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Focus On NSF Supercomputing FREE

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Focus On NSF Supercomputing

Stephen G. Davis

With over 6000 users, five national centers must apply advancing technology to meet the growing needs of the scientific community

Since 1984, the National Science Foundation's five supercomputer centers have awarded nearly $200 million worth of supercomputer time free to more than 6000 scientists working on some 3000 research projects. The physics community is among the leaders in demanding that precious time, which can cost up to $2000 an hour at a commercial facility: of 100,000 total CPU hours awarded to researchers, over 20% were devoted to physical science research activities.

"There are 2500 individual users of this system alone," says Sidney Karin, director of the San Diego Supercomputer Center. "It's providing a tool for [scientists] you can't provide any other way." Today, at SDSC and its sister centers, an increasing number of scientists are clamoring to log on to a lineup of leading-edge hardware which includes Cyber 205s, a vectorized IBM 3090, and several Cray X-MPs. Indeed, the use of NSF-sponsored supercomputer time has increased from 600 hours a month in 1985 to over 8200 hours a month today.

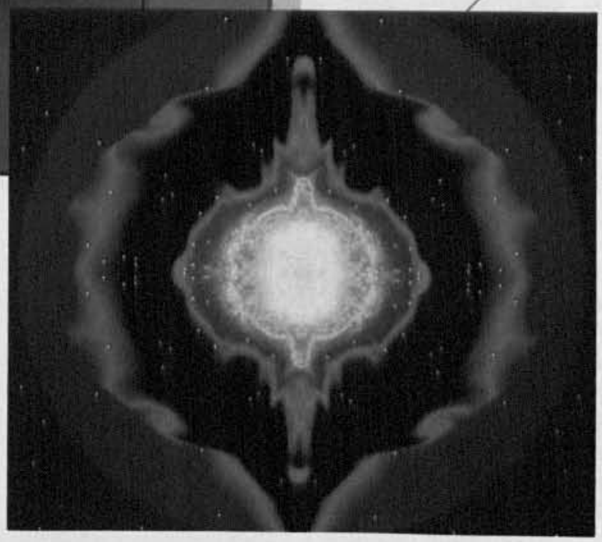
Over the next 5 years, meeting the NSF's dual goals for the supercomputer centers–to give scientists broad access to supercomputers and to encourage the development of advanced scientific computing in the U.S.–will challenge the centers to apply ever-advancing computer technology to meet the growing computing needs of the scientific community.

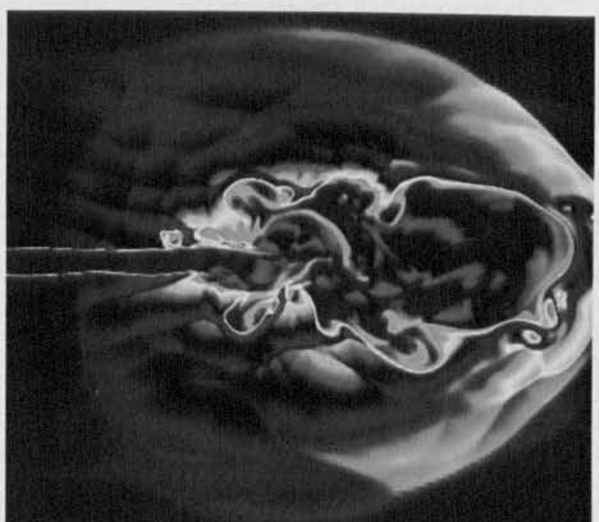
"Maintaining the centers at the peak of computing power means getting them to the next Cray, the next IBM, and the next ETA," says Gordon Bell, head of the NSF Directorate for Computer and Information Science Engineering, out of which the centers program is funded.

Indeed, the five centers are already pursuing ways to secure the next generation of supercomputing technology. In addition, access to high-powered scientific computing is spreading via a growing availability of low-priced minisupercomputers. And many scientists who have used the centers over the past 2-1/2 years are grappling with technical issues such as software portability and the need to learn new operating systems, while other scientists are just beginning to see the benefits of the centers.

The NSF's Advanced Scientific Computing division began Phase I of its program in late 1984 by buying time for researchers on six existing commercial and university supercomputer centers. Early in 1985, NSF unveiled a five-year, $200 million, Phase II program to establish new national supercomputer centers dedicated almost entirely to NSF-sponsored research. After a national competition, five centers were created in 1985 and 1986. They are: the John von Neumann Center (JVNC) near Princeton, N.J., the Cornell National Supercomputer Facility, in Ithaca, N.Y., the Pittsburgh Supercomputer Center, the National Center for Supercomputer Applications at the University of Illinois, Urbana-Champaign, and the San Diego Supercomputer Center (SDSC) at the University of California, San Diego. In one form or another all the centers

UNIVERSITY OF ILLINOIS





were offering computing time to researchers by June 1986, and last spring, NSF cancelled its previous agreements with the Phase I sites.

Between them, the five Phase II centers offer three Cray X-MP supercomputers made by Cray Research Inc., Minneapolis, Minn., two Cyber 205s from Control Data Corp., Bloomington, Minn., and a configuration that mates an IBM 3090/600E to five FPS 264 attached scientific computers from Floating Point Systems, Beaverton, Ore.

The Cray machines are located at the Pittsburgh, Illinois, and San Diego centers. Both Cyber 205s are at the JVNC. Cornell features the IBM-FPS configuration. (For a breakdown of hardware and software at each center, see the accompanying sidebars.)

All the systems at the NSF centers offer computing power at the Class 6 level, to use the designation system derived from federal procurement procedures. The lower threshold of Class 6, which roughly encompasses today's commercial state-of-the-art supercomputers, is now

A neutron star collision (right, top), by Charles Evans (CalTech) and Donna Cox (U. of Ill., Urbana-Champaign), and an astrophysical jet, by Cox and Michael Norman (U. of Ill.), are among the images scientists have produced with Illinois' Cray X-MP (above).


UNIVERSITY OF ILLINOIS

UNIVERSITY OF ILLINOIS, CHAMPAIGN-URBANA NATIONAL CENTER FOR SUPERCOMPUTER APPLICATIONS

Background: Five-year, $45 million NSF grant commitment awarded Feb., 1985, to University of Illinois at Urbana-Champaign.

Cray X-MP/24 supercomputer opened to researchers Jan. 1986; later upgraded to Cray X-MP/48.

Main offices on University of Illinois campus, with supercomputer currently housed in university astronomy building (pictured). On-site NSF-funded staff: 100.

Noted for vigorous effort in visualization techniques and industrial affiliates program. Current top official is astrophysicist Larry Smarr (U. of Illinois), chief author of center proposal.

Supercomputing resources: Cray X-MP/48 supercomputer with 4 processors, running CTSS, 8 megaword main memory, and 128 megaword auxiliary solid-state storage device. Clustered Digital VAX 11/785 front ends running VMS; IBM 4341 mass storage system. An Alliant FX-8 minisupercomputer is used by the Illinois visualization project. Languages include CFT (Cray FORTRAN) and a vectorizing C compiler (from Lawrence Livermore National Laboratory). Numerous scientific and graphics packages include DI-3000, a graphics library from Precision Visuals Inc.; CFTMATH mathematical software from Cray Research; and NCAR graphics subroutine library from the National Center for Atmospheric Research.

Network access through NSFNET and associated Internet networks; major node on MIDNET, wide area network linking universities in the Midwest; network management center for NCSANET, regional network linking Illinois and Indiana sites; 22 dial-in ports (300-9600 bps); public-access network connection to TELENET.

Contacts for system help and training programs: Mike Smith, 217-244-7714 (operations, hardware); Lex Lane, 217-244-0642 (application software); Charlie Catlett, 217-333-1163 (network access); Alan Craig, 217-244-1988 (training programs).

Grant Application Information: Illinois shares a local allocation committee with the Pittsburgh center. Requests made to Illinois for over 50 hours of computer time are reviewed by the committee on a quarterly basis; start-up accounts of up to 10 hours as well as 10-50 hour accounts are reviewed on-site and awarded throughout the year. Other awards may be given through Illinois' affiliates.

Application deadline for major grants that begin Apr. 1988: Feb. 1, 1988.

To write for forms:

Supercomputing Proposals
National Center for Supercomputer Applications
University of Illinois
152 Computing Applications Bldg.
605 East Springfield Ave.
Champaign, Ill. 61820

For further information, call 217-244-0072.

Institutions Affiliated with Center: NCSA's Academic Affiliates program has over 40 members, including: Clemson, Colorado State, Gallaudet, George Washington U., Georgia Tech, Harvard, Illinois Institute of Technology, Indiana U., New Mexico State, NYU, N. Dakota State, Northwestern, Notre Dame, Oklahoma State, Oregon State, Penn State, Southern Ill. U. at Carbondale, Stanford, Vanderbilt, U. of Alaska at Fairbanks, U. of Alaska at Anchorage, U. of Arkansas, UCLA, UC Riverside, UC Santa Barbara, U. of Chicago, U. of Colorado, U. of Delaware, U. of Idaho, U. of Ill. at Chicago, U. of Iowa, U. of Kansas, U. of Maryland, U. of Missouri (at Columbia, at Kansas City, and at Rolla), U. of Nebraska, U. of New Mexico, U. of Rochester, U. of Tulsa, U. of Washington, U. of Wisconsin (at Milwaukee, and at Madison).

usually taken to be the Cray-1; according to its own machine-specific measure of processing speed, the single-processor Cray-1 can exceed 100 megaflops (millions of floating-point arithmetic operations per second). Today's supercomputers generally cost between $5 and $20 million.

The JVNC's two Cyber 205s are due to be replaced this month with an ETA-10, a significantly more powerful, Class 7 machine from ETA Systems, a St. Paul, Minn.-based subsidiary of Control Data. ETA claims the ETA-10 is the first true Class 7 machine and will ultimately be capable of over 10,000 megaflops (10 gigaflops). The machine JVNC is currently installing, which is only the second ETA has shipped to date, should be capable of 3 gigaflops and will be upgraded to 10 gigaflops next spring, according to Vercell Vance, JVNC's user services manager.

In addition, two centers offer access to minisupercomputers, less expensive machines which are capable of roughly 25 percent of the computing power of a single-processor Cray at far less cost–generally between $100,000 and $2 million. Minisupercomputers available at NSF centers are the SCS-40 from San Diego-based Scientific Computing Systems, available at SDSC, and an FX-8 from Alliant Computer Systems Corp., Littleton, Mass., based at the Illinois center. A research project at the Cornell center which is separate from the production supercomputer facility uses an iPSC VX/d5 hypercube made by Intel Scientific Computers, Beaverton, Ore.

Researchers across the country can gain access to any of the national centers through a variety of networks. Public-access phone systems, commercial data networks such as TELENET, and federal- or state-run networks including ARPANET, BITNET, and CSNET, offer one route of access.

In addition, NSF has linked all five centers and the National Center for Atmospheric Research (NCAR)–a Boulder, Colorado facility, also funded by NSF, that houses both a Cray X-MP and Cray-1/A, among other machines–with a new medium-speed datacom network called NSFNET.

NSFNET comprises a series of "backbone" links between nodes at the centers which, in turn, connect to other wide-area and regional networks. Itself an internet, or network of networks, NSFNET is part of the federal Internet scheme; thus, a researcher with a link to one of the various government-run networks that support the Transmission Control Protocol/Internet Protocol (TCP/IP) message exchange standard, including ARPANET, MILNET, and others, can usually use that link to reach any of the supercomputer centers. The network backbone became operational in October, 1986, and has since been improved with several gateway facilities to other networks, broadening access to the centers. The backbone currently consists of a series of 56Kbps land-based links with far greater capacity than typical public-access dial-up links. Last summer, NSF requested bids to further upgrade the backbone to a network of high-speed 1.544M bps T-1 standard connections. (Further information on remote access can be obtained either through the centers, or by calling the NSF Network Service Center, located at BBN Laboratories Inc., Cambridge, Mass, at 617-497-3400.)

In most cases, all that a scientist needs to connect to a supercomputer center is a workstation (which for some cases could be a personal computer), a modem, and a telephone. Researchers who require graphic-intensive output will typically require a more sophisticated workstation and a high-capacity communications link; in any case, hardcopy and magnetic tape output can be produced at the centers and shipped directly to any researcher. In addition, many of the centers now also feature film output devices, capable of producing still or in some cases animated simulation results.

Access to the centers can be easily obtained by all bona fide researchers. "Today, if a graduate student has a good idea that passes muster," says John W.D. Connolly, who had guided the NSF program from its inception until September, 1987, "that student will get a thousand hours of Cray time."

Ninety percent of the cycle time available at the centers is awarded to academic and independent researchers: some by NSF directly and the rest by allocation committees set up by the centers. The time is awarded for projects in virtually all disciplines–social scientists have been granted time to run population study programs, for example. The majority of users and hours awarded, however, have been in mathematical and physical sciences; of the nearly 50,000 hours actually used by NSF grantees at the five centers through last summer, more have gone to researchers in physics than in any other discipline, according to NSF.

SAN DIEGO SUPERCOMPUTER CENTER

SAN DIEGO SUPERCOMPUTER CENTER
UNIVERSITY OF CALIFORNIA, SAN DIEGO

Background: Five-year, $65 million NSF grant commitment awarded Feb., 1985, to GA Technologies, a private research organization in San Diego that is a worldwide leader in fusion research.

Supercomputer services on Cray X-MP/48 officially began Jan., 1986.

Located in new building completed Nov., 1985 (pictured) on campus of University of California, San Diego. On-site NSF-funded staff: 70.

Most highly used center, noted for emphasis on user services, including system documentation. Current top official is Sidney Karin, a nuclear engineer with GA and chief author of center proposal.

Supercomputing Resources: Cray X-MP/48 supercomputer with 4 processors, running CTSS, 8 megaword main memory; SCS-40 minisupercomputer, also running CTSS. Clustered VAX 11/780 and 11/785s front ends running VMS; IBM 4381 mass storage system. Languages available include CFT (Cray FORTRAN), Cray C, and PROLOG. Numerous scientific and graphics packages include CA-DISSPLA, a graphics package from Computer Associates; mathematical program libraries such as IMSL, the International Mathematical and Scientific Library; and NAG, the Numerical Algorithms Group.

Network access through NSFNET and associated Internet networks; network management center for SDSCNET linking SDSC's member institutions; major node on other wide-area networks, including MFENET, the network of the National Magnetic Fusion Energy Computer Center, Livermore, Calif.; SPAN, the NASA space physics analysis network; and HEPNET, the Dept. of Energy's high energy physics network; 32 dial-in ports (300-2400 bps); public-access network connection to TYMNET.

Contacts for system help and training programs: SDSC consulting services, 619-534-5100 (system operations); Dan Sulzbach, 619-534-5125 (training programs).

Grant Application Information: Proposals made to San Diego are reviewed by an allocation committee, which meets four times a year. Start-up and training accounts of up to 10 hours are awarded throughout the year; other awards may be given through San Diego's member institutions. Application deadline for major grants that will begin Jan. 1988 is Nov. 15, 1987; for grants beginning April 1988, deadline is Feb. 15.

To write for forms:

San Diego Supercomputer Center
GA Technologies Inc.
P.O. Box 85608
San Diego, Calif. 92138

For further information, call SDSC consulting services, 619-534-5100.

Institutions Affiliated with Center: Agouron Institute, California Institute of Technology, National Optical Astronomy Observatories, Research Institute of Scripps Clinic, Salk Institute of Biological Studies, San Diego State, Scripps Institution of Oceanography, Southwest Fisheries Center, Stanford, U. of Hawaii, U. of Maryland, U. of Michigan, USC, U. of Utah, U. of Washington, U. of Wisconsin, and 9 U. of California campuses, including: Berkeley, Davis, Irvine, Los Angeles, Riverside, San Diego, San Francisco, Santa Barbara, and Santa Cruz.

NSF's awards go both to researchers who have made applications solely for supercomputer time as well as to principal investigators who have won monetary grants (whether from NSF or some other agency) for projects that also require some supercomputer time. Grants from NSF are made without regard to academic affiliation. Nor does an applicant need to have a current NSF grant to apply for supercomputer time.

The five centers each make their awards with the help of four local allocation committees (the Illinois and Pittsburgh centers have a joint local allocation committee), all of which meet at least four times a year. According to centers officials, upwards of 80 percent of applicants who send proposals directly to the centers receive some supercomputer time; as many as half receive less than they requested because, as one official put it, "they don't do a good job of justifying their need for our resources." (Further details on applying can be obtained from each of the centers; for information on applying directly to NSF, contact the NSF's Division of Advanced Scientific Computing, at 202-357-7558.)

Have the centers improved researchers' access to computers? "Enormously," says physicist Arthur Freeman, who leads a solid-state structures research group at Northwestern University. Freeman's group, which has been one of the heaviest users of both the Illinois and Pittsburgh centers, relies on atomic structure modeling techniques and algorithms made possible only by the advent of supercomputers. "I think the NSF program has made a major impact on computational science and engineering in this country," he says. "It means we've caught up with Western Europe and Japan in fact."

Before the NSF program began just four of the U.S.'s 3200 colleges and universities owned supercomputers and remote access to those was limited. The testimony of American academics who spent their summers in Europe to get time on U.S.-made supercomputers in the early 1980s helped persuade Congress to fund the NSF's proposed initiative. Some other academics had managed, prior to the centers program, to get time on stateside supercomputers in federal labs and research centers either by virtue of their specialty (40 percent of NCAR's computing resources, for example, are available to outside researchers, but in atmospheric science only) or by obtaining the necessary security clearances and slipping in runs during holidays or other off-peak time. "We got access out of sheer desperation wherever and however we could," says Freeman.

Today, the broader access to supercomputing made possible by the centers program is beginning to produce results. Program officials have tracked hundreds of papers in a wide range of fields that cite work

JOHN VON NEUMANN CENTER

JOHN VON NEUMANN CENTER

Background: Five-year, $69.2 million NSF grant commitment awarded, Feb. 1985, to Consortium for Scientific Computing, a group of 13 universities, mostly in the Northeast (see below).

Supercomputer services on CDC Cyber 205 offered to researchers July 1986.

Located in new building completed June, 1985 (pictured) in office park near Princeton. Facilities management by Sterling Software, ZeroOne group. On-site NSF-funded staff: 45.

Features access through JVNCNET, one of the fastest wide-area academic data networks in the world. Current top official is Doyle D. Knight, aeronautics engineer formerly at Rutgers and coauthor of center proposal.

Supercomputing Resources: Two CDC Cyber 205s running VSOS 2.3, with 4-megaword main memory each. Due to be replaced this month by an ETA-10 4-processor system running VSOS, with 4-megaword main memory per processor, plus 128-megaword shared memory. Upgrade to 8-processor, 256 megaword shared memory ETA-10 system scheduled for Spring, 1988.

Clustered Digital VAX 8600 front-end systems running VMS and Ultrix.

Languages include CDC's Cyber FTN200 (FORTRAN), Florida State's Vector C, and LISP.

Numerous scientific and graphics application packages include MOVIE.BYU, a 3-D graphics and animation package from Brigham Young; VAST-2, a precompiler from Pacific-Sierra Research Corp.; and CHARMM, a molecular modeling package from Polygen Corp.

Network access through NSFNET and associated Internet networks; network management center for JVNCNET (direct links to JVNC's 13 participating campuses); major node on other wide-area networks, including SURANET (linking universities, mostly in the Southeast); 32 dial-in ports (300-2400 bps); public-access network connection to TYMNET.

Contact for system help and training programs: Vercell Vance, user services manager, 609-520-2000 (technical operations, allocation, and training).

Grant Application Information: Proposals made to JVNC are reviewed throughout the year and acted on within 4-6 weeks. Other grants may be given through JVNC's member institutions.

To write for forms:

Supercomputing Proposals
John von Neumann Center
P.O. Box 3717
Princeton, N.J. 08543

For further information, call Vercell Vance, 609-520-2000.

Institutions Affiliated with Center: Consortium for Scientific Computing members include Brown, Columbia, Harvard, Institute for Advanced Study, MIT, NYU, Penn State, Princeton, Rutgers, U. of Arizona, U. of Colorado, U. of Pennsylvania, U. of Rochester. Three New Jersey institutions participate in JVNC as well: N. J. Institute of Technology, Stevens Institute of Technology, and the U. of Medicine and Dentistry of N. J.

done at the centers. Says Ken Forster, a researcher in a University of Houston physics group that has received supercomputer time on the NSF's Illinois center: "It has really made a huge difference to us, and we're an experimental group. We're getting things done we couldn't even think of doing two years ago. And we're getting things published, too. It has really been a boon."

Forster's group, led by principal investigator Simon Moss, is studying the physics of "novel structures" and uses compute-intensive modeling programs to help visualize data obtained from various tests.

Enthusiasm for the centers among physicists is hardly new, however. The idea of NSF funding a supercomputer center dedicated to scientific research arose in the early 1980s, after a committee looking into the needs of theoretical physics suggested it in a 1981 report.

Among the physicists NSF later brought before Congress was Illinois center director Smarr, whose longtime advocacy for centers led Connolly to refer to the program as the "Smarr Wars Initiative" in a 1985 speech. Connolly, himself trained in physics, also credited the 1982 Nobel prize won by Cornell physicist Kenneth G. Wilson, "the first computer jock to do so," as a key event that provided some early momentum for the program. (Connolly, who is now director of a state-sponsored supercomputer center at the University of Kentucky, has been succeeded at NSF by Melvyn Ciment.)

Four of the winning proposals for Phase II centers were written or cowritten by physicists of one kind or another, including Smarr (Illinois), Wilson (Cornell), Steven Orszag (then at MIT, now at Princeton, and coauthor of the JVNC proposal), and Carnegie-Mellon's Ralph Z. Roskies and University of Pittsburgh's Michael Levine (who both helped write the Pittsburgh proposal). Smarr, Wilson, Roskies, and Levine remain directors of their respective centers. The San Diego center is directed by a nuclear engineer, Sidney Karin. At JVNC an aeronautical engineer, Doyle F. Knight of Rutgers, recently replaced Columbia computer scientist Joseph P. Traub as the center's top official.

Roskies at Pittsburgh sees some parallels between the physicists who helped start the centers and those who have come later to use them. Unlike the heavy users in chemistry, whose computer work typically relies on massive off-the-shelf calculating programs like CHARMM, GAUSSIAN, and others, says Roskies, "Physicists tend to write their own code. I've often wondered if this may help explain why so many physicists were involved in setting up the centers.

PITTSBURGH SUPERCOMPUTER CENTER

PITTSBURGH SUPERCOMPUTER CENTER

Background: Five-year, $36 million NSF grant commitment awarded Jan., 1986, to a consortium of the University of Pittsburgh, Carnegie-Mellon University, and Westinghouse Electric Corp.

Cray X-MP/48 supercomputer officially opened to researchers June, 1986.

Main offices in Mellon Institute building on CMU campus (pictured); supercomputer located at Westinghouse. On-site NSF-funded staff: 40, may increase to 60 by year-end.

Rated highly by users for its services and education programs; upgrade to Cray Y-MP planned for 1989. Current top officials are physicists Michael J. Levine (Carnegie-Mellon) and Ralph Z. Roskies (Univ. of Pittsburgh), coauthors of center proposal.

Supercomputing Resources: Cray X-MP/48 supercomputer with 4 processors, running COS and UNICOS, 8 megaword main memory, with 128 megaword auxiliary solid-state storage device. Clustered Digital VAX 8650 front ends running VMS. Languages include CFT and CFT 77 (Cray Fortrans); and Cray Pascal. Numerous scientific and graphics packages include BCSLIB, mathematical software from Boeing Computer Services; NCAR and NCARGKS, graphics subroutine libraries from the National Center for Atmospheric Research; and MOVIE.BYU, a 3-D graphics and animation package from Brigham Young.

Network access through NSFNET and associated Internet networks; major node on other wide-area networks, including CCNET, a DECNET network linked to CMU, SURANET, a network linking several universities in the Southeast, and PSCNET, a regional network currently in development; 8 dial-in ports (300-2400 bps); public-access network connection to TELENET.

Contacts for system help and training programs: PSC consulting services, 412-268-6350 (technical operations); Janet Brown, 412-268-4960 (training). Next scheduled training session: introductory workshop, Dec. 7-11, 1987.

Grant Application Information: Pittsburgh shares a local allocation committee with the Illinois center. Requests made to Pittsburgh for over 50 hours of computer time are reviewed by the committee on a quarterly basis; start-up accounts of up to 10 hours as well as 10-50 hour accounts are reviewed on-site and awarded throughout the year. Other awards may be given through Pittsburgh's affiliates.

Application deadline for major grants that begin Apr. 1988: Feb. 1, 1988.

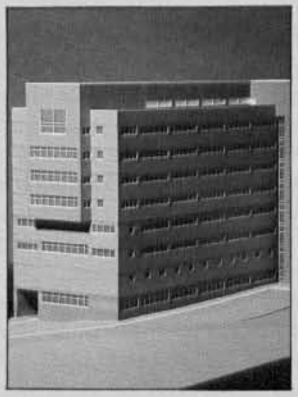
To write for forms:

Wendy Janocha
Pittsburgh Supercomputing Center
4400 Fifth Ave.
Pittsburgh, Penn. 15213

For further information, call 412-268-5005.

Institutions Affiliated with Center: CMU, Case Western Reserve, Drexel, Duke, U. of Florida, Georgia Institute of Technology, Johns Hopkins, Lehigh, U. of Maryland, U. of Michigan, Michigan State, North Carolina State, Northwestern, Ohio State, U. of Pennsylvania, Penn State, U. of Pittsburgh, U. of Rochester, Temple, U. of North Carolina, U. of Tennessee, U. of Virginia, Washington U., West Virginia U., U. of Wisconsin, Yale.

CORNELL THEORY CENTER



CORNELL NATIONAL SUPERCOMPUTER FACILITY

Background: Three-year, $21.9 million NSF grant commitment awarded Feb., 1985, to the Center for Theory and Simulation in Science and Engineering, an academic research group at Cornell that manages the Cornell National Supercomputer Facility (CNSF) among other projects.

First NSF center to open officially, offering services on IBM 3084QX/FPS 164 configuration in Oct., 1985; several system upgrades have followed.

Administrative offices and computers currently in housed in separate locations on Cornell campus; new building in planning stages (one model is pictured). On-site NSF-funded staff: 44. Total staff: 63.

First funded as an "experimental" site by NSF, Cornell center features on-going research and production use of parallel computing architecture. Theory Center's current top official is Kenneth G. Wilson, Cornell physicist and chief author of center proposal; CNSF is run by Larry Lee, formerly with NSF's Division of Advanced Scientific Computing.

Supercomputing Resources: IBM 3090-600E containing six processors, running VM/XA SF operating system, 256 megabyte main memory, with five Floating Point Systems FPS 264 attached scientific computers (SJE operating system). Gould 9050 network front end running Unix; IBM mass storage system. Other supercomputer hardware used by Theory Center research includes two FPS 164s and an Intel iPSC VX/d5 hypercube. Languages include IBM VS FORTRAN Vector compiler, APFTN64 (FPS FORTRAN 77), IBM Pascal VS, PROLOG. Numerous scientific and graphics packages include FIDAP, a fluid dynamics analysis program from Fluid Dynamics Intl., and DI-3000, graphics subroutines from Precision Visuals Inc.

Network access through NSFNET and associated Internet networks; major node on other wide-area networks, including NYSERNET which links various academic and industrial groups in New York state; 24 dial-in ports (300-9600 bps); public-access network connection to ACCUNET.

Contacts for system help and training programs: CNSF consulting services, 800-346-2673; Peter Siegel, 607-255-3985 (system operations), Betsy Schermerhorn, 607-255-3985 (application software and training programs); Craig Callinan, 607-255-5060 (network access).

Grant Application Information: Proposals made to the Cornell National Supercomputer Facility are reviewed throughout the year. Startup grants are awarded to applicants who have submitted proposals; other grants may be given through participants in Cornell's Smart Node program (see below).

To write for forms:
Janice Abraham
Center for Theory and Simulation in Science and Engineering
265 Olin Hall
Cornell University
Ithaca, N.Y. 14853
Further information, 607-255-8686.

An allocation subcommittee reviews applications for Cornell's Strategic User program, which reserves one-third of the center's processing power a month for projects that exploit parallelism and other large-scale resources. For information, call Sandy Adams at 607-255-3985.

Institutions Affiliated with Center: Participants in Cornell's Smart Node program include: CUNY, Clarkson, Cornell Medical College, Duke, John Hopkins, Louisiana State, NYU, N. Carolina State, Northwestern, Penn State, RPI, Rockefeller U., SUNY (Binghamton, Buffalo, Stony Brook), Syracuse, Texas A&M, UCLA, U. of Delaware, U. of Florida, U. of Ill. at Chicago, U. of Ill. at Urbana-Champaign, U. of Mass., U. of Nebraska, U. of N. Carolina, U. of Rochester, U. of Tennessee, Virginia Polytechnic, Washington State.

There's something about physicists, when there's a job that needs to be done they go out and do it."

To continue to meet the needs of the scientific community it serves, NSF has asked Congress to provide $46.6 million for the supercomputer centers for fiscal 1988 (which began October 1, 1987). That is an 18 percent increase in total center funding, within a total NSF budget that is up 17 percent over last year.

Funding provided by NSF to the five centers during the 2-1/2 remaining years of Phase II will depend on how much money NSF itself receives from Congress. However, that request is subject to the budget-balancing pressure engendered by the Gramm-Rudman-Hollings resolution to balance the federal budget. The American Physical Society's Washington, D.C., news service recently reported that "although there is little opposition to the NSF request, it now appears that [the NSF] will be lucky to get off with a freeze at this year's level."

Regardless of the 1988 funding level, no center faces serious trouble this year, say NSF officials. Of greater concern is the amount of money that will be allocated during fiscal 1989 and 1990 and beyond. Significant continued funding is needed because, while supercomputer technology has been advancing in roughly two- or three-year cycles over the past decade, only two of NSF's five-year agreements–with JVNC and Pittsburgh–include plans for upgrades. While JVNC's ETA-10 is due to come on line this month, Pittsburgh's plan is to trade in its Cray X-MP for the follow-on Y-MP in 1989.

The rest of the centers are, as San Diego director Karin puts it, "explicitly underfunded," and are actively seeking additional funds for upgrades, both from NSF and from other sources. The San Diego center is aiming for an upgrade to the Cray Y-MP, while the Illinois center–which has so far been most successful in attracting industrial partners–is seeking both a Y-MP and a Cray-2. Cornell, which has so far received its IBM machines free, is counting on continued largess to reach IBM's next generation machine, which could come as soon as next year.

The very expense of the state-of-the-art, on the other hand, underlies the appeal of minisupercomputers. "There's a modest amount of funding for the minisupers now," says Bell at NSF. Cornell, San Diego, and Illinois, have bought minisupercomputers. But, he says, "we're spending $50 million a year in supercomputers. I think if the same $50 million were thrown at buying minisupers, we could get a lot more done."

Bell, whose involvement with low-cost, high-performance computers began in the 1960s when he was a principal architect of several minicomputers at Digital Equipment Corp., has been reported to be considering leaving NSF this spring to return to a startup he cofounded, Sunnyvale, Calif.-based Dana Group, which is building a line of downsized "personal supercomputers." He explains, "I'm challenged by the idea of trying to provide better, alternative power a lot more cheaply–science will win on it."

Some scientists dispute the view that minisupers offer a viable alternative for leading-edge science. According to Joan Centrella, a cosmologist at Temple University, "All cycles are not equal. Cycles attached to large memory are far more useful to me than cycles connected to small memory." Northwestern's Freeman, who thinks that keeping the centers at the state-of-the-art is the essence of the NSF program, agrees: "It's like if you added together a hundred Volkswagens, you don't get a Saturn V rocket."

A Thornier Issue

Science's need for ever more powerful computing engines will soon present the centers with a thornier issue: whether or not to buy Japanese supercomputers. Until a few years ago, the worldwide market for supercomputers was entirely the province of U.S. manufacturers. Japanese competition first arrived in the U.S. around 1985 in the form of three new lines: the Hitachi S810-20, the Fujitsu Vector Processors, and the SX-2 from Nippon Electric Co. (NEC). A new generation of these machines, which may begin shipments in 1988, is expected to reach the 3 gigaflop threshold of the ETA-10 and will almost certainly be competively priced (NEC sold its first SX-2 in the U.S. by undercutting a comparably performing Cray-2 by one-half).

CORNELL THEORY CENTER

Cornell's IBM-FPS system offers scalar, vector, and parallel processing.

"If the Japanese come out with a machine that's significantly better than what the U.S. makers offer," observes ex-director Connolly, "then we're going to have a dilemma. We won't be able to satisfy both science and the U.S. supercomputer industry." He adds, "So far it hasn't happened."

Some of the centers have been visited by Japanese salesmen, however, and the centers officials–themselves scientists–are at least listening. "More competition is good for everything," ventures Wilson at Cornell. "On the other hand, [supercomputer centers] have to develop a very deep relationship with manufacturers. It would be very difficult to get much done if you had to travel across the Pacific for every business meeting."

Even if the centers do end up buying some Japanese machines, the program will be helping U.S. supercomputing, argues Connolly, by keeping the most computer-hungry scientists in the U.S. By keeping the centers at the leading edge, he notes, "we keep our best people here, in the universities, where they can work with graduate students and train the next generation."

The differences among the five centers prove that there is clearly no single best way to operate a center. Not only do the centers feature four different makes of supercomputers and at least that many different operating systems; they also embody a startling variety of types of organization (from a private sector operator at SDSC to a consortium of 13 universities at JVNC, for example), locales and office facilities (from an office park to on-campus, to separate and disbursed facilities), and philosophies toward supercomputing (from vigorously advancing the state of computation to diligently providing production cycles). Observes Bell: "I think they're all independently defining what they want to be."

Even as many scientists are getting up to speed in using the supercomputer centers, others have yet to be convinced that they should be using them. "There's still a big gap between scientists who work with computers and those who don't," says Cornell's Wilson.

When Wilson won the 1982 Nobel for his theory of critical phase transitions, he told *Physics Today* that some physicists had been skeptical of his underlying work because it had been done on a computer. Today, Wilson says, "the skepticism to computational science outside the field is still there." He adds, "And it's perfectly justified, because [the field's] biggest scientific breakthroughs are still in the future."

Supporters of the centers program point to the sharp increase in publications based on work done at the centers. "That's the real measure of the scientific productivity of the centers," says SDSCs Karin. ■