel'nik, Tekhnika peredachi gazet po nazemnym i sputnikovym liniiam sviazi, Moscow, 1987, p. 4.

L'vov and Donetsk in 1972, and to Gor'kii in 1973. The distribution system has from the beginning been built on a star design, with several receiving points in each of several "directions." I believe the signal is sent simultaneously in all directions at once. As the system grew, the commitment of 60 channels per direction meant a heavy demand for channels, which was both expensive and periodically disruptive of telephone service.

To reduce the demand on telephone network capacity it was decided to shift to transmission via satellite, for which several systems were developed. The first was in the form of a subcarrier on the TV transmission to Orbita stations via the Raduga satellite, using an analogue signal. The error rate is fairly high but they use the high capacity of the channel code to correct errors. The first use of comsats was in 1978 in the link to Khabarovsk via the Raduga satellite and an Orbita ground station. Krasnoiarsk and Irkutsk were later similarly served.

The second satellite system was the Orbita-RV, a multi-purpose digital channel with time division, which occupies one transponder on Gorizont and is received by Orbita earth stations.[180] Half the time of this channel is devoted to telephony and the other half to sound or facsimile. The transmission rate of the channel is 2,048 kilobits per second, so several facsimile transmissions can be multiplexed into the same channel. It seems doubtful that it actually handles more than one transmission at a time since the Gazeta-2 machines in the Moscow sending office produce signals at a rate constrained by the receiving systems. The first use of the Orbita-RV system was expected in 1982 (I don't know if that target was met or not).

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[180] The most complete source on Orbita-RV is L. Ia. Kantor and E.Ia Chekovskii, "Sputnikovaia sistema Orbita-RB dlia peredachi programm zvukovogo veshchaniia i gazetnykh polos," Elektrosviaz', 1982:5, pp. 5-8.

The Gazeta-2 system is to be followed by a third generation Gazeta-3 with higher scan rates (32 lines per mm compared to the 15 used in Gazeta-2) to offer the better resolution of graphic material demanded by offset presses. Gazeta-3 is supposed to go into operation sometime in the Twelfth FYP. It was originally hoped to handle the higher transmission rates required for Gazeta-3 through a broad-band analogue signal over Moskva.[181] But that did not work and they have instead created a digital satellite channel with a capacity of 512 kilobits/second to be received via Moskva terminals. The Moskva system, also, has a relatively high error rate but again special coding is used to correct errors.[182] The first of the channels using the time-division channel on Moskva was used for Gazeta-2 since Gazeta-3 for which it was created was not yet developed.

Minsviaz has done reasonably well at fulfilling plans for adding receiving points, but the schedule for getting those links onto satellites has been rather badly missed. One of the high priority targets for the 12th FYP is to shift many of the existing links to comsat channels.

The original use of the system was to send Moscow papers to various parts of the Soviet Union but subsequently transmission of two republic newspapers has been undertaken. In Kazakhstan transmission to Tselinograd and to Karaganda began in 1978 and in the Ukraine service to a number of oblast centers was inaugurated in 1982.[183] In both these republics there has been

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[181] This was the recommendation of the Scientific Council of Minsviaz', reported in Elektrosviaz', 1982:4, p. 15.

[182] R.A. Kudriavtsev, et al, "Sistema peredachi gazet na baze apparatury tret'ego pokoleniia," Elektrosviaz', 1982:10, p. 30.

[183] The Kazakh receiving points already get the central newspapers and so I suppose they use the same equipment for the transmission from Alma Ata. The Kazakh system is to be expanded to include Chimkent and Aktiubinsk. As

some further expansion since. These republic systems all apparently use terrestrial lines and the Gazeta-2 equipment. Links for the republic press are also to be introduced in the Uzbek and Belorussian SSRs.

By now this is a very substantial system. By the end of the 10th FYP, i.e. December 31, 1980, 14 central newspapers were being sent to 41 cities. By the end of the 11th FYP (December 31, 1985), 18 papers were being sent to 59 cities. The scope and growth of this network and the list of newspapers sent is indicated in Appendix A. Early in 1986 they were preparing to connect the 60th city (Iuzhno-Sakhalinsk, I believe) to this network.[184] I would like to finish with several tentative generalizations. This is an interesting case study because there are a number of Western analogues with which to compare the Soviet program and my conclusion will include some contrasts and comparisons with two US systems, those developed by USA Today and the Wall Street Journal.

The growth of the Soviet system has been slow and steady. We are talking about a system that has been evolving and expanding over a 25 year period. The US systems came later and were put in place quite rapidly. The WSJ system began in 1975, was put into operation rapidly, and continued to expand along with the WSJ operations. USA Today's system was installed over a period of 18 months, beginning in 1982, though this pace was limited more by the expansion of the printing operation than by the creation of the distribution network. The Soviet system, with distribution of 18 newspapers

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of the end of 1985 the Ukrainian system involved transmissions from Kiev to Donetsk, Khar'kov, Odessa, L'vov, and Dnepropetrovsk. All of these are also on the system from Moscow, so I suppose they use the same local facsimile equipment and, in the case of Donetsk, the same Moskva satellite terminal.

[184] Elektrosviaz', 1986:1, p. 4.

to 60 cities, is impressive in size. The WSJ is distributed to 17 printing plants.

As might be expected over so long a period, there has been quite a bit of change and experimentation both with the facsimile equipment itself and with the transmission channels used. The US systems were able to use off-the-shelf equipment and to contract with outside firms to build the system for them.

One of the most striking differences is in the client-transmission system interface. The US satellite communications systems were created and are owned by the newspapers themselves and are integrated in a more complex way with their operations. The WSJ owns the two transponders it uses on a Westar satellite. Both US networks are used not only for delivery of finished newspaper pages, but also as part of an integrated system for gathering news, writing and makeup, and management communications. The WSJ network has surplus capacity and WSJ has become a provider of communications services to other organizations. The Soviet network is more functionally specialized, serving the single purpose of distributing a fixed format newspaper from Moscow or regional capitals. One article says one-way facsimile is preferred over other transmission means because the task is to get identical material to local areas. (There are references to some local variation (i.e. the local weather, radio and TV news that appears on the back page of local editions) but how that works I don't know). Moreover, the operation of the network is handled completely by Minsviaz rather than by the publishers. The equipment at each end is located on the premises of the printing plants but is operated by Minsviaz through a special "service" of its central telegraph office. This is necessary because the complexity of

the equipment and the network arrangements requires the attention of Minsviaz specialists. But it is interesting to find one writer saying that by nature this is a subscriber system with a fixed timetable of demand for transmission service and is so organized in other countries. I have not yet found any commentary indicating how well the newspapers like the arrangement.

Rates of transmission are about the same as those of the US systems. It takes 2.12 minutes to transmit a page using Gazeta-2.[185] The WSJ system involves sending at a rate of about a page a minute. USA Today uses 150 kbits per second, to get transmission at 3 minutes per page for black and white. But I have an impression that the Soviet system does not make very efficient use of channel capacity. Terrestrially, the WSJ system uses a T1 line, with a capacity of 24 telephone channels, compared to the Soviet use of a whole supergroup of 60 telephone channels.

The Soviet system seems to be somewhat less sophisticated technologically. The US systems use lasers on both ends, while the Soviet system uses older technologies. I gather the Soviet system is somewhat less reliable. High reliability is crucial in these kinds of systems, given the rigid timetable necessary for a daily newspaper. Both USA Today and the WSJ have elaborate backup features to ensure that they can get the paper out, but apparently both exhibit very high reliability. Since the inception of its system in 1975 the WSJ has not lost an edition to a power failure. The Soviet system apparently suffers to some extent from noise on the terrestrial transmission lines, requiring repeat transmissions (a story in

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185 A. I. Prilepina in Vestnik sviazi, 1982:10, p. 28. Prilepina is the chief of the "service" that handles this transmission. Another source says 2.15 minutes per standard 610x420 mm page (Radio, 1975:9, pp. 11-12.)

Trud, 6 Nov, 1984, mentions specifically the link to Mineral'nye Vody as being especially troublesome). Currently it is reported that 1.2 per cent of all pages transmitted must be repeated. That strikes me as not a bad record and not terribly disruptive of printing schedules, but it is certainly on a lower level than the 99.9 per cent reliability of the USA Today system.

I gather that the transmission rate the Russians use is characteristic for facsimile systems in general. There are more efficient systems for coding the information — text, photos, typeface instructions, layout, etc -- that is involved in a newspaper page. One Soviet author says that the Gazeta-3 system with its higher resolution will require a 256 megabit message to send the image of a standard page. Compression could reduce that by a factor of 4 to 6. But if the whole composition and makeup process was computerized with the use of binary coding this could be reduced to about 9 megabits. I don't know how the trade off between transmission costs and other costs works in these matters. But the Russians cannot take advantage of this kind of saving in telecommunication without computerizing the associated processes as well. Technological advance in printing equipment is another area that seems to have suffered under pressure from military demands. This is another case where the Gorbachev regime wants a turnaround and has apparently instructed the VPK ministries to shift attention to civilian needs.[186]

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[186] An article in Pravda, 11 March, 1988, reports on an exhibition and conference concerned with printing equipment, attended by a whole set of defense-industrial officials. Among the themes were statements that the industry producing printing equipment had been burdened by "non-profile production" and that it was necessary to develop computer-controlled composing equipment for newspapers.

Soviet officials seem pleased with the system's performance. In 1985 a group of workers responsible for developing and installing the system was awarded a prize by the Council of Ministers.

On the R and D interface, I get the impression that Minsviaz has depended very much on its own resources in developing the facsimile system. The Gazeta-2 system was developed in TsNIIS and responsibility for some R and D work for the Gazeta-3 system has apparently been assigned to a "problem lab" of the Leningrad Electrotechnical Institute of Communication imeni Bonch-Bruevicha. On the whole, this case reinforces my idea that Minsviaz is poorly situated to get help from the high tech producers in the Soviet economy. The Gazeta-2 equipment is produced by Minpromsviaz.[187] As mentioned earlier (see chapter 4) Minpromsviaz has dragged its feet in going back to the drawing board on Gazeta-3.

This example demonstrates for me a lot of the eternal verities of the Soviet approach in developing and applying a new technology. The planners often have a bold early vision and commitment. They are then pretty slow in realizing it and proceed without a very well thought-out plan to get there. There is a lot of backing and filling in the development phase. But they plug away at it and, when the goal has the kind of saliency for the top leadership this one does, it is eventually met. Other standard features seen in this case are some technological borrowing, some use of proven components and systems, some brute force aspects (60 telephone channels), some compromises on performance, narrowing of mission objectives, and some costly choices.

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[187] The group that received the Council of Ministers prize included workers from Minpromsviaz.

DATA TRANSFER AND COMPUTER NETWORKING

Data transfer and computer networking are served in the Soviet Union by a) branch networks patched together with various combinations of customer and Minsviaz equipment and lines and b) by an embryonic "General State System for Data Transfer," or OGSPD. I want to review the status of the telecommunications infrastructure for data transfer, evaluate it with respect to the needs of the information society, and consider prospects for its development.

A number of separate branch systems for data transfer and computer networking have been put into operation or projected. The best known is the Akademset' computer network, which sits atop a number of local area networks and regional networks. McHenry concludes his description of this system by saying that "the necessary hardware and software for networking applications exist" though "the phone system continues to serve as a brake on large amounts of network traffic" and that high costs and complexity of use will continue to inhibit growth of use.[188]

These computer networks are built on a telecommunications

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188 Wm. McHenry, "Computer Networks in the Soviet Scientific Community," in C. Sinclair, ed., The Status of Soviet Civil Science, (Dordrecht: Martinus Nijhoff, 1987) pp. 151-171. Akademset uses packet switching. It has taken a long time to get this network into operation, as indicated by a story by the chief designer of Akademset' to the effect that only in 1986 had the "experimental zone" of the network in Lithuania been "accepted for operation". (Trud, 21 June 1986). The author says that this is the first time such a "complex information complex has been created in the country." The story makes clear that the developers of Akademset were forced to create their own network of circuits and that in developing the system they depended for equipment on one plant in Minpribor. Minpromsviaz turned down flat their request for equipment.

infrastructure that includes telephone lines (regular switched circuits or lines leased from Minsviaz) and subscriber telegraph (abonentskii telegraf or AT). Some accounts mention use of the PD-200 system (see below), but McHenry believes that system is used primarily for industrial branch systems of management information (i.e. the ASU or automated systems of management) and is not available for large computer networks. In any case, its datarate of 200 baud would make it quite unsuitable for serious computer networking.

In 1972, the idea of the OGSPD was advanced as a utility system that could serve the needs of the ASU systems then being projected, rather than having each ministry or department develop its own.[189] A typical statement is that "the creation and development of automated systems of control (ASU) in different branches of industry and of multi-purpose data banks, demanded the creation of a network for data transfer."[190] One way to provide this infrastructure would be to use the circuits of the regular telephone or switched telegraph network, connected through modems to various kinds of terminal equipment. The AT-50 telex system was already performing this function in some simple applications and some minor use had been made of the telephone system for the purpose. But I think this route was not attractive because of the small capacity (50 baud) and low quality of the circuits in those systems. For a utility system it was decided to develop a separate

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[189] There were some precursor systems for the OGSPD--Onega for clearing money orders in Gosbank (which began operating in 1965), Pogoda for the weather service. These were primitive systems. The Onega system operated on both telephone and telegraph lines, using punched card and perforated tape inputs. (Vestnik sviazi, 1970:5, p. 37). There must also have been precursors in military and space operations--the article on data transfer in the BSE specifically mentions data transfer systems in the space program.

[190] Elektrosviaz', 1982:12, p. 4.

network of lines and switching centers.

The original version of the OGSPD system was the PD-200, development of which began in 1972 and which was operating by the late 70s. PD stands for peredacha dannykh (data transfer) and the 200 indicates a baud rate of 200. It has its own dedicated lines within Minsviaz.[191] In addition to subscriber terminals there were to be utility offices to which customers would bring perforated tape to be sent like a telegram. I believe that they do operate such offices. This feature and the low transmission rate indicate that this system has very little relation to what would be thought of in the West as a system for high speed data transfer. From the beginning it was intended to move ultimately to higher transmission rates, specifically to 2400 baud. In speaking of this step, Shamshin said in 1982 that "we want to create a network with higher transmission rates, and with a choice of switching methods. It now seems that the advantages of circuit switching and synchronous transmission make that the proper choice."[192]

The current status and development plans for the utility Pd-200 network remain mysterious. One can find occasional brave statements on the part of Minsviaz that it is making progress on the OGSPD. In reporting on Minsviaz accomplishments in the Tenth FYP, Shamshin claimed that "the capacity of the

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[191] I have been unable to find out much about the technical characteristics of the PD-200 system and its follow-ons but I think that it may use channels adapted to digital information. In discussing the relative merits of different links for a data bank system one author says "difficulties in using the PD-200 network are connected with the necessity of using more specialized telecommunication and terminal apparatus compared to the analog means of the telephone network, and the higher tariffs." (A.I Mikailov, et al., "Nauchnye problemy sozdaniia raspredelennogo banka dannykh SANTsI", in A.S. Alekseev, ed., Perspektivy razvitiia avtomatizirovannykh system upravleniia, proektirovaniia, i informatsii, Moscow, 1986, p. 71.

[192] Elektrosviaz', 1982:12, p. 4.

switching nodes of the OGSPD and the telegraph system" has increased by 1.7 times.[193] A subsequent statement says that the PD-200 system exists and encompasses "practically all the large centers of the country."[194] It is claimed that a regional PD network was in operation in Latvia in 1982, connecting all the raion centers in the republic, with a connection to Moscow, and to neighboring republics.[195] But a statement in 1986 describes the network in Lithuania, operating at 200 baud, as "newly mastered."[196] Since the Baltic republics tend to be pioneers in telecommunications systems, this Lithuanian case suggests that the network in the country as a whole is still in the teething stage. I have seen no claims of operation anywhere at a baud rate higher than 200 and no statements about traffic or subscribers. The Lithuanian system is to be enhanced during the 12th FYP to handle 2400 baud.

My conclusion is that as of 1988 the OGSPD program has not achieved significant development. One problem may be equipment for connecting computers to it. McHenry says that the only smart terminal for the PD-200 system is a Hungarian one, and that equipment for connecting SM computers to it is not available.[197] Though large capacity data transfer systems must

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[193] Elektrosviaz', 1981:5 p. 2.

[194] Elektrosviaz', 1982:12, p. 4. Another Soviet source from about the same time says that 129 switching nodes and substations had been installed. (Cited in Wm. McHenry, "Computer Networks in the Soviet Scientific Community," in C. Sinclair, ed., The Status of Soviet Civil Science, (Dordrecht: Martinus Nijhoff, 1987) p. 152.

[195] Elektrosviaz', 1982:3, p. 3.

[196] Elektrosviaz', 1986:6, p. 9.

[197] Wm. McHenry, "Computer Networks in the Soviet Scientific Community," in C. Sinclair, ed., The Status of Soviet Civil Science, Martinus Nijhoff, 1987, pp. 152-3. I am not certain who owns the terminal equipment. I

exist in some military applications, there is certainly no indication of such systems in operation today in civilian applications except for Akademset.

One of the most interesting aspects of the situation is the unhelpful attitude of Minsviaz in meeting data transfer needs. Not only has it dragged its feet in creating the PD-200 network, but it also makes it difficult for clients to use Minsviaz connections for data transfer. First, it allows access to the telephone network for data transfer only to enterprises and institutions, not to individuals.[198] For authorized users Minsviaz has set limits on data transfer connections on the switched network -- 18 minutes out of any hour on PD-200, 9 minutes on the switched telephone network, 12 minutes for AT-50.[199] There are also frequent complaints about the high cost of leasing lines from Minsviaz for data transfer use.[200] According to one source "the high cost of leasing dedicated intercity channels is hindering the development of research and experimental work on the creation of information and computer networks."[201] That seems to be a justified

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suspect that it may be Minsviaz. The article on the Lithuanian PD-200 network says that its circuits could handle 2400 baud but that until Minsviaz receives new modems, they are stuck at 200 baud. So this might well be another example of the deadening hand of a telecom monopolist inhibiting technological change.

[198] Literaturnaia Gazeta, 27 January 1988, p. 10.

[199] A.I Mikailov, et al., "Nauchnye problemy sozdaniia raspredelennogo banka dannykh SANTsI", in A.S. Alekseev, ed., Perspektivy razvitiia avtomatizirovannykh system upravleniia, proektirovaniia, i informatsii, Moscow, 1986, p.71.

[200] An article in Pravda by officials of the AN SSSR, translated in CDSP, vol XXXIII, No. 11, p. 23. See also P.V. Diatlov, deputy chief of the main computing center of Gosbank, in Den'gi i kredit, 1980:5, p. 30.

[201] CDSP, vol XXXIII, NO. 11, P. 23.

complaint. Minsviaz figures the charge for a leased telephone line at the rate for individual calls. The tariff for a 600 km call is .15 rubles per minute, for an annual lease cost of 78,850 rubles. Telegraph lines must be leased round the clock, and a 500 km line would cost 21,900 rubles per year.[202] An institution wanting to use telephone line occasionally for data transfer must have an agreement with the phone company and then order the service when needed. Such calls are charged at double the normal rate.[203] I have been unable to find information on charges for a PD-200 connection, though one source indicates it exceeds that for a leased telegraph line. An alternative way to use the PD-200 service is to take one's data on punched tape to an office, where they will guarantee delivery with an accuracy of 1 in 1 million. The charge for that service is 1 ruble per meter of length of tape, plus a 2 ruble flat fee per addressee.[204]

Another slant on the current status of data transfer is provided by examination of particular applications. Cases for which it is possible to develop a reasonably clear picture are the data transfer operations in the Gosbank and the State Statistical Committee. Both have a dispersed organizational structures within which fairly significant amounts of data need to be transferred.

Data Transfer in the Gosbank

The Gosbank serves as the payment and credit agent for the entire Soviet economy and its "system" also includes several specialized banks, i.e. the savings bank (Gostrudsberkass), the foreign trade bank

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202 O.S. Srapionov, Tarify na uslugi sviazi, Moscow, 2965, pp. 7-8.

203 Tarify i uslugi, p. 125

204 Tarify i uslugi, pp. 158-159.

(Vneshtorgbank), and the investment bank (Stroibank). It also has close connections with the Ministry of Finance and the State Insurance Agency (Gosstrakh).

Data processing in the Gosbank has evolved slowly in the direction of more computerization. The process began with punched card machines, with a subsequent delayed and still incomplete shift to computers. Data transfers take place within a three-level hierarchical structure of data processing bodies, i.e. bookkeeping departments at the level of divisions (otdeleniia) dealing directly with clients, middle level bodies now called group computer centers (kustovye vychislitel'nye tsentry) serving the oblast level offices of the bank, and the Main Computer Center (GVTs) attached to Gosbank headquarters. Many of the 4200 divisions now have their accounting work done in IVS or informatsionno-vychislitel'nye stantsii serving several divisions.[205] On January 1, 1986, there were 38 group centers — 10 with computers of the ES series (with three more being organized), 9 with SM-5000 computers, and the rest with punched card equipment. The Main Computer Center uses ES computers.[206]

At present the bank is still far from being computerized in any modern sense. As of 1986, only 43 per cent of the offices had their work done on computers.[207] There is very extensive use of punched cards for data entry even in computerized offices. Many offices still have no telecom link to

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[205] Den'gi i kredit, 1987:9, p. 16 and V.S. Alikhimov, Gosbank SSSR i ego rol' v razvitii ekonomiki strany, Moscow, 1987, p. 216.

[206] Den'gi i kredit, 1986:7, p. 46.

[207] Den'gi i kredit, 1987:9, p. 17.

their superior organ or to other divisions for data transfer.[208]

Data are transferred up and down this hierarchy for creating bank-wide statements and balances and among divisions for clearing purposes.[209] Data transfer mostly uses telegraph links, though transfer between the group centers and the Main Computer Center is apparently handled also by physical transfer of punch cards and magnetic tape and some small use of electronic transfer.[210]

Clearing operations now generally use telegraph links.[211] These telegraph ties include both subscriber telegraph and dedicated telegraph lines. A typical linkage uses a telegraph installation at the sending point, working off a keyboard or punched tape prepared on punchcard machines, sending information to a telegraph instrument at the receiving office. That instrument is connected to a card punch via a device that converts the

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[208] At the beginning of the 11th FYP only half the establishments of the Gosbank were telex subscribers. Den'gi i kredit, 1979:8, p. 38.

[209] If the vertical transfer system were fully operable, it could take over clearing. At the present time clearing is carried out laterally and "controlled" vertically.

[210] This process is described in Den'gi i kredit, 1986:7, p. 46. One source says that of the information reported to the GVTs, 85 percent comes in by subscriber telegraph.

[211] The clearing function is basically a message telling the payer's bank to debit the payer's account, on confirmation of which the payee's account is credited. In the past these communications went by mail. Telegraphic communication was introduced selectively, depending on time required for mail turnover between any two offices, and on amount. Today telegraphic communication is used for all transactions exceeding 10,000 rubles, and where mail transfer requires more than one day. It is also used at the request of the payee for amounts over 1000 rubles, if mail time exceeds one day. Den'gi i kredit, 1986:7.

telegraph message back to decimal code.[212] As an alternative the sending office can take its paper tape to the local telegraph office to be sent. The receiving end can print out, and/or produce punched tape, as an input medium for the punched card equipment at the receiving end. In this process, numerous transformations lead to numerous errors. In a few instances telephone rather than telegraph lines are used, as in an experimental network developed in the Belorussian bank.[213] Where the group center is equipped with a computer, incoming telegraph lines are connected via a device that can send the information from a number of telegraph lines directly to memory.

This system grew up by a process of automating existing routines and experimenting with equipment in different units of the bank, rather than by designing a system from scratch. A great variety of computing equipment is used and, even for a given computer and a given operation, different offices use different programs. The many drawbacks and inefficiencies of these procedures are well understood: repeated entry of data; time-consuming checking to correct errors; and slow rates of transmission. Error rates on the telecom link are said to be in the range of one bit per 10,000 to one bit per 1,000, depending on the quality of the line.[214] One-third of the time spent in telegraphic communication involves straightening out operator

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[212] V.I. Kovalev, and Iu. N. Rakhmanova, Avtomatizirovannaia obrabotka informatsii v Gosbanke, Moscow, 1984, p. 73.

[213] Den'gi i kredit, 1985:10, p. 59.

[214] Den'gi i kredit, 1986:7, p. 46.

errors.[215] Data processing remains a labor intensive task for the bank.[216]

Thus far, telecoms has probably not been an independent constraint on data processing in the Gosbank — the system does not require transfer of high volumes at high rates. The Gosbank's essays into automated data processing have not speeded up the work much, have not required rapid bulk transfer of information, or integrated the work of the offices and the higher level overview very successfully. Given the unambitious goals for the system, there was not a lot of information to transfer and low capacity telegraph links were adequate. Errors introduced in telecom links were small in relation to all the other errors.

Gosbank officials are now trying to move toward a more complete computerization and integration of the bank's data processing work, incorporating direct interaction between personal computers or work stations at the bottom with higher level computer centers. They want a system in which data is entered once, in which many intermediate documents drop out in a movement toward "paperless operation," and in which there is feedback from the data base to the worker at a peripheral terminal. Current thinking also recognizes that another dimension of the task is to connect the Gosbank's data operations with those of the other banks of the system and with the Ministry of Finance. This larger task has not yet been tackled. A pilot project for tying together the Gosbank system with the other systems has

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215 Den'gi i kredit, 1987:7. p. 43.

216 Of the Gosbank's approximately 400 thousand employees, 56 thousand workers in the divisions, plus 14 thousand in the data processing centers attached to various levels of the system are directly engaged in the work of entering and processing data (Den'gi i kredit, 1987:9).

just recently been authorized for the Tartu raion in Estonia.[217] The plans for this system envisage using telephone rather than telegraph links. Also they see advantages in hooking bank operations directly into the client's computer.

Data Transfer in Other Banks

There is a considerable literature on the analogous processes in the other banks. But in looking over the descriptions of those cases, I find nothing novel.[218] The other organizations probably require less data transfer than does the Gosbank and to the extent they do have to transfer data, they follow the same principles.

Current Plans

What are Soviet plans for handling the telecoms component of a more sophisticated system? In particular what demands will they put on Minsviaz and how do they feel about Minsviaz. Most discussions are generally vague about this. Complaints about either the terminal equipment or the quality of lines do not seem to be a major worry. I see no reference in any of this Gosbank literature to the SPD system. Use of telephone lines is only

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[217] Den'gi i kredit, 1986:3.

[218] An article in Voprosy Ekonomiki, 1988:2 describes the operations of the Stroibank. The author's idea is a little more ambitious -- he wants to get a connection not just to the accounting aspect of it but also to the decision-making elements -- i.e. the economist should be able to pull up the information he needs for a decision. And he wants there to be a city-wide data bank covering a lot of institutions (Minfin, Gosbank, Stroibank) that he can call on when he wants to check or do something.

An article in Den'gi i kredit, 1987:7 reports a meeting called to discuss computerization and telecoms in the Gostrudsberkass. I think their problem is different. They don't have so much data transfer. One of their problems is that the different offices use different computers -- ES, Ural 14d, and M-5000.

beginning but future systems will rely much more heavily on them.[219] This discussion does not reveal much about the sources, types, and quality of modem equipment. Most importantly, I see virtually no reference to high capacity links.[220] When the volume of data handled goes beyond the needs of subscriber telegraph, they use dedicated telephone lines, leased from Minsviaz. Since leased lines are expensive, the Deputy director of GVTs suggests that they ought to lease circuits from Minsviaz for use during the night hours, presumably to save on cost.

Data Transfer in the State Statistical Committee

Essentially the same state of affairs exists in the State Committee for Statistics. One of their oldest computing dreams is to have this body operate a system of local computer centers that can offer utility data processing service to enterprises and can be tied together with telecommunication links into a single organ producing the country's statistical data. The net of computer centers is well established but is not tied together with telecommunication links. Ultimately they want all the customer firms linked to the regional computer centers for remote data entry. As in many other computer and telecommunication applications, this idea has been carried farthest in a couple of experimental installations. By the mid eighties a system had been demonstrated in Estonia that covers a lot of clientele and sends data laterally to the Estonian Gosplan and upward to

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219 I think that at some point they also introduced some voice grade telephone lines. And for both, they have operated both through lines of the switched network and through dedicated lines.

220 In some cases they use "physical ties" i.e. computer cabling—in the Belorussian system, for example. (Den'gi i kredit, 1985:10, p. 59). One fellow mentions that ultimately they might use satellite channels, which I would not take seriously, except that he is chief of the department for mechanization and automation of the Pravlenie of the Savings Bank.

TsSU in Moscow. A Belorussian installation seems to have done the same in a thinner way. [221] These use switched and dedicated telephone lines, and the Estonian one claims to have a fiber-optic line. They must somehow have gotten around the time limitation on the switched telephone lines. Perhaps the Estonian and Belorussian Minsviazi are more accommodating than the general rule. These experiments have probably not spread very far.

In 1987 the FYP goal was to have all regional offices connected by teletype to their superior oblast offices, and all oblast offices connected upward via telephonic links.[222] The intermediate target for 1987 was to acquire tie lines from oblast offices to the corresponding city exchanges. The current version of the vision to provide all raion level offices with terminals or PC's and to fully automate in an elaborate integrated system the whole process of entering data, passing it upward, and processing it. The telecom link for this is still conjectural — the design is intended to use the OGSPD and "insofar as possible telex and the Minsviaz switched network."[223]

Implications for the Information Society

What insights do these data transfer examples offer regarding the themes of the information society? How successfully can they keep information compartmentalized? Their vision of integration involves making access more transparent. Improving input by giving people terminals will also give more access to information for anyone who has a terminal. The stock of information is going to be much harder to keep locked up. Remote

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221 Vestnik statistiki, 1984:1 and 1984:5.

222 Vestnik statistiki, 1987:10, p. 5.

223 Vestnik statistiki, 1984:8.

access and paperless production implies supplementing the input of data with some reverse flow of data for checking and re-use. People lower in the organization can get at it. An interesting feature of the discussion of the Tartu experimental inter-institutional project is recognition that when such other organs as the Bank for Construction and the Ministry of Finance can get information on a client directly out of the Gosbank computer, access to some data banks will have to be restricted. Another author notes that there will have to be considerable changes in laws to permit electronically transferred data be legally acceptable.

What is most interesting about current statements in the literature on the State Statistical Committee is that they are talking about enhanced access to the system. All the administrators in the system should have terminals, providing "transparency of terminal access to computing resources. Equipping the raion level with personal computers must be at the head of the organizational work." (p. 6). Moreover the system should provide data banks to serve the clients of Goskomstat, organized on the "register principle," which I suppose means with access differentiated to give clients only the data they are authorized to have.

Appendix A. Cities and newspapers in the facsimile system

Cities

	date begun	terminal equipment	type of link*
1. Aktiubinsk	85		
2. Alma Ata	70	G-2	T
	82	"	O-RV
3. Arkhangel'sk	82(P)	G-2	O
4. Ashkhabad	82(P)	G-2	O
5. Astrakhan	11th FYP(P)	G-2	T
6. Baku	78	G-2	T
7. Barnaul	78	G-2	T
8. Blagoveshchensk	86	G-2	O
9. Cheboksary	11thFYP(P)	G-2	?
10. Cheliabinsk	71	G-2	T
	1/84	"	M
11. Dnepropetrovsk	76	G-2	T
12. Donetsk	72	JAP**	T
	86		M
13. Dushanbe	77	G-2	T
14. Erevan	79	G-2	T
15. Frunze	78	G-2	T
16. Gorky	12/75	G-2	(SAT?)
17. Irkutsk	12/66	G-1**	T
	78		OR
18. Kaliningrad	85	G-2	M
19. Karaganda	77	G-2	T
20. Kazan'	72	G-2	?
22. Kemerovo	82(P)	G-2	O
23. Khabarovsk	12/66	G-1	T
	68		OM
	77		OR
24. Khar'kov	65	JAP	T
25. Kherson	85	G-2	?
26. Khmelnitskii	85	G-2	?
27. Kiev	65	GERM	T
28. Kirov	85	G-2	?
29. Kishinev	78	G-2	T
30. Krasnodar	65	JAP	T
	85		M
31. Krasnoiarsk	77	G-2	T
	79	"	OR
32. Kuibyshev	65	JAP	T
33. Leningrad	6/64	ENG	T
	8/68	JAP	T
34. L'vov	72	GERM	T
35. Mineral'nye vody	78	G-2	T
	1/84		M
36. Minsk	65	GERM	T
37. Novosibirsk	1/65	G-1	T

	77	G-2	T
38. Odessa	76	G-2	T
39. Omsk	77	G-2	T
40. Orenburg	85	G-2	?
41. Perm	72	G-2	?
42. Riga	77	G-2	T
43. Rostov-na-Donu	65	JAP	T
44. Saratov	70	G-2	T
	1/84	"	M
45. Semipalatinsk	85	G-2	?
46. Simferopol'	76	G-2	T
47. Sverdlovsk	65	G-2	T
48. Tashkent	65	G-2	T
49. Tbilisi	77	G-2	T
50. Tiumen'	11thFYP(P)	G-2	?
51. Tselinograd	76	G-2	T
52. Ufa	78	G-2	T
53. Ulianovsk	76	G-2	?
54. Ustinov	85	G-2	?
55. Vilnius	85	G-2	T
56. Vladivostok	?	G-2	O
57. Volgograd	71	G-2	T
	85		M
58. Voronezh	85	G-2	?
59. Voroshilovgrad	78	G-2	T
60. Zaporozh'e	77	G-2	T

*T= terrestrial; O=Orbita; O-RV=Orbita-RV via Gorizont; OR=Orbita via Raduga; OM=Orbita via Molniia; M=Moskva. **All G-1 and imported equipment had been replaced by G-2 by the end of 1983.

Newspapers Sent as of 1987

1. Futbol-Khokkei
2. Gudok
3. Izvestiia
4. Komsomol'skaia Pravda
5. Krasnaia Zvezda
6. Lesnaia Promyshlennost'
7. Literaturnaia Gazeta
8. Meditsinskaia Gazeta
9. Nedel'ia
10. Pravda
11. Sel'skaia Zhizn'
12. Sotsialisticheskaia Industriia
13. Sovetskaia Rossiia
14. Sovetskaia Torgovlia
15. Sovetskii Patriot
16. Sovetskii Sport
17. Trud
18. Uchitel'skaia Gazeta

CHAPTER 7

TELEVISION AND RADIOBROADCASTING

In their expansion of the telecommunications system radio and television broadcasting have been a high priority area for the Soviet leaders. An infatuation with radio as a hallmark of the new socialist society goes back to the very beginning of the regime. One of the classic Soviet icons, frequently found in books on the telecommunications system, is Lenin in front of a microphone, either making a record or a speech on the radio. In developing the television medium, the USSR started late compared to other countries, but then undertook a rapid expansion of facilities and service, and the Soviet Union is today heavily blanketed with television.

RADIOBROADCASTING

The original Soviet approach to radiobroadcasting was "radiofikatsiia", or the radio diffusion network, based on local nets with a large number of receivers wired to a central receiver. In the beginning, these systems offered only one program, broadcast to all receivers on the net at the same time. Subsequently more than one channel might be offered and the head end might be equipped with some simple programming devices, such as a record player or microphone. After the Second World War, there was an expansion of multi-channel systems. At the end of 1971, 200 cities were operating 3-program systems and 30 million of the 50.8 wired receivers could receive 3 programs. By 1975, 450 cities, and by 1976 almost 520 cities, were similarly served. By the early eighties, more than half the receivers were of the

three-program type.[224] One target in the 1985 decree on improving services to the population in the period to the end of the century is to give all systems 3-channel capability.

In the thirties, speakers in wired systems outnumbered regular radio receivers by 10 to 1. This approach demonstrates clearly the Soviet conception of the medium as one of the famous "transmission belts," a way of delivering the message from the top directly to the populace. But reliance on wired speakers was diminishing already before the Second World War and in the early postwar period the ratio of wired to regular speakers fell to a little less than 3. By 1963 regular receivers outnumbered wired receivers. In 1973 the ratio again reversed and today there are slightly over 100 million wired receivers, or 1.25 times the number of regular receivers. This is a large enough number that today, according to Minister Shamshin, 85 per cent of households are served by a wired speaker.

Some of these diffusion nets are operated by Minsviaz, some by other organizations -- probably mostly institutions and housing administrations. But Minsviaz has taken on a growing share of this task. In 1960 it operated only about 29 per cent of the nets. But by 1970, the last year for which I can find data, its nets included about 20 million, compared to 12.4 million in other departments, for a share of 56 per cent. I have not found data for any later year but would guess that the Minsviaz share has continued to grow.

The broadcasting network consists of a number of large stations, which both cover their own area and provide feeds for wired systems and local

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224 Useful sources on the spread of TV availability are the annual summaries on radio and television in BSE Ezhegodnik, Vestnik sviazi, 1983:3, p. 2, and Elektrosviaz', 1978:4, p. 2.

relay stations. These feeds employ several media -- wire and cable, long and short-wave, and in recent years comsats. Radio broadcasts were for a long time only AM, on short and medium wave. As the distribution network has grown, it has become possible to reach the population almost completely through medium- and long-wave broadcasts and to discontinue domestic short-wave broadcasts. The latter are now used only in the Far North, Central Asia and the Far East.[225]

A shift to FM began in the sixties (there were about 60 FM stations by the end of 1959).[226] It was reported in the early eighties that the producers of radio receivers were unwilling to produce FM receivers on the scale needed and that this limited the growth of FM broadcasting.[227] I have not seen any discussion of this issue more recently.

An important recent trend has been the introduction of stereo broadcasting, first offered in 1972 with 28 hours of programming in the Baltic region. By 1975, 50 hours of programming were being broadcast and by 1976, stereo was available in 23 cities. One source makes the interesting observation that stereo began on a local level because of a technical reason: the equipment of the national distribution system could not handle stereo.[228] But stereo is now expanding rapidly. In 1983, stereo was being broadcast in 42 cities and by 1987, in 100 cities; thus, it was available to

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[225] Radio 1986:3, p. 4.

[226] Kaftanov, ed., Radio i televidenie v SSSR, Moscow, 1960, p. 130. Much of the information on the changing forms of radio broadcasting comes from the summaries provided in the annual supplements to the Soviet encyclopedia (BSE, Ezhegodnik, various years).

[227] Vestnik sviazi, 1983:4, p. 2.

[228] Elektrosviaz', 1984:10, p. 6

about 40 per cent of the population in 1987.[229] By 1984 there was a stock of 6.8 million sets capable of receiving stereo[230] though I imagine it has grown considerably since.

Further expansion of stereo is an important goal for Gosteleradio and stereo distribution is one use to which comsats will be put. This was a major purpose for the Orbita-RV system, which began to operate in 1984. It uses half the capacity of one transponder to distribute up to 25 radio programs. Our treatment of this topic ends with the usual refrain — in trying to extend stereo and FM service, Gosteleradio officials feel handicapped by the failure of the producers to produce either the transmitting or the receiving equipment.

Radio programming has three main elements: a) central programs, distributed nationally and adapted to local time; b) republican programming, and c) a set of programs at the oblast, (krai, ASSR) level. Today, there are three all-Union programs distributed in a multi-zone format.[231] It is my impression that oblast-level programming is not extensive. A source from the late fifties speaks of a few hours a day. But some data for 1974 shows programming at this level amounting to 385 hours daily in the RSFSR and 416 hours daily in the other republics.[232] Information on the share that is in languages other than Russian is very scarce, though one suspects that it may

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229 Elektrosviaz', 1987:5, p. 3 and Vestnik sviazi, 1983:4, p. 2.

230 Elektrosviaz', 1984,10, p. 6.

231 A good descriptive source for the early eighties is E.E. Dobrovol'skii, "Po puti nauchno-tekhnicheskogo progressa," Vestnik sviazi, 1983:4, pp. 2-5. Dobrovol'skii is deputy chief of the chief administration for space and radio broadcasting.

232 S. Kaftanov, ed., Radio i televidenie v SSSR, Moscow, 1960, and BSE.

be relatively slim. There is also some "local" broadcasting, which I take to be essentially the use of the wired networks in a program originating mode. Programming for radio, as for television, is the responsibility of Gosteleradio, about which more will be said below.

The jamming of foreign radio transmissions (a sort of negative broadcasting) is an important aspect of Soviet radio and relevant to our concern with information and its impact on Soviet society. But Soviet radio jamming is too big a subject to be dealt with here and we will pass over it, saying only that it is sophisticated, expensive, and intermittent.

TELEVISION BROADCASTING

The Production and Distribution Network

The Soviet television broadcasting system is set up as a hierarchical network of major stations with studio facilities, smaller regional stations also with studio facilities, and an extensive network of large and small retransmitting stations. (For data on growth of the network, see the statistical appendix.) A large portion of these facilities function as a distribution network for centrally or regionally produced material. The system is tied together by terrestrial and comsat links.[233]

Terrestrial links

Within regions, and especially in the European part of the USSR, terrestrial lines are still used heavily to distribute the central programs. The BSE Ezhegodnik summaries give varying figures for the total length of

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[233] According to Minashin in Elektrosviaz', 1987: 12, p. 2, 100 percent of the terrestrial TV distribution network is made up of radio-relay channels.

radio relay line for TV, citing a figure of over 100 thousand km in about 1975 and 90 thousand km in 1980. Information as to the character of this terrestrial net is contradictory. One source says that it uses both radio-relay and coaxial lines[234] but according to a more recent source it consists 100 percent of radio relay links.[235] This may be an indication that they have dropped coaxial lines due to inadequate quality.

Comsats

The comsat system operates through several different satellites and several kinds of receiving stations.[236] One system -- Ekran -- relays TV through a geosynchronous, high-power satellite at 99 degrees E. The use of a high-power transmitter (200 watts) makes it possible to use relatively simple and inexpensive ground stations; however, because Ekran broadcasts at frequencies that are also used for terrestrial applications, it can be used for only a relatively undeveloped part of the USSR. Its service area is a wide swath through the midsection of the USSR that encompasses 40 per cent of Soviet territory. Another system broadcasts through transponders carried both on elliptical-orbit Molniia satellites and the geosynchronous Raduga satellites to Orbita stations (of which there are about one hundred). The Orbita stations were expensive as they demanded mobile, 12-meter antennas to track the Molniia satellites which they all used originally. With the advent

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234 One of the BSE articles says that at the end of 1975 there were over 100 thousand km of terrestrial TV channels, of which 70 thousand were radio relay links.

235 Elektrosviaz', 1987:12, p. 2.

236 A fuller description of the Soviet communication satellite system and its development may be found in Robert W. Campbell, "Satellite Communications in the USSR," Soviet Economy, October-December, 1985, pp. 313-339.

of the Raduga satellites some Orbita stations had their antennas turned permanently to Raduga's geosynchronous location. Of the several transponders carried on the Gorizont geosynchronous satellites, some are used to relay television signals to Moskva ground stations, another type of station which is relatively simple and inexpensive and which uses a 2.5 meter circular dish. These various kinds of ground stations are located in areas difficult to reach with terrestrial lines, and all three are used to provide feeds to local broadcast and rebroadcast facilities. (A few of the Ekran receivers are more likely to be isolated and serve only one or a few TV sets).

Satellite distribution of TV began in 1967 with the broadcast of only 1 program through Molniia to about 20 ground stations. As the number of stations in both the space and ground segments has increased, satellite distribution has come to be the major method of disseminating TV across the vast reaches of the USSR. The system today is used to relay the first and second programs of central television to five zones (each consisting of two time zones) at separate times appropriate for each zone. The five-zone format, broadcasting the same program, has been in effect since 1980. A second national program for 3 zones was added in 1982 and began to be delivered in a four-zone pattern in 1983.

The rationale for the Molniia-Orbita system with its distinctive orbits was that only in this way was it possible to reach certain far northern points. But the Molniia system is very expensive, requiring large numbers of launch vehicles and payloads, and it has now been decided to abandon use of the Molniia system for TV distribution, shifting exclusively to dependence on geosynchronous satellites. TV distribution via Molniia was to be dropped

on July 1, 1988.

The most interesting aspect of Soviet TV experience from the point of view of this paper is that the regime has sought and achieved widespread availability of television. Between 1970 and the present, ownership of TV sets has doubled from 143 sets per thousand persons to 299 per thousand. In the process, the differential favoring urban population (the urban/rural ratio for ownership per thousand was 185/88 in 1970) has been nearly eliminated (317/266 today). As another measure, the Russians claim that at least one program is available to 92 per cent of the population. I think this figure actually refers to the share of the population living in areas where reception is possible and, so, involves some exaggeration. One source suggests that even within the areas considered as being served, 17 million inhabitants cannot get quality reception. Even in major cities large areas are shadowed out.[237] As a second qualification, the variety of programming available to most people, even within the limited menu of the three major central programs, is extremely limited. In the mid-eighties, when one-program coverage reached 92 per cent of the population, coverage for two or more programs was only received by 76 per cent.[238] In 1987 if there were 20 million people who did not receive any program, an additional 46 million who were able to receive only 1 program.[239]

The goal for the end of the 12th FYP is to reach nearly the whole

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237 Elektrosviaz', 1987:5, p. 3. In Latvia, densely populated, simple in terrain, and advanced in telecommunications affairs, 10 per cent of the population do not have reception of adequate quality. (SW/W1451/B/1) 21 July, 1987.

238 Elektrosviaz', 1986:1, p. 3.

239 CDSP, vol XXXVII, No 35, p. 27.

population with at least one program. More precisely, one-program service is to be extended to additional areas with a population of 12 million people, which I figure would add another 4-5 per cent to the 92 per cent now said to be served. Two-program service will be provided to an additional 20 million people.[240]

Color broadcasting began in 1967 and spread rapidly. By 1978 all central television production was in color; in 1982, 81 of the 117 stations having studio facilities worked in color; since the beginning of 1986, all television broadcasting has been in color.[241]

Television receivers

The reception end of the television system is a network of television sets, the stock of which has grown steadily as shown in the statistical appendix. The USSR has reached something close to saturation, at about 300 TV sets per thousand persons. Today virtually every family in the areas where TV is available has a television set. And it is worth emphasizing that despite the gap between urban and rural life in the USSR in many respects, there is not much difference in television availability between the rural and urban populations — 317 per thousand in the urban areas and 266 per person in rural areas.

As broadcasting has shifted to color, the composition of the stock of sets has altered as well, though color reception still lags well behind color transmission. The share of color sets in the receiving network had

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240 Elektrosviaz', 1987:5, p. 3.

241 There is a lot of detail on the spread of color broadcasting in the summaries in the BSE Ezhegodnik; see also EKO, 1987:5, p. 135.

reached about 10 per cent in 1982[242] and even in 1988 is still relatively small — if we judge by cumulations, it may total as much as a quarter by the mid-eighties.

In the mid-eighties there has been a terrible row about the quality of TV sets, which became especially serious when large scale production of color sets began. Much more will be said about this below but its significance is that we should perhaps discount the official Soviet figures on availability of television sets a bit — some of those they claim to have in place may not be operable. Still, despite whatever qualifications might be in order, the bottom line is that the television medium in the Soviet Union is now set up to reach a very large share of the population.

Programming

Programming for both radio and television is the responsibility of the State Committee for Television and Radiobroadcasting — Gosteleradio.[243] My understanding of the relationship between Minsviaz and Gosteleradio is that Minsviaz constructs and operates the broadcast facilities, while Gosteleradio produces the programs. Radio and television broadcasting is financed through charges for television sets and radio sets. Charges used to

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242 Vestnik sviazi, 1983:4, p. 3.

243 A succession of bodies has been charged with this task. In the early postwar period it was the Commission on Radio Information attached to the Council of Ministers of the USSR (Komitet radioinformatsii pri Sovete Ministrov SSR). In 1953, the agency was reorganized as the chief administration of radio information in the Ministry of Culture of the USSR. In 1957 it was renamed the State Committee on Radiobroadcasting and Television attached to the Council of Ministers of the USSR. The final change, in 1970, was to put television before radiobroadcasting in its name in accordance with the growing importance of television and to give it full ministerial status. It is a union-Republic Committee, i.e. there is a hierarchy of similarly named bodies at the republican level and also at the level of oblasts, krais, and ASSRs.

be collected in the form of an annual fee but are now built into the price of the set. There are also charges for having a wired receiver in one's apartment. At one point some of the revenue from the these fees was handed over to Gosteleradio for its support, with the rest going to Minsviaz to cover the costs of operating the facilities. I am not at all sure how the finances work, though I suspect that the system has evolved in a complicated way. One source says that from January 1, 1960, half of subscriber fee income was given to Gosteleradio. Today, Gosteleradio has to finance not only its production costs but also leases transmission facilities from Minsviaz, as we know from an interesting recent development. Gosteleradio has decided to drop delivery of TV via Molniia, which means that many of the institutions in the United States which have set up facilities to receive these broadcasts will no longer be able to do so. As Western parties have expressed their dismay to Gosteleradio officials, they have been told that Gosteleradio must pay Minsviaz 3.5 million rubles per year to lease the Molniia transponders and under the pressures of self-financing they have calculated that the return is not worth the cost. I assume that Gosteleradio pays similar fees for use of other television and radiobroadcasting facilities. The books on the economics of communications show Minsviaz figuring profit, cost, and so on for TV and radiobroadcasting. But these financial arrangements have never been clear and though it is said that the whole system of khozraschet and financing is being revamped in Minsviaz, I have seen no full explanation of what the situation is today.

Television programming provides some interesting variations on the theme of centralization/decentralization in handling information. Soviet TV programming started out with a somewhat decentralized structure because of

technology limitations. Specifically, there was a significant amount of local programming since equipment and technology for centralized distribution was not yet developed or not available. Radio relay and coaxial cable were expensive and comsats were still in the future. When the USSR did acquire the technology for centralized production and distribution, local programming was reduced in favor of central programming. The number of studios was reduced in the early seventies (see statistical appendix). A Soviet source explains that there seemed little reason to maintain the local facilities if the material could be provided from fewer, larger, studios at the center. Moreover they used this technology to maximize the degree of central control. Full programming of the satellite feeds was done in Moscow and distributed in successive broadcasts from Moscow rather than from a one-time feed to be taped in the local zone. To do this they had to proliferate satellites, which must have made it very expensive compared to fewer feeds which could have been taped at the receiving end and rebroadcast at the appropriate time. I wondered if there might be some technical or economic reason for this, along the lines that taping was unreliable or expensive. But that explanation was never convincing to me, and I conclude that this choice illustrated the extreme intolerance on the part of the authorities for any kind of local control or local variation from the fully centralized message. If that is correct, we have here an interesting illustration of shaping technology to achieve the desideratum of controlling information — and the antithesis of progress in information technology acting as an autonomous force to decentralize information.

Video cassette recording

The final system element in the TV distribution system is the VCR and

its appurtenances. Until the late 1980s the USSR simply did not produce any VCRs or videotapes for household use. (Needless to say they did not produce camrecorders, either). In this situation, there was an inflow of players and tapes from abroad. It has been estimated that by the mid-eighties there were a couple of hundred thousand VCRs in the USSR. The demand for tapes was filled by smuggled foreign program tapes or by empty tapes which were then used to capture and distribute other programming — usually foreign programming received in those areas of the USSR where foreign TV broadcasts are available. The Soviet leaders finally realized they had to coopt this technology and began to produce VCRs themselves. They have one model, the Elektronika VM-12, produced by the Elektronika plant in Voronezh. Apparently 1985 was the first year of production of players (with an output of 8.5 thousand). An output of 40,000 was planned for 1987. Soviet sources speak of a possible output of 200 thousand by the end of the 80s (see statistical appendix).

To deal with the problem of material, they finally began to produce tapes. But this has a been a weak effort. Responsibility was assigned to a unit within the State Committee on Cinematography, which has so far produced a limited variety of material and failed to develop outlets where these tapes can be bought or rented. Departmental barriers are not limited to the military-civilian interface -- one of the agencies strongly criticized is Minkhimprom, which does not produce tape of the requisite quality. A new decree in 1986 instructed the relevant ministries to make a more serious effort and authorized the building of new plants to produce this line of equipment.[244]

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[244] Izvestiia, 31 March, 1986.

Cable TV

The Russians talk about cable TV, but have done virtually nothing to develop networks yet. There is one experimental cable system being installed in Moscow.[245]

TELEVISION AND RADIO EQUIPMENT AND TECHNOLOGY

The development of the broadcast media reflects fully the troubles of the Soviet economy in trying to master the ever-expanding technical potentials of telecommunications. It was much more aware of the gains to be made by improving this kind of communications than it was for the telephone and has given TV a much higher priority than the telephone. It has been much less willing to accept dependence on foreign suppliers for equipment and R and D; some of the most strenuous efforts it has made for technical advance have been designed in part to modernize this sphere, e.g. the use of comsats for TV, and later for radio, program distribution. Television was no doubt a communications medium much more compatible than the telephone with the traditional information prejudices of the Soviet-type society.

Equipment Supply for Production and Broadcasting

The equipment for television and radiobroadcasting have largely been domestically supplied, though we should perhaps differentiate here between two elements of the system, i.e. the transmission facilities and the reception network. The USSR has been much more dependent on foreign sources for production and broadcast facilities than for TV sets.

Gosteleradio and Minsviaz have had a hard time getting production and

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245 Izvestiia, 18 March, 1986.

broadcast equipment from the VPK ministries. This is an old story — in the mid-1970s, the transition to color broadcasting was delayed by the unresponsiveness of Minpromsviaz and Minelektronprom.[246] Today there are numerous complaints in the press to the effect that Minpromsviaz, and the R and D organizations in that ministry, will not supply the kind of equipment Gosteleradio needs — cameras, taping equipment, etc. There is a comprehensive and damning indictment in two informative articles in Izvestiia, on 6 and 8 October, 1986. The author ends his article with a remark that for real war the Ministry produces excellent equipment but for this kind of psychological war, it won't provide it at all. The Ministry of Machinebuilding (another of the VPK ministries) was to produce a video tape recorder for Gosteleradio but reneged.[247]

In this situation they have turned to both Western and East European sources. One of the workhorses of the TV broadcasting network is the Zona station produced in Czechoslovakia.[248] The other is the Iakor', the origin of which I have not yet been able to determine. Soviet R and D organizations handled the original development of comsats domestically but have turned to Eastern Europe in developing the follow-on system. In the development work on Ku band satellites the USSR has received extensive help from the East Europeans under the Interkosmos program, the umbrella agreement for cooperative R and D among the socialist countries in space

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246 Pravda, 23 October, 1975.

247 Radio, 1987:5.

248 Elektrosviaz', 1987:12. An account of TV improvements in Latvia says that a new generation of TV and radio transmitters manufactured by Tesla of Prague is the basis for modernizing the Latvian TV broadcast network. (SU/41409/b/1), 26 September 1986).

research. As V.P. Minashin, Director of NIIR, says: "Plans for expanding the possibilities of satellite communications systems are reflected in the Complex Program of Scientific-Technical Progress of the member countries of SEV to the year 2000. The program has two main directions: the creation of national systems of satellite sound and TV broadcasting in the 12 MHz range; and perfecting ground station equipment for satellite broadcasting."[249] Tests of propagation are mentioned frequently, the East European partners have done system design studies, are testing prototypes of ground stations. Poland and Czechoslovakia have created facilities for testing transponder designs. The most active partners here are the Germans, the Czechs, and the Poles. Another example is the Interchat multi-station access equipment for the Intersputnik system, discussed already in the chapter on R and D. Finally, in connection with the Olympics, the Soviet Union has resorted to Western sources. Gosteleradio bought taping equipment for the Olympics from the Ampex firm and apparently continues to depend on Ampex for it.[250] The Olympics also provided the motivation for upgrading satellite hookups with Intelsat.

Television sets

With respect to television sets, the USSR has produced its own. A small number of foreign sets are imported but the USSR has a significant net export. These go mostly to Eastern Europe or to other communist countries, though the USSR has been able to sell TV sets in three market economies —

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249 Elektrosviaz', 1987:12.

250 Soviet Foreign Trade, 1986:11

Italy, West Germany, and Great Britain.[251]

Responsibility for producing television sets has been assigned entirely to the VPK ministries. The most important producer is Mimpromsredsviaz, with 72 per cent of the output; Minradioprom produces 18 per cent; Minelektronprom 4 per cent; the remaining 6 per cent is produced in "other solidnye departments."[252] The other major source is Minobshchemash,[253] the VPK ministry whose primary function is producing rockets. In total, there are about 30 TV factories. Some are large, well-known ones, such as the L'vov "Elektron" factory, the Minsk "Gorizont" factory, "Foton," "Elektrosignal" in Voronezh, and the NPO "Pozitron." Some, however, are "dwarfs" producing only a few tens of thousands of sets per year. Most of the components for all these producers come from another of the VPK ministries, Minelektronprom.

The industry has gone through a series of technological advances, from black and white to color sets, and from a first generation that used tubes and transistors to a second generation using only solid state devices. The third generation models now being produced use integrated solid state devices.[254] This advance has been a rather tortured and halting process in

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[251] In 1986, exports were 1,045 thousand sets, of which 805.2 thousand went to communist countries. Belgium has been added to the list of countries to which the Soviets export television sets—an order for 3,200 in 1988 is reported in Ekonomicheskaia Gazeta, 1988:18, p. 5. I have not been able to identify the source of any of the imports.

[252] "Po obe storony televizionnogo ekrana," EKO, 1987:5, p. 115.

[253] See the summary of the Politburo session of 24 July, 1986, discussing measures for improving the quality of television sets. (Ekonomicheskaia gazeta, 1986:31)

[254] I think that the shift to this third generation model was pretty slow. They say so explicitly and it is interesting that for the first few years of the shift the statistical handbook carried a series on the share of

which the Soviet Union has gradually fallen behind the rest of the world industry. Television sets have been a classic illustration of the failure to produce consumer durables that either meet consumer wishes or keep up with what is happening in the market economies. Some of this is just the standard quality problem endemic to the Soviet economy; however, it has been strongly complicated by the fact that responsibility for this purely civilian product has been assigned to the defense industry ministries, where it has to compete directly with the higher priority demands of military production.

The failure to achieve quality and technical progress has become a highly controversial issue in Soviet society and a large and revealing literature has emerged on the causes underlying it. This is not the place to go into it in detail but a few salient aspects are worth noting.[255]

The stories of sets that explode and cause fires are known to all readers of the Soviet press. Actual reliability and service life are subject to dispute but they are clearly atrocious. The producers cite figures for service life and mean time to failure based on test stand experiments, apparently which bear no relation to actual experience reported by the repair shops. According to TsSU data, in 1985, one-third of all sets sold had to be repaired within one year of purchase. Other statements vary and involve different concepts but all agree that TV sets go out of commission soon and frequently. Four per cent of all those sold are returned to the factory as scrap. It is reported that this rate is higher for Minradioprom

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TV's that were based on integrated schemes. These numbers did not grow very fast, rising during the 11th FYP to only a quarter of all sets produced and the series was dropped from the handbooks.

[255] Much of the discussion that follows is based on two main sources -- a long and informative discussion in EKO, 1987:5, pp. 114-151 and B. Talanov, "Televizor prokhodit gospriemku," Radio, 1987:8, pp. 8-9.

and for Minelektronprom than for Minpromsviaz. Minpromsviaz has a much bigger emphasis on civilian goods than do the others and is the lead ministry for TV sets. This difference in return rates may reflect a greater neglect of consumer needs in relation to the ministry's fulfillment of military electronics needs.

There is also a terrible problem with getting television sets repaired. The current approach to solving the problem is to establish manufacturer's outlets for sales and repair. It is too early to assess how likely this is to solve the problem but it is an interesting development that will put the VPK ministries fact to face with civilian pressures in a way they have not previously experienced.

Modernization of the product line to meet customer desires and to raise quality has been slow. The transition to color sets (series production of which began in 1976) and the complete shift to solid state components has been disappointingly slow. These transitions were intended to end production of vacuum-tube sets completely and to shift to the second generation (solid state components) and third generation (integrated solid state) by 1985. In fact, in 1985 large numbers of tube-based sets were still being produced. The goal has been restated for 1987; however, even as it was stated, there was little hope it could be achieved. Despite the low reliability and higher costs of color sets, compared to black and white, buyers demand a faster shift than the producers have achieved and a large stock of unsold black and white sets have piled up in the stores (some 5.9 million sets at the end of 1986, according to one account, constituting more than a year's output. There is also a large, but comparatively much smaller, stock of unsold color sets).

There are many stories to explain what is wrong. One of the long-running arguments concerns who to blame for poor quality products. The producers put the blame on component suppliers in Minelektronprom and on the shippers. Minelektronprom's response is that much of the quality problem is due to defective design and bad production engineering. According to Minelektronprom, bad design is demonstrated by the fact that some components never give trouble in some designs but fail repeatedly in others because they are not appropriate to the application. An important cause of failures is defective solder connections in the manufacturing process. There are 2600 solder joints in a third generation set (supposedly an integrated component design !). One source says that 13 percent are missed and are taken care of subsequently by hand soldering. One author explains that the problem is that components do not meet any uniform standards. The production process is one in which components are assembled on a circuit board and soldered automatically but the connections are imperfect because heat absorption by the components and the condition of their leads are not uniform. One plant director's solution has been to set up a special shop which re-tins the leads on 100 per cent of all components.

The low quality of components and the total unwillingness of Minelektronprom to cater to the needs of the TV manufacturers is obviously much of the problem. Minelektronprom holds that it is meeting its obligations if its shipments contain no more than 10 per cent defective parts and it somehow has the clout to get away with this policy. One of the most serious quality breaches seems to be picture tubes — one plant says that last year it sent back 60 carloads of such tubes. Another says that the share of brak in shipments received is 10 per cent. This is interesting

because it would seem to have nothing to do with the common assertion that Minelektronprom systematically selects good output to be used in defense equipment and ships the uncontrolled output to the producers of civilian products. Picture tubes would seem to be produced exclusively for TV factories. Minelektronprom takes a high-handed attitude in other respects as well. For example, it refuses to produce the new integrated components and improved picture tubes called for in the new designs. So the fourth generation designs have to be produced with the old-style picture tubes rather than the new ones around which they were designed. Nor will Minelektronprom cooperate in developing standards together with the users of its components to ease the job of designing reliability into final products, as in the instance mentioned above of standards for component leads.

The regime has taken an increasingly strong line on this in the eighties, with decrees, reprimands of officials, and so on. Early in the Gorbachev regime, an unusual departure from the gentle treatment of the VPK ministries occurred — an official reprimand was issued in the name of the Central Committee to the Minister of the Radio Industry for inadequate attention to the quality of consumer goods and warnings sent to the Ministers of Minpromsviaz, Minelektronprom, and Minobshchemash that they would be held personally responsible for improving the quality of television sets.[256] These appear to have been ineffective so far. The problem is that television production has been accorded low priority in the work of these ministries, which have been indoctrinated over many years to prioritize their military work.

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[256] Pravda, 6 March 1986.

Radio Receivers

Radio sets are a simpler product, which the Russians have been producing in quantity for a long time. Radios, like TV sets, are produced in the VPK ministries. The Russians produce their own and have a significant net export of something over a million sets, mostly to Eastern Europe. But they have been increasingly exporting to non-socialist markets as well. The story of quality and technological upgrading to provide higher quality and more features in the radio case is somewhat like the TV story, though probably not quite so bad. The main problem is that Soviet industry has been slow to provide the innovations and the quality that consumers want. Models with the new features common in the world market have been slow to appear and Minelektronprom has been a stumbling block as the plants try to improve output.[257]

Audio Tape Recorders

The USSR has a large output of tape recorders (magnitofony, a term which I suspect must also cover tape players) but supplements domestic output with imports of both tape recorders and players (if I understand magnitola correctly to mean tape player). An interesting feature of Soviet production is that they were slow to shift over to cassette players. They seem to have produced virtually none in the 1970s and in 1980 cassette type players were only a little over a third of all tape players. But they have risen fast and, by 1986, most tape players were of the cassette type. So far, I have been unable to find much information on the production of audio

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[257] A. Grif has a long story on the efforts of the workers at the Berdskii radio receiver plant, often cited as a model plant, to introduce new models. They are constantly blocked by bureaucratic footdragging from their supervisors in Minelektronprom. A.Grif, "Zvesda nad Berdskom," Radio, 1987:11, pp. 6-9, 64.

tapes.

COMPATIBILITY OF TECHNOLOGICAL PROGRESS AND SOVIET SOCIETY

What does Soviet handling of the broadcast medium tell us about the compatibility of new technological potentials with the system? What does it reveal about the ability of the system to develop the new technology and the willingness of the system bosses to accept the opportunities for expanded information flow which it offers?

It is difficult to disentangle the motive of improving the system for top down information transfer from the motive of making this medium of communication serve consumer needs better. Radio and television are media perfectly suited to use as transmission belts. They lend themselves very well to the top-down dissemination kinds of activity. If the state can monopolize these media it can control access to information and use it to enforce its notion of what is fit to be known and to propagate its values. On the other hand, our cursory review of the recent history of these activities in the USSR demonstrates a strong interest on the part of the leadership in catering to consumer desires for higher quality, more variety, more features, and greater convenience, in the equipment and services associated with radio and TV. One of the fascinating issues is how the technology of the medium interacts with other factors to influence the outcome of these two tendencies. It is of course an issue in any society, and has spawned a huge general literature; however, the treatment here will be rather narrow.

One of the most striking aspects of TV and radio in the USSR,

distinguishing it from telephony, is the high priority the leaders assigned it. They spent a lot of resources on it and have reached near saturation rather rapidly, in sharp contrast to the situation with telephones. The policy-makers did not let the USSR be dependent on outside equipment. The comsat program for TV distribution was probably the most ambitious and best technological effort they have made in any telecommunications technology. As compared to television, I think they have been a little careless (a point to be developed more fully below). The general subject of information, telecommunications and social change more generally will be taken up in the next chapter, but it will be useful to look here at a few specific points closely tied to the technology of the television and radio media.

The Capacity-Variety Dilemma

Generally, the Russians have exploited these media with a heavy emphasis on central control, though there have been some interesting twists where technological change has interfered with centralism. One example is the fact mentioned earlier that at first there was appreciable local programming both in TV and in radio. As the technology improved Moscow was able to re-centralize program control. Paradoxically the next improvement in technology and capacity may lead them back in the opposite direction to less centralism. They are now talking about using expanded satellite capabilities to provide more local input. The current effort is to develop a new generation of communication satellites in the Ku band — the STV-12 system -- which will provide many more channels. When fully developed, it will permit the distribution of two additional national programs to the five-zone

distribution program and distribution of a republican program.[258]

The dilemma is how to fill up the larger number of channels. As one author says with reference to US experience, programming is expensive and he sees the proliferation of centralized US network offerings as a terrible waste. Ideas for content may be easier to find at the local level; here is a case where growth of capacity may willy-nilly lead to expanding the room for local variation. In any case, it will certainly expand the range of user choice at the reception end.

Local programming must be a desire that has been undersatisfied. In response to the cultural grievances of the Armenians, the Central Committee promised the Nagorno-Karabakh area access to the All-Union program; it also guaranteed access "in full volume to Azerbaidzhani and Armenian TV."[259] There are probably two things going on here. This is a mountainous region, with poor reception for any kind of TV. But we must conclude that access to Armenian TV was a specific demand. It is bad enough that there is probably only a limited amount of Armenian language programming and to be cut off from what there is is especially aggravating. I wonder if this case is not symptomatic. Probably lots of nationalities do not get enough local and local language programming; this precedent might set off a change. The concession to the Armenians shows some willingness on the part of the leaders to give in to that kind of demand.

Another illustration of the peculiar dynamics of the capacity-variety

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[258] I have not seen any discussion of how this republican program will work. It doesn't really make sense for the RSFSR where "local" usually means something below the republican level. There must also be some sensitivities about giving control over programming to each ethnic republic.

[259] See the March 21, 1988, Politburo decision on Nagorno-Karabakh (Ekonomicheskaia Gazeta, 1988:13).

dilemma is that, in radio, technical progress is facilitating moving to more centralization. The use of comsat systems has created the possibility of moving to a national level network controlled from the center. The creation of Orbita RV (which has not been exploited very rapidly) makes possible much more centrally produced, satellite-distributed radio programming. Its 25-channel capacity is going to create the same pressure for variety, perhaps as suggested above for TV, by accepting more local content.

Short-wave/Long-wave Tradeoff

One of the interesting policy issues is the relative number of long- and medium-wave receivers versus those capable of receiving short-wave broadcasts. At first, the regime had to accept the idea of producing a lot of short-wave sets to get their own broadcasts to the population, though this allowed reception of foreign sources. That made them vulnerable, we had jamming. When the number of local stations had been expanded sufficiently, it became possible to reach most people by medium-wave and Soviet industry began to produce fewer short-wave sets. I haven't found enough data on this to come to any conclusions, however. It may be that absolute numbers of short-wave receivers has continued to grow even as the shares were changing.

The VCR-audio cassette problem

One of the most intriguing aspects of this is the VCR and audio cassette problem. The cassette and the VCR are perhaps the best examples we have of how the goods and evils of telecommunications come in inseparable bundles and thus complicate the task of controlling the impact of technological change on the use of information in society. From one point of view, the VCR is merely an extension of the broadcast medium, giving the receiver more control over how he will receive the centrally controlled

message. And indeed by serving the watcher's (or listener's) convenience, the center increases its chance of getting its message to the recipient. But, at the same time, the VCR is a means for totally decentralized dissemination of information laterally among groups in society and for serving non-official tastes and messages. It presents the same dilemma as the printer adjunct to the PC. (I am fascinated by a magazine I receive that has as one of its aims the promotion of "cassette networking").

Magnetic audio tape is probably the case that best supports the proposition advanced by Fred Starr that the Soviet populace has been continuing an old Russian tradition of employing every advance in communications technology simply to go around the regime. "Magnitizdat" does indeed seem to exist on a large scale. There is a shortage of blank tapes, I hear. There must be a big trade in illegal recordings on tape. And tape is an especially treacherous medium -- even if the state produces and disseminate tapes containing its own approved messages and information, people can always erase that message and put on their own (one Soviet story I saw mentioned this specifically). An earlier version of this effort at local recording was to use old X-ray film as a base for phonograph recordings. The job is much easier when you have magnetic tape, and still easier when it is in the form of cassettes. Cassette tape is allegedly the medium through which Khomeini got his message to the peasants and made a revolution. The regime has aided the process by shifting from production of reel-type equipment to cassette equipment.

The VCR presents exactly the same kind of problem but, because of the greater power of TV as a medium, its threat to maintaining the principles of centralism and monopoly in use of the TV medium is even more dangerous.

Certainly the early use of the VCR in the USSR was an illustration of the Starr model.

The wired city

One of the most interesting issues in distributive modes involves the combination of broadcast to individual receivers versus various kinds of wired city concepts. The attractiveness of the wired city mode is partly a matter of cost minimization in network design, partly a question of economies from agglomeration, and partly an issue of catering to viewer taste by providing variety and choice.

The USSR started off with wired radio in the classic "Big Brother" mode and, despite the vacillation described earlier, has in effect achieved the wired city for this medium. Shamshin claims that 85 per cent of all urban households (dwelling units?) have access to a wired system. On the other hand, virtually no progress has been made in creating cities wired for broad band-width uses. The desirability of doing so is asserted, though I am not sure yet what they see as the relevant considerations. There is less possibility of outside access in TV than there is in radio and, hence, not the same rationale for tying the receiver to a controlled source. But the telecoms planners do seem to want this control; I think they are put off primarily by cost and technology obstacles.

Ironically, having achieved the wired city through a continuing effort and at considerable cost, no doubt, Minsviaz now finds this investment obsolete. The quality of these installations is not high, they are expensive to maintain, and it is difficult to recruit and pay people to operate

them.[260] A serious defect in the current context is that they are unsuitable for high quality sound reproduction and, specifically, are unsuitable for transmitting stereo broadcasts. Another irony here is that just as they are shifting their national distribution net to stereo, the facilities they have at the local level to disseminate it are unsuitable for the purpose. This wired network is of even less use for other broad band-width applications such as TV. Just at the time when they finally get the objective of wiring the cities accomplished, an advance in technological potential (in the form of high fidelity broadcasting), a rise in consumer expectations, and cost factors make the network obsolete!

A somewhat agonized and desperate argument is now occurring over how to deal with this situation. Shamshin suggests that they ought to abandon the existing system and move toward alternative approaches to the wired city. In particular, he suggests that to add new radiobroadcasting services, they ought to develop equipment to exploit existing telephonic links to households. And that seems not to be just a casual thought. First Deputy Minister Kudriavtsev, whose portfolio seems to include radio and TV, says that it is intended in the 12th FYP to begin multi-program radio broadcasts over the telephone network.[261] That seems to me a strange idea, especially since the telephone network does not reach into that many households yet — 25 per cent of urban households versus the more than 85 per cent that have wired radio and the essentially 100 per cent with TV.

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[260] Shamshin makes this point in one of his articles and the deputy chief of the chief administration responsible for these operations also stresses that this is a very labor-intensive operation. (Vestnik sviazi, 1983:4, p. 3).

[261] Radio, 1986:3, p. 4.

Even in areas where an activity is allowed but ringed round with control, there are breaches. People can build their own short-wave sets and ham radio is an officially encouraged activity in certain contexts. Control and supervision are based on the fact that most amateur radio is done through DOSAAF and it is probably pretty hard to get materials for this hobby outside official channels. But Fred Starr notes that the population has made an end run around the regime with amateur radio and mentions as a case in point the fact that the first news of Chernobyl was via ham radio.

CONCLUSION

The conclusion I draw is that in the radio and TV component of the telecommunications system the character of the medium reinforces transmission of centrally generated information and values and the leaders have accordingly been willing to give it a high priority. That is why this is a much more fully developed and technologically more advanced part of the telcoms system than is telephony. Even so, they have had a hard time getting anywhere the world level of technology.

What is most interesting is that they have not been able to fully control the scale and form of this technology and have had to accept some use of this part of the system for private goals. The expansion of information potential and the capacity of the system in these areas has indeed been to some extent taken advantage of by the population.

CHAPTER 8

TELECOMMUNICATIONS AND SOCIETY

The interaction of telecommunications and society is only one aspect of the larger issue the Hudson project, "The Implications of the Information Revolution for Soviet Society," is trying to deal with. The larger concern covers all dimensions of the generation, storage, processing and exchange of information, and the way in which a revolution of technical opportunity in that sphere may interact with whatever we mean by "society" to create the "information society." To think productively about "telecommunications and social change" we must first develop some general ideas about what "information" means, the forms "communication" takes, and how both concepts relate to the functioning of society.

TWO MODELS OF SOCIETY

A useful way to start is to review two alternative conceptions of society. The literature of Soviet and East European studies contains many contrasting labels and models for Soviet-type and Western societies, such as totalitarian vs free, and monolithic vs pluralist. There are similar pairs for narrower components of the society: in economics, the administered economy vs the market economy; in law, the rule of men vs the rule of law. One generalizing concept of Soviet society that I find useful is Richard Pipes' notion of the "patrimonial state." The idea is that the rulers conceive of the society as their patrimony and view government as the

mechanism for administering this patrimony. In this conception the national goal is defined as identical with the goals of the autocrat, the people exist for the state rather than the other way round. Other corollaries are the absence of parliamentary institutions, the rule of men rather than the rule of law and the notion of the "service state" in which status and emoluments are based on service to the ruler rather than on independent property rights. Pipes originally offered this as an interpretation of the Tsarist state but neither he nor I have much problem in seeing the current Soviet society in much the same terms.

The antithesis of the patrimonial state is the "civic society". In this model individual rights and purposes are the foundation of society and the state is the servant of the people. The national purpose is an aggregation of the private goals of the members of society. Since individual goals often conflict, the rationale of the state and the various social mechanisms it supports, such as the market, the law, government, and so on, is to reconcile competing goals and to resolve conflicts among members of society. Some private goals may be most effectively pursued collectively, justifying a public sector. Since collective purposes such as national defense often involve externalities and an associated free rider problem, the social contract accordingly concedes to the government coercive powers to carry them out effectively. But these activities of the public sector must in principle rest on the consent of the governed. We may, of course, be hard put to find social decision processes that can aggregate private goals effectively, that satisfy a shared sense of justice, or that can generate consensus regarding the rights of the minority vs the majority or the weak vs the strong. The functioning of such a system implies the socialization of

its members in these values and the inculcation of a sense of civic responsibility balancing the principle of civic rights, in contrast to the adversarial "we-they" mentality of Russian-Soviet culture.

When it is said that Russia has never had a "civic society," it is the contrast between these two models that we have in mind. What is most exciting about Soviet reform thought today is that Soviet writers seem to be groping toward some understanding and appreciation of the civic society model. Tatiana Zaslavskaia and her colleagues talk about private and group "interests" and the need to accommodate them and to work through them. Leonid Abalkin, Director of the Institute of Economics of the Academy of Sciences and one of the most interesting economic reform thinkers, suggests a "new concept of centralism" which takes the enterprises of an economy as its "primary" units, which cede some rights to higher level organs to facilitate the more effective pursuit of the primary units' goals. And he explicitly extends this idea to the state as well. "Enterprises delegate a portion of their rights and sovereignty to the higher organs of administration for the more effective achievement of their own goals. And in the same degree the state and its organs play a service role in relation to socialist society."[262] (emphasis added.)

INFORMATION AND SOCIETY

These alternative models differ from each other also in the way they produce and use information and in the forms and channels of information

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[262] Leonid Abalkin, "Novaia kontseptsiia tsentralizma," Ekonomicheskaia Gazeta, 1987:50, p. 2.

transfer. To understand this we need to clarify what information and communication mean as aspects of social process. What is "social information" and what role does information play in the functioning of society?[263] It seems to me that the basis of society is a kind of "primary information" that has to do with the values, goals, and motivations of its members. For their own sphere, the Western economists have this thoroughly worked out in their concept of preference orderings for utilities and disutilities, with carefully defined properties such as transitivity, convexity, consistency, and so on. Taking that precedent as our paradigm, we can imagine something analogous for other domains of social life. Values and preferences also encompass such political and social variables as attitudes regarding matters such as tradition vs change, equity, altruism, and so on. A second kind of basic information refers to the environment — the state of the world external to society. Examples are production capacities, technological tradeoffs, and so on. Much of this information is held privately.

We should think of information as having a hierarchical structure, in which primary information can be processed into ever higher and more complex forms. These derived forms arise through exchange and processing of information. Given people's preferences, there are demand curves for output and supply curves for inputs. There are technologies for turning inputs into outputs. Together these basic facts may imply possibilities for profit, advantageous trades, and so on. Ultimately, the information most relevant

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263 The ideas developed here about information and society are not out of line with what can be found in Soviet discussions. A particularly interesting Soviet statement is an article by Academician A. Ershov, "Informatizatsiia: Ot Komp'iutornoi Gramotnosti Uchashchikhsia k Informatsionnoi kul'ture obshchestva," Kommunist, 1988:2, pp. 82-92.

to social decision-making is that lodged at relatively higher levels of the hierarchy of generalization and aggregation and consists of views or forecasts as to possible alternative future states of the world in the various social domains. If abortion is legalized, the response we can expect is so and so. If a certain political package is offered, it will be acceptable to a majority or to a winning coalition. This is what society is about -- social institutions can be thought of as organized ways to absorb and process information into decisions that represent one particular outcome from among all the possible states.

"Information" in this view is not a fixed-sum magnitude. Some of the primary information may be more or less fixed in amount, but if we conceive information to include more highly processed forms as well, the information base on which social choices are made depends on how much communication and processing capacity is available and licit. Information and communication have a relationship to "power" in society, but power understood in a broader sense than political power alone, i.e. power defined as something like "potential." One concept of power is that which sees politics as a zero-sum game in which power can only be diluted or lost by sharing it -- the classic formulation is the Leninist "kto-kogo" concept. An alternative view of politics is that it is a process generating and allocating power or potential, and that the magnitude of this power is not fixed in amount. Politics is a mixed conflict-cooperative game in which a society's potential can vary, depending on how well the "game" of social integration is played.

The processes that give the game its nonzero-sum character, and that enable power to expand, are communication and information processing. The potential of the society expands through extending participation and

eliciting effort through payoffs for commitment and contribution. This involves communicating information that people can process into visions to which they can respond. This is the mechanism by which civic society works and in groping for a new method of social management to replace the "administrative pressure" (administrativno-nazhimnyi) approach of the patrimonial state, Soviet reformers are looking for a kind of civic society model. Democratization does not mean fully giving up central power over goals, but of enhancing fulfillment of those goals by socializing people in them and by increasing potential so that both private and collective goals can be served more fully.

THE TRIPARTITE INFORMATION STRUCTURE

It might be helpful to distinguish three circuits in which information is communicated and processed in any society. One kind of communication is that in which information flows from the center, or some high level unit in a polycentric structure, to lower level units in "broadcast" form. The "transmission belt" institutions of Soviet society — the central press, distribution of central TV programming to all citizens, the traditional Soviet system of wired loudspeakers for radio distribution — are classic illustrations. This information is intended more to inculcate values than to provide detailed information about the state of the world. It tends to be rather unspecific and abstract. To the extent it deals with information about the state of the world it is not directly operational, that is, it is not intended to generate specific acts.

This is an aspect of information and communication to which the Soviet

leaders have always given very high priority. In the past, the press was a major channel for this kind of information. But technical change has shifted the emphasis to telecommunications, first in the form of radio and, today, even more powerfully in the form of television. In the Soviet model, the media for communicating this kind of information are monopolized by the state and used to influence images and values.

There are analogous forms of communication in the civic society, of course. Until recently, governments of many West European countries reserved TV as a medium for their own use, for purposes not dissimilar to those that motivate the Soviet leadership. In the US, the TV medium is used in rather the same way but is controlled by commercial interests rather than by a political leadership. Characteristically, it works in an idiom of images, values and moods more than in an idiom of hard information.

A second circuit of communication has to do with much more operational social choices and decision variables. These are the communications that determine outcomes in the use of society's resources, in the distribution of authority, and in the exercise of coercive state power. The input is detailed information about the state of the world and possible future states. In the economic sphere the issues involve the various dimensions of the allocation problem; in the political sphere, what programs alternative contenders for leadership have in mind; in the social sphere, choices to be made in the light of what the consequences of alternative behavior will be. In both kinds of society these are two-way communication processes involving exchange of information and negotiation. In the Soviet-type society communication in this circuit utilizes vertical flows up and down a hierarchy rather than lateral exchanges and is characterized by what the

Russians call "addressedness" (adresnost'). Directives and incentive information are addressed to specific persons and institutions, take very concrete form, and their substance is differentiated by recipient. The language is one of specific orders and payoff information to specific actors, rather than announcement of general rules and criteria. An enterprise is told what its assignment is, what the criterion for its success will be, and so on, without knowing much about what other actors are being told. The principle governing access to information is "need to know." The principles of "need to know" and adresnost' apply to the upward flow of information as well as to the downward flow. Information is required and actively solicited by the center for its own purposes but information received from executants is kept compartmentalized and shielded from public view as the information is passed up to the center. Concealment of production failures, transportation accidents, and social problems such as crime and health problems are well-known examples. In the political sphere, adresnost' means closely held decisions, communicated only to those responsible for executing the decisions. There is a huge sphere of secret laws, secret orders, and use of the coercive power of the state which is never publicly acknowledged. In this morass of secrecy it is difficult to know whether something can be divulged or discussed since the laws that explain what is secret are themselves secret. This information and communication environment gives rise to the principle that "what is not expressly permitted, is prohibited," versus the civic society principle that "what is not expressly prohibited is permitted."

It is against this background that the term glasnost', which has given Westerners such fits in its translation, is best explained. Glasnost' means

a partial shift in the principle governing access to information from "need to know" to general disclosure, or at least to a widening of the audiences acknowledged as having a need to know. In an earlier reform period, the economist V.S. Nemchinov, in pushing for the release of more data, complained that most of the information the Central Statistical Administration produced was never disclosed and that even the professional economists had to make do with the "general-citizen ration" of information it published.

One of the central problems governing the effectiveness of the Soviet-type system is the problem of informational asymmetry between the top and the bottom in this communications circuit. The most detailed and accurate information about the state of the world is held by lower level actors and the task of the communication process is to force disclosure of this information to the central managers. This communication process works very imperfectly. People at the bottom know that any information they provide will be used to "steer" them and they try to use the communication process to influence outcomes to their own advantage. We know most about this phenomena as it operates in the economic sphere; economists have constructed elaborate models for information exchange in these situations that will force disclosure. But the phenomenon is clearly at work in the other domains of social life as well, with people at the bottom trying to conceal information about outcomes and potentials in their sphere of responsibility, and to use the information process to influence orders and evaluations issued from above to their own advantage.

In the civic society model, the operational information which generates operational outcomes is more likely to flow in lateral channels and to be of

the broadcast type. In the economic realm, where this process of information exchange and decision-making is basically embodied in the institutions of the market, information is in the form of solicitation of bids, offers to sell to anyone at the going price, and so on. To the extent central institutions intervene, they tend to do so not in the form of institution-specific, or person-specific, directives, but in the form of general laws and regulations, general tax rates, manipulation of macro-regulators that have an impact on all alike. Departures from this principle, as in tax loopholes designed to benefit special interest groups, are generally recognized as a dysfunctional distortion. The political sphere in the civic society operates with similar norms, an example of which is the metaphor of blindfold justice's indifference to individual circumstance. Both these cases illustrate the idea that much information in the civic society has a "parametric" character. The general norms and signals are not immutable, but changes in them must be based on the principle of due process. In the competitive market model, prices are a bit of social information presented to decision-makers which they cannot control, but which can change in an impersonal "due process" fashion to reflect changes in scarcity relations.

A third circuit for information sources and exchange is distinguished by its essentially "private" character. "Private" means that the related values and behaviors do not affect central goals (in the Soviet kind of structure), or involve conflicts that have to be reconciled in the process of aggregating individual interests in the civic-society model. These are values, behaviors, and communicative acts that do not generally have obvious and broad externalities. Examples include who wants to marry whom, whether one wants her/his life prolonged by extraordinary means, and in general how

one gets his/her kicks. The direction of communication here is basically lateral but can be addressed or broadcast.

The border delimiting this private sphere from the other two spheres is ill-defined and disputed. In the civic society model we do a lot of agonizing as to what activities, with their associated information and communications, have this private character and when social externalities justify intervention. Can information on the performance of doctors and hospitals be kept private, or should it be public knowledge? At what point does access to communications media by those holding counterculture values, and engaging in counterculture behavior become a matter of public rather than private concern and, thus in the civic society model, require reconciliation through the political sphere? Are knowledge of contamination by AIDS and the activities that disseminate it, private information or public? But in general the civic society treats a broad range of such decisions and, hence, the information and the communication that they involve as private. Even when they have externalities, the civic society relies heavily on "civic responsibility" to regulate them rather than requiring disclosure of information to the state as a basis for corresponding decision processes. To handle the supra-personal externalities of these processes, the civic society model also makes extensive use of voluntary association as in peer review and control in medicine and other professions.

A broad area in which this third kind of information and communication operates is the area of "popular culture." A central concern in the literature on that subject is whether popular culture is indeed spontaneous and autonomous, arising from and reflecting popular values and tastes and

sustained by informal communication, or is captured, increasingly formed and manipulated for commercial or political purposes. And this ambiguity exists in both the polar societal models we are dealing with.

The "social engineers" responsible for the design of Soviet-type society have always been much more worried about these "private" areas of information and communication than are civic societies. Important to the concept of totalitarianism is the unwillingness of the state to coexist with any private sphere of values, communication, and decision-making. Such societies show little tolerance for letting private values and cultural tastes flourish on their own. They also exhibit an unwillingness to let any aspect of social control be taken over by private professional control. They seek either to suppress the activity or to coopt it and to move the corresponding information and communication processes into one of the other domains. In terms of values, they set goals for correct thinking at the center and propagate them energetically. In functions with important operational significance they absorb the function into the officially manipulated sector, and bring all the corresponding information flows into the requisite two-way, vertical, <u>adresnost'</u> form. They take responsibility for the quality of health care or education and collect the information and use it in a control process. There have occasionally been interesting exceptions, but they are rare. In one famous case, in contrast to the usual Stalinist style, the Party declined to interfere in a scientific dispute, on the grounds that the scientific community possessed the information and a communication and decision process that could settle the issue better than the Party could.

So much for what is meant by information, communication and society. But that is only background. What interests us in the Hudson Project most is how the technology of information storage, processing and communication supports or constrains choice in the design of the societal model, and how change in these technologies and social change interact with each other. There is a great variety of competing propositions and perspectives we can bring to this question. One is that technology has but little influence in the choice of a societal structure and that technological change is a pliable and derivative variable rather than an autonomous force in changing structure. Those with power over social arrangements can shape the means for information transfer to some idea of serving existing social institutions and can inhibit technical change that would upset the existing arrangements. There is a great deal to be said for this line of argument. The Soviet system has inhibited technical change, first because the system is not stimulative of change. In addition, those in power have sought to channel change in directions consistent with a societal structure that is impoverished as regards social process and restrictive as regards information processing and exchange. The leaders let happen what they want to happen. If they fear the personal computer, they can prevent its spread. If they want to keep TV as a medium that only disseminates messages from those in power, they foreclose alternative access. They can choose computer applications, hardware, and software, consistent with their societal model.

Soviet telecommunications offers abundant material supporting the

notion that telecommunications technologies can be bent to reinforce and support the traditional Soviet-type information structures. From the first, the telecommunications link with the populace was conceived of as a way of top down connection of the leadership to every citizen. Lenin had this idea about the press and about radio, the latter embodied in the Minsviaz model of "radiofication", which wires public loudspeakers to central sources so that everyone gets the same message at the same time, no matter where they are. The distribution of centrally produced TV in a uniform format to all the USSR is a technologically up-to-date form of the same idea. Similarly the use of facsimile machines to distribute centrally produced newspapers for printing and distribution in uniform format over the whole USSR strongly reflects a wish to make sure that communication takes the form of center-to-periphery, not lateral-among-peripheral-units. We mentioned earlier how the hierarchical pattern of communication in the Soviet system influenced the structure of the telephone switching network. In tying the phones together it was more important that any telephone have a connection to Moscow than that channels be available to connect it laterally to other phones across the reaches of the USSR. This is reflected both in the lines tying phones and zonal systems together, and later in the way introduction of direct dialing focused on connections to Moscow rather than connections to other cities even in the same oblast. Surely the suitability of communication satellites for one-way distribution was one of the attractions that encouraged the leaders to give them such a high priority.[264]

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[264] There are counter examples, of course. The telegraph has always had a different structure. Though directions were restricted for telephone calls, you could send telegrams anywhere in the system. And in telegraph traffic, private use played a proportionally more important role than in telephonic communication.

The option of using the capabilities of a technology to support the existing system through proper design apply today as new technologies emerge. The Russians can use the CAMA system for identifying callers by class to allow prioritizing access to the telephone system.[265] They can establish gateways to the phone system that will make it difficult for individuals equipped with personal computers to engage in uncontrolled, widespread dissemination of information or to communicate laterally. As mentioned in the chapter on data transfer, Minsviaz explicitly excludes individuals from access to the telephone network for data transfer. Some commentators go so far as to suggest that expansion of the phone system, if properly designed, would give the regime much fuller access to what people are doing and saying than it has now.

Bill McHenry puts the problem very well in his discussion of how the regime would be likely to treat one particular form of an enhanced communication infrastructure, i.e. electronic mail. "On the surface, [electronic mail] would appear to amount to electronic publishing without censorship, because messages could be sent simultaneously to a large number of users. However, the CPSU may also view electronic mail as nothing more than a faster version of regular mail. It would be possible to delay the delivery of some messages while they were being checked, to use random searches, and to monitor all transactions by individuals under surveillance. The interference could be crude enough that most users would be aware of it and would practice self-censorship, particularly in communications with foreigners. The party could reap the benefit of more efficient communication

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[265] Ivan Selin, "Communications and Computers in the Soviet Union," Signal, December 1986, p. 92.

without a substantial threat of increased activity by dissidents."[266] What McHenry does not address here is how costly that would be and how heavy a cost the regime is willing to bear, both in terms of direct outlays and in terms of benefits foregone, to ensure that full control were exercised over communication technologies.

But I think we have to keep another perspective in mind as we ponder this relationship between social change and advances in information technology. If social change is on the agenda for other reasons, and driven by other forces, advances in information technology can be consciously used as an instrument for changing the societal model. I believe that Gorbachev and some other members of the top leadership do want to move toward the civic society and appreciate the possible utility of using telecommunications to aid the process. As the USSR moves forward in the process of reform, I believe the reformers will shape and exploit information technology to assist the evolution to another kind of society.

Democratization is seen as an important element in the reforms. One of the favorite themes of the Gorbachevians is the need to elicit initiative from below. Gorbachev surely sees democratization and influence from below as an instrument for achieving his own goals more than as an aim in itself, but in many ways he accepts the importance of a different kind of information system to go along with the new structure of society. Gorbachev is using all the media as instruments of glasnost', but as is often noted, he is the first Soviet leader fully aware of the potential of television as a tool for reaching broader strata of society. Similarly the current

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[266] William McHenry, "Computer Networks in the Soviet Scientific Community," in C. Sinclair, The Status of Soviet Civil Science, Martinus Nijhoff, 1987, p. 171.

emphasis on making the telephone a consumer good is not just productivity-motivated. It accepts an enlargement of private communication. In conveying an image of what the telephone future will be like, there is extensive discussion today of new services for the public, including information services, call forwarding, redial capabilities, etc. Minsviaz officials also have in mind the introduction of "paid services" (platnye uslugi) — travel information, weather information, psychological and educational information. All these involve applications in the domain of private values, information, and choices. Many recent statements state clearly a goal of "informationizing society" (informatizatsiia obshchestva). It is disconcerting to see an old-style bureaucrat like Shamshin supporting this idea. And tying this idea to society rather than to the economy suggests going beyond productivity-enhancement.

Another suggestive article describes a system recently set up in the Rovno city government in which the citizen can telephone complaints and requests to a telephone answering machine with systematic transcription, follow up, and call-back.[267] This is modeled to some extent on the press but in a technologically modernized way. The author recommends that this system be adopted by other units and levels of government. He further suggests that this use of the telephone as "a new weapon in the arsenal of glasnost'" should be extended to give access to a computerized source of information on the names, telephone numbers, visiting hours, and so on of local government officials.

There are two cautions in drawing any conclusions from this. First Gorbachev may be unable to carry off his vision of modernizing society, and •

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[267] Sovety narodnykh deputatov, 1987:5, p. 24.

his successors may be less willing to restructure the information system to make it consistent with a new kind of society. Second, even Gorbachev may have some reservations about the extent of social change that is desired and will probably try to direct the information processing and communications revolution to support some features of the present system.

TECHNOLOGICAL CHANGE AS AN INDEPENDENT VARIABLE

We must therefore still consider the issue of whether and how technological change in telecommunications can have an autonomous influence on social change. It is perhaps an unanswerable question, but we can consider several possibilities.

First, one basic mechanism underlying such a possibility is that new technology often comes as a package. The computer can best be used to enhance individual productivity on a wide scale in the form of the personal computer. But the PC comes with a printer, which has other potentials. Big Brother can more effectively beguile the citizen to sit still for his message by providing a VCR to reconcile their schedules, but that extends to the citizen many other choices as well. What makes control difficult is that technical changes can often have unforeseen and unintended consequences -- it is far from clear what is <u>in</u> any particular package. The introduction of any technology, especially those that are complex and pervasive in the way the telephone system or computers are, can have unintended consequences that will lead to social change.

Second, the leaders may be pressured reluctantly into accepting social change as the price of getting the benefits of a more information-rich society. Perhaps the information-based society must itself be bought as a

package, complete with social changes that go against the natural instincts of the power elite and top decision-making groups of Soviet society. The really tough part of this question is to sift out of what is happening in the design of the telecommunications system and technology some sense of how the leaders see the risks of more information rich society and how far they seem willing to trade off acceptance of the information-rich society, with all its consequences, as the price for achieving other gains.

Another complication in control of telecommunications technology is the multi-actor mechanism. I have been speaking as if the leaders at the top are the only ones to decide what technical changes will be introduced. But other actors have their own influence and their motivations may affect how the technological choices come out. This seems to be a motivation of growing importance. As explained earlier, Minsviaz is undergoing a transition in which commercial motives have come to play a more important role in its choices. In discussing paid services, Shamshin says something very interesting, i.e. that one way to improve the situation of the telephone service under conditions of self financing is to introduce more "paid services". Minsviaz is adding novelty telegraph forms for holiday messages for delivery in rural areas, it is accepting telegrams for delivery on board river steamers, and it will introduce paid information services. Shamshin wants to get the intercity pay phones in working order, since that could add about 5 million rubles of revenue in 1987.[268] This is an interesting hint of how commercial motives in a system that is changing the rules for policy makers at lower levels might begin to impact on the shape of information technology. As Minsviaz makes this transition, its officials will ever more

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[268] Elektrosviaz', 1987:5, p. 2.

frequently find themselves in situations where the mandate to control information flow comes into conflict with some customer demand and will be giving more weight to the demands of the population for telephone service that serves their, rather than the regime's, goals. This is partly tied in with general expansion of capacities, as in the example of proliferation of TV and radio channels discussed earlier. In Primorskii krai, the telephone company is offering a service in which families of seamen can call them at sea from telephones in Vladivostok.[269] The service will use satellites of the Kospas-Sarsat system, which is really intended for rescue at sea, not general telephone service. But the existence of spare capacity, perhaps with some push from commercial motivations, has induced local telephone officials to facilitate a form of communication that is much more consumer-motivated than production-motivated.

Moreover, the values of the leaders are not necessarily always in conflict with those of the population and a partial overlap offers an entering wedge for more subversion. One of the intriguing developments under the program to provide more household service is a policy to transfer telephones and numbers from institutions and enterprises to households.[270] Part of the rationalization is that this is the only way to offer more phones quickly for invalids and veterans, who according to the rules have a

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[269] SU/W1451/B/2, 24 July 1987.

[270] Illustrative cases are described in Izvestiia, 16 November, 1987, 24 November, 1987, and 16 December, 1987. In one peculiar case, numbers were shifted from factories during work hours to households at night (Ekonomicheskaia Gazeta, 1987:17).

priority. I would assume that policy is consistent with popular values.[271] But one wonders what is really going on here. The allocation of phones is a notorious source of corruption -- one has to pay a bribe to get on the list, and further bribes to get favorable consideration on the list.[272] It is intriguing to think what kind of system of bribes, payoffs, and final allocation of the released phones may emerge from the welter of cross purposes, as party and state officials try to comply with a campaign, enterprises fight to keep their phones, and the public feels good about supporting veterans and invalids, while telephone company employees revel in a bonus of phones to generate bribes. But I am certain that in the end the phones are likely to move into uses that raise consumer welfare.

Another consideration that needs more thought than I have been able to give it is whether there may be some differential between the two kinds of societies in the advantage conferred by progress in information technology. What technological change does is to cheapen the process of communication and of processing primary information into more useful bases for decision-making. One of the insights economists have is that information is costly (though some of their most powerful models are based on assuming it is costless), and that optimality in resource allocation is really a tradeoff between the cost of information versus the loss from failing to reach optimal allocations. As information processing and transmission gets cheaper, it permits us to move closer to better decisions in either of these

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271 The priority rules are explained in Izvestiia, 11 January, 1986. Most general treatments say that invalids and veterans get priority but, in fact, deputies of the various levels of soviets and the holders of certain orders take second place behind invalids.

272 Ivan Berenyi, "Obtaining a Phone in the USSR," Telephony, 24 June, 1985, drawing on a long series of articles in the Soviet press.

societal models. One of the biggest issues is whether there is any bias that would permit cheapening of information to benefit one of the societal models proportionally more than the other. My guess is that cheaper information and communication technologies offer each system about equally good opportunities for improving its allocations.

Is it possible that there are differentials in the social change spillovers of various information technologies? The xerox machine, the printer, and the VCR, all give the private sector more tools for private communication, attitude formation, and information processing. Is there anything that makes it less easy and, in net terms, more costly to lock up the PC printer and the VCR cassette than to lock up xerox machines? I think we could easily say yes, as far as the VCR is concerned. It is an electronic printing press and very difficult to control. As for the point to point switched network, I am not so sure -- it is itself a central facility that can enhance eavesdropping. The growth of electronic storage means that information is stored differently. In its electronic form it is perhaps more difficult to keep inventoried and hence more difficult to control access to.

In the end I think it is just very hard to judge whether technology itself will buttress the old system or offer benefits that cannot be refused even at the risk of opening the door to social change. The dilemma is well illustrated in a fascinating recent article in which a geographer catalogues numerous cases of space photography that reveal gross errors in official information collected by TsSU or provided by departments.[273] Examples include much larger areas under cultivation or under irrigation than

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[273] B. Vinogradov, "Proverka iz kosmosa," Kommunist, 1988:3, pp. 65-67.

officially reported, overstatement of land areas reforested, understatement of forest lost to fires, land lost to salination, and steppe pastures lost to desertification. Significant diversions (up to 50 per cent) of water from irrigation canals were revealed, areas reported as under crop rotation were in fact under monoculture, and local agencies had encroached on preserves to offset land lost through their destructive practices. In one case in Central Asia the number of sheep revealed by space photos was 20 times the number shown in official statistics.

The author has a dual concern. On the one hand, this new information technology offers a kind of bypass surgery for sclerotic official information channels and can improve central control. "It appears that the use of aero and space photo information by Goskomstat for verifying and correcting the information obtained by traditional channels will permit raising its reliability significantly." But at the same time it provides a powerful new information tool to be used by groups speaking for the general good (such as the ecological concerns of the author) or motivated by viewpoints and/or interests competing with those engaged in these deceptions. Thus, "The most important condition for the effectiveness of aero and space expertise is glasnost' and access to both branch and general information". In this example, as in most of the rest we have looked at, technological progress in information technology does not unequivocally force a widening of information circuits, but does raise the cost of the traditional restrictions and increases the payoff for moving in the direction of the civic society model.

So at the end I am very skeptical that we can see progress in information technologies as necessarily strengthening the hand of either the

central controllers or the decentralized users of information, or offering a differential advantage to one or the other polar societal structures. For me the final conclusion is that the civic society has a huge advantage over the patrimonial society from numerous points of view. If the leaders recognize this and undertake to move in the civic society direction, then they cannot help but accept the reorganization of the information structure and the acceptance of the new information technologies. For me it is that imperative, rather than any independent technological imperative, that will force the acceptance of the information revolution, with all its attendant implications.

DATA BASE FOR SOVIET TELECOMMUNICATIONS

CONTENTS

Notes to Table 1. TELEPHONES AND SUBSCRIBER LINES

All figures are in thousands.

My interpretation of these statistics is based on the following description of a telephone system. A central concept is the "terminal exchange", to which telephone instruments are connected through subscriber loops (which I take to be identical with "main lines").

The capacity of a terminal exchange is measured in terms of the number of numbers (which should be identical with the number of lines or subscriber loops) they can handle. All exchanges are divided into those owned by Minsviaz (Minsviaz exchanges) and those owned by other organizations (departmental, or vedomstvennye, exchanges). I am not sure how PBX's of various kinds are treated—my tentative interpretation is that they would be called departmental exchanges. In 1969 the number of numbers per departmental exchange averaged 132, so this population is obviously heavily loaded with very small capacity exchanges.

Telephones connected via subscriber loops to Minsviaz terminal exchanges are Minsviaz telephones. Those connected to departmental exchanges are departmental telephones. Incidentally, I assume that all payphones are Minsviaz telephones and are connected to Minsviaz exchanges.

There is an overarching category of telephones "on the public network", which consists of those telephones (and the exchanges to which they are connected) in both systems that theoretically have access to each other. (This does not necessarily imply that they do in fact all have access to each other).

There are substations, such as those which concentrate lines in a neighborhood. Since they do essentially what a concentrator within a terminal exchange does, I think that we count numbers and subscriber loops in such cases outward from those substations, rather than outwards from the terminal exchange.

The data for main lines comes from the ITU and is described by them as subscriber loops connecting instruments to the public switched network. I do not have a clear idea of how the departmental system is connected to the Minsviaz system. PBX's would likely be connected by subscriber loops to the Minsviaz system. Larger departmental exchanges might be connected to Minsviaz terminal exchanges or transit exchanges via trunks or via tandem stations. But I have seen no discussion of this in Soviet sources. Another difference between subscriber loops and telephones is represented by party lines, i.e. more than one telephone per loop. Twenty per cent of all residential phones are party-line connected, usually with two parties per line.

Another concept is subscribers (abonenty). My interpretation would be as follows: the number of abonenty would seem to be the same as the number of subscriber loops, except to the extent that there are multiple users on

party lines. There is a potential ambiguity in the case of departmental exchanges. If there is more than one line from the PBX to the Minsviaz terminal exchange, they might still call the PBX customer a single subscriber.

It is said that intercity phones have their own network and I wonder if it is possible that they are connected directly to transit exchanges rather than via terminal exchanges.

Stock figures refer to end of year. Except as noted below, these are all standard series, available in TsSU, Narodnoe khoziaistvo SSSR, ITU, Yearbook of Common Carrier Telecommunication Statistics, TsSU, Transport i sviaz' SSSR, and general handbooks on the communications sector.

All telephones. This figure includes departmental telephones, but we know from notes in earlier editions of the Nar khoz that it does not include those in military establishments. 1964--interpolated.

In the late sixties TsSU shifted from a series covering just Minsviaz phones to one covering all phones having access to the public network.

Minsviaz: 1980, 1985--taken from Table 8, as is also the division into rural and urban. We also know that the increment in 1983 of 946 thousand residential telephones was 75 per cent of all new telephones, (Elektrosviaz', 1984:4, p. 3), which implies a total increment of 1261. This is smaller than the increment shown in the public network series, and I assume it refers to Minsviaz. 1976-1979 and 1981-1984 are not handbook figures, but should be close as they are based on nearly complete regional data from Table 7.

Minsviaz payphones: planned increment, 1982-85 was to be 45 thousand and the increment planned for 1982 was 9 thousand (Elektrosviaz, 1982:4, p. 5).

Minsviaz intercity pay phones: The numbers shown here for early years from current handbooks are below those shown in earlier handbooks. 1977--number increased by 12 per cent (Elektrosviaz', 1978:4, p. 1; by the end of 1971 there were "several thousand" according to N.D. Psurtsev, Razvite sviazi v SSSR v deviatoi piatiletke.

Main lines: ITU, Yearbook of Common Carrier Telecommunication Statistics.

Subscribers: I imagine that abonenty has to refer to Minsviaz, and that it should generally be somewhat smaller than main lines, since some subscribers could have more than one line. 1951-65--Psurtsev, N.D., Razvitie sviazi v SSSR, Moscow, 1967, pp. 362-63; 1981--16.5 million urban + 3.6 rural = 20.1 million total (Elektrosviaz', 1982:4, p. 1). Urban subscribers grew 2.3 x in 70's, and rural subscribers by 2.75 x (Elektrosviaz', 1982:12, p. 2), which implies at end of 1970 urban = 7.2, rural = 1.3, total = 8.5.

Public minus Minsviaz: I take this as a proxy for phones on PBX's connected to Minsviaz exchanges plus extension and party-line phones.

Departmental, nonpublic: These are the phones that are on departmetnal exchanges that are totally independent of the Minsviaz net.

TABLE 1 TELEPHONES AND LINES

YEAR	ALL PHONES	DEPT'L PHONES	PUBLIC NETWORK	MINSVIAZ ONLY	MINSVIAZ URBAN	MINSVIAZ RURAL	PUBLIC DIAL UNITS	PUBLIC OTHER	PUBLIC URBAN	PUBLIC RURAL	MINSVIAZ RESIDENT
1950	NA	NA	2272	1410	1231	179	872	1400	2092	221	338
1951	NA	NA	2475	1500	1307	193			2231	244	359
1952	NA	NA	2686	1598	1392	206			2422	264	381
1953	NA	NA	2837	1686	1464	222			2548	289	402
1954	NA	NA	3024	1816	1586	250			2698	326	435
1955	NA	NA	3190	1931	1663	269	1393	1797	2839	351	499
1956	NA	NA	3366	2067	1770	297			2983	381	563
1957	NA	NA	3558	2220	1896	324			3145	413	630
1958	NA	NA	3810	2370	2032	338			3360	450	701
1959	NA	NA	4023	2513	2192	381			3520	503	777
1960	NA	NA	4301	2697	2284	413	2210	2091	3753	548	852
1961	NA	NA	4619	2932	2484	448			4021	598	954
1962	6000	1000	5000	3215	2732	483			4350	650	1066
1963	6600	1311	5289	3479	2819	660			4475	814	1196
1964	7200	1443	5757	3900	3166	734			4864	893	1385
1965	7800	1401	6399	4459	3715	744	4450	1949	5490	909	1657
1966	7900	785	7115	5072	4266	806	5243	1872	6132	983	2006
1967	9700	1758	7942	5760	4898	862	6127	1815	6867	1075	NA
1968	10800	1931	8869	6591	5597	995	7167	1702	7677	1192	NA
1969	12000	2106	9894	7472	6353	1119	8273	1621	8570	1324	NA
1970	13500	2513	10987	8436	7168	1268	9471	1516	9504	1483	4100
1971	15100	3022	12078	NA			10657	1421	10436	1642	
1972	15700	2501	13199	NA			11821	1378	11380	1819	
1973	16200	1737	14463	NA			13116	1347	12450	2013	
1974	17700	1875	15825	NA			14631	1194	13589	2236	7700
1975	19300	2139	17167	14064	11591	2473	16050	1117	14694	2473	
1976	20900	2478	18422	15250			17385	1037	15712	2710	
1977	24200	4562	19638	16434			18700	938	16690	2948	
1978	25600	4656	20944	17612			20122	822	17752	3192	
1979	27300	5005	22295	18872			21605	690	18855	3440	
1980	29100	5393	23707	20169	16687	3502	23068	639	20029	3678	11600
1981	30600	5531	25069	21298			24385	684	21144	3925	
1982	32400	5993	26407	22790			25858	549	22265	4142	
1983	34000	6169	27831	24127			27316	515	23422	4409	
1984	35900	6438	29462	25639			29041	421	24807	4655	15900
1985	37200	6100	31100	27200			30700	400	26200	4900	17100
1986	39500	6500	33000				NA		27700	5300	18500
1987											
1988											
1989											
1990			43700P								26200

TABLE 1

YEAR	MINSVIAZ RESIDENT URBAN	MINSVIAZ RESIDENT RURAL	MINSVIAZ PAYPHONES	MINSVIAZ PAYPHONES INTERCITY	MINSVIAZ NONRESID	MINSVIAZ MAIN LINES	MINSVIAZ SUB-SCRIBERS	PUBLIC MINUS MINSVIAZ	DEPT'L NONPUBLIC
1950	3318	0	12		1934			862	
1951	3569	0	13		2116		1170	975	
1952	3811	0	16		2305		1242	1018	
1953	4012	0	18		2435		1349	1151	
1954	4315	0	20		2589		1443	1208	
1955	4614	14	22		2692		1565	1259	
1956	5145	18	27		2803		1859	1299	
1957	6018	22	31		2928		1773	1338	
1958	6775	26	35		3109		1915	1440	
1959	7240	37	40		3246		1996	1510	
		0							
1960	8113	89	44		3449		2140	1604	
1961	9004	50	49		3665		2324	1687	
1962	10112	54	54		3934		2534	1785	1000
1963	11004	92	57		4093		2604	1810	1311
1964	12814	101	64		4372		2907	1857	1443
1965	15318	119	80		4742		3408	1940	1401
1966	18617	139	84		5109			2043	785
1967	22662		96		7942			2162	1758
1968	27719		109		8869			2278	1931
1969	32209		121		9894			2422	2106
1970			132	8.2	68817	72200		2551	2513
1971					120778	78312			3022
1972					131599	88103			2501
1973					144663	95664			1737
1974					81255	105665			1875
1975				11.9	171667	121812		3103	2133
1976					184222	135001		3172	2478
1977					196538	161001		3204	4562
1978					209444	175466		3392	4656
1979					222295	191664		3429	5005
1980				18.9	119007	201481		3518	5393
1981				21.1	250699	229131	201001	3271	5531
1982				22.4	264071	245401		3617	5993
1983	128001	20001		24.1	278311			3704	6169
1984				24.9	135621			3823	6438
1985				27.5	140001			3900	6100
1986				32.9					6500
1987									
1988									
1989									
1990				110P					

Notes to Table 2. TELEPHONE EXCHANGES AND TRANSMISSION FACILITIES

Stock figures refer to the end of the year.

For interpretation of concepts regarding exchanges and their capacity see notes to Table 1.

Minsviaz exchanges, capacity (thousands): For years after 1970, estimates are approximate and tentative. A fairly exact figure of 18441 for 1978 is implied by a statement in the 1979 plan speech that a planned increase of 1,254 thousand numbers would be an increase of 6.8 per cent. The plan for 1980 was a 6.5 per cent increase, and assuming it was fulfilled, we get 20975 for 1980. We can work backward from 1980 on the basis of the reported 1.43-fold growth in the Tenth FYP (Elektrosviaz', 1981:5, p. 2), to get 14668 for 1975. Subsequent tests show enough consistency to accept 14668 as the best estimate for 1980. 1977—by addition of urban and rural (see below).

The growth planned for 1981 was 6 per cent and and it was said to be fulfilled by 100.2 per cent (Elektrosviaz', 1982:4, p. 4) giving 22233 for 1981. In 1982 1488 thousand numbers were added (Vestnik sviazi, 1983:3, p. 3) making 23721 at the end of 1982. 1985--in the 11th FYP new telephone exchanges with >8.2 million numbers were put into operation (Vestnik sviazi, 1986:10, p.3). There is a little problem here in that the addition of 12.1 million numbers in the 12th FYP is supposed to raise the capacity by 1.55 times, implying 22 million for 1985 and 34.1 for 1990 plan. I have not reconciled this yet. In 1986 the plan was to add 2 million numbers in automatic exchanges, giving 31 thousand for 1986.

Minsviaz exchanges, division into urban and rural. In 1976 + 1977 the number of numbers added to urban exchanges was about 2 million. (Elektrosviaz', 1978:4, p. 1), for an increase of 15.6 per cent, implying approximately 12820 for 1975 and 14820 for 1977. Subtraction gives 1848 as the capacity of rural exchanges for 1975. According to the same source, the capacity of rural exchanges rose by 18.9 per cent over the 2 years, giving 2197 for 1977. In the Tenth FYP in rural areas, on the public network, and in intra-organizational production systems, ATS with capacity of 1,620.4 numbers were added (Elektrosviaz', 1983:3, p. 3) and I use this to show 3187 for rural for 1980, and I fill in urban for that year by subtraction. In 1982 the absolute increments were 1186 in urban exchanges, 302 in rural exchanges (Vestnik sviazi, 1983:3, p. 3).

On the automatic-nonautomatic breakdown, I have a statement about the number of manual exchanges in the rural system.

The plan was to add in the rural network in 1983-90 exchanges with capacity of 3.3 million numbers. (Vestnik sviazi, 1983:1, p. 2).

The plan for new automatic exchanges in 1978 involved addition of about 1 million numbers.

Psurtsev gives some data for the share in crossbar exchanges for various years in urban exchanges (p. 363): 1963---35.37; 1964----52.17; 1965---71.1.

Channel-kilometers: (I believe these figures refer to the telephone network only. At the end of 1967, the total including TV was over 25,000, compared to the 21,670 shown here. By the 70s the length of TV channels had risen to 90-100 thousand). 1955, 1960, 1966—Minsviaz SSSR, Sviaz' SSSR za 50 let: statisticheskii sbornik, Moscow,, 1968; 1958, 1965, 1969—M.G. Kozlov, Ekonomika sviazi, Moscow, 1971, p.19; 1961-64, 1967-68--I.A. Podgorodetskii, Statistika, sviazi, Moscow, 1973, p. 37; 1974—according to Elektrosviaz', 1975:5, p. 22, the figure is "now more than 60 thousand"; Other years are tentatively and approximately estimated as follows: The total at the end of 1980 was 4 times that at the end of 1970 (Elektrosviaz', 1982:12, p. 2). If we assume that 1970 exceeded 1969 by the average growth in 1969/1965, the number at the end of 1970 was 34 million, and at the end of 1980, 136 million. We know the increment in 1981 was 17.9 million, and in 1982, 17.2 million (Shamshin in Vestnik sviazi, 1983:3, p. 2), giving the figures shown in the table. It is also said that by the end of 1984, the number was 1.6 times that at the end of 1980 (Elektrosviaz', 1985:1, p. 1) which implies 217.6 at the end of 1984 for an annual rate of growth in 1983 and 1984 of 12.8 percent per year. That is plausible considering that the planned growth in 1983 was 14 per cent). The 11th FYP target of a 1.8-fold growth was achieved (Elektrosviaz', 1986:2, p. 3) implying 245 for the end of 1985. The 10th FYP growth was 1.93 times (Elektrosviaz', 1982:1,. p. 1) so working backward from 1980 gives 1975 = 77.7, which implies AARG = 14 per cent which is consistent with examples of growth 1977/1975 = 25 per cent realized (Elektrosviaz', 1978:4, p. 1), 1980 = 13 per cent planned. The target for the 12th FYP is growth by 1.55 times (Elektrosviaz', 1986:2, p.3) implying 380 by the end of 1990. Another source gives 1.56, implying 382.2 thousand (Vestnik sviazi, 1986:2, p. 2).

Trunk (in the source this means lines connecting zonal systems); All from Minsviaz SSSR, Sviaz' SSSR za 50 let: statisticheskii sbornik, Moscow,, 1968.

Intraoblast' (i.e. within zonal systems): Minsviaz SSSR, Sviaz' SSSR za 50 let: statisticheskii sbornik, Moscow, 1968.

TABLE 2 TELEPHONE EXCHANGES

YEAR	MINSVIAZ EXCHANGES NUMBER	AUTOMATIC	URBAN	RURAL	MINSVIAZ EXCHANGES CAPACITY THOUS	AUTOMATIC THOUS	URBAN THOUS	RURAL THOUS	DEPTL EXCHANGES NUMBER	DEPTL EXCHANGES CAPACITY THOUS	NUMBERS PER DEPTL EXCHANGE
1950	12682	249	5109	12777	1575	563	1341	233.5	13852	1040.5	74
1951	13381	348	5124	13257	1683	619	1428	255.1			
1952	13797	461	5167	13630	1810	693	1533	276.8			
1953	14254	623	5135	14119	1892	742	1509	302.9			
1954	20141	813	5179	14962	2057	833	1716	341.3			
1955	20721	965	5201	15520	2184	902	1817	367.1			
1956	21425	1158	5129	16298	2315	976	1904	411.3			
1957	22113	1547	5154	16959	2479	1068	2031	449.1			
1958	22775	2051	5147	17626	2651	1187	2168	482.5			
1959	23495	2761	4886	18609	2857	1342	2303	554.1	24385	2519.1	104
1960	24203	3702	4945	19254	3094	1544	2494	600			
1961	25071	4666	5143	19928	3386	1795	2741	645.5			
1962	25812	6158	5302	20430	3691	2110	3004	687.5	27981	2640.5	95
1963	27873	8742	4602	23271	4095	2530	3130	964.6			
1964	29660	11569	5190	24470	4582	3060	3538	1044			
1965	31210	14484	6107	25111	5223	3767	4193	1080.3	27554	3106.4	113
1966	32288	16721	6456	25832	5879	4484	4703	1096.3			
1967	33500	19070	6740	26760	6653	5593	5402	1177.3	30570	3045.7	131
1968	34706	21415	6886	27820	7472	7471	6176	1295.4			
1969	35727	23743	6904	28793	8384	8384	6945	1439.1	31181	4120.2	132
1970	37008	26327	7016	29990	9408	9408	7792	1616.2			
1971											
1972											
1973											
1974											
1975					14668		12830	1846			
1976											
1977					17016		14820	2197			
1978					18441						
1979					19695						
1980					20975		17158	3817			
1981					22233						
1982					23721						
1983											
1984											
1985					29175						
1986					31000						
1987											
1988											
1989											
1990					41300						

TABLE 2

YEAR	CHANNEL/KM INTERCITY T'PHONE	TRUNK	INTRA OBLAST	AVERAGE CHANNEL LENGTH KM
1950		1180.4		
1951				
1952				
1953				
1954				
1955	3066.1	2144	922.1	
1956	3594.2			
1957	4162.6			
1958	4704.3			
1959	5360.2			
1960	6130	4641.8	1488.2	116
1961	7250			
1962	8060			
1963	9770			
1964	11600			
1965	14585.3	11177.8	3407.5	111.7
1966	18585.3	14360.2	4063.7	119.9
1967	21670			
1968	24810			
1969	29008.1			
1970	34000			
1971				
1972				
1973				
1974	>60000			
1975	70500			
1976	77550			
1977				
1978	88125			
1979	100110			
1980	136000			
1981	153900			
1982	171100			
1983				
1984	176000			
1985	245000			
1986				
1987				
1988				
1989				
1990	300000			

Notes to Table 3. TELEPHONES IN AGRICULTURE

These are standard handbook series.

Number of sovkhozy and kolkhozy are in thousands.

Share "telephonized" (percent): Before 1965 the definition is the share that had a telephone connection, after 1965 it is the share with some kind of PBX.

TABLE 3 TELEPHONES IN AGRICULTURE

YEAR	NUMBER OF SOVKHOZY	SHARE T'PHONIZED	NUMBER T'PHONIZED	NUMBER OF KOLKHOZY	SHARE T'PHONIZED	NUMBER T'PHONIZED
1950	4908	77.5	3866	12140	21.5	2610
1951						
1952						
1953	4957			9120		
1954						
1955		90.2			59.1	
1956	5098			8300		
1957	5905			7650		
1958	6002	95.8	5750	6770	83	5619
1959	6496	97.4	6327	5340	92	4912
1960	7375	98.1	7235	4400	98.3	4325
1961	8300	98.7	8192	4050	98.7	3997
1962	8600	99	8514	3970	99.1	3934
1963	9200	99.1	9117	3810	99.4	3856
1964	10100	99.1	10009	3760	99.4	3737
1965	11681	68.1	7955	3630	31.8	1154
1966	12200	NA		3650	NA	
1967	12800	NA		3620	NA	
1968	13400	NA		3470	NA	
1969	14310	NA		3420	NA	
1970	14934	79	11845	3300	51	1683
1971	15502	80	12402	3230	55	1776
1972	15747	82	12913	3160	60	1896
1973	17300	82	14186	3090	64	1977
1974	17717	82.2	14563	2960	69.8	2066
1975	18064	84	15174	2850	76	2166
1976	19617	83	16282	2730	81	2211
1977	20066	85	17056	2670	85	2269
1978	20434	87	17821	2630	88	2314
1979	20767	88	18275	2600	91	2366
1980	21057	89	18741	2590	93	2408
1981	21603	89	19227	2590	93	2408
1982	21991	89	19572	2590	94	2434
1983	22313	90	20082	2600	95	2470
1984	22515	90	20264	2620	96	2515
1985	22700	91	20657	2670	96	2563.2
1986	22900	92	21068	2670	96	2563
1987						
1988						
1989						
1990						

Notes to Table 4. TELEPHONE TRAFFIC

Intercity telephone calls (millions): This is a basic handbook series.

Shares of different users: Breakdown of intercity telephone calls by client, J. Patrick Lewis, "Communications Output in the USSR: A Study of the Soviet Telephone Systems," Soviet Studies, July, 1976, p 412, and O.S. Srapionov, Ekonomika sviazi, Moscow, 1982, p. 130; 1985--Vestnik sviazi, 1986:10, p 38.

International telephone calls: ITU, Yearbook of Common Carrier Telecommunication Statistics.

TABLE 4 TELEPHONE TRAFFIC

YEAR	INTERCITY TELEPHONE CALLS	HOUSEHOLD SHARE PER CENT	FIRMS SHARE PER CENT	INSTITUTIE SHARE PER CENT	SHARE DIRECT DIALED PER CENT	INTNTL TELEPHONE CALLS
1950	103					
1951	108					
1952	115					
1953	119					
1954	126					
1955	135.2					
1956	143					
1957	152					
1958	163.1	30.7	39.3	30		
1959	171.1					
1960	185					
1961	196.9					
1962	210					
1963	218.2					
1964	226.9	29.8	48	29.2		
1965	256.5					
1966	283					
1967	314					
1968	343					
1969	386					
1970	431	33.1	45.5	21.5		0.6
1971	479					0.8
1972	535					1.15
1973	604					1.47
1974	684					1.6
1975	768	39.7	42.2	19.1		1.9
1976	868					2.17
1977	960					2.35
1978	1060					2.49
1979	1160					2.49
1980	1265	43.8	38.5	17.7	42.3	2.20
1981	1362				44	2.14
1982	1454				47	2.13
1983	1562				60	
1984	1685				65	
1985	1813	42	40	18	66	
1986	1995					
1987						
1988						
1989						
1990						

Notes to Table 5. TELEGRAPH AND TELEX

Capacity of subscriber telegraph exchanges: 1969--Kozlov, Ekonomika sviazi, 1971, p. 19.

Lines, subscriber telegraph; 1974--Elektrosviaz', 1975:5, p. 22; 1975--in 9th FYP increment of subscriber installations (abonentskie ustanovki) was 17.3 thousand (Elektrosviaz', 1977:11, p. 38); 1978--Ekonomicheskaia Gazeta, 1979:44, p.p. 1-2; 1980--in 10th FYP number planned to rise 1.4 times (Elektrosviaz', 1977:11, p. 38); (There may be some confusion here as to when people are talking about lines, and when about installations).

Number of Telex Lines: ITU, Yearbook of Common Carrier Telecommunication Statistics.

Number of Telegraph apparatuses: Basically a handbook series. 1977--number rose over 1970 1.73 times (Elektrosviaz', 1979:6).

Telegrams sent: Standard handbook series.

International Telex (minutes); ITU, Yearbook of Common Carrier Telecommunication Statistics.

Telegrams by sender: 1956, 1967--N.D. Psurtsev, Sviaz' v deviatoi piatiletke, Moscow, 1970; 1958, 1964--Sviaz' SSSR za 50 let; 1970, 1975, 1980--O. S. Srapionov, Ekonomika sviazi, Moscow, 1982, p. 130).

TABLE 5: TELEGRAPH AND TELEX

YEAR	CAPACITY, SUBST'GRAF EXCHANGE	LINES, SUBSCRIBER T'GRAF	NUMBER OF TELEX LINES	NUMBER OF T'GRAF APPARATU	T'GRAMS SENT MILLIONS	HOUSEHOLD SHARE PER CENT	FIRMS SHARE PER CENT	INSTITUT SHARE PER CENT
1950	1544			26	152.9			
1951	2079			28	167			
1952	2905			29	181			
1953	3077			30	195			
1954	3589			32	201			
1955	4236			33	203.2			
1956	4876			35	206	60.6		
1957	4756			36	227			
1958	6183			38	223.2	59.2	21.7	19.1
1959	8093			37	230.4			
1960	10403			37	240.9			
1961	12692			38	245			
1962	15428			41	252.2			
1963	17683			42	254.4			
1964	23831			45	257.3	58.6	25.2	16.2
1965	31061			50	273.2			
1966	37250			55	290.8			
1967	42529			62	303	59.7		
1968				69	319			
1969	49854			76	357			
1970		240000	410	87	365	58.1	22	14.9
1971			471		372			
1972			522		385			
1973			586		404			
1974		370000	663		421			
1975		413000	771		443	62.1	24.6	13.3
1976			850		458			
1977			930		477			
1978		550000	1143		491			
1979			1178		511			
1980		578000P	1226		531	67	19.1	13.9
1981			1317		540			
1982			1446		540			
1983			1512		471			
1984					452			
1985					455			
1986								
1987								
1988								
1989								
1990								

Notes to Table 6. ECONOMIC DIMENSIONS

All figures are in million rubles except employment, which is in thousands. This table consists of three parts--one dealing with communications (sviaz) in general, the second with Minsviaz only, and the third with elektrosviaz only. Each part covers the items listed below. Except as noted, items are from standard statistical handbooks.

All sviaz employment: Basically a Nar khoz series. There is a separate series for Minsviaz' employment, and I assume that this larger series includes some departmental telephone systems.

All sviaz revenues: 1956-57. 1959—Tochil'nikov; 1958--A.I Podgorodetskii, Ekonomika sviazi, Moscow, 1967, p. 29; 1965. 1970-71—A.I. Podgorodetskii, Statistika sviazi, Moscow, 1973, p. 119; 1975, 1980—O.S. Srapionov, Ekonomika sviazi, Moscow, 1982.

All sviaz outlays: 1958, 1965, I.A. Podgorodetskii, Ekonomika sviazi, 1967, p. 29.

All sviaz profit: 1965-86--Nar khoz, 1958, 1960, 1964-65—Transport i sviaz', 1967. Basically these are all standard handbook numbers, except where I do them as a residual.

All sviaz output: 1950--Lewis, p. 409; 1951-1954, 1956-1957--estimates from Kaplan, Soviet Transport and Communications Output Indexes, Rand, 1964; 1958-59. 1961-63, 1970-71—A.I Podgorodetskii, Statistika sviazi, Moscow, 1973, pp. 119, 217.

All sviaz fixed assets: 1960, 1965--A.I. Podgorodetskii, Ekonomika sviazi, 1967, p. 29; 1970, 1975, 1980—O.S. Srapionov, Ekonomika sviazi, Moscow, 1982.

All sviaz investment: 1950, 1955, 1960, 1965--I.A. Podgorodetskii, Ekonomika sviazi, Moscow, 1967, p. 195 (it is possible this could be Minsviaz only); 1961-64—Transport i sviaz', 1967, p. 42; 1966—Sviaz' SSR za 50 let, p. 22; 1968--M.G. Kozlov, Ekonomika sviazi, Moscow, 1971, p. 145 (includes centralized and decentralized); 1979--Ekonomicheskaia Gazeta, 1979:44, pp. 1-2; 1980--estimate based on EKO, 1981:1; 1985--estimate based on 12th FYP (9.5 BR) given in Plan khoz, 1986:6.

A possible substitute for investment data is the data on commissionsings (vvod v deistvie) that appear in recent issues of Nar khoz. What we have is the following, in billion rubles:

Year	old prices	1984 prices
1975	.951	1.1
1971-75	4.227	4.8
1980	1.169	1.3

1976-80	5.280	6.0
1981	1.230	1.398
1982	1.253	1.424
1983	1.400	1.591
1984	na	1.6
1985	na	1.6
1981-85	na	7.6

Minsviaz employment: (this seems generally to be po osnovnoi deiatel'nosti): 1951-54, 1956--interpolated on the basis of a broader series from TsSU, Transport i sviaz', 1957, p. 216; 1958--M.G. Kozlov, Ekonomika sviazi, Moscow, 1971, p. 19; 1959, 1961-64--I.A. Podgorodetskii, Ekonomika sviazi, Moscow, 1967, p. 217, using 1960 as a base; 1975, 1980--O.S. Srapionov, Ekonomika sviazi, Moscow, 1982, p. 175. There is a larger series (in Transport i sviaz' 1957, that must include employment outside osnovnaia deiatel'nost', i.e. I would guess construction and industry, maybe ag and trade. It is 86 thousand people in 1956.

Minsviaz outlays: 1950-57, 1959, 1961-63--Sviaz za 50 let, p. 18.

Minsviaz revenues: 1957, 1959, 1961-63--Sviaz' za 50 let, p. 18; 1975, 1980--O. S. Srapionov, Ekonomika sviazi, Moscow, 1982, p. 175.

Minsviaz profit: 1975, 1980--O.S. Srapionov, Ekonomika sviazi, Moscow, 1982, p. 175.

Minsviaz fixed assets: 1958, 1969--M.G. Kozlov, Ekonomika sviazi, Moscow,, 1971, p. 19; 1960--I.A. Podgorodetskii, Ekonomika sviazi, Moscow, 1967, p. 29; 1965, 1970, 1975, 1980--O.S. Srapionov, Ekonomika sviazi, Moscow, 1982, p. 175.

Minsviaz output: 1950, 55, 60, 65-70=--Transport i sviaz' , 1972, p. 299; 1965, 1970, 1975, 1980--O.S. Srapionov, Ekonomika sviazi, Moscow, 1982, p. 175.

The following items for elektrosviaz only are usually additions of the rural and urban telephone, intercity telephone, and telegraph subsectors. They do not include radio and television broadcasting. Usually what is given in the source is a percentage of electrosviaz in the Minsviaz total, and I have converted these to absolute amounts.

Elektrosviaz employment: 1959--A.A. Vishnevskii, Ekonomika sviazi, Moscow,, 1961, pp. 201; 1962, 1965--I.A. Podgorodetskii, Ekonomika sviazi, Moscow, 1967, p. 241; 1975, 1980--O.S. Srapionov, Ekonomika sviazi, Moscow, 1982, p. 268.

Elektrosviaz revenues: 1959--A.A. Vishnevskii, Ekonomika sviazi, Moscow, 1961, p. 253.

Elektrosviaz outlays: 1953, 1956, 1962--I.A. Podgorodetskii, Ekonomika sviazi, Moscow, 1967, p. 262; 1965, 1968, 1970--O.S. Srapionov, Ekonomika

sviazi, Moscow, 1982, p. 290.

Elektrosviaz investment: 1950--A.A. Vishnevskii, Ekonomika sviazi, Moscow,, 1961, pp. 142-3; 1971-75--O.S. Srapionov, Ekonomika sviazi, Moscow, 1982, p. 203.

Elektrosviaz fixed asets: 1965--I.A. Podgorodetskii, Ekonomika sviazi, Moscow, 1967, p. 38 (this seems to be a bit large--maybe a narrow denominator ?); 1970, 1975, 1980--O.S. Srapionov, Ekonomika sviazi, Moscow, 1982, p.175.

Elektrosviaz output: 1950, 1960--J. Patrick Lewis, "Communications Output in the USSR: A Study of the Soviet Telephone Systems," Soviet Studies, July, 1976, p. 409; 1962, 1965--I.A. Podgorodetskii, Ekonomika sviazi, Moscow, 1967, p. 241; 1970, 1975--A.V. Razgovorov, Planirovanie razvitiia sviazi, Moscow, 1978, p. 56 (this seems a bit large--maybe a narrow denominator ?).

TABLE 6 ECONOMIC DIMENSNS

YEAR	ALL SVIAZ EMPLOYMENT	REV	OUTLAYS	PROFIT	INVESTMENT	FIXED ASSETS	OUTPUT	MINSVIAZ EMPLOYMENT	REV	OUTLAYS	PROFIT	INVESTMENT
1950	542				68		734	511.9	713.9	525.5	187.8	
1951	559						781	532	788.6	554.4	234.2	
1952	565						816	549	845.4	577	268.4	
1953	582						868	561	844.2	592.5	251.7	
1954	595						917	579	901.6	647	254.6	
1955	611				110.1		967.1	602.2	974.3	685.6	288.7	
1956	624	1045.8					1027	620	1045.4	729.4	316	
1957	641	1165.1					1080	635.5	1165.3	781.4	383.9	
1958	664	1249.5	837.4	416			1175.6	652	1249.5	837.5	412	
1959	691	1341.7					1254.4	674	1341.7	904	437.7	
1960	738			391	213.3	2050	1361.9	731	1444.1	1056.9	387.2	
1961	790				223		1456.5	779	1572.2	1248	324.2	
1962	832				264		1565.8	824	1648.9	1323.3	325.6	
1963	877				301		1692.8	874	1739.4	1317	422.4	
1964	928			425	405		1829.1	923	1849	1437.3	411.7	
1965	1007	2002.1	1592.5	425	436	3568	2013.4	1006.4	2002.5	1592.5	410	
1966	1073			488	548		2235.8	1071	2216.1	1744.7	471.4	
1967	1123	2466.8	1900.4	588			2471.6	1121.5	2466.8	1900.4	566.4	
1968	1187			652	620			1174.7	2770.9	2143.1	627.8	
1969	1260			762				1231.9	3027.9	2299.1	728.8	
1970	1330	3297.1		840		6450	3291.7	1301.2	3297.1	2497.5	799.6	
1971	1394	3588.5		960			3570.4	[1359]				
1972	1435			1067			3800	[1395]				
1973	1465			1172			4100	[1420]				
1974	1499			1197			4500	[1447]				
1975	1528	4946.2		1290		10635	4820.8	1479.1	4946.2		1232.7	
1976	1555			1387			5100	[1499]				
1977	1575			1507			5400	[1518]				
1978	1599			1738			5800	[1540]				
1979	1613			1955	989.3		6100	[1552]				
1980	1634	7097.2		2282	1100	15149	6478.7	1571	7097.2		2282.2	
1981	1649			2527								
1982	1666			2665								
1983	1674			3298								
1984	1672			3569								
1985	1670	9600		3863	1500							
1986		10100		4224								
1987												
1988												
1989												
1990												

TABLE 6

YEAR	FIXED ASSETS	OUTPUT	ELEKTRO-SVIAZ EMPLOYMENT	REV	OUTLAYS	PROFIT	INVESTMENT	FIXED ASSETS	OUTPUT
1950		734.4		289.5			51.1%		285
1951				310.6					
1952				332.5					
1953				345.1	235				
1954				359.6					
1955		967.1		372.6					
1956				394.2					
1957				411.7	314				
1958	1850	1177.6		429.3					
1959			222	452					
1960	2050	1361.3		498.3					558
1961				547.9					
1962			322	609.3	523				38.8%
1963				661.4					
1964				717.2					
1965	3963.	2013.4	396	793.8	670	124		69.8%	789
1966		2235.8		893.1					
1967		2471.6		1029.8					
1968		2723.7		1190.6	829	362			
1969	5280.	3001.6		1357.2					
1970	6450	3279.6		1509.3	1099	772		70.4%	1522
1971							65.2%		
1972							65.2%		
1973							65.2%		
1974							65.2%		
1975	10625	4820.8	607				65.2%	73.3%	2351
1976									
1977									
1978									
1979									
1980	15148	6478.7	652					75.1%	
1981									
1982									
1983									
1984									
1985									
1986									
1987									
1988									
1989									
1990									

Table 7. REGIONAL DISTRIBUTION OF MINSVIAZ TELEPHONES

All figures are in thousands.

Date are from regional handbooks except as noted.

Data shown are explicitly labeled Minsviaz telephones with a few exceptions: Moldavian SSR [but we know Minsviaz only for 1970 (83.4-68-15.4) and for 1965 (36.5-28-8.5)]; Turkmen SSR [we know the 1965 figure is Minsviaz only, and we have Minsviaz only for 1977 (97.9-80.9-17.0), 1976 (91.7-76.6-15.1), 1975 (84.9-72.0-12.9), and for 1970 (48.1-42.3-5.8); Latvian SSR [we know the figures for 1980 are Minsviaz only, and the figures for 1975 are Minsviaz only since they are from a series where 1970 is smaller than the usual number. We also know Minsviaz only for 1970 (161.6-129.6-32.0) and for 1965 (122-94-28)].

In some sources, figures for the Azerbaidzhan SSR are labeled public network, but other sources make clear that those same numbers are for Minsviaz only.

We know the Lithuanian SSR data are for Minsviaz only from the fact that these numbers fit in a series where 1960 is labeled Minsviaz only.

The 1980 figures for Tadzhik and Armenia are calculated on the basis of phones per inhabitant given in Vestnik statistiki, 1986:8, p. 42. Tadzhik, 1975—Elektrosviaz', 1982:6, p. 6.

The figure for Gruzinskaia SSR in the 1980 table is for 1979.

The Lithuanian source says that in 1984 in addition to Minsviaz telephones, there were 98 thousand departmental telephones.

TABLE 7

YEAR 1985	REGIONAL DISTRIBUT TOTAL	URBAN	RURAL	CHECK]
RSFSR				0
UKRAINE	4952	4209	743	4952
BELORUSSIA	112.2	874	238.2	1112.2
MOLDAVIA	365	278.5	86.5	365
UZBEKISTAN				0
KAZAKHSTAN	1283	929	354	1283
KIRGIZIIA				0
TADZHIK				0
TURKMENISTAN	193	164.7	28.3	193
LITHUANIA	592.4	466.2	126.2	592.4
LATVIA	600	470	130	600
ESTONIA				0
AZERBAIDZHAN				0
ARMENIA				0
GRUZINSKAIA				0
TOTAL USSRACT	8097.6	7391.4	1706.2	9097.6

YEAR 1984	TOTAL	URBAN	RURAL	CHECK]
RSFSR	14165	11902	2262	14164
UKRAINE	4695	3997	698	4695
BELORUSSIA	1028.7	805.5	222.9	1028.4
MOLDAVIA	340.2	261.3	78.9	340.2
UZBEKISTAN	872.6	664.7	207.9	872.6
KAZAKHSTAN	1206.8	874.6	332.2	1206.8
KIRGIZIIA	208.4	148	60.4	208.4
TADZHIK				0
TURKMENISTAN	176.3	150.3	26	176.3
LITHUANIA	554.8	437	117.8	554.8
LATVIA	575	450	125	575
ESTONIA	279	218	61	279
AZERBAIDZHAN	439.5	351.7	87.8	439.5
ARMENIA				0
GRUZINSKAIA	432.5	351.2	81.3	432.5
TOTAL USSRACT	24973.8	20611.3	4361.2	24972.5

YEAR 1983				
RSFSR	13348	11198	2150	13348
UKRAINE	4418	3765	653	4418
BELORUSSIA	958.4	750.2	208.2	958.4
MOLDAVIA	323	249.4	73.6	323
UZBEKISTAN	805.8	611.8	194	805.8
KAZAKHSTAN	1132	819.2	312.8	1132
KIRGIZIIA	190.4	133.6	56.8	190.4
TADZHIK				0
TURKMENISTAN	161.6	136.9	24.7	161.6
LITHUANIA	520	410.8	109.2	520
LATVIA	555	433	122	555
ESTONIA	268	210	58	268
AZERBAIDZHAN	410.1	327.5	82.6	410.1
ARMENIA				0
GRUZINSKAIA	418.8	341.7	77.1	418.8
TOTAL USSRACT	23509.1	19087.1	4122	23503.1

YEAR 1982	TOTAL	URBAN	RURAL	CHECK]
RSFSR	12620	10580	2040	12620
UKRAINE	4183	3574	609	4183
BELORUSSIA	895.5	701.4	194.1	895.5
MOLDAVIA	307.6	236.8	70.8	307.6
UZBEKISTAN	743.6	567.8	175.8	743.6
KAZAKHSTAN	1058	764.4	293.6	1058
KIRGIZIIA	179.4	126.5	52.9	179.4
TADZHIK				0
TURKMENISTAN	147.9	125	22.9	147.9
LITHUANIA	485.3	384.9	100.4	485.3
LATVIA	539	422	117	539
ESTONIA	258	205	53	258
AZERBAIDZHAN	380.7	303.3	77.4	380.7
ARMENIA				0
GRUZINSKAIA	404.1	336.2	67.9	404.1
TOTAL USSRACT	22202.1	18327.3	3874.8	22202.1

YEAR 1981				
RSFSR	11922	9987	1935	11922
UKRAINE	3947	3377	569	3946
BELORUSSIA	842.8	661.6	180.8	842.4
MOLDAVIA	291.7	224.1	67.6	291.7
UZBEKISTAN	678	538.6	139.4	678
KAZAKHSTAN	992	717.5	274.5	992
KIRGIZIIA	166.2	137.7	28.5	166.2
TADZHIK				0
TURKMENISTAN	138	116.3	21.7	138
LITHUANIA	455.5	354.4	101.1	455.5
LATVIA	522	410	112	522
ESTONIA	248	196	52	248
AZERBAIDZHAN	348.4	273.2	75.2	348.4
ARMENIA				0
GRUZINSKAIA	387.1	323.8	63.3	387.1
TOTAL USSRACT	20938.7 20100	17317.2	3620.1	20937.3

YEAR 1980	TOTAL	URBAN	RURAL	CHECK]
RSFSR	11201	9495	1706	11201
UKRAINE	3711.2	3082.6	628.6	3711.2
BELORUSSIA	784.2	594.9	189.3	784.2
MOLDAVIA	275.9	213.3	62.6	275.9
UZBEKISTAN	628.6	503.8	124.8	628.6
KAZAKHSTAN	929	672.4	256.6	929
KIRGIZIIA	153.5	127.2	26.3	153.5
TADZHIK	132.3	106	26.3	132.3
TURKMENISTAN	133	109.9	23.1	133
LITHUANIA	427.5	333.6	93.9	427.5
LATVIA	503	396	107	503
ESTONIA	237	188	49	237
AZERBAIDZHAN	323.8	256.6	67.2	323.8
ARMENIA	397.4	316.6	80.8	397.4
GRUZINSKAIA	351.4	291	60.4	351.4
TOTAL USSRACT	20208.8	16686.9	3501.9	20188.8

YEAR 1979	TOTAL	URBAN	RURAL	CHECK]
RSFSR	10441	8844	1597	10441
UKRAINE	3477.4	2897.7	579.7	3477.4
BELORUSSIA	733.5	560.2	173.3	733.5
MOLDAVIA	259.2	194.5	64.7	259.2
UZBEKISTAN	579.3	464.1	115.2	579.3
KAZAKHSTAN	863	686.2	176.8	863
KIRGIZIIA	140.4	115.3	25.1	140.4
TADZHIK				0
TURKMENISTAN	126.3	104.4	21.9	126.3
LITHUANIA	396.6	309.9	86.7	396.6
LATVIA				0
ESTONIA	223	16.9	54	223
AZERBAIDZHAN	299.9	232.9	67	299.9
ARMENIA				0
GRUZINSKAIA	351.4	291	60.4	351.4
TOTAL USSRACT	17831	14969.2	3021.8	17991

YEAR 1978	TOTAL	URBAN	RURAL	CHECK]
RSFSR	9745	8258	1487	9745
UKRAINE	3252	2717.2	534.8	3252
BELORUSSIA	685.8	527.7	158.1	685.8
MOLDAVIA	242.5	184.4	58.1	242.5
UZBEKISTAN	526.3	423.6	103.1	526.7
KAZAKHSTAN	800	638.8	161.2	800
KIRGIZIIA	127.6	104.5	23.1	127.6
TADZHIK				0
TURKMENISTAN	120.4	99.5	20.9	120.4
LITHUANIA	367.4	287.8	79.6	367.4
LATVIA				0
ESTONIA	213	164	49	213
AZERBAIDZHAN				0
ARMENIA	348.8			0
GRUZINSKAIA				0
TOTAL USSRACT	16428.8	13405.5	2674.9	16080.4

YEAR 1977				
RSFSR	9103	7731	1372	9103
UKRAINE	3035.9	2544.7	491.2	3035.9
BELORUSSIA	634.4	491.9	143.2	635.1
MOLDAVIA	226.1	173.1	53	226.1
UZBEKISTAN	469.6	380.5	89.1	469.6
KAZAKHSTAN	737	592	145	737
KIRGIZIIA	116.2	94.9	21.3	116.2
TADZHIK				0
TURKMENISTAN	112.8	93.4	19.4	112.8
LITHUANIA	340.1	267.2	72.9	340.1
LATVIA	435	347	88	435
ESTONIA	201	155	46	201
AZERBAIDZHAN				0
ARMENIA	329.1			0
GRUZINSKAIA				0
TOTAL USSRACT	15740.2	12870.7	2541.1	15411.8

YEAR 1975	TOTAL	URBAN	RURAL	CHECK	YEAR 1970	TOTAL	URBAN	RURAL	CHECK	YEAR 1953	TOTAL	URBAN	RURAL	CHECK
RSFSR	9457	7210	1257	8467	RSFSR	4890	4213	677	4890	RSFSR	1241.1	1008	153.1	1241.1
UKRAINE	2838.8	2392.9	445.9	2838.8	UKRAINE	1480	1270.4	209.6	1480	UKRAINE	264.8	222	42.8	264.8
BELORUSSIA	587.4	458.4	129	587.4	BELORUSSIA	286.8	224.9	61.9	286.8	BELORUSSIA	52.8	43	9.8	52.8
MOLDAVIA	203	156.2	46.8	203	MOLDAVIA	95.2	79.8	15.4	95.2	MOLDAVIA	17	14	3	17
UZBEKISTAN	402.9	331.7	71.2	402.9	UZBEKISTAN	192.5	160	32.5	192.5	UZBEKISTAN	37.3	33	4.3	37.3
KAZAKHSTAN	675	545.3	129.7	675	KAZAKHSTAN	343	280.5	62.5	343	KAZAKHSTAN	59.9	51	8.9	59.9
KIRGIZIA	106	86.1	19.9	106	KIRGIZIA	54.4	44.9	9.5	54.4	KIRGIZIA	12.2	11	1.2	12.2
TADZHIK				0	TADZHIK	56.5	49	7.5	56.5	TADZHIK	10.3	9	1.3	10.3
TURKMENISTAN	105.6	90.2	15.4	105.6	TURKMENISTAN	58.9	52.9	6	58.9	TURKMENISTAN	13.1	12	1.1	13.1
LITHUANIA	312.1	245.8	66.3	312.1	LITHUANIA	161.6	129.6	32	161.6	LITHUANIA	27.2	21	6.2	27.2
LATVIA	418	337	81	418	LATVIA	243	199	44	243	LATVIA	57.1	41	16.1	57.1
ESTONIA	194	150	44	194	ESTONIA	113	87	26	113	ESTONIA	33.8	25	8.8	33.8
AZERBAIDZHAN				0	AZERBAIDZHAN	157.7	127.6	30.1	157.7	AZERBAIDZHAN	40.7	37	3.7	40.7
ARMENIA	313.6			0	ARMENIA	174	143	31	174	ARMENIA	21.8	19	2.8	21.8
GRUZINSKAIA	265.7	242.3	43.4	285.7	GRUZINSKAIA	167.7	145	22.7	167.7	GRUZINSKAIA	42.4	37	5.4	42.4
TOTAL	14309.1	12245.9	2349.6	14595.5	TOTAL	8474.3	7206.6	1267.7	8474.3	TOTAL	1951.5	1663	288.5	1951.5
USSRACT					USSRACT	8479	3715	764		USSRACT	1931	1663	268	

YEAR 1975					YEAR 1965					YEAR 1950	TOTAL	URBAN	RURAL	CHECK
RSFSR	7825	6678	1147	7825	RSFSR	2715	2393	321.9	2714.9	RSFSR	913	812	101	913
UKRAINE	2631.9	2229.6	402.3	2631.9	UKRAINE	623.1	505.9	117.2	623.1	UKRAINE	187.8	159	28.8	187.8
BELORUSSIA	532.2	416.3	115.9	532.2	BELORUSSIA	130.4	99.7	30.9	130.6	BELORUSSIA	41.1	35	6.1	41.1
MOLDAVIA	184.4	147.1	37.3	184.4	MOLDAVIA	44.7	37.1	7.6	44.7	MOLDAVIA	9.6	8	1.6	9.6
UZBEKISTAN	351.5	290.7	60.8	351.5	UZBEKISTAN	105.5	84.3	21.2	105.5	UZBEKISTAN	27.8	25	2.8	27.8
KAZAKHSTAN	611	496.6	114.4	611	KAZAKHSTAN	170	136.9	33.1	170	KAZAKHSTAN	48.3	38	5.3	48.3
KIRGIZIA	97.2	79.3	17.9	97.2	KIRGIZIA	31.5	26	5.5	31.5	KIRGIZIA	7.7	7	0.7	7.7
TADZHIK	08.1			0	TADZHIK	28.1	24.2	3.9	28.1	TADZHIK	7.8	7	0.8	7.8
TURKMENISTAN	98.3	85.1	13.2	98.3	TURKMENISTAN	29	25	4	29	TURKMENISTAN	8.9	8	0.9	8.9
LITHUANIA	283	223.4	59.6	283	LITHUANIA	81.7	64.4	17.3	81.7	LITHUANIA	17.4	15	2.4	17.4
LATVIA	393	319	74	393	LATVIA	139	111	28	139	LATVIA	44.1	31	13.1	44.1
ESTONIA	180	144	36	180	ESTONIA	69	53	16	69	ESTONIA	24.9	17	7.9	24.9
AZERBAIDZHAN	225.5	177.8	47.7	225.5	AZERBAIDZHAN	105.4	93.1	12.3	105.4	AZERBAIDZHAN	28.3	26	2.3	28.3
ARMENIA	264.8			0	ARMENIA	87.5	77	10.5	87.5	ARMENIA	15.9	14	1.9	15.9
GRUZINSKAIA	267.8	227.9	39.9	267.8	GRUZINSKAIA	94	81.1	12.9	94	GRUZINSKAIA	32.6	29	3.6	32.6
TOTAL	14063.7	11514.8	2166	13680.8	TOTAL	4403.9	3761.7	642.3	4404	TOTAL	1410.2	1231	179.2	1410.2
USSRACT					USSRACT					USSRACT	1410	1231	179.2	

YEAR 1974					YEAR 1960				
RSFSR				0	RSFSR	1702.1	1472	230.1	1702.1
UKRAINE				0	UKRAINE	371.4	305	66.4	371.4
BELORUSSIA				0	BELORUSSIA	73.8	56	17.8	73.8
MOLDAVIA				0	MOLDAVIA	22.4	17	5.4	22.4
UZBEKISTAN				0	UZBEKISTAN	61.7	51	10.7	61.7
KAZAKHSTAN				0	KAZAKHSTAN	89	75	14	89
KIRGIZIA	88.6	72.5	16.1	88.6	KIRGIZIA	16.9	14	2.9	16.9
TADZHIK				0	TADZHIK	16.3	14	2.3	16.3
TURKMENISTAN				0	TURKMENISTAN	18.9	17	1.9	18.9
LITHUANIA				0	LITHUANIA	46.8	36	10.8	46.8
LATVIA				0	LATVIA	81.9	61	20.9	81.9
ESTONIA				0	ESTONIA	42.4	31	11.4	42.4
AZERBAIDZHAN				0	AZERBAIDZHAN	58.9	53	5.9	58.9
ARMENIA				0	ARMENIA	39.4	35	4.4	39.4
GRUZINSKAIA				0	GRUZINSKAIA	55.5	47	8.5	55.5
TOTAL	88.6	72.5	16.1	88.6	TOTAL	2697.4	2284	413.4	2697.4
USSRACT					USSRACT	2697	2284	413	

Notes to Table 8. TELEVISION AND RADIO
These data are mostly from standard statistical sources. Those sources have been supplemented significantly by the summaries on radio and television which appear in the annual supplements to the BSE. Data from other sources are so noted.

Retail sales of televison sets. TsSU has used two different definitions. Most of the data refer to sales to the population, but those before 1960 are the numbers "put into the retail trade network for sale to the population." Apparently some are unsold, pilfered, or whatever, since in 1960 some 40 thousand fewer were sold than were put into the network. I used this attrition ratio to estimate the number sold in 1960, for which only the old definition is available.

High- and low-power retransmitters: 1980--implied in Elektrosviaz',1981:2, p. 3. High-power, 1981--implied in Elektrosviaz', 1983:10, p. 20.. High-power means 5-50 KW (Elektrosviaz', 1981:2, p. 3); low-power is 1-100 watts (BSE). low-power, 1985--Vestnik sviazi, 1986:3, P. 4, but another source says 5,000, which makes more sense.

Total receiving sets includes TV sets, radio sets, and wired receivers.

VCRs produced: 1987-1990 (planned)--Izvestiia, 21 March, 1987. The Soviet VCR is the VM-12, produced in Minelektronprom. Alternative targets (from the complex program for consumer goods production) are 60 thousand in 1990, 120 thousand in 2000 (Izvestiia, 15 October 1985).

Moskva receivers: 1981--F. Varbanskii in Elektrosviaz', 1983:10, p. 20; 1983--Elektrosviaz', 1984:4, p. 4.

Ekran receivers: 1981--F. Varbanskii in Elektrosviaz', 1983:10, p. 20; 1983--Vestnik sviazi, 1983:4, p. 3; 1985--Radio, 1987:4, p. 2.

Videocassete production: 1985--Izvestiia, 15 October, 1985.

Fraction of population receiving TV: 1970, all--N.D. Psurtsev, Sviaz' v deviatoi piatiletke, M. 1970; 1980, Elektrosviaz', 1981:2, p. 3; 1981--Elektrosviaz', 1982:4, p. 1; 1984--Elektrosviaz', 1985:11,, p. 61; 1986--Radio, 1987:4, p. 2.

TV ownership per thousand: One source suggests that this may be ownership "in the zone of possible reception."

TV broadcast hours: Problemy televideniia i radio, vypusk 2, M., 1961, except 1950-51, all--S. Kaftanov, Radio i televidenie v SSSR; 1986--Radio, 1987:5, p. 2.

Radio broadcast hours: Mostly BSE Ezhegodnik, various years; 1986--Radio, 1987:5. p. 2.

TABLE 8 TELEVISION AND RADIO

YEAR	NUMBER OF TV STATIONS TOTAL	PROGRAM STATIONS	HIGH POWER RETRANS	LOW POWER RETRANS	MOSKVA RECEIVERS	EKRAN RECEIVERS	TV RECEIVERS MILL	WIRED RADIO RECEIVERS MILL	NO OF RADIO RECEIVERS MILL	WIRED RADIO HEADENDS THOUS	TOTAL RECEIVING POINTS MILL
1950	2	2	0	0			0.015	9.685	3.643	18.9	13.343
1951	2	2	0	0			0.056	10.64	4.84	22	15.536
1952	3	3	0	0			0.114	11.678	5.8	25.4	17.592
1953	3	3	0	0			0.225	13.841	7.313	28.1	21.379
1954	4	4	0	0			0.45	16.439	10.013	31	26.902
1955	18	12	1	5			0.823	19.544	12.972	33.5	33.339
1956	34	20	2	12			1.324	22.191	16.244	35.2	39.759
1957	49	28	2	19			1.767	24.771	19.077	36.522	45.615
1958	139	60	7	72			2.539	27.117	21.694	37.855	51.35
1959	210	68	16	126			3.576	29.155	24.729		57.46
1960	275	82	18	175			4.788	30.837	27.811	39.033	63.436
1961	347	93	23	231			6.535	32.096	30.471	38.067	69.102
1962	397	100	30	267			8.298	33.078	32.835	36.756	74.211
1963	460	107	43	310			10.48	33.753	35.189	35.372	79.422
1964	586	115	53	418			12.838	34.642	36.687	34.897	84.167
1965	653	120	65	468			15.693	35.638	38.228	34.206	89.553
1966	748	121	79	548			19.043	36.999	39.805	36.822	95.847
1967	890	129	98	667			22.7	38.9	41.8	36.518	103.4
1968	991	127	116	748			26.8	41	44.4	35.982	112.2
1969	1078	126	129	823			30.8	43.4	46.7	35.71	120.9
1970	1233	128	152	953			34.8	46.2	48.6	35.145	129.6
1971	1341	131					39.3	49.4	50.8		139.5
1972	1466	132					45.4	52.1	53.2		150.7
1973	1620	130					49.2	59.5	54.8	35	163
1974	1749	130					52.5	59	57.1		172.3
1975	1957	130					55.2	62.7	59.8		181.4
1976	2116	121				FIRST	57.6	66.4	64.5		192.3
1977	2259	119					59.9	70.2	63.3		197.2
1978	2504	117					62.5	74	64.7		205
1979	2882	117					64.3	77.8	66.2		130.5
											81.6
1980	3447	117	333	2967	FIRST	470	66.8	81.6	67.9		220
1981	4150	116	333		100F	2300	70.7	85.3	71.6		231.3
1982	4861	117			50	1500	74.7	89	74.8		242.4
1983	5606	117			160	1900	79	92.9	78		253.8
1984	6146	120	~500				80.3	96.8	81.2	33.5	262.2
1985	6812	115	~500	5000	~900	3000	82.4	100.7	82.1		269.3
1986	7401	NA				4000	85.2	104.8	82.6		ERR
1987											0
1988											0
1989											0
1990											0

TABLE 61

YEAR	PRODUCTION OF TV SETS THOUS B+W	COLOR	TOTAL	RETAIL SALES OF TV'S THOUS B+W	COLOR	TOTAL	PROD-SALES THOUS B + W	COLOR	TOTAL	CUM TOTAL SALES THOUS	IMPLIED ATTRITION IN YR THOUS
1950	12	0	12	12	0	12	0	0	0	12	-3
1951	25	0	25	54	0	54	-29	0	-29	66	13
1952	37	0	37	68	0	68	-31	0	-31	134	10
1953	84	0	84	122	0	122	-38	0	-38	256	11
1954	254	0	254	287	0	287	-33	0	-33	543	62
1955	495	0	495	483	0	483	12	0	12	1026	110
1956	596	0	596	583	0	583	13	0	13	1609	82
1957	709	0	709	590	0	590	119	0	119	2199	147
1958	979	0	979	912	0	912	67	0	67	3111	140
1959	1278	0	1278	1132	0	1132	146	0	146	4243	95
1960	1726	---	1726	1488	0	1488	238	0	238	5731	276
1961	1948.9	---	1948.9	1756	0	1756	192.9	0	192.9	7487	9
1962	2168.5	---	2168.5	1977	0	1977	191.5	0	191.5	9464	214
1963	2473.5	---	2473.5	2231	0	2231	242.5	0	242.5	11695	43
1964	2927	---	2927	2645	0	2645	282	0	282	14340	287
1965	3655	---	3655	3338	0	3338	317	0	317	17678	483
1966	4415	---	4415	3973	0	3973	442	0	442	21651	623
1967	4955	---	4955	4271	0	4271	684	0	684	25922	614
1968	5742	---	5742	4991	0	4991	751	0	751	30913	691
1969	6595	---	6595	5073	0	5073	1522	0	1522	35906	1073
1970	6636	46	6682	5557	23	5580	1079	23	1102	41543	1890
1971	5758	59	5817	NA	NA	6244	NA	59	-427	41543	1744
1972	5903	27	5930	NA	NA	6706	NA	27	-816	41543	698
1973	6105	166	6271	NA	NA	6105	NA	166	166	41543	2905
1974	6163	406	6569	NA	NA	5941	NA	406	628	41543	3641
1975	6371	589	6960	5568	434	6002	803	155	958	47111	3302
1976	6258	805	7063	5073	618	5991	885	187	1072	52404	3591
1977	5951	1122	7073	5214	938	6152	737	184	921	57696	3852
1978	5734	1431	7165	5659	1127	6780	81	304	385	63381	4180
1979	5457	1814	7271	5093	1360	6453	364	454	818	68444	4653
1980	5266	2262	7528	4715	1908	6523	551	454	1005	73159	4023
1981	5480	2710	8190	4655	2036	6691	825	624	1449	77814	3791
1982	5236	3116	8354	4678	2395	7073	558	763	1321	82492	3839
1983	5170	3408	8578	4636	2729	7409	534	635	1169	87128	3109
1984	5400	3598	8998	4511	3504	8015	689	94	983	91639	3715
1985	5042	4024	9371	4361	3755	8116	986	269	1255	96000	4016
1986	5070	4366	9436	4474	4156	8630	596	210	806	100474	3830
1987	4690P	5137P	9827P				0	0	0		
1988							0	0	0		
1989							0	0	0		
1990							0	0	0		

TABLE 8

YEAR	TV BROADCAST HRS DAILY TOTAL	LOCAL PROGRAMS	CENTRAL PROGRAMS	RE-TRANSMISS	RADIO HOURS DAILY DOMESTIC	RADIO HOURS CENTRAL ONLY
1950	3.6					
1951	4.1					
1952	5.8					
1953	7.7					
1954	9.3					
1955	15.3	15.3	4.4	--		
1956	129.5	115.5	9.4	8		
1957	194.7	172.8	10.1	16.9		
1958	276.5	250.3	10.1	26.2		
1959	402.1	339.7	11.6	62.4		
	536.3	405.6	12.5	130.7		
1960	621.2	433.8	12.2	107.4		
1961	695.8	454.3	12.5	241.5		
1962	792.2	462.2	14.7	330		
1963	1018.4	480.8	16.7	537.6		
1964						
1965						
1966						
1967						
1968						
1969						
1970						
1971	1656		41.3		1040	
1972	1883				1080	155.8
1973	1900		45			150
1974	1900		48			
1975	>2000		58			150
1976			58.4			
1977			79.8			
1978			83.7			
1979			84.3			180
1980			90			160
1981			87			179.4
1982						
1983						214.4
1984						
1985		~500	147			
1986	>3600				1400	
1987						
1988						
1989						
1990						

TABLE 8

YEAR	TV OWNERSHIP P/1000 ALL	SHARE RECEIVING TV (%) ALL	URBAN	RURAL	RADIO RECEIVER PRODUCTION THOUS	VCR PRODUCTION THOUS	VIDEO CASSETTES PRODUCED THOUS.	MAGNITO-PONY PRODUCED THOUS TOTAL	CASSETTE
1950					1072				
1951					1234				
1952					1296				
1953					1641				
1954					2900				
1955					3549				
1956					3772				
1957					3951			59	
1958					3902			70.9	
1959					4035			93.7	
1960	22				4165			128	
1961					4251			149.3	
1962					4401			195	
1963					4796				
1964					4766				
1965	68	94	37		5160			453	
1966					5842			648	
1967					6416			792	
1968	112				6978			928	
1969	127				7276			1004	
1970	143	195	88	>70	7815			1192	
1971	160			70	8794			1384	
1972	182				8842			1636	
1973	195			72	8615			1797	
1974	207			73	8753			2112	
1975	215	250	161	75	8376			2525	
1976	223	253	174	80	8456			2601	
1977	230	259	181		8652			2801	
1978	237	268	186		8728			2623	
1979	242	271	193	89	8452			2741	
1980	249	278	200	86	8478			3045	1302
1981	262	290	211	87	8704			3216	1695
1982	274	301	224	88	8906			3446	2021
1983	287	314	237	92	9290			3734	2415
1984					9391			4084	3084
1985	293	314	255	93	8849		25	4665	3795
1986	299	317	266		8924	35.5		4785	3928
1987					8980P	50		5617P	5098P
1988									
1989						200			
1990									

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