Communications and Computers in the Soviet Union

ILLEGIB

By Dr. Ivan Selin

The Soviet Union is moving to an integrated nationwide telephone system that AT&T at its peak would have envied, and the Soviets appear to be succeeding in their ambitious plan. At the same time, they are having serious problems in developing computer systems at a level comparable to those in the West.

Several years ago, the Soviets decided to end the proliferation of special-use local and long distance communications circuits, many of which were being developed independently by various ministries and institutions. Instead, they decided to develop a single, all-encompassing, centrally planned and managed telecommunications system.

When completed, this system will make extensive use of conventional cable, but most of the expansion will be based on satellite communication channels for all-digital, high data rate communications between cities and other major nodes, supplemented by fiber optics within cities and heavily built-up regions. The system will use major digital, computer controlled switching centers and, for the most part, will soften the distinction between military and civilian circuits. A high degree of encryption and security can be expected for a significant portion of the traffic.

Attempts will be made to standardize modulation techniques and devices. Eastern Europe is expected to be integrated fully into this system.

This is a massive project and a great consumer of resources. It is possible, given the hard choices facing the Soviet economy, that at some point Soviet planners will stretch out funding of the telecommunications system. But if they do not, progress to date suggests that it will be completed before the turn of the century.

Current Soviet Telecommunications

The current Soviet transmission network consists of cables carrying analog signals over long distances, heavily supplemented by microwaves carrying less secure digitized signals and by communications satellites. There is a trend toward digitized signals on the copper cable as well. Shorter haul communications also are primarily via copper cable carrying analog signals, but the systems make generous use of fiber optic cables for high capacity, short haul digital transmission. Soviet international communications rely heavily on microwave and communications satellites.

The architecture of the Soviet civilian system follows international standards. It has a single international gateway at Moscow and a standard hierarchy consisting of high level districts, each of which connects to a number of secondary centers, which are connected to many low level centers. There appear to be about 15 district centers, each of which is connected to the international gateway and to all of the other district centers by trunk lines. Each secondary center within a district is connected upward only to its own district center and can communicate only with other centers within the district.

Thus the Soviet telephone system is interconnected in a mesh network. The telephone systems of the Eastern European countries are integrated into this system, using the same types of equipment, the same architecture and basically the same numbering systems. The adherence to international architecture and signaling standards is a key feature of the Soviet system. It permits the Soviets to upgrade their telephone network via standard Western commercial equipment.

Most telephone systems outside of the United States use periodic pulse metering to monitor and determine charges for toll calls. Although this is inexpensive, it does not determine the called number, nor does it produce records of individual calls.

A more costly system is called centralized automatic message accounting (CAMA). CAMA identifies individual calls, including the calling and called numbers. The Soviets decided to invest in CAMA in the 1950s, perhaps to achieve the level of accountability and counterintelligence that CAMA provides.

The use of CAMA has a interesting side effect, relevant to the military use of the civilian system. Since calling subscribers are identified, they can be segregated into classes. This feature allows subscriber classes to be assigned discrete priorities. In particular, it enables military subscribers to be identified and given override privileges, a Soviet prerequisite for joint military civilian use of a single integrated telecommunications network.

Military Implications

Not much is known about how the Soviet Ministry of Defense uses the Ministry of Communications public network, but an informed guess can be made based on technology and defense requirements.

The public network is well-deployed geographically to meet military needs. The high level district centers use relatively modern computer controlled electronic technology. The geography of these centers lines up well with the Soviet military districts and groups of forces and with Soviet intercontinental ballistic missile (ICBM) complexes. The automatic subscriber identification feature of the CAMA accounting system allows high priority users to be identified and facilitates military preemption of channels when required.

These features combine to make the first level of the public network an appropriate vehicle for long-haul military communications in the Soviet Union. The extensive use of cable for this network prevents intercepts of telecommunications traffic. The Ministry of Defense probably relies on the public network for long-haul nontactical communications. This common network most likely is supplemented by dedicated, survivable circuits for long-haul tactical use (for example, control for ICBM launches) and short-haul military communications within a district via dedicated military circuits.

Soviet Trends and Prospects

This overview of Soviet telecommunications shows a country with a clear idea of what it wishes to achieve in telephony. The Soviet Union has made a number of basic technical and managerial decisions consistent with its objectives and has chosen a technical approach taking advantage of its penchant for large projects of relatively straightforward technology (brute force approach).

The Soviets have not been as successful with their data communications. While the underlying telecommunications network will be digital, obliterating distinctions between voice and data as far as transmission is concerned, problems of local interconnections among processors remain to be solved. There is no provision for maintenance and multiple access to common data bases, and protocols for computer-to-computer communications are lacking.

The West has tried to set standards for local area networks and for teleprocessing. The efforts failed, in part because of the variety of users and applications to be served and in part because of the high rate of change in these areas. Instead, the West has learned to rely on market dictated standards. This will be difficult for the Soviet Union, with its rigidities; its propensity to centralize development as well as decision making; its abhorrence of the inefficiency of uncoordinated, competitive, small-team research; and its tradition of ignoring the wishes of the users.

In short, the Soviet Union probably will achieve its plan for an integrated, centralized, mostly digital telephone network by the end of the century. However, it is much less likely to achieve the other, potentially critical benefits of such a network, either in distributed processing for enterprises or in bringing computational and data capabilities to the many organizations and individuals who could benefit by them.

Soviet Computers

Soviet telecommunications indicates that the Soviets do well where they benefit from economies of scale and centralization, but they do poorly in areas requiring competition, decentralization, customer feedback and individual initiative. This pattern of strengths and weaknesses is observed in computers as well. Some computer aspects, such as very large batch oriented main frame computers, centralized storage and processing of information and megamodels, benefit from economies of scale and highly centralized management. These are the areas of computing in which the Soviets have done well. One example of a relatively successful effort is technical support to the State Planning Committee (GOSPLAN). The Soviets attempt not only to describe but also to plan and control their huge economy with a single set of centralized programs operated by GOSPLAN. For pure tenacity, it would be hard to find a set of programmers and programs anywhere in the world to match those of GOSPLAN. When the rulers of the Soviet Union change the guidance under which their planners are operating—as General Secretary Mikhail Gorbachev did at the beginning of 1986—the planners can produce a new plan in only a few weeks.

Even in GOSPLAN, however, the Soviets have succeeded only in single site computing. They have not been able to link the Moscow site to planning and reporting computers around the country for a single, all-union network.

Of course, the plan is notorious for its inaccuracy. When faced with this situation, top political and economics figures in the Soviet Union seem to split into diametrically opposed camps. One side attributes the problem to the need for even bigger and faster computers, while the other places the blame on the intrinsic faults of the highly centralized planning process itself.

Other examples of moderately successful, large-scale computer projects include the centralized command post for controlling many of the municipal operations of the city of Moscow or the huge process control operations that occur in large refineries and petrochemical plants. But Soviet computing failures far outnumber the successes for

any of these same reasons. Before examining the Soviet Union's computing problems in detail, consider what appear to be the Soviet objectives for informatics, the Soviet term for the combined fields of computer science and computer applications.

Apparent Soviet Computing Goals

Several major factors, different from those in the United States, affect Soviet computing goals. In Soviet society, information is power, and in direct contrast to United States society, it is a monopoly of the State. In a country in which copier machines are locked and relatively innocuous data, such as economic or morbidity statistics, are held secret, access to computers and information is a prize the State awards only to its most favored and trusted citizens.

Another aspect of Soviet informatics is its prestige. Many Soviet institutions attempt to automate, to start computer science projects or to obtain a charter for computer manufacture for reasons of prestige rather than for need. Thus an objective of many Soviet institutions is to participate in the informatics program, whether or not a practical goal is foreseen.

The closely held authority for computation, the prestige of informatics and the paucity of decentralized decision making lead to the following assumptions on Soviet computing goals.

- *Scientific*—The Soviet Union attempts to have state-of-the-art theoretical and experimental programs in all fields of science. In this respect, it is similar to the United States but different from every other country in the world. This objective includes all branches of computer sciences. Separately, there is a need for computational facilities to support Soviet programs in other sciences, ranging from astronomy to zoology.
- *Military*—Little unclassified information is available on the plans and the progress of Soviet military computer programs.
- *Central Planning*—The level of computational support required by Soviet central economic planning and monitoring is enormous.
- *Industrial*—The Soviets appear to put a very high priority on automation of factory operations. Soviet objectives for computing in this area are much more limited than their U.S. analogues. The Soviets are striving for productivity and quality control in their production process, but they have much less need than the United States does for the associated planning, ordering and inventory control functions—the Soviet Union has a supply-push system; the United States has a demand-pull system. The factory receives inputs according to the plan and has to do the best it can with them. Furthermore, few changes occur in what the factory is supposed to produce. Soviet industry does not have the frequent model changes, retooling or shifts to new product lines that characterize much of U.S. industry. Consumer goods are defined by the plan, not by rapid response to the latest market research or sales figures.
- *Business Applications*—Most computing applications in the United States fall in the area of business data processing, that is, the support of planning, management, accounting and general white collar business functions. Soviet computing problems and failures generally involve business applications. Yet it is clear that Soviet priorities for computing are lower in this area than in any other, largely because of the much lower status and independence of mid-level managers in Soviet bureaus and enterprises, compared to their U.S. counterparts.

Soviet Progress Against Computing Priorities

One source of trouble for the Soviets is their relative backwardness in the manufacture of miniaturized electronics, especially in microcircuits for computers. This problem, coupled with their weaknesses in quality control and the unavailability of advanced Western computers, affects all of the following application areas. Of course, their problems go beyond hardware into software, organization, economics and leadership.

The Soviets have made progress in the mathematics of computing, but when it comes to the nonmathematical aspects of computer sciences, they have had serious problems. One source of their problems is the scarcity of computer resources. One Soviet research institute visited was reminiscent of a U.S. computing facility of the 1960s—a great deal of pencil and paper analysis, the computer center operating as a closed shop with jobs submitted across a counter to the technician and machines so expensive that the researcher is able to use them only once per week.

Another problem is instructive. Last year the Soviets decided to invest widely in small computers for educational purposes. However, the program stalled because of the debate between those who want to buy Western machines quickly and those who see the opportunity to develop another Soviet machine. This is an example of the broader political problem that afflicts the field. Since informatics is a high prestige field, the Party is loathe to allow real control to the scientific community; within this community, access to choice assignments goes to senior people as rewards rather than to the junior specialists who could contribute the most.

The scientists are making some progress in controlling their program, but the shortage of computing equipment at all levels and the pervasiveness of Party and bureaucratic meddling will continue to haunt them.

The economic reforms that General Secretary Gorbachev is calling for would require a revolution in computing.

Soviet progress in central planning is impressive, given the limitations in equipment, software and interactive development facilities. However, further progress appears to be blocked until the Soviets agree on the diagnosis of their problem.

A visit to an institute supporting GOSPLAN's economic planners showed the mismatch between the theoretical knowledge of the workers and their lack of practical opportunities. They were developing relational data bases, elegant computational models and some networking software, all of which were being implemented on obsolete PDP-9s and -11s. If the Soviets do decide upon even more highly centralized planning, they will come up short in the areas of software and interactive support for modeling and testing. Furthermore, if they opt for a more decentralized planning and control function, they will be almost completely without tools to implement the decision. But even before having to deal with computer problems, they would have to face the economic implications of delegating real decision making to managers who currently are allowed to do no more than maximize the output of factory products against quotas handed down.

The Soviet press has discussed the need to measure profit and to build large-scale financial systems for large enterprises as part of a decentralized planning system. Such financial systems are useful only if managers have freedom to vary their inputs and outputs. In visits to Soviet computer institutes, none of the hosts appreciated the revolutionary changes implied by the widespread use of automated information systems.

Progress is slow even against the limited Soviet objectives of industrial automation. Productivity is low; quality control is poor; and the ability to change output is terrible. In a number of automated plants, shortage of good equipment and software is a problem, but confusion on objectives appears to be a greater problem. Generally, the Soviets have a bad copy of a Western production system rather than a clear idea of what should be accomplished in the Soviet context.

In the business applications area, there is little economic demand for good computing at the enterprise level, except to automate record keeping and to improve white collar productivity in carrying out preplanned tasks. Soviet enterprises are operations facilities, not planning and decision making units, so little would be gained by giving them planning and decision support tools.

On the other hand, all of the economic reforms that General Secretary Gorbachev is calling for would require a revolution in computing, one to which the Soviet political system would have difficulty responding.

Computing Prospects

Prospects depend on what path the Soviet Union chooses for its economy and for its information strategy. Although the state of informatics is poor in the Soviet Union, the only serious civilian performance shortfall is the inability to support the scientific and technical establishment adequately. A secondary shortfall is the lack of automation in current industrial processes.

Much of the problem can be attributed to the Soviet lack of good manufacturing technology for making main frame computers and related devices that are dependent on microelectronics. If the Soviet Union had abundant computer equipment, it eventually would overcome many of its scientific and engineering problems in the development of large computer systems. However, the Soviet Union would still face formidable problems in applying large-system technology and in extending technology to decentralized systems and decision making.

In the areas of central planning and business applications, the Soviet Union's computing weaknesses have not yet limited its performance. Economic theory, political control and organization seem to be much more limiting factors. But as the Soviets try to change their economic strategy, the situation changes.

Even the modest economic reforms that General Secretary Gorbachev has proposed will require additional information and computational tools. If the Soviets choose fundamental economic reform more along the Chinese model, where establishments have some freedom in deciding what to produce and where to obtain their supplies, the needs for business data processing will increase exponentially. If this happens, the Soviets will face crippling problems in computing. The problems fall into four main areas:

- *Hardware.*
- *Data*—Where will the managers obtain the needed economic and market data; prices and sources of supply; and transportation and distribution information? In addition to computational problems, the reforms would require direct communication between low level nodes in the telecommunication network, which would not be well supported by the telephone system that the Soviets are installing.

• *Software Development and Distribution*—Development of hardware and system software in the United States often is carried out by large organizations, which are roughly comparable to Soviet institutes plus a market research capability. But applications software is better produced by small suppliers developing many competitive offerings, with extensive marketing networks to distribute the software and to stay in close touch with the users.

Such a distribution network is practically unthinkable in the Soviet Union, where all of the prestige accrues to the remote, grand institutes that decide for themselves what the establishments need, and the establishments are left to cope with the products they receive. There is no customer support, no user groups, no configuration control, no maintenance and enhancement program. To understand what life is really like for the director of a Soviet establishment, imagine the head of a U.S. consumer products company being forced to obtain all the business software from either Harvard or the University of California.

• *Control*—The more important informatics becomes to the modern Soviet economy, the less amenable the Party will be to turning control over to the scientists and the new business leaders. It would be hard to imagine a group of people less qualified to manage informatics than the Party *apparatchiki*, who lack familiarity with computers and consider information as a resource to be guarded, rather than as something that can be spread out for a tenfold return.

Conclusions

The Soviet Union probably will achieve its plan for a massive, highly integrated telephone system, benefiting for once from its penchant for centralization. The system will look like a large version of a Western European post telephone and telegraph administration except for the lack of residential subscribers—that is, it will be relatively efficient if its functions do not change; however, it will be unresponsive, serving data users poorly, if the Soviet leaders decide to change the economy.

The state of Soviet computing is poor, but as disappointing as it must be to the Soviet leadership, the Soviet economy is not yet at the point where its computing limitations are a serious constraint. Currently, the computing limitations are more of a hindrance on scientific progress and probably on the military.

The military and scientific fields would benefit from a highly integrated computational system, featuring networked main frame computers and massive data bases. Such a system would not require the Soviets to change their centralizing ways, although they would face major problems in security. The lack of Western computers in significant numbers has been a major impediment to their achieving this large-scale system.

Currently, the Soviet economic system does not require much computing support, and the Soviets could not provide the needed support if they decided to move to a reformed economic system. Business data processing requires the kind of decentralized computing that most severely would strain the Soviet system of centralized control, planned innovation centered at massive research institutes and highly classified data. Access to Western technology at the microcomputer end of the scale is probably also a prerequisite for this type of computing, to support a move away from the Stalinist and toward the Chinese model of economic and political control.

• • • — • —

Dr. Ivan Selin is President of American Management Systems, Incorporated.