COMMUNICATIONS AND COMPUTERS IN THE USSR

SUCCESSES AND FAILURES

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In a project little noted in the West, the Soviet Union is moving to an integrated nationwide telephone system which AT&T at its peak would have envied, and they 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. In this paper I will examine their telecommunications experience in some depth, compare it with their much less successful computer experiences, and hazard some guesses on why they are succeeding in one, and failing in the other.

TELECOMMUNICATIONS: The Planned Soviet System

Several years ago the Soviets decided to put an end to 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.

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. Major digital, computer-controlled switching centers are to be involved. For the most part the distinction between military and civilian circuits will soften. A very high degree of encryption and security can be expected for a significant portion of the traffic.

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

In order to appreciate what the Soviets are trying to accomplish in telecommunications we have to know where they are today.

Transmission The current Soviet transmission network consists of cable carrying analogue signals over long distances, heavily supplemented by microwaves carrying less secure digitized signals, and by communications satellites. There is a trend towards digitized signals on the copper cable as well.

Shorter haul communications are also primarily via copper cable carrying analogue signals, but with generous use of fiber optics cables for high-capacity, short-haul digital transmission.

Soviet international communications rely heavily on microwave and communications satellites.

Architecture The architecture of the Soviet civilian system follows international standards. There is 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 in turn connected to many low level centers.

There appear to be about fifteen District centers, each of which is connected to the international gateway and to all other District centers by trunk lines. Each secondary center within a District is connected upwards 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 generally speaking the same numbering system.

The adherence to international architecture and signalling standards is a key feature of the Soviet system. It permits the Soviets to upgrade their telephone network via standard Western commercial equipment.

Message Accounting and Security Most telephone systems outside the USA use a method known as periodic pulse metering to monitor and determine charges for toll calls. Although this method is cheap, it does not determine the called number, nor does it produce records of individual calls.

A more expensive system is called CAMA -- centralized automatic message accounting. CAMA identifies individual calls, including the calling and called numbers. The Soviets decided to invest in CAMA as long ago as the 1950's, perhaps to achieve the level of accountability and counter-intelligence that CAMA provides.

The use of CAMA has a very 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 prerequisite in Soviet eyes for joint military/civil use of a single integrated telecommunications network.

Military Implications We do not really know a great deal about the degree to which the Soviet Ministry of Defense uses the Ministry of Communications public network, but a reasonably 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 ICBM complexes. Finally, 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.

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These features combine to make the first level of the public network an appropriate vehicle for long-haul military communications in the USSR. The extensive use of cable for this network has the additional advantage of preventing intercepts of telecommunications traffic. A reasonable guess is that the Ministry of Defense relies on the public network for long-haul non-tactical communications. This common network is probably supplmented by dedicated, survivable circuits for long-haul tactical use (e.g. control for ICBM launches), and short-haul military communications within a District via dedicated military circuits.

Soviet Trends and Prospects

This picture of Soviet telecommunications shows a country with a clear idea of what it wishes to achieve in telephony, which has made a number of basic technical and managerial decisions consistent with its objectives, and which has chosen a technical approach that takes advantage of its penchant for very large projects of relatively straightforward technology ("brute force" approach).

A far less rosy picture emerges with respect to data communications. On the positive side, the underlying telecommunications network will be digital, obliterating distinctions between voice and data as far as transmission is concerned. Nevertheless 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.

In the West we have at times tried to set standards from above for local area networks and for teleprocessing. The efforts failed, in part because of the very wide variety of users and applications to be served, and in part because of the high rate of change in these areas. Instead, we have 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 decisionmaking, its abhorence of the messiness and inefficiency of uncoordinated, competitive, small-team research, and its tradition of ignoring the wishes of its users.

In short, the USSR will probably 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 greatly benefit by them.

THE WORLD OF SOVIET COMPUTERS

The review of Soviet telecommunications indicated that the Soviets appear to be doing well where they benefit from economies of scale and centralization, but they are doing poorly in those areas which require competition, decentralization, customer feedback, and individual initiative.

This pattern of strengths and weaknesses is observed in computers as well. Some aspects of computers also benefit from economies of scale

and highly centralized management. Examples are very large, batch oriented mainframe computers; centralized storage and processing of information; and megamodels.

These are the areas of computing in which the Soviets have done best. One example of a relatively successful effort is technical support to the State planning effort (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 Gorbachev did at the beginning of this year -- the planners can produce a new plan in only a few weeks time.

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 attributing the problem to the need for even bigger and faster computers, while the other lays the blame on the intrinsic faults of the highly centralized planning process itself.

There are other examples of moderately successful, large-scale computer projects, such as 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 many of the same reasons cited above. Before examining these cases in some depth, it is worthwhile to consider what appear to be Soviet objectives for "informatics", the Soviet term for the combined fields of computer science and computer applications.

Apparent Soviet Goals for Computing

In considering Soviet goals it is important to bear in mind several major factors, different from those in the US, which affect the Soviet computing scene.

In Soviet society, information is power and, in direct contrast to the US, it is a monopoly of the State. In a country in which copier machines are kept under lock and key, and relatively innocuous data such as economic or morbidity statistics are held secret, access to computers and information is a prize that the State will award only to its most favored and trusted citizens.

Another aspect of Soviet informatics that must be born in mind is its prestige -- many institutions attempt to automate, to start computer science projects, or to obtain a charter for computer manufacture, for

reasons of prestige rather than need. Thus one goal of many Soviet institutions is to participate in the informatics program, whether or not any practical goal is foreseen.

Bearing in mind these factors -- closely held authority for computation, the prestige of informatics, and the paucity of decentralized decisionmaking -- we can make a guess at Soviet goals for computing.

Scientific The Soviet Union attempts to have state of the art theoretical and experimental programs in all fields of science -- in this respect they are like the US 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 I know very little about the plans and the progress of Societ military computer programs.

Central Planning As mentioned earlier, 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 American analogues. The Soviets are striving for productivity and quality control in their production process, but they have much less need than we do for the associated planning, ordering, and inventory control functions, because theirs is a supply-push, not demand-pull system like ours. The factory receives inputs more or less according to the Plan, and has to do the best it can with them. Furthermore, changes are few in what the factory is supposed to produce. They do not have the frequent model changes, retooling, or shift to a new product line that characterizes so much of American 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 U.S. fall in the area of business data processing, i.e. the support of planning, management, accounting, and general white collar business functions.

When we think of Soviet computing problems and failures, we first think of business applications. Yet it is clear that Soviet priorities for computing are lower in this area than in any other, in large part because of the much lower status and independence of mid-level managers in Soviet bureaus and enterprises, compared to their American 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, af-

fects all the application areas discussed next. Of course, their problems go beyond hardware into software, organization, economics and leadership.

Scientific The Soviets have made fine progress in the mathematics of computing, but when it comes to the non-mathematical aspects of computer sciences they have had serious problems. One source of their problems is the scarcity of computer resources. A visit to a Soviet research institute reminded me of an American 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 gets only one turn per week.

Another example is instructive. Last year the Soviets decided to invest widely in small computers for educational purposes. However, the program has gotten hung up between those who want to buy Western machines quickly, and those who see the opportunity to kill two birds with one stone and develop another Soviet machine.

This case is an example of the broader political problem that afflicts the field. Since informatics is a high prestige field, the Party is loathe to cede real control to the scientific community; within this community access to plum assignments go to senior people as rewards rather than the junior specialists who could contribute the most.

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

haunt them.

Central Planning Soviet progress here is rather impressive, given the limitations in equipment, in software, and in interactive development facilities with which they have to deal. However, further progress appears to me to be virtually blocked until they agree on the diagnosis of their problem.

I have visited an institute which supports GOSPLAN's economic planners, and was appalled by 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 they were implementing on hopelessly obsolete PDP-9s and -11s. If the Soviets do finally come down on the side of even more highly centralized planning, they will come up short in the areas of software and interactive support for modelling 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 today are allowed to do no more than maximize the output of factory output against quotas handed down from on high.

There have been discussions in the Soviet press of 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 really useful only if managers are given much greater freedom to vary their inputs and outputs. In my visits to Soviet computer institutes none of my hosts appreciated the revolutionary changes implied by the widespread use of automated information systems.

Industrial Use Even against the limited Soviet objectives for industrial automation one would have to conclude that progress is slow. Productivity is low, quality control is very poor, and ability to change output is terrible. I have visited a number of automated plants, and generally found that shortage of good equipment and software was a problem, but confusion on objectives was a greater problem. Generally I found a very bad copy of a Western production system, rather than a clear idea of what should be accomplished in the Soviet context.

Business Applications In this area, even more than the others, the visitor finds a chicken-and-egg situation. On the one hand, there is very little economic demand for good computing at the enterprise level, except to automate record-keeping and improve white collar productivity in carrying out pre-planned tasks. Soviet enterprises are really just operations facilities, not planning and decision-making units, so as matters now stand, little would be gained by giving them planning and decision support tools.

On the other hand, all of the economic reforms that Gorbachev is calling for would require a revolution in computing, one that the Soviet political system would find very difficult to respond to.

Computing Prospects

Prospects depend on what path the USSR chooses for its economy and its information strategy. Although the state of informatics is very poor in the Soviet Union, the only really serious civilian performance shortfall is their inability to support their 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 their lack of good manufacturing technology for making mainframe computers and related devices dependent on microelectronics. If they had computer equipment in abundance, I am confident that they would eventually overcome many of their scientific and engineering problems in the development of large computer systems. However, they would still face formidable problems in applying large-system technology, and in extending technology to decentralized systems and decisionmaking.

In the areas of central planning and of business applications, their computing weaknesses have not yet really limited their 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 Gorbachev has proposed will require additional information and computational tools. If they choose fundamental economic reform more along the Chinese model, where establish-

ments have some freedom in deciding what to produce and where to get 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 Discussed earlier.

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 USA is often carried out by very 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 stay in close touch with the users.

Such a distribution network is practically unthinkable in the USSR, where all the prestige accrues to the remote, grand institutes who decide for themselves what the establishments need, and the establishments are left to cope as best they can with the products they receive. There is

no customer support, no users groups, no configuration control, no maintenance and enhancement program. To picture what life is really like for the director of a Soviet establishment, imagine that you were the head of an American consumer products company, but you were forced to get all of your business software from 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 businessmen. 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 husbanded, rather than as bread to be cast upon the waters for a ten-fold return.

CONCLUSIONS

The Soviet Union will probably achieve its plan for a massive, highly integrated telephone system, benefitting for once from their penchant for centralization. The system will look like a large version of a Western European PTT except for the lack of residential subscribers, i.e. it will be relatively efficient as long as its functions do not change, but unresponsive if the Soviet leaders decide to change the economy it is designed to serve. It will serve data users poorly.

The state of Soviet computing is poor, but as disappointing as it must be to the Soviet leadership, their economy is not yet at the point where their computing limitations are a serious constraint. Currently the

computing limitations are more of a drag on scientific progress and probably on the military.

These two fields would benefit from a highly integrated computational system, featuring networked mainframe 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.

As far as support for business data processing is concerned, the Soviets do not now have an economic system which requires much computing support, but they could not provide the needed support if they decided to move to a reformed economic system. Business data processing requires exactly the kind of decentralized computing that would most severely 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 towards the Chinese model of economic and political control.