

Information Technology for the Twenty-First Century (IT²)

Briefing at Peta(Fl)ops II
Birds of a Feather

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The IT² Planning Team

Information Technology for the Twenty-First Century (IT²) - An Investment in America's Future

- President Clinton and Vice President Gore propose a \$366M increase in the Government's investment in IT R&D for the fiscal year 2000 budget
- IT² builds on the Government's previous accomplishments and current investments

Compelling Reasons to Increase IT R&D (1)

- IT is a growing component of the U.S. economy, currently accounting for more than \$750 billion in annual revenue
- IT leadership will be critical in the 21st century
- Past Government-funded IT R&D has yielded huge economic return on investment, and continues its pivotal role in promoting innovation
- IT is beneficial to a wide range of important national goals, including a world-class education system, a strong defense, access to affordable high-quality health care, and improved quality of life for Americans

Compelling Reasons to Increase IT R&D (2)

- As our economy and society increasingly depend on IT, we must be able to design information systems that are more reliable and more secure
- IT will revolutionize our national science and engineering R&D strategy - high-performance computing and simulation technology will allow researchers to develop life-saving drugs more rapidly, better understand the functions of our genes once they've been sequenced, more accurately predict tornadoes, and design engines that are cleaner and more fuel-efficient
- Funding research will help the intellectual base grow, thereby ensuring continued innovation

IT's Potential Benefits are Enormous:

- Improved quality and delivery of health care
- Stronger national security
- Safer and cheaper transportation by air, land, and sea
- More efficient and responsive government
- Better quality and delivery of education and training to all Americans
- Increased productivity of research in all disciplines
- A safer and improved environment through efficient design and operation of buildings, vehicles, and equipment
- Better warnings of dangerous weather
- Improved climate models to support more informed decisions
- Faster response to hazardous materials releases
- Decreased reliance on untested and insecure information systems

IT²: Built on a Firm Foundation

■ IT²:

- Builds on previous and current programs, including the Federal High Performance Computing and Communications (HPCC) Program, the Federal Next Generation Internet (NGI), and the Department of Energy's Accelerated Strategic Computing Initiative (ASCI)
- Responds to recommendations from the President's Information Technology Advisory Committee (PITAC)
- Reflects output from numerous workshops held by research communities

Major IT² Investments

- IT² will increase Federal investments in:
 - Fundamental IT research
 - Advanced computing for science, engineering, and the Nation
 - Research in the ethical, social, and economic implications of the Information Revolution, and support for the education and training of America's IT workforce

Fundamental IT Research

- Long-term high-risk investigations of key issues in computer science and engineering
- Research focal points:
 - Software
 - Human computer interfaces and information management
 - Scalable information infrastructure
 - High-end computing

Fundamental IT Research: Software

- Highest IT R&D priority according to PITAC
 - The demand for software exceeds our ability to produce it
 - Today's software is fragile, unreliable, and difficult to design, test, maintain, and upgrade
- Proposed research areas:
 - Software engineering
 - End-user programming
 - Component-based software development
 - Active software
 - Autonomous software
 - High-assurance software

Fundamental IT Research: Human Computer Interaction and Information Management

■ Research to improve the ways we interact with computers

- Computers are still too hard to use; surveys show that computer users waste over 12 percent of their time because they can't understand what their computers are doing
- Improved accessibility for people without a keyboard (for example, mobile professionals and doctors) and persons with disabilities
- Better techniques for locating data and extracting “knowledge” from data

■ Proposed research areas:

- Computers that speak, listen, and understand human language
- Information visualization

Fundamental IT Research: Scalable Information Infrastructure

- Research to support the phenomenal growth of the Internet
 - In 1985 the Internet connected 2,000 computers
 - Today it connects over 37 million computers
 - Future networks will connect at least a billion users and will be more complex - they will connect sensors, wireless modems, and embedded devices
- Proposed research areas:
 - Deeply networked systems
 - Anytime, anywhere connectivity
 - Network modeling and simulation

Fundamental IT Research: High-End Computing

- Leading-edge research for future generations of computing to:
 - Improve computational speed on applications
 - Increase the efficiency of massively parallel systems, with a focus on systems software
 - Develop technologies to enable future systems capable of a thousand trillion (10^{15}) calculations per second
- Proposed research areas:
 - Improved supercomputer performance and efficiency
 - Creation of a computational grid
 - Revolutionary computing

Advanced Computing for Science, Engineering, and the Nation (1)

- IT² will obtain computers that are 100 to 1,000 times more powerful than those now available to the civilian research community, and make them available on a competitive basis
 - These systems will have several thousand processors, high speed shared and distributed memory, and state of the art switching technology
 - Install and develop systems capable of 5 trillion (a thousand billion) computations per second by the end of fiscal year 2000, and 40 trillion by the year 2003

Advanced Computing for Science, Engineering, and the Nation (2)

- Develop scientific and engineering simulation software and tools to make these computing systems useful research tools:
 - Advanced technologies in computational algorithms and methods and in software libraries
 - Problem solving and code development environments and tools
 - Distributed computing and collaborative environments
 - Visualization and data management systems

Advanced Computing for Science, Engineering, and the Nation (3)

- Establish and fund multidisciplinary teams working on our most challenging problems, including:
 - Predicting climate change
 - Predicting severe weather
 - Understanding genetic function
 - Computational seismology
 - Simulating combustion
 - Simulating materials
 - Modeling the evolution of the universe
 - Simulating complex vehicles and missions

Economic and Social Implications of IT and IT Workforce

- Increased research in economic and social impacts will:
 - Help in the design of information systems
 - Identify barriers to adopting IT and its applications
 - Provide more empirical data to policymakers
 - Encourage the solution of problems caused by IT
- Proposed efforts in training IT workers at U.S. universities:
 - Faculty access to modern curricula and instructional material
 - Graduate and post-graduate traineeships
 - University research grants through other components of this initiative will help support graduate students

IT² Management

- Senior management team reporting to the President's Advisor for Science and Technology will:
 - Help establish and monitor goals
 - Allocate research tasks
 - Ensure tight Federal coordination
 - Ensure open competitive allocation of funds
- Working group reporting to the senior management team:
 - Chaired by NSF Assistant Director for Computer and Information Science and Engineering
 - Members appointed by principal agencies
 - Oversee research in all major IT² areas
 - Develop and operate advanced infrastructure made available under IT² funding
 - Ensure competitive purchase, siting, and availability of new computers
 - Ensure availability of systems to appropriate research teams

Proposed FY2000 Budget

Agency	Fundamental Information Technology Research	Advanced Computing for Science, Engineering, and the Nation	Ethical, Legal, and Social Implications and Workforce Programs	Total
DOD	\$100M	---	---	\$100M
DOE	\$ 6M	\$ 62M	\$ 2M	\$ 70M
NASA	\$ 18M	\$ 19M	\$ 1M	\$ 38M
NIH	\$ 2M	\$ 2M	\$ 2M	\$ 6M
NOAA	\$ 2M	\$ 4M	---	\$ 6M
NSF	<u>\$100M</u>	<u>\$ 36M</u>	<u>\$ 10M</u>	<u>\$146M</u>
Total	\$228M	\$123M	\$ 15M	\$366M

Next Steps

- Refine management structure
- Continue to refocus and strengthen related ongoing programs
- Continue to seek external advice from industry and academia
- Develop detailed technology and programmatic roadmaps