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Next Generation Internet and Related Initiatives

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Summary

The Next Generation Internet (NGI) program would advance the current state of the Internet and university research capabilities, and assist federal agencies to achieve their missions. The NGI is part of a larger federal policy umbrella that also includes the High Performance Computing and Communications (HPCC) initiative. On September 28, 1998, President Clinton signed into law the Next Generation Research Act (P.L. 105-305), which extends congressional authorization for both NGI and the HPCC initiatives through FY2000. For FY2000, the Clinton Administration has asked for $1.8 billion for information technology federal R&D funding: $1.46 billion for the HPCC initiative (including $100 million for the NGI) and $366 million for Information Technology for the 21st Century, or IT^2. This last initiative is a request for an additional increase in federal funding for fundamental, long-term research; advanced computational applications; infrastructure for research, and research on the economic and social impacts of information technology.

Background

The Clinton Administration has emphasized federal support of research for computer and communications technologies, networks, and applications. The three cornerstones to this policy are the Next Generation Internet (NGI), High Performance Computing and Communications (HPCC), and the Information for the 21st Century (IT^2) proposal.

The Next Generation Internet Initiative

The Internet is a "network of networks," originally created in the late 1960s by the Department of Defense to connect a small group of university researchers working on defense-related research and development programs.[1] The Internet evolved over time as

[1]Specifically, it was the Defense Advanced Research Projects Agency, or DARPA, which provided (continued...)

local computer networks, mid-level networks, and national "backbone" networks were tied together through computing and network standards and protocols. By 1985, the National Science Foundation (NSF) replaced DOD as the principal player for the Internet. This included NSF's support for several existing supercomputer centers at U.S. universities, in which high-speed, high-end computation machines were linked to each other. Other regional and university research centers subsequently gained access to this high-speed network, and the genesis of the Internet as we know it today was created.[2]

The Internet has grown in size at nearly 100% per year since 1968, and traffic has been growing at a rate of 400% per year in recent years. By the year 2000, according to the one source, more than 50% of the U.S. population will have access to the Internet, while another source estimates that as of January 1999, over 153 million people worldwide have access to the Internet.[3] To facilitate increased growth and traffic, many experts contend that immediate improvements are needed to improve Internet traffic capacity. Many also contend that improved Internet transmission capability is intertwined with high-performance computing advances and that U.S. funding, research needs, and priorities are a national concern in these (and related) science and technology areas.[4]

In October 1996, President Clinton announced that the federal government would renew its efforts to support infrastructure, technology, and applications to relieve mounting Internet congestion at federal agencies and to give agencies new technologies. President Clinton stated that since the creation of the Internet was in large part based on federal investment in network technologies and applications, that it was proper and fitting that federal efforts should provide the support and context for the next generation of network technology for the 21st century. The President called for an increase in federal funding for federal agencies' network programs. A subcommittee on Computing, Information, and Communications Research and Development (CIC R&D) within the executive branch would oversee the Next Generation Internet, or NGI. In 1997 and 1998, the executive branch published an NGI Initiative Concept Paper, and later, a more detailed NGI Implementation Plan, which outlined goals, objectives, funding and policies.[5]

The NGI has three program goals. The first is **Experimental Research for Advanced Network Technologies**. Activities that will support this program goal include network growth engineering, end-to-end quality of service for networks, and network and communications security. The second program goal is **Next Generation Network Testbed**. If one views the Internet as a series of connected network strands comprising a fabric of connections, then this goal would boost high-speed connectivity and performance.

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[1](...continued)
both the funding and technical support for what has now become the Internet.

[2]Congressional Research Service, *The Internet: History, Infrastructure, and Selected Issues,* by Rita Tehan, CRS Report 98-649, 28 July 1998, 21 pages.

[3]Brad Meyers, *Computer Almanac: Interesting and Useful Numbers About Computers* [http://www.cs.cmu.edu/afs/cs/user/bam/www/numbers.html].

[4]U.S. House of Representatives. *High Performance Computing.* Hearing before the Committee on Science. October 6, 1998.

[5]See: NGI Implementation Plan [http://www.ngi.gov/plan.html] and NGI Initiative Concept Paper [http://www.ccic.gov/ngi/concept-Jul97/introductn.html].

Two activities would support this: a minimum improvement of 100x greater speed and capacity over current Internet connections for 100 participating institutions, and the creation of ten high-risk ultrahigh speed switching sites. The third goal is **Revolutionary Applications**. This would link the missions of federal agencies' with the needs of universities, federal laboratories and industry through innovative applications.

For FY1999, the NGI will be funded at $110 million at six agencies (see Table 1). This overall funding is the same as FY1998 funding for NGI, which was also at $110 million. However, not all NGI program allocations within agencies receive the same proportion of funding. In addition, the Department of Defense has received a significant increase in overall NGI funding from FY1998 to FY1999 ($35 million to $50 million), while DOE has had its NGI funding reduced over the same period of time.[6]

Table 1: Program Funding: FY1999 Appropriations for NGI
(in millions of dollars)

Program Title	DOD	NSF	DOE	NASA	NIST	NLM/ NIH	TOTAL
Experimental Research	20	7	7	2	3	-a	**30**
Next Generation Network Testbed	20	10	10	3	-a	-a	**33**
Revolutionary Applications	10	8	8	5	2	5	**22**
TOTAL	**50**	**25**	**15**	**10**	**5**	**5**	**110**

Source: National Economic Council, Office of the President, The White House, Washington, D.C., February 1, 1999. [a] *All program funding levels are estimates based on existing agency levels; in some areas, agencies were not appropriated specific funds.*

NGI and Related Initiatives

The NGI is also a part of several broader federal information technology initiatives. In 1993, the Clinton Administration described its national information technology policy in its National Information Infrastructure (NII) policy. The NII was intended to be an overarching national policy initiative to extend basic principles of universal access and

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[6]For FY1999, policymakers increased DOD's Defense Advanced Research Projects Agency (DARPA) NGI funding by $15 million over the Clinton Administration request, citing support for DARPA's dual-use, long-term R&D as a part of NGI. For DOE's NGI funding in FY1999, congressional policymakers did not approve the Clinton Administration request, instead reducing DOE's NGI funding by $15 million. Policymakers contended that DOE's computing indicatives were adequate and did not necessitate a budget increase for FY1999.

open service of telephone service to the Internet age. The Clinton Administration views its information infrastructure policy and the NGI as complementary; the former is the broad policy blueprint for the United States in the Information Age, while the latter provides specific program funding at federal agencies directed at supporting Internet R&D consistent with agencies' missions.

Pre-dating both the NII or NGI is the federal High Performance Computing and Communications program. This federal high performance computing initiative began in 1989 under President Bush, who responded to industry and academia calls for a "Grand Challenge" to advance high-end computing technologies and applications. The federal High Performance Computing and Communications (HPCC) initiative was authorized by Congress from FY1991 through FY1995. During this period, the HPCC program increasingly became the focal point for all Executive branch computer and communications R&D, and was favorably received by many in industry, academia, and government. However, Congress did not renew this authorization at the end of FY1995 (although it continued to appropriate money for similar federal efforts).[7] What followed were a series of program name changes and modifications of federal goals, in part to address rapid technology changes, and in part to address the concerns of Congress.

The 105th Congress passed legislation that reauthorized the HPCC, as well as providing authorization for the NGI. The Next Generation Internet Research Act (P.L. 105-305), signed into law by President Clinton on October 28, 1998 amended the High Performance Computing Act of 1991 to authorize NGI appropriations for fiscal years 1999 and 2000. This law ensures that congressional authorization and appropriations for NGI and related programs are consistent in FY1999 and FY2000.

Information Technology for the 21st Century (IT^2)

While there has been a great deal of public and private sector support for the NGI, some are concerned that the initiative does not address several long-term IT problems. In August 1998, the President's Information Technology Advisory Committee (PITAC) released an interim report that addressed the problems facing the United States with regard to the adequacy of federal support for long-term research and development.[8] The PITAC recommended increasing the federal investment in IT R&D by approximately $1 billion over five years. The Clinton Administration used the PITAC interim report as part of its examination of current federal information technology programs and in preparation for its FY2000 budget request.

On January 24, 1999, Vice President Gore gave the keynote address at the annual meeting of the American Association for the Advancement of Science. At this meeting, the Vice President announced a new multi-agency research and development program in information technology as part of the FY2000 budget proposal. Called Information

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[7]There were two main concerns: the first was that continued HPCC program modifications meant that the original authorization did not correlate with what the HPCC had become; the second was that without a "sunset" provision, some congressional policymakers feared that the HPCC could continue without congressional oversight.

[8]PITAC is comprised of public and private sector leaders and is one of several types of advisory committees advising the President on science and technology issues.

Technology for the 21st Century, or IT^2, his proposal called for an expansion of federal R&D spending on advanced computing, develop new software technologies for "mega" computers, and create new computer simulation and modeling capabilities.

On February 1, 1999, President Clinton highlighted the IT^2 initiative as part of the Administration's FY2000 budget proposal. (See Table 2). The President's request calls for a total of $1.8 billion in FY2000 for federal IT research and development (R&D). Of this, $1.46 billion is for HPCC, the largest federal effort in computing and communications R&D;[9] $100 million for NGI; and $366 million for IT^2. The IT^2 initiative is intended to supplement, not supplant, the HPCC and the NGI. It would provide additional federal funding for software research, scalable information infrastructure, high-end computing, and workforce training and employment. The IT^2 would be focused on long-term and diverse information technology R&D across six federal agencies.

Table 2: Clinton Request
HPCC, NGI, & IT2 for FY2000
(in millions of dollars)

AGENCY	HPCC FY200 Request	NGI Request (part of HPCC)	IT^2 FY2000 Request
DOD	207	40	100
DOE	659	15	70
NASA	136	10	38
NSF	314	25	146
COMMERCE[b]	27	5	6
NLM/ NIH	115	5	6
TOTAL	**1,462**[a]	**100**	**366**

Note: [a] *For the HPCC, the FY2000 request total also includes $4 million for the Environmental Protection Agency.* [b] The Department of Commerce includes the Naitonal Institute of Standards and Technology (NIST) and the National Oceanographic and Atmospherics Administration (NOAA).

Internet2

Another important information technology policy initiative comes from U.S. universities. In the fall of 1996, just before the Administration announced its NGI proposal, over 200 universities committed to developing an expanded version of the

[9]The passage of P.L. 105-305 reauthorized the HPCC, thus changing the name of the LSN/HPC to the HPCC. This is the fourth name change in five years for this initiative.

Internet. It was called Internet2. This proposal would expand current Internet connections with greater data transmission capacity. In October 1996, when President Clinton called for the NGI, he singled out the Internet2 as an important university initiative as well as complementary to ongoing federal efforts.

By the end of 1996, university, industry and federal policymakers developed the Internet2 through existing computing and communications computing programs. On April 14, 1998, Vice President Gore announced that several high technology companies, in concert with many of the universities already committed to Internet2, would provide $500 million for the Internet2. In addition, DOD would allocate $50 million over several years through meritorious grants to universities, many a part of the Internet2, as part of the NGI.

The Internet2 and NGI programs intersect several ways. The NSF has approved 92 institutions for high performance computing network connections as part of NSF's very high performance Backbone Network Service (vBNS). Of these, 77 institutions are Internet2 universities; the vNBS is considered an integral part of NSF's contribution to NGI. Internet2 universities also are establishing GigaPoPs (Gigabit per second Points of Presence) that provide regional connectivity for universities for Internet2, the NGI, and other advanced federal networks (e.g., vNBS). Third, researchers at Internet2 universities are developing a wide range of applications that require advanced networking. Many applications are being funded by federal initiatives, including the NGI.

Issues for the 106th Congress

Many in government, academia, and industry support the NGI as consistent with long-term federal support for information technology R&D. The 1998 National Research Council (NRC) report, *Funding A Revolution: Government Support for Computing Research,* provides evidence that a wide range of computing and communications technologies have benefitted greatly from federal support. The Internet was created through DOD funding, and according to the NRC, data networking in general and many computing and communications technologies specifically have benefitted from government support. While the NRC cautions that historical case studies cannot determine the future, government support of the Internet and related networks can provide lessons of how government-industry-university collaboration has worked, and why.[10]

Some caution, however, that continued reliance on government funding for Internet development, including the NGI and related programs, may unduly influence how future network technologies and applications are utilized. If the federal government is the primary source of Internet R&D, will the private sector not undertake the kind of research, development, and commercialization that it should to make the Internet ready for the 21st century? Another concern expressed by policymakers is whether several large, interagency federal programs can be adequately coordinated across multiple government agencies. Can the Clinton Administration ensure that multiple federal computing and communications efforts are effective, efficient, and serve the national interest?

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[10]National Research Council, *Funding A Revolution: Government Support for Computing Research* (Washington: National Academy of Sciences, 1999) p. 169-183.