INFORMATION TECHNOLOGY FOR THE 21ST CENTURY

IT² Initiative

- Long term IT research for computing breakthroughs
- Advanced computing for science, engineering, and the Nation
- Research on economic and social impacts of the Information Revolution

TOTAL: $ 366 M

NSF	DEPARTMENT OF DEFENSE	DEPARTMENT OF ENERGY	NASA
$146M	$100M	$ 70M	$ 38M

NATIONAL INSTITUTES OF HEALTH	NOAA
$ 6M	$ 6M

IT²:

- Responds to recommendations made by the President's Information Technology Advisory Committee (PITAC) in their February 1999 report "Information Technology Research: Investing in Our Future"
- Will be managed jointly with the High Performance Computing and Communications (HPCC) programs and the Next Generation Internet (NGI) initiative
- Will be coordinated by the National Coordination Office for Computing, Information, and Communications

INFORMATION TECHNOLOGY FOR THE 21ST CENTURY (IT²)

#1 Priority

Fundamental long-term, high-risk IT research in computer science and engineering

- Software
- Human computer interfaces and information management
- Scalable information infrastructure
- High-end computing

TOTAL: $ 228M

NSF: $100M	DEPARTMENT OF DEFENSE: $100M	NASA: $ 18M
DEPARTMENT OF ENERGY: $ 6M	NATIONAL INSTITUTES OF HEALTH: $ 2M	NOAA: $ 2M

INFORMATION TECHNOLOGY FOR THE 21ST CENTURY (IT²)

#2 Priority

Advanced computing for science, engineering, and the Nation: Using the world's most powerful computers to address problems of critical national interest

- Obtain computers 100 to 1,000 times more powerful than those now available to researchers and make them available on a competitive basis
- Develop scientific and engineering simulation software and tools to make these machines useful for research
- Build multidisciplinary teams with researchers in challenging science and engineering research areas who will benefit from fundamental IT R&D advances

TOTAL: $ 123 M

$ 62M

$ 36M

$ 19M

$ 4M

$ 2M

INFORMATION TECHNOLOGY FOR THE 21ST CENTURY (IT²)

#3 Priority

Understand the Social, Economic, and Workforce Implications of IT

Increased research and greater interaction between computer and social scientists will:

- Provide insight into how information systems are actually used, contributing to information systems design
- Help identify barriers to the adoption of IT and its application
- Assist policymakers by providing more empirical data on the impact of IT
- Encourage the development of technical solutions to problems caused by IT

TOTAL: $ 15 M

NSF $ 10M

DEPARTMENT OF ENERGY · UNITED STATES OF AMERICA · $ 2M

NATIONAL INSTITUTES OF HEALTH $ 2M

NASA $ 1M

INFORMATION TECHNOLOGY FOR THE 21ST CENTURY (IT²)

National Science Foundation

Fundamental IT Research

- Software
  - Innovative research addressing real problems
  - Improved software development through science and engineering
- Human/computer interface and information management
  - Sensors and actuators to enhance physical and mental abilities
  - Technologies that let people meet, work, and collaborate in cyberspace
  - IT for using what we know and what we can find out
- Scalable information infrastructure
  - Technologies to let all Americans access information
  - Improve security, privacy, reliability
- High end computing
  - New algorithms and tools
  - Terascale opportunities for promoting science

Advanced Computing for Science, Engineering, and the Nation

- Open, competitive access to terascale computing systems (with DOE)
- Interdisciplinary computational science and engineering research
- Revolutionary computing systems
- Distributed databases for national applications

Economic and Social Impacts of IT

- Joint social science/computer science research
- Insight into how information systems are used

IT Workforce

- Understand the IT pipeline
- Technologies for learning
- High end IT for researchers, educators, and students

INFORMATION TECHNOLOGY FOR THE 21ST CENTURY (IT²)

Department of Defense

Software for reliable, safe, and cooperative operation of free ranging autonomous systems

- Mobile robots to range over air, land, or sea
- Knowbots to range over cyberspace
- Ability to learn and adapt to change and uncertainty

Scalable networks to manage 100 billion embedded and autonomous sensors and actuators in direct contact with real world processes

- Flexible mechanisms for naming, addressing, configuring, and administration
- Traffic models, architectures, and protocols
- Nomadic middleware for data fusion and dissemination

High end computing

- Processors whose logic is configurable cycle by cycle
- Reduced latency through logic-in-memory fabrication and programmable caches
- Bio-digital interfaces and processing techniques

Mechanisms

- Young Investigator Awards
- University Research Initiatives

Participants

- Office of the Director of Defense for Research and Engineering (DDR&E)
- Defense Advanced Research Projects Agency (DARPA)
- Advanced Research & Development Activity (ARDA)

Aligned with Joint Chiefs of Staff's Joint Vision 2010 to achieve warfighting effectiveness

INFORMATION TECHNOLOGY FOR THE 21ST CENTURY (IT²)

Department of Energy

Scientific Simulation Initiative (SSI)

- Understand, model, predict global effects of greenhouse gases
- Understand, model, predict combustion devices and processes
- New generation of teraflops simulations to revolutionize scientific research
- Basic computer science and applied mathematics

Software for very high performance computing systems

- Problem solving environments
- Distributed computing
- Collaboration technologies
- Visualization
- Manage petabytes of experimental data and simulation output
- Human/computer interaction
- Reliable fault tolerant components

National terascale distributed scientific computing infrastructure (with NSF)

IT Workforce

- Undergraduate and graduate fellowships
- Retrain applications scientists in computational and computer science

INFORMATION TECHNOLOGY FOR THE 21ST CENTURY (IT²)

National Aeronautics and Space Administration

Goals

- Reduce risk, cost, and development time
- Increase performance and reliability

Intelligent Synthesis Environment

- Develop an immersive collaborative engineering environment to reduce mission design and development time to less than 30 months
- Develop very rapid, high fidelity life-cycle simulation methods incorporating virtual prototyping

Intelligent Systems that "think," not just compute

- Autonomous, self-reliant, adaptive spacecraft and rovers
- Technology to build high-assurance mission software
- Enhanced human computer interactions
- Systems to extract information and knowledge from massive data streams for scientific understanding and to guide investigations

INFORMATION TECHNOLOGY FOR THE 21ST CENTURY (IT²)

National Institutes of Health

Biomedical computing for the new millennium: Applying IT to problems in biology and medicine

- Molecular modeling simulations to determine protein structure
- Medical imaging to diagnose human disease

Software research to advance insight into biological mechanisms

- Navigate through the visible human — see musculature, organs, and bones
  - Medical practitioners can see beyond the physical limits of the human body
  - Medical researchers can develop technologies for virtual surgery
  - Computer researchers can develop user interfaces and new technologies for image compression, transmission, and storage
- View a patient's colon as a physician would while performing a colonoscopy
  - Physicians and radiologists use CT imaging as a safer, non-invasive procedure
  - Can be used for remote diagnosis, eliminating the need for a colonoscopy in a doctor's office
  - Aids fundamental research in automated identification of tumors and lesions
- Use nanomanipulation in virtual collaboratories to feel molecules
  - Researchers can understand how molecular forces work to form biological structures such as viruses
  - K-12 students are exposed to biology through direct sensory access to microscopic objects

High-end computing

- Research biologists can enhance their ability to model even the smallest forms of life

IT workforce

- Non-biologists such as engineers, mathematicians, and computer scientists, will be trained to work in cross-disciplinary biomedical research teams

INFORMATION TECHNOLOGY FOR THE 21ST CENTURY (IT²)

National Oceanic and Atmospheric Administration

Software for coupled ocean/atmosphere/land simulations

- Flexible, component-based models to facilitate collaborative research
- Self-describing data formats to encourage sharing of results
- Use of cache-based commodity processors to improve performance

Acquisition of a large balanced system for research in modeling and prediction

- Scalable parallel architecture
- Balanced data storage, analysis, and visualization
- Long history of competitive acquisitions and cost-effective management

Weather and climate research

- Additional advances in hurricane prediction
- Physically consistent, deterministic short-term (El Niño) climate prediction
- Address climate model drift and improve ocean model startup
- Improved treatment of cloud-radiative feedback in climate simulations

INFORMATION TECHNOLOGY FOR THE 21ST CENTURY (IT^2)

National Coordination Office for Computing, Information, and Communications (NCO/CIC)

- Coordinates planning, budget, and assessment activities for IT^2, the HPCC programs, and the NGI initiative
- Supports the President's Information Technology Advisory Committee (PITAC)
- Assists the IT^2 Working Group to integrate coordination of IT^2 with HPCC and NGI
- Assists the Subcommittee on Computing, Information, and Communications and its Working Groups:
  - HECC — High End Computing and Computation
  - LSN — Large Scale Networking (including the NGI)
  - HCS — High Confidence Systems
  - HuCS — Human Centered Systems
  - ETHR — Education, Training, and Human Resources
- Supports R&D outreach to other Federal organizations through the:
  - FISAC — Federal Information Services and Applications Council
- This coordination will evolve as IT^2, HPCC, and the NGI are integrated

INFORMATION TECHNOLOGY FOR THE 21ST CENTURY (IT²)

National Coordination Office for Computing, Information, and Communications (NCO/CIC)

IT² Coordination

IT², HPCC, and the NGI will be coordinated through the Presidential National Science and Technology Council

- IT² Senior Principals Group
  - NSF Director
  - Under Secretary of Defense (Acquisition and Technology)
  - Under Secretary of Energy
  - NASA Administrator
  - NIH Director
  - NOAA Administrator
  - Senior OMB and NEC officials
- IT² Working Group includes representatives from all participating agencies and departments
  - Chaired by NSF Assistant Director for Computer and Information Science and Engineering
- Multiagency organizations will coordinate Federal R&D in Software
  - Human computer interaction and information management
  - Scalable information infrastructure (including the NGI)
  - High end computing
  - High confidence systems
  - Socio-economic and workforce issues
- The National Coordination Office for Computing, Information, and Communications supports the IT² Working Group and will support multiagency IT² coordination

Web sites

- http://www.ccic.gov/
- http://www.ngi.gov/