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Where minicomputers do all of the job

A network of minis that no longer needs a big expensive central authority

Data system designers have long tried to string mini-computers together to form big processing systems—for the simple reason that mass production and standardization make a string of minis about one-fourth as costly as big machines of comparable computing power. But such efforts have had only limited success. Multiple minis have been designed into a number of systems, but much of the potential saving vanished because the systems generally had to rely for central guidance on a big and expensive computer.

Now a system developed at the University of California at Irvine and backed by the National Science Foundation has chucked the big central computer, and this seems to work just fine. Irvine researchers say they can hook any number and type of minis together and program them to split up data processing tasks according to the computing powers and available capacity of each machine, without using a central computer. The minis, in effect, form one big, highly flexible machine.

An experimental Irvine system, using three minis made by Lockheed Aircraft Corp., has begun functioning and should be in full operation by September. If it works smoothly, it may point the way to significant benefits for computer users—even beyond the basic cost advantage of minis over maxi-machines. The Irvine system would let users start with a few minis and add others gradually. It also helps avoid duplicating peripherals, a pitfall of using any size computers that are not interconnected. And because the Irvine system has no "central authority" it cannot be shut down through the failure of the big computer. A faulty mini is automatically bypassed until repaired or replaced.

The system's drawback is that it cannot handle the kind of big programs that large computers take in stride—problems involving such areas of higher mathematics as partial differential equations. But a mini can offer unlimited capacity for small- and medium-sized programs. And says Professor David Farber, who heads the Irvine project: "Small jobs are what happens in the real world."

The costs. The only hardware needed beyond the minis themselves is one Irvine-developed interface box per computer. These boxes would cost about $300 each to produce, Farber estimates, or possibly as little as $40 each using large-scale circuit integration.

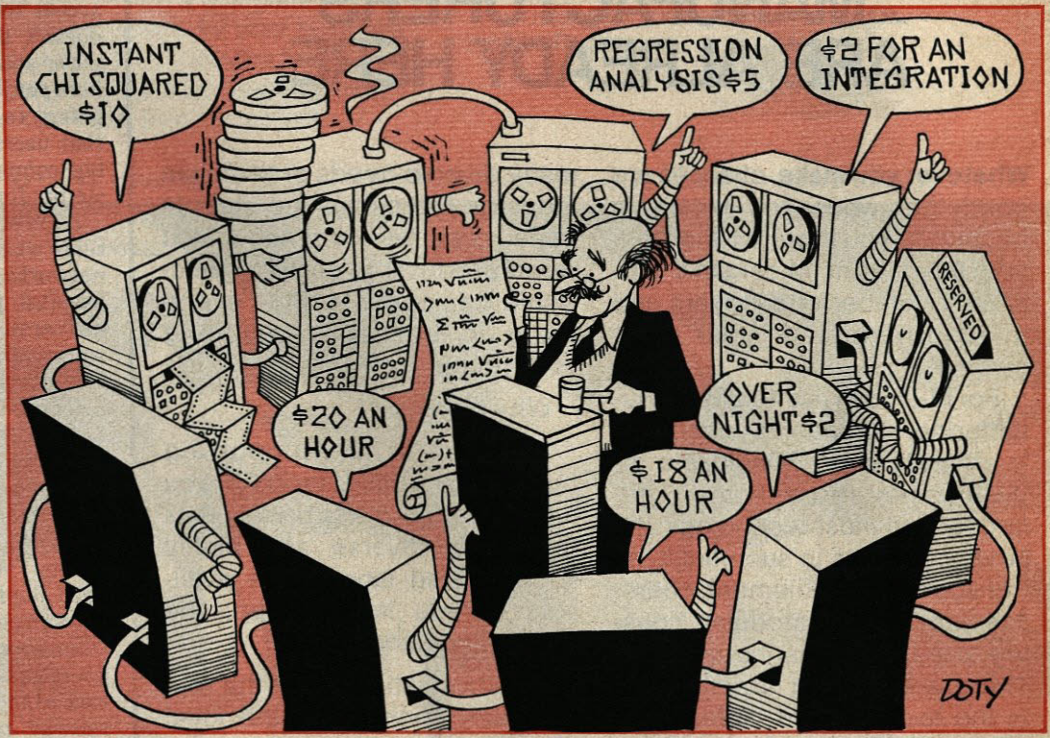
Irvine is not alone in working on such mini networks, known as "ring systems." Bell Labs, where Farber spent 11 years, and the University of Toronto are also doing ring research, but the Irvine project apparently is the leader in actually getting into operation.

Ultra-fast communication is essential to making the system work. Data dances around the wires that connect the computer ring at the rate of 2-million digital pulses per second. That high-speed "bit stream" has more than enough capacity to handle the input and output for many computers and terminals, just as a circular expressway with entrance and exit ramps might handle a mixed stream of cars and trucks. But high-speed communication alone is not enough.

The big problem Irvine's researchers think they have conquered—that of eliminating the central control—meant they had to devise a different way to assign workload among the minis. Irvine researchers solved it through an ingenious system of having each mini "bid" on work. The user signs in with a coded message that races around the ring describing the job he wants done. Computers that have the speed and available capacity to handle it quote a price, and the user picks the cheapest one. The price could be quoted in dollars for users who will actually pay for the service, or in other charge units.

Some machines may come back with several bids, based on alternative response times. A machine that lacks enough capacity for the job may bid nonetheless, figuring to "subcontract" some of its workload to another member of the ring at a lower price.

Flexibility. This ability to shift work if a more attractive job comes along, or if a computer needs to be shut down for repairs, makes the system flexible and reliable and helps insure that each computer's capacity and special computing abilities are used to the fullest. The user never knows—or needs to know—



Roy Doty

The ring acts as a single, highly flexible machine in which individual units can bid for jobs.

which computer is handling his work. Once he accepts a bid, he files his program with the winning machine, which may later pass the program to another machine.

An electronic message called a "control token" circulates continuously around the ring. When a user wants access to his program, he informs the control token, which then interrogates the interface box attached to each computer to see which machine contains

The major pluses: Lower costs, flexibility, greater security

the program at that moment. Then the dialogue can begin.

Because many programs are contained in many different machines, a ring system can be made secure more easily than a single computer, Farber says. Only an authorized user can gain access to a given machine. "Industry doesn't pay much attention to computer security because nobody has got hurt yet," says Farber. "But industry is going to get hurt." Farber believes that users may eventually shun single big computers in favor of mini rings simply for security reasons.

At first, though, interest in ring systems will probably be confined to data networks requiring many terminals: hospital patient-surveillance systems, universities, hotel reservation networks and the like. Dale Hanks, a senior data system designer at Computer Sciences Corp., predicts that ring systems will have big appeal for airline ticketing networks. Because computers are the heart of these systems, most of them have total—and wasteful—hardware duplication in case of breakdowns. "With minis in a ring you don't need duplication," he says. "You just have one or two spares."

Customers. A group of Japanese engineers has visited Farber's laboratory to look over his mini ring for a Japanese railway reservation system they are designing. A federal agency is also considering a ring data network.

Irvine, a computer-conscious campus that has terminals in dormitories and requires that even social science students take a programming course, has no plans yet to drop its 300-terminal IBM/360 for a ring network. But Farber thinks rings have great promise for universities. "Our cost per terminal connection with the 360 has been around $5,000," he says. "You can get a pretty good mini now for $900."

Rings within rings offer further potential. Eventually, Farber hopes, an Irvine ring might be hooked to a ring at, say, UCLA—50 mi. away—giving Irvine students and researchers access to more specialized hardware and programs on other campuses. ■