New Chips Shed Light on Soviet Electronics

But Control Data Corp.'s lode of Soviet devices also illuminates the politics of export control

Seven tiny electronic components—each the size of a grain of rice—that officials at the Soviet ministry of electronics handed to a ranking U.S. industrialist in Moscow in February are causing a stir among government and industry experts.

Lynn W. Gallup, manager of Control Data Corporation's (CDC) East-West technical strategy, who was the recipient of this Soviet boon, says the chips show the Soviets to be "within 2 to 3 years of us" in a field where nearly everyone else thought the United States had a much longer lead.

In a subsequent report released by CDC at a press conference in Washington on 28 February, Gallup claimed that "the Soviets obviously have developed the semiconductor processes and know-how sufficient to make devices very close to the leading edge of technology." It also stated, "they will eventually achieve a technological level which lags the United States by around two years. . . . Following this they will branch off into a leading position in certain specific areas." These statements resulted in a flurry of articles in the technical press, which also took note of comments comparing the Soviet level with that of Japan, currently a hot competitor of the U.S. electronics industry.

Nonetheless, experts in the Departments of Defense and Commerce and the intelligence community are not exactly trembling at Gallup's announcement of unexpected Soviet advances in this militarily strategic field. One expert who has seen the chips admits that they are the most advanced Soviet electronics devices that "the government"—presumably including U.S. intelligence—has seen thus far. But experts are withholding judgment on whether to revise previous assessments of Soviet capability until after the government subjects the devices to extensive tests. CDC, having issued its own conclusions, has turned them over to the government for this purpose.

"CDC is getting all the publicity because . . . it is trying to make the point that the Russians really have the technology to make the big computers that CDC wants to sell," explained a defense official who monitors the export of strategic electronics to Iron Curtain countries. If CDC can show that the Soviets are nearly equal to us in electronics, the government's case against such exports will be weakened.

In fact, *Electronics News*, a trade journal, reported that CDC has an application pending with the Commerce Department's Office of Export Administration (OEA) to sell an array of computing equipment to the Soviets for weather forecasting. The equipment would fill a need alleged to have been left when, 2 years ago, OEA barred CDC from exporting one of its larger, but older, computers—the CYBER 76—to the Soviet Union for weather forecasting. In conjunction with an interagency review, OEA decided that the computer was too big for the task the Soviets said it would perform.

CDC is among the American companies most anxious to ease export controls to communist countries. In the past it has successfully exported some smaller models—CYBER 172's and 173's—to the Soviets for use in seismic exploration, nuclear research, and meteorology. IBM Corp., Sperry Univac Division of Sperry Rand Corp., and Honeywell Inc. sell computers to the Soviet Union as well. In general, the U.S. government has barred export of large computers or computer systems to the Soviet Union; the Soviets just announced plans to buy an $18 million system originally designed by Honeywell but made and marketed in France—the Iris 80—to handle news media needs during the 1980 Olympics in Moscow. The Soviets are also reported to have ordered another $2 million worth of Japanese computers for hotel record keeping during the international festival. American computer firms led by CDC are miffed at U.S. export policies that prevent them from competing for such sales. Not coincidentally, another CDC official, George Bardos, made two congressional appearances to plug for lessened export controls at about the time Gallup unveiled his Soviet treasures.

Government officials recall that a similar gift of electronic devices occurred in 1973, when Harry Sello, a high executive of Fairchild Space and Defense Systems, Inc., which had an application pending to build a plant in the Soviet Union, was handed some devices during a visit to Moscow. Presumably, the Soviet officials in this case handed over the devices for the same reason: to channel them to the West and, so to speak, show off.

But the 1973 Fairchild case backfired. Analyses of the devices showed that the Soviets were seriously behind the United States in the then-exploding field, and the government denied Fairchild's request to construct the plant.

The new lode of Soviet devices has stirred interest among government experts, however, since the devices are among the most advanced seen so far. The device of most interest is a random access memory (RAM) chip having 16,384 bits. It is very similar to but not an exact copy of one developed by the Mostek Corporation, the Mostek 4116 Revision E. The Gallup report says that the similarity to the Mostek model shows the Soviets are using a "follow the leader" approach in semiconductor technology by skipping expensive, independent R & D work and adapting foreign designs to their own purposes.

Commerce Department officials note, however, that the similarity between the 16,000-bit Soviet chip and the Mostek one undercuts the industry argument that semiconductor products can be exported freely because they cannot be copied without the accompanying export of know-how. And a defense official suggests that although the circuit architecture may have been borrowed from Mostek, the know-how could have come from elsewhere in the world. "We don't know what help they may have had from other countries in fabricating it," he said.

As the features become finer, more of them can be put on a single chip, and the chip can perform more complex tasks. So feature width is an important indicator of the state of a semiconductor manufacturer's art. The Soviet 16,000-bit RAM, and a second Soviet RAM having 4000 bits, have feature widths of 5 micrometers—comparable to devices marketed by U.S. companies about 3 years ago. Currently U.S. manufacturers offer devices with features 2 to 3 micrometers wide. A new program sponsored by the Defense Advanced Research Projects Agency (DARPA) seeks techniques for reducing feature width to 0.5 micrometer in the 1980's and down to the molecular level later (*Science*, 23 June 1978, p. 1364).

0036-8075/79/0420-0283$00.50/0

By another measure, the Soviet 16,000-bit chip lags several years behind U.S. off-the-shelf products. It has 17,000 "gates" or switches, according to the CDC report. Current U.S. devices on the market have 64,000 gates. The DARPA program aims at making a single chip even more intelligent, so to speak, by placing 500,000 gates on it, and, one day, perhaps even 25 million gates.

Gallup was also handed a 4-bit microprocessor, shorter than, but capable of some of the same functions as the AVM-2901 marketed by Advanced Micro Devices Inc. in the United States in 1975. Two other devices, meant to be used with the microprocessor, were supplied: a control memory circuit and a peripheral controller. The latter two are of less interest to government officials, as they appear to be somewhat older. The Soviets provided duplicates of two devices so that one could be broken down for testing.

While CDC's report has stressed how advanced these individual devices are, government experts caution that the test of a nation's semiconductor prowess is not the ability to produce a few working devices but the ability to produce a sufficient number of reliable devices, so when built into a computer, or the guidance system of a missile, they will work. "Sure, at their laboratory in Novosibirsk they could produce a few of anything," says one official formerly concerned with the status of Soviet electronics. "But semiconductor production is a black art. The Soviets have a tremendous ability to do individual pieces of science; but they have never been good at translating that into production."

U.S. companies, such as Texas Instruments (TI), try to achieve very high yields—so that, for instance, every single hand-held calculator that is sold can actually be counted on to work. "You should see the Texas Instruments production line," says another official. "They spend millions of dollars and years refining and cleaning it to get perfect yields. But the Soviets are strangled by their own system. The plant manager wants to meet his production quota and produce 100,000 devices. He doesn't care if they work or not."

Even CDC's analysis indicates that the show-off samples it obtained are less than perfect. An enlarged photo of the 16,000-bit RAM shows that the contact points for some of the gates are not in perfect alignment. The alignment of the "mask" or template from which the circuits are printed is slightly askew, according to the CDC analysis. Such a defect in production can make it difficult to print large numbers of chips accurately or to print more complex circuit designs.

A more skeptical assessment of the Soviet chips' significance would place that country 6 or even 9 years behind the United States, rather than the 2 years that CDC claims. If, as seems likely, the 16,000-bit chip is a prototype and not a production line sample, it would be comparable not to the 4116 Revision E that Mostek marketed in the mid-1970's, but to the prototype chips that the company developed in small quantities in 1970 and 1971. Experts suggest that if it took Mostek—then a leader in the state of the art—5 years or more to develop reliable production of this chip, it should surely take the Soviets as long or longer.

J. Fred Bucy, president of TI, estimates that Soviet production of advanced chips gets "less than 1 per cent" yields, whereas TI must get "20 to 70 percent" yields for production to be meaningful. Bucy estimates the Soviets to be 5 to 7 years behind.

Given the Soviets' track record, the devices may never even be seen again. One Army electronics expert says, "It is not unusual for all of a sudden some [Soviet advanced technology] parts to appear, and for us to . . . obtain no additional parts or obtain no additional evidence that they are being used and produced."

Another defense official recounts that American industrialists have come to him with glowing reports of, for instance, a "new" Soviet machine tool seen at a trade fair in Eastern Europe, such as the annual one in Leipzig, East Germany, where the Soviets traditionally exhibit their latest wares. "I'll ask them whether they went to the fair in Brno [Czechoslovakia] and they'll say 'no.' I'll check with my staff and it will turn out the Soviets exhibited the same machine tool in Brno a few months before. They've only got one of them and they cart it around!"

So far, government officials have found little support for CDC's conclusion that the Soviets are showing the technical virtuosity of the Japanese in this field, or that they may soon "branch off into a leading position in certain specific areas" of semiconductor technology. They are awaiting the results of the tests of CDC's Soviet jewels, and what the latest trade fairs in Eastern Europe turn up. Meanwhile, CDC's Gallup could not be reached for comment. He is in China, a CDC official explained, where the company has a $69 million contract for computer sales—yet to be approved by the U.S. government.

—DEBORAH SHAPLEY

Carter Privacy Bills Cover Research, Medicine

The Carter Administration has proposed sweeping privacy legislation that will have important consequences for medical and scientific researchers, as well as academic faculty in general.

Personal records compiled for research, medical treatment, commercial transactions, and communication would get enhanced protection under the legislation, which was proposed on 2 April. A major bill in each area was devised to meet two objectives: to increase awareness of invasions of privacy, and to limit official access to personal records. "Privacy is a permanent public issue," said Carter when the four bills were announced. "Its preservation requires constant attention to social and technological changes, and those changes demand action now."

In the bill relating to medical treatment, the Administration proposes a general rule that individuals have a right to see their own medical records, but that others cannot see the records without permission first. Alas, there are also 22 exceptions to this rule, and one of them provides that epidemiologists need not ask permission if (i) the importance of their research outweighs any risks from disclosure; (ii) copies of the records in researchers' hands are destroyed when no longer needed; and (iii) further disclosure by the researcher is avoided. The bill also prevents the use of blanket disclosure authorizations, and provides a penalty for obtaining medical records under false pretenses.

In the bill relating to scientific research, the Administration proposes to formalize (read *enforce*) pledges of confidentiality commonly made to research subjects. In most cases, researchers would be expected to recite a sort of reverse *Miranda* warning: "I am prohibited by law from releasing information about you to anyone except those that I tell you about. If I should break the law, I will be subject to a $5000 fine, and you will have the right to sue me." The requirement for such a statement could be waived by an institutional review board (IRB), an authorized group that approves research proposals.

0036-8075/79/0420-0284$00.50/0