how the system would be managed. The House wanted the project to be run by the National Science Foundation, which now operates NSFNet, a digital system that connects its four supercomputer centers with regional networks and into hundreds of universities and laboratories at speeds of 1.544 megabits per second in the US and bursts of 2.048 megabits in some European countries. The Senate Energy and Natural Resources Committee, however, fought for the Department of Energy, with its MFENet for magnetic fusion researchers, to be the lead agency. This year the House again designated NSF as the program manager, while the Senate preferred that the President decide who would run the show. Worried that Japan might succeed in supplying supercomputers, fiberoptic cables or other components to the project, some House members inserted a "buy American" proviso into their version of the bill (see box on page 55). Under the threat of a Presidential veto, both bodies agreed that the final bill would give the White House the job of overseeing the operation through its Office of Science and Technology Policy, headed by D. Allan Bromley.

The act provides for a "coordinated Federal program to ensure continued US leadership in high-performance computing . . . as vital to the prosperity, national and economic security, industrial productivity, engineering and scientific advancement." A key component is a high-capacity and high-speed National Research and Education Network. The act authorizes R&D funds for NREN to rise steadily over the next five years to almost $1 billion by fiscal 1996. The goal for that year is to have more than 1 million computers linked.

The act mandates four related programs: computer hardware and systems, software technology and algorithms, NREN, and basic research and human resources. The hardware program seeks a thousandfold improvement in computing capacity, to 1 trillion operations per second—a goal considered unduly ambitious when set in 1989 but now deemed attainable with recent developments in parallel processing, electronic switching and multichannel optical interconnects. Software has usually been a limiting factor in the use of supercomputers by most researchers other than those programming mavens who write elaborate codes for problems in, say, nuclear weaponry, theoretical physics, aerodynamic designs and climate modeling. So the aim of the software program is to devise "user friendly" software for researchers in other fields seeking, for instance, to understand the behavior of complex materials and organic molecules, to design new pharmaceutical compounds and to predict particle masses with lattice gauge theory.

NREN is seen as the next generation in science data networks. The mother of them all was ARPAnet, conceived in the late 1960s for use by a small community of computer whizzes and academic researchers under contract to the Defense Department. The largest system today is Internet, consisting of more than 5000 unclassified, interconnected data networks, including NSFNet and Bitnet. When NREN is turned on it will probably operate at NSFNet's upgrade of 45 megabits per second. Considering the pace of advances in computers and networks, by the turn of the century NREN should be capable of transmitting information at speeds of between 1 and 3 gigabits per second—about 50 000 single-spaced typed pages each second.

Opposed by Congress, Fujitsu Withdraws Supercomputer

Reacting quickly to opposition from Washington, Fujitsu Ltd withdrew its offer to donate a $17 million supercomputer to an international consortium of scientists who had negotiated to use the machine at the National Center for Atmospheric Research in Boulder, Colorado. The machine would have been used to produce models and perform research on global climate problems.

The incident is the latest in a politically sensitive contretemps over how far the US government should go to protect the interests of the nation's supercomputer industry. Japan's supercomputer makers have sold few of their machines in the US, mainly because national laboratories and universities are either compelled or coaxed to "buy American." This practice has placed US officials in an awkward position in light of a 1987 US–Japan agreement that provides for more open bidding in Japan's own supercomputer market. US trade representatives demanded the accord in response to complaints from American manufacturers that they had been excluded from bidding on Japanese government contracts.

Fujitsu's fiasco was another instance in which Japan's supercomputer producers have attempted to show that their machines are faster number crunchers than Crays or Connection Machines and thereby to gain acceptance among scientists and engineers. In 1987 MIT was ready to lease an NEC supercomputer at an attractive price, but the US Commerce Department, worried that Japan was "dumping" the machine, pressured university officials to cancel the deal. Last year NEC Corporation lodged a protest with the Commerce Department after it was kept from bidding on a supercomputer contract with NASA's Ames Research Center. NEC was subsequently permitted to enter the bidding, along with Hitachi and Fujitsu. All three are also bidding for other contracts with NASA and the Department of Energy.

In the past two years some Japanese supercomputers have exceeded Crays in test runs called benchmarks. But these machines can be tuned to score high in such tests, and American experts such as Jack Dongarra of the University of Tennessee and Oak Ridge National Laboratory stress that benchmarks don't really show how a machine will work day in and day out. Moreover, US supercomputers have more sophisticated software. Although a few customers, including Lawrence Livermore and NASA's Jet Propulsion Lab, can write their own programs for specific problems, most want proven software for designing aircraft, pharmaceuticals or composite materials.

When the High Performance Computing Act was going through the House last spring, some members wanted to make sure that no Federal agency would buy a foreign supercomputer or component under the legislation. After the White House threatened to veto the measure over this provision, the House removed it. Still, the Fujitsu offer was protested by the House majority leader, Richard A. Gephardt of Missouri, who wrote both the Japanese embassy and President Bush's science adviser, D. Allan Bromley. In his letters Gephardt cited "continued trends in unfair pricing practices, including heavy discounting and outright donations," by Japan's supercomputing firms.

Asked about Fujitsu's decision to drop the offer, Richard Anthes, president of the University Corporation for Atmospheric Research, which manages NCAR, said the company "felt the political heat." He said that the scientific group for whom the machine was intended, known as the Model Evaluation Consortium for Climate Evaluation and representing organizations in the US, France, Italy and Japan, was "very disappointed" by the opposition. "Here was a donation," he said, "that would have advanced scientific understanding and collaboration in global climate change."

—Irwin Goodwin