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

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
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

#1 Priority

INFORMATION TECHNOLOGY FOR THE 21ST CENTURY (IT²)

TOTAL: $228M

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

INFORMATION TECHNOLOGY FOR THE 21ST CENTURY (IT²)

#2 Priority

TOTAL: $ 123M

$ 62M

$ 36M

$ 19M

$ 4M

$ 2M
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: $15M

$10M  $2M  $2M  $1M
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
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
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
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
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
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
• Coordinates planning, budget, and assessment activities for IT², the HPCC programs, and the NGI initiative

• Supports the President's Information Technology Advisory Committee (PITAC)

• Assists the IT² Working Group to integrate coordination of IT² 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 IT², HPCC, and the NGI are integrated
IT\textsuperscript{2} Coordination

IT\textsuperscript{2}, HPCC, and the NGI will be coordinated through the Presidential National Science and Technology Council

- IT\textsuperscript{2} 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

- IT\textsuperscript{2} 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 IT\textsuperscript{2} Working Group and will support multiagency IT\textsuperscript{2} coordination

Websites

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