eration" in Audi 5000 cars. Seidemann last summer published an article in the *Buffalo Environmental Law Journal* disputing a 1986 analysis by NYPIRG that recommended that New York City abandon an incinerator plan in favor of more waste recycling. Seidemann interprets its alleged inconsistencies and arbitrary use of numbers as "falsifications." And he says NYPIRG's behavior clearly fits the National Academy of Sciences' definition of "fabrication, falsification, and plagiarism."

Steve Romalewski, a co-author of the recycling report, has written extensive technical rebuttals. But Romalewski considers the charges basically absurd because the recycling study, like the Audi and SAT reports, presents no original data. "Our approach ... is to compile existing information and documentation," he says. NYPIRG's reports "hide nothing," and "we do talk about what our methods are."

It's not clear how many of the co-signers of Seidemann's petition feel as strongly as he does. But biology professor David Nishiura explained that Seidemann convinced him during a 2-hour personal visit that a "misrepresentation" had occurred in a NYPIRG press release. "The level of proof [in a press release] probably doesn't have to be as high as if you submitted a paper, but certainly the statements shouldn't be misrepresentations of what the evidence indicates," Nishiura remarks.

Members of CUNY's humanities faculty have come to NYPIRG's defense. Political science professor Michael Kahan, for example, says Seidemann and his colleagues are turning differences in interpretation into major offenses. Usually when scientists disagree, Kahan says, they "publish a counterargument" and let the public make its own judgment. "I don't see why [the scientists] don't treat NYPIRG that way," he says. "To charge somebody with what is tantamount in the scientific community to a criminal charge is very serious."

Brooklyn College administrators have shown little interest in the case. In November, CUNY's acting vice chancellor for academic affairs, Anne Martin, declined to intervene, saying: "Science has to allow latitude for disagreement, differing interpretations of data or results, and outright error."

Lacking a legal forum, Seidemann says he intends to take his charges to the court of public opinion. But this approach has risks, too. It may appear, as NYPIRG staffer Romalewski says, that in taking this advocacy approach, Seidemann is "doing the same kind of thing that he accuses us of doing."

–Jock Friedly

Jock Friedly is a free-lance writer based in Arlington, Virginia.

HIGH-END COMPUTING

Panel Hopes to Splice Pieces Of U.S. Research Network

For computer scientist Ken Kennedy, the search for high-end performance never ends. As director of the Center for Research in Parallel Computation at Rice University, one of the National Science Foundation's (NSF's) showcase science and technology centers, he has direct access to powerful IBM, Cray, and Intel supercomputers. But he also needs high-speed connections to researchers in other institutions. So last summer, Kennedy's center joined with two local universities in a successful bid to hook up to NSF's very high speed Backbone Network Service (vBNS), a network initially created to link five NSF-supported supercomputing facilities. The center also is competing for a major role in the next iteration of NSF's supercomputing program (see sidebar).

These programs are allowing researchers like Kennedy to redefine what it means to be connected. Their scientific needs have long since exceeded the capabilities of the Internet, the once-proud federal creation that has become a victim of its own popularity, and led them to hook onto more capable networks like vBNS to share and manipulate vast amounts of data. But even these high-speed networks have their limitations: Access is costly and limited (see table), and in general, the networks don't connect with each other. Fortunately for Kennedy and other data-hungry researchers, two separate new initiatives have emerged to help lead the way toward an even more connected future.

One is a 5-year, $500 million program, called the Next Generation Internet (NGI), that President Clinton announced with great fanfare last October in the heat of the election campaign (*Science*, 18 October 1996, p. 335). The second is a loose-knit university initiative, called Internet-2, to upgrade campus networks and develop educational applications that make use of these improved links.

Although these initiatives and existing high-speed agency networks have sprung up independently, all are integral to creating the next U.S. information highway. Larry Smarr, director of the NSF-funded National Center for Supercomputing Applications, likens NGI to the top of a three-layer cake. Internet-2 provides the foundation for universities to take advantage of im-

The Next Wave of Supercomputing Centers

For academic researchers seeking access to the fastest machines, the four supercomputing centers created in 1986 by the National Science Foundation (NSF) offered entree to a new world of modeling, data crunching, and manipulating vast amounts of information. But in the decade since they were established, that capacity has become available at dozens of other university-based supercomputing centers. So last year, NSF decided to replace its existing network of centers with a smaller number of core facilities that would provide researchers not only with the fastest machines—capable of performing more than 1 trillion operations per second (teraflops)—but also would work closely with scores of other computing groups around the country.

On 27 to 28 March, the National Science Board, NSF's oversight body, is expected to announce the winners in a hot competition to participate in this new $65-million-a-year program, called Partnerships for Advanced Computational Infrastructure. Although the official results remain a closely guarded secret, knowledgeable sources say that three of NSF's existing supercomputing centers are expected to emerge victorious. These sources say that the two big winners will be the National Center for Supercomputing Applications (NCSA) at the University of Illinois, Urbana-Champaign, and the San Diego Supercomputing Center at the University of California, San Diego. The Pittsburgh Supercomputing Center is expected to be a regional partner for the NCSA-based center, with a special focus on high-end computing. The fourth of the current supercomputing centers, the Cornell Theory Center, is said to have finished out of the money in the competition among six proposals.

None of the competitors was willing to talk publicly about the proposals, which were reviewed last week by a panel of senior NSF officials. The new awards will be for 5 years, and NSF hopes to negotiate terms of the agreements, including budgets, and make the awards before funding for the existing centers runs out on 30 September. **–J.D.M.**

proved networking, he says, while individual agency programs like vBNS sit in the middle, generating the applications that will create demand for the high-end systems. "The president has said that NGI is part of his bridge to the 21st century," says Smarr. "And the middle layer will produce the success stories to justify the cost of Internet-2."

The White House's direct involvement with NGI is likely to make it the most visible of these efforts. In the 5 months since Clinton announced it, federal officials have been beavering away at a plan. They are talking about giving 100 sites around the United States a connection 100 times more powerful than what is now available on the Internet and wiring 10 sites with 1000 times the present capacity. The Defense Advanced Research Projects Agency, with $40 million requested for 1998, will get the biggest share of NGI money, followed by a proposed $35 million for the Department of Energy (DOE) and $25 million divided among NASA, NSF, and the National Institute of Standards and Technology. Despite its name, NGI will serve more as a showcase for new technology than an early vision of the next Internet. "It's not the start of a commercial network," says DOE's Dave Nelson. "It's a test-bed for what can be accomplished with greater capacity and innovative uses. Then it's up to industry to make available what the customer wants."

The task of sketching out a new information superhighway will fall to a presidential panel of 22 university and industry bigwigs, which met for the first time last week. A group led by Carnegie Mellon University computer scientist Raj Reddy and Microsoft's Jim Gray is hoping to complete a report on NGI by June, while two other subcommittees—one to examine high-performance computing and the other to address information management—are being formed to develop recommendations before the panel goes out of business in 2 years. Not surprisingly, most of the people at the table are already involved in such efforts, including the man running the meeting—Kennedy.

The panel's official name—the Advisory Committee on High-Performance Computing and Communications, Information Technology, and the Next Generation Internet—reflects how much ground it has been asked to cover. One major challenge is to meet the needs of society as well as research institutions, its initial focus. "If only the top researchers have a clear pipe and the rest of society has clogged pipes, there will be a revolt," says Smarr, a panel member.

The panel will also focus on building a more robust and useful network than the old Internet. "In 20 years, the average person will be able to access a petabyte (10^{15} bytes) of information for $100," predicts Reddy. "That's equivalent to all the printed material that's ever been created. But what will they do with all that information? And will it work reliably, without rebooting?"

Out of the dirt. While the panel deliberates, select groups of researchers have already found relief from what Smarr calls the "one-lane dirt road" and "cyber-sewer" that the Internet has become as a result of its exponential growth. Help has come in the form of specialized networks set up in the past few years by the four federal agencies with the largest stake in high-end computing—NASA, NSF, and the Departments of Defense and Energy. But while they give government researchers and outside scientists funded by those agencies high-speed access to facilities within the network, they typically rely on the clogged Internet to connect to other networks. The result is enhanced computing for a relative handful of researchers working on selected projects.

"Before we connected to vBNS, we had a standard Internet connection," says University of Pennsylvania physicist Robert Hollebeek, co-director of the NSF-funded National Scaleable Cluster Project at Penn, the University of Maryland, and the University of Illinois, Chicago. The 2-year-old project, which hopes to provide researchers at the three institutions with access to high-end computing from their desktops, was one of 13 projects chosen by NSF in a first round of competition last summer to expand vBNS. "You can't do high-volume, high-speed work without it," says Hollebeek. NSF expects to announce another round of winners next month from a pool of 50 proposals, on its way toward linking 100 institutions.

But even vBNS has its limitations. One is its high cost: Hollebeek's $350,000 grant pays for the special equipment needed to connect to the nearest node, which is 65 miles away, and for the monthly long-distance phone bills. It's also not for everyone: Researchers on the three campuses must apply for the chance to be hooked up and show a "legitimate reason" to use the greater bandwidth and speed, he says.

Penn is also participating in Internet-2, which was begun last fall. The consortium, which has tripled in size since 34 universities founded it, has pledged to spend about $500 million over the next 3 to 5 years to upgrade campus networks and to develop applications that make use of broadband capacity. Members also hope to link to each other through one or more of the existing high-end networks.

Mike Roberts of the Washington-based EDUCOM, who is directing the project, says some applications—multiple media, interactivity, and real-time collaborations, for example—would be useful to all researchers, while others, such as distance education and lifelong learning, are particularly important to universities. "We're focusing on the average faculty member who says [the current network] is too hard to use or too slow for research and teaching," says Roberts.

The new presidential panel is expected to make recommendations on achieving a seamless fit among these emerging networks. "We want to help them achieve a balanced portfolio among seeding new hardware, developing the appropriate software, and conducting research on new applications," says Kennedy. "We're looking 10 to 15 years down the road." If they succeed, thousands of researchers may find themselves in the driver's seat as they head down the next information highway.

–Jeffrey Mervis

HIGH-PERFORMANCE NETWORKS

GOVERNMENT-WIDE

Next Generation Internet (NGI)
Proposed this year to provide high-speed links to 100 sites and very high speed links to 10 sites in the next 2–3 years; test-bed for technology and applications.

BY AGENCY

National Science Foundation
vBNS (very high speed Backbone Network Service)
1995 research successor to NSFnet targeted for some 100 universities beyond original five NSF supercomputing sites. Presently, 30 awards with 45- to 155-Mbps links to 622-Mbps national backbone; operated by MCI.
(http://www.cise.nsf.gov/ncri)

Department of Energy
ESnet (Energy Sciences Network)
Serves DOE's research labs; provides backbone for ASCI (Advanced Scientific Computing Initiative) at three weapons labs. Combination of 1.5-Mbps and 45-Mbps lines; operated by Sprint.
(http://www.es.net)

Department of Defense
DREN (Defense Research and Engineering Network)
Implemented this year for 57 DOD research labs, planned expansion to 200 defense sites. Combination of 1.5-Mbps and 45-Mbps lines, with planned upgrade to 10–155 Mbps by end of year; operated by AT&T.
(http://www.hpcmo.hpc.mil)

National Aeronautics and Space Administration
NREN (NASA Research and Education Network)
Created in 1994 to connect five NASA research centers with 155-Mbps lines; possible upgrades to other NASA centers and higher speeds. Operated by Sprint.
(After March 15: http://www.nren.nasa.gov)

UNIVERSITY-BASED

Internet-2
Consortium of universities formed last fall; each has pledged to spend $500,000 over 3–5 years to upgrade on-campus connections, which will then link to outside networks. Focus is on educational as well as research applications.
(http://www.internet2.edu)

SOURCES: NSF/NASA/DOE/DOD/I-2