Federal Next Generation Internet Initiative

A Glimpse into the Future

Public Technology, Inc.

Technology Solutions: Service Delivery

Into the 21st Century Annual Member Conference

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Chicago, Illinois

Kay Howell, Director

National Coordination Office for

Computing, Information, and Communications

Famous Quotes about the Future of Computing

- "I think there is a world market for maybe five computers." **Thomas Watson, chairman of IBM, 1943.**
- "Computers in the future may weigh no more than 1.5 tons." **Popular Mechanics, forecasting the relentless march of science, 1949**
- "I have traveled the length and breadth of this country and walked with the best people, and I can assure you that data processing is a fad that won't last out the year." **Editor in charge of business books for Prentice Hall, 1957**
- "But what ... is it good for?" **Engineer at the Advanced Computing Systems Division of IBM, commenting on the microchip, 1968**
- "There is no reason anyone would want a computer in their home." **Ken Olson, president, chairman and founder of Digital Equipment Corp., 1977**
- "So we went to Atari and said, 'Hey, we've got this amazing thing, even built with some of your parts, and what do you think about funding us? Or we'll give it to you. We just want to do it. Pay our salary, we'll come work for you' And they said, 'No.' So then we went to Hewlett-Packard, and they said, 'Hey we don't need you. You haven't got through college yet.'" **Apple Computer Inc. founder Steve Jobs on attempts to get Atari and HP interested in his and Steve Wozniak's personal computer**
- "640K ought to be enough for anybody." **Bill Gates, 1981**

Explosive Growth and Adoption

The Internet's pace and adoption eclipses all other technologies that preceded it.

- Radio was in existence 35 years before 50 million people tuned in
- TV took 13 years to reach that benchmark
- PCs took 16 years from the time the first PC kits were introduced
- *The Internet crossed that line in 4 years!*

Source : The Emerging Digital Economy, U.S. Digital Economy, April 1998

Statistics on Internet Growth

- In 1996, fewer than 40 million people worldwide were connected to the Internet – in 1997, 100 million
- In 1997, registered domain names rose from 627,000 to 1.5 million
- In 1996, Cisco Systems made $100M worth of sales on the Internet – in 1997, $3.2B
- In 1998, it takes only 100 days for the Internet's volume of traffic to double

Next Generation Internet (NGI)

Imagine an Internet a thousand times faster than today:

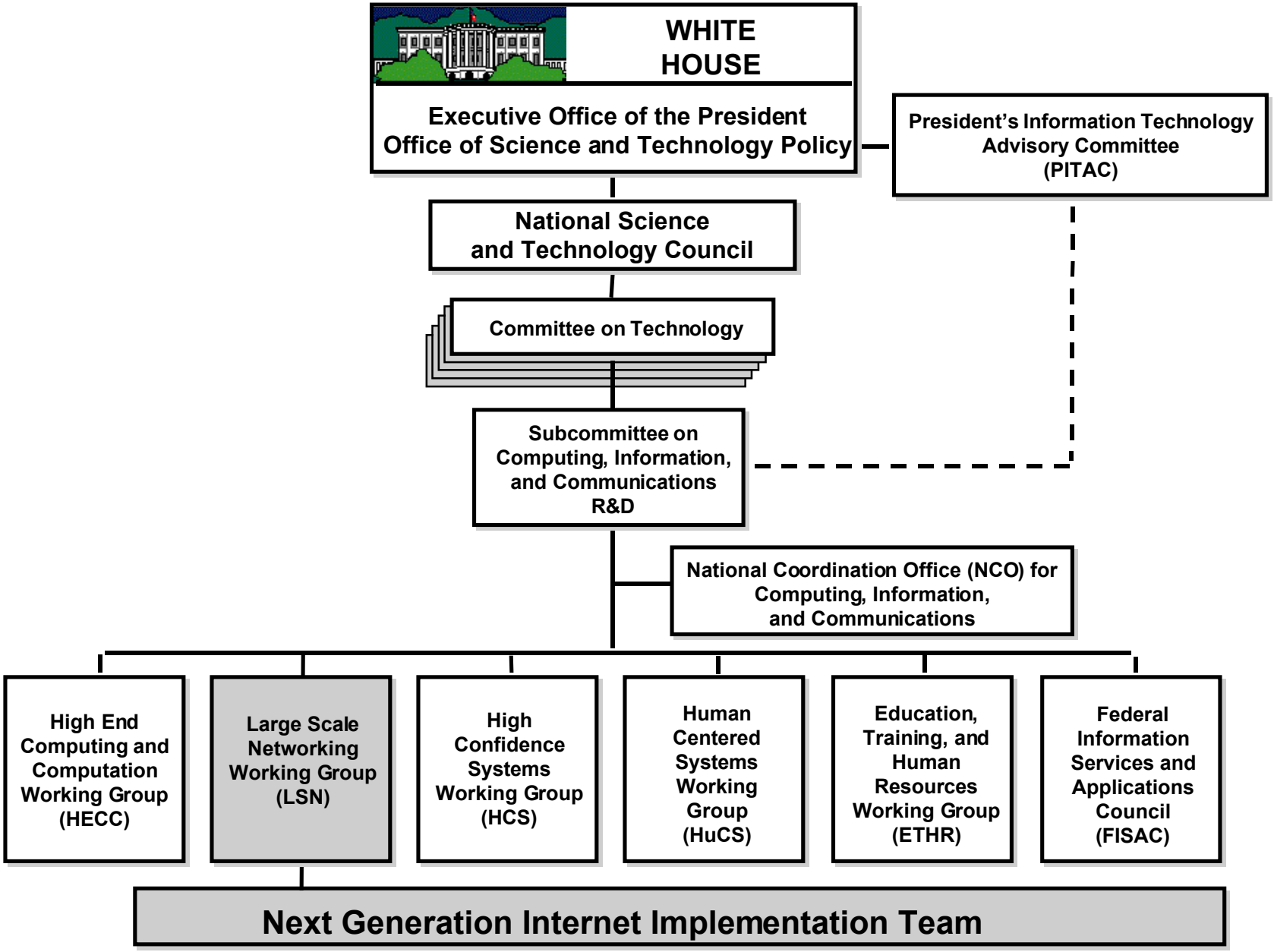
- An Internet so ubiquitous that it interconnects all Americans regardless of location, age, income, or health
- An Internet so safe and reliable that Americans confidently use it of their most important communications
- An Internet so intelligent that it can be used effortlessly to help us preserve our environment, improve our productivity, and get first rate medical care

NGI Initiative

The Next Generation Internet (NGI) initiative is a multi-agency Federal R&D program that will:

- Develop new and more capable networking technologies to support Federal agency missions
- Create a foundation for more powerful and versatile networks in the 21st century
- Form partnerships with academia and industry that will keep the U.S. at the cutting edge of information and communications technologies
- Enable the introduction of new networking services that will benefit our businesses, schools, and homes

How the NGI Initiative is Coordinated



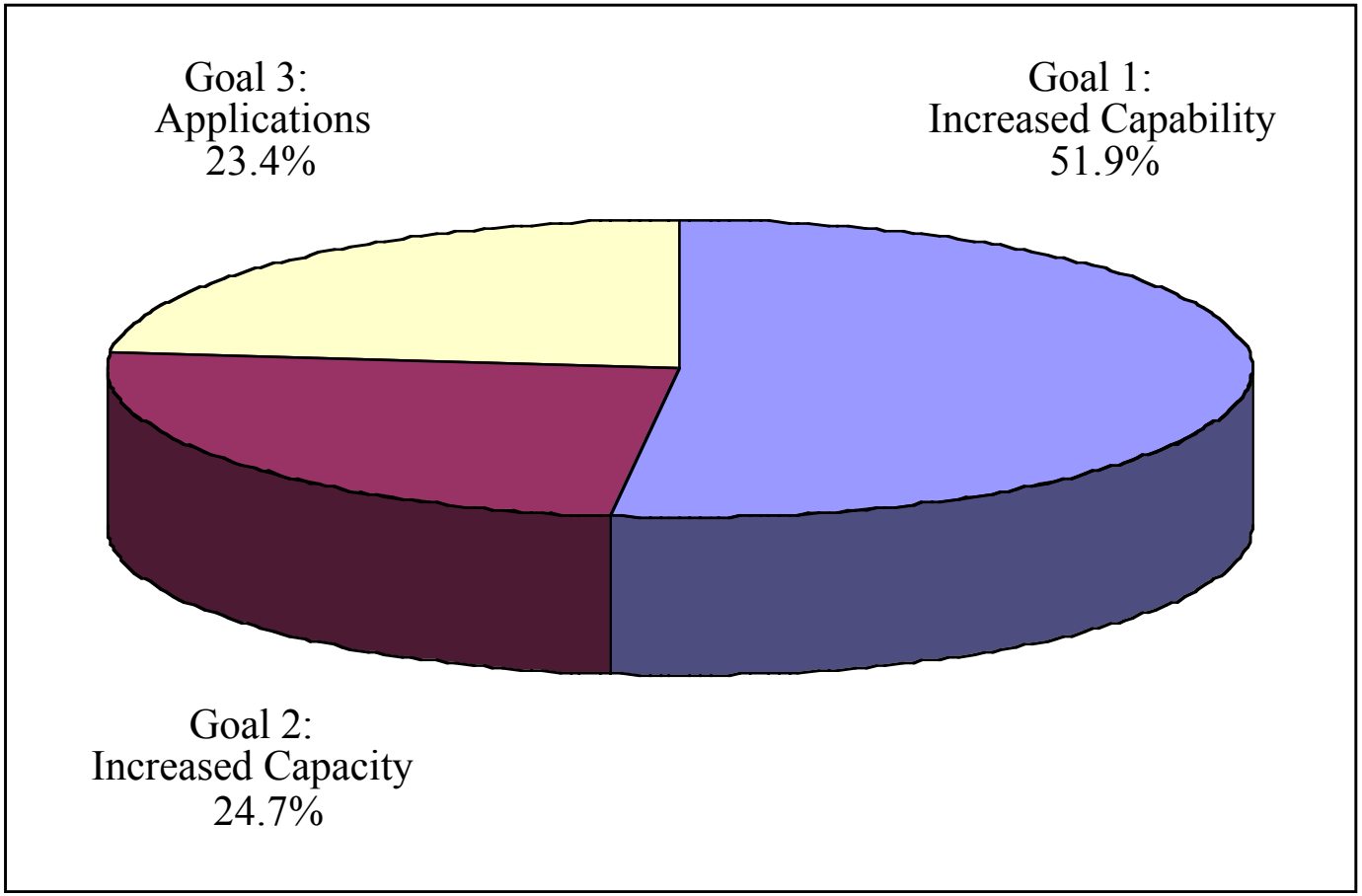
NGI Budgets
(Dollars in Millions)

Agency	FY 1998 Proposed	FY 1998 Estimated	FY 1999 Proposed	FY 1999 Estimated	FY 2000 Proposed
DARPA	42	42	40	40	40
NSF	23	0	25	25	25
DOE	25	0	25	15	15
NASA	10	10	10	10	10
NIH/NLM	5	5	5	5	8
NOAA	5	5	5	5	5
Totals	**110**	**62**	**110**	**100**	**103**

Goals and Metrics

Initiative Goals	Metrics
1. Promote experimentation with the next generation of network technologies	• Quality of service including security • Adoption of technologies by private sector
2. Develop a next generation network testbed to connect universities and federal research institutions at rates that are sufficient to demonstrate new technologies and support future research	• Ability of network testbed to accommodate goal 1 research results and goal 3 applications • 100-1000 times end-to-end performance improvement • About 100 research institutions connected
3. Demonstrate new applications that meet important national goals and missions	• 100+ high-importance applications • Value of applications in testing networking technologies

NGI FY 1999 Funding by Goal

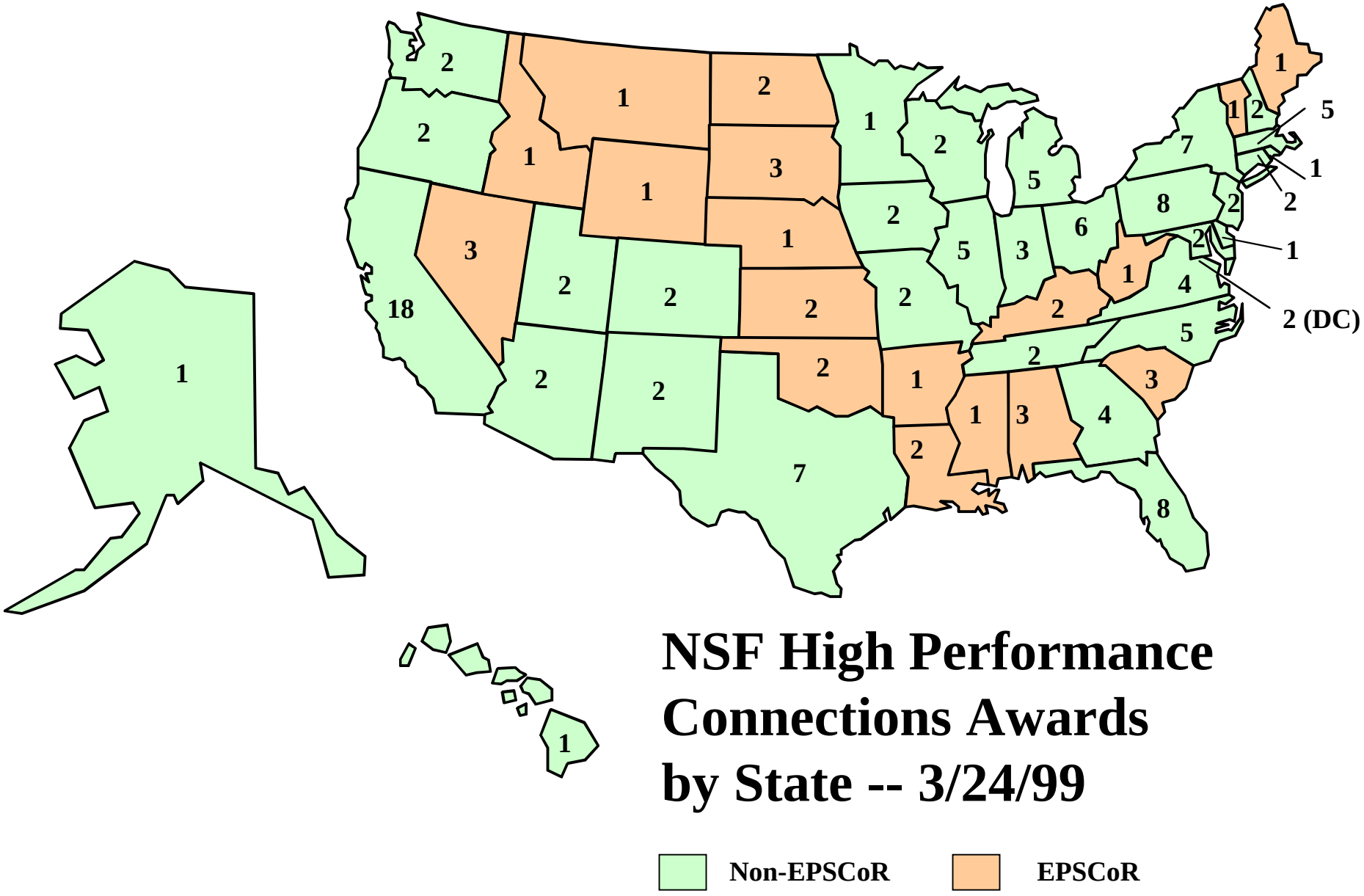


Goal 1: Networking Research

- Conduct R&D in advanced end-to-end networking technologies
  - Reliability
  - Robustness
  - Security
  - Quality of service/differentiation of service (including multicast and video)
  - Network management (including allocation and sharing of bandwidth)

Goal 2.1: 100x Testbed

- Establish and operate 100x testbed
  - To connect about 100 universities, Federal research institutions, and other research partners at speeds 100 times faster end-to-end than 1997's Internet
  - Built on Federal networks:
    - NSF's very high performance Backbone Network Service (vBNS)
    - NASA's Research and Education Network (NREN)
    - DoD's Defense Research and Engineering Network (DREN)
    - DOE's Energy Sciences network (ESnet)
  - Have connected about 150 sites as of March 1999



NSF High Performance Connections Awards by State -- 3/24/99

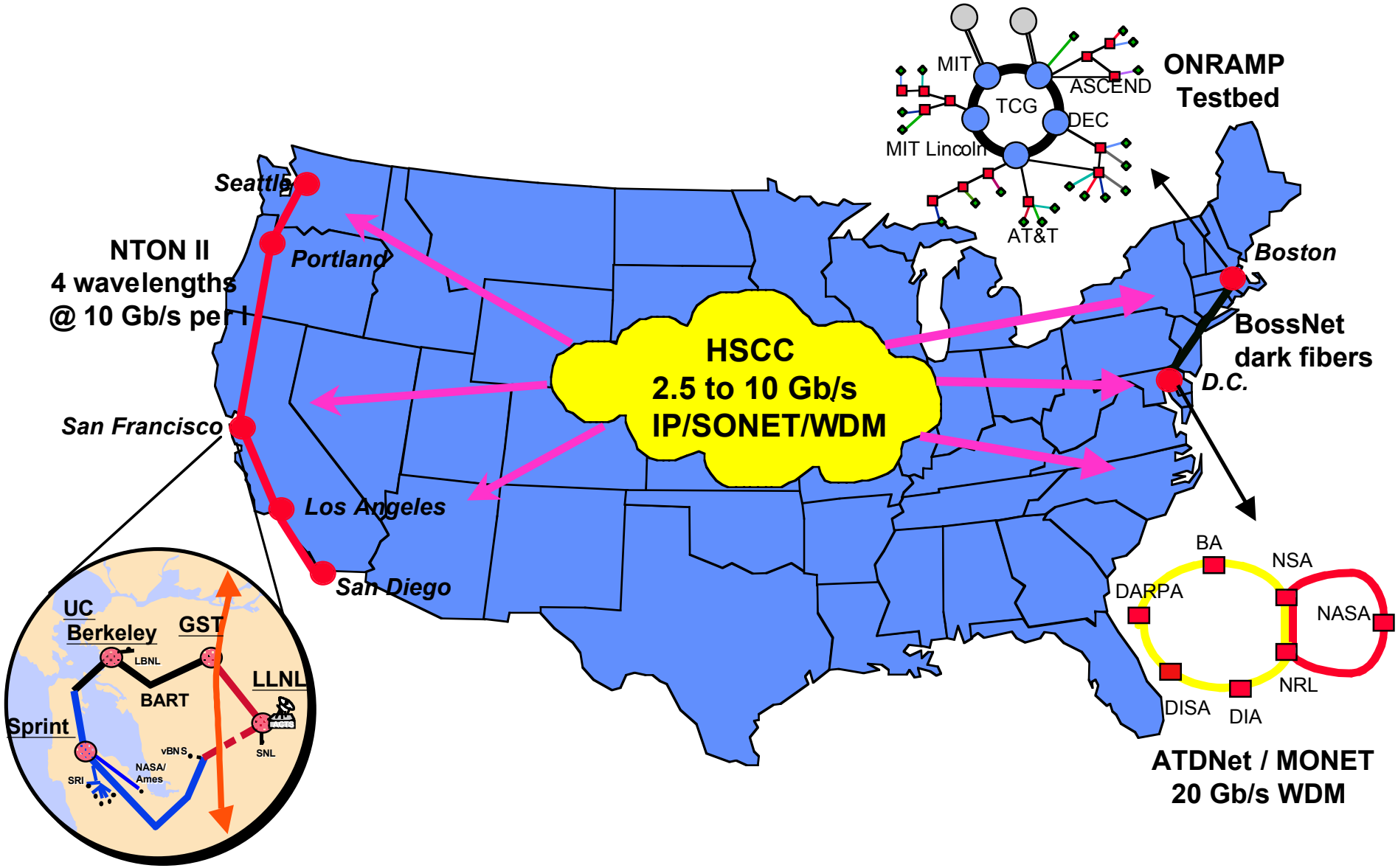
Non-EPSCoR

EPSCoR

Goal 2.2: 1,000x Testbed

- SuperNet goal:
  - Connect about 10 sites with end-to-end performance at least 1,000 times faster than the Internet of 1997
- Built on Federal networks:
  - Multi-agency Washington, DC area Advanced Technology Demonstration network (ATDnet)
  - Multi-site Boston area BossNet
  - Multi-site West Coast network (Nortel network, includes NTON)
  - Qwest fabric between West and East coasts (OC48)
- For system-scale testing of advanced technologies and services and developing and testing of advanced applications
- Have connected about 20 sites as of March 1999

1,000x SuperNet Testbed



Goal 3: Applications (1)

- Conduct R&D in applications that require high performance networks
- This includes enabling applications technologies:
  - Collaboration technologies
  - Digital libraries
  - Distributed computing
  - Privacy and security
  - Remote operation and simulation
- And ...

Goal 3: Applications (2)

- And disciplinary applications:
  - Basic science
  - Crisis management
  - Education
  - The environment
  - Federal information services
  - Health care
  - Manufacturing

NGI Demonstrations

- 17 applications at Netamorphosis
  - March 1998 in Washington, DC
- 11 applications at SC98 (Supercomputing)
  - November 1998 in Orlando, Florida
- Next:
  - SC99 in November 1999 in Portland, Oregon

A collaboratory for structure-based Drug Design

A prototype collaborative environment for carrying out interactive 3-dimensional studies of molecular structure among scientists at distant locations.

SPONSORS

- NIH: National Center for Research Resources

PERFORMERS

- Collagen Corporation
- State University of New York at Stony Brook
- University of California Computer Graphics Laboratory
- University of Washington

USERS & USES

The collaboratory is used for drug design, protein engineering, biomaterials design and fabrication, and bioremediation.

NGI RESEARCH NEEDS

Advancements in high performance network access, collaborative molecular modeling software and desktop videoconferencing.

Primary Contact: Thomas Ferrin, University of California, San Francisco

Web Site: *http://www.cgl.ucsf.edu/home/research/collaboratory/*

Interactive Echocardiography over the Next Generation Internet

Interactive Echocardiography (EC) generates full-motion video of cardiac structure and cardiovascular blood flow and delivers these images in real-time to physicians in remote locations.

SPONSOR

- NASA

PERFORMERS

- Cleveland Clinic Foundation Imaging Center
- NASA:
  - Ames Research Center
  - Johnson Space Center
  - Lewis Research Center

PARTNER

- NUKO Information Systems, Inc.

USERS & USES

Cleveland Clinic Foundation and satellite facilities in Ohio and Florida, and the Clinic's outpatient labs currently use interactive echocardiography. Echocardiographs are transmitted from the cardiac operating room to remote locations so that cardiologists can provide guidance even when they are not physically present. Echocardiography images are also relayed from satellite facilities to the main facility for diagnosis. Remote echocardiography will be critical for the future International Space Station, in battlefield conditions, and in medically underserved areas around the world.

NGI RESEARCH NEEDS

Increased bandwidth and end-to-end Quality of Service guarantees to distribute 30 megabytes/second of full-screen, full-motion image data over wide-area networks.

Primary Contact: Dr. James Thomas, Cleveland Clinic Foundation

Web Site: *http://www.nren.nasa.gov/echo.html*

Real-time Functional MRI

Watching the brain in action

The Brain in Action allows remote viewing of brain activity while a patient is performing cognitive or sensory-motor tasks.

SPONSORS

- NIH
  - National Center for Research Resources
  - National Institute of Mental Health
  - National Institute on Drug Abuse
- NSF

PERFORMERS

- Carnegie Mellon University
- Pittsburgh Supercomputing Center
- University of Pittsburgh
- University of Pittsburgh Medical Center

USERS & USES

Neurosurgeons, neurologists, psychiatrists, and brain scientists will investigate brain function and diagnose and treat brain diseases. For example, this application will enable neurosurgeons to develop surgical plans for tumor removal based on an understanding of the cognitive and sensory-motor abilities located near a tumor site.

NGI RESEARCH NEEDS

Improvements in available capacity, interactive real-time capability, security, privacy, and integration with advanced computing to ensure high performance, wide-spread availability, online visualization, and patient confidentiality.

Primary Contact: Nigel Goddard, Pittsburgh Supercomputing Center

Web Site: *http://www.psc.edu/science/goddard.html*

Nanotechnology Research

Controlling atoms from a distance

The Scanning Tunneling Microscope (STM) can measure and manipulate atomic structures (measured in nanometers, or billionths of a meter), whose images have been magnified to a workable human scale. The Field Ion Microscope (FIM) is used to shape the STM's probe, or tip, so it can accurately measure these structures.

SPONSOR

- NIST

PERFORMERS & PARTNERS

- EMCOR
- Kurt J. Lesker Co.
- Sandia National Laboratories
- NIST
- Topometrix
- University of Maryland

USERS & USES

Manufacturing researchers use the STM and its close relative, the Atomic Force Microscope, as quality control tools for developing standard measurements of small-scale products and their component parts, such as computer chips and their circuitry.

NGI RESEARCH NEEDS

A high-speed, secure, reliable network and simultaneous voice, video, and data transmission to make these microscopes, located at NIST's Gaithersburg, MD campus, accessible by "remote control" to companies and universities nationwide.

Primary Contact: Theodore Vorburger, NIST/MEL

Web Site: *http://www.nist.gov/mel/namt/*

Octahedral Hexapod

An Information Age machine tool

The hexapod is an innovative experimental metal-cutting machine tool with the potential to deliver an unprecedented combination of versatility, speed, accuracy, and portability.

SPONSOR

- NIST

PERFORMERS & PARTNERS

- Deneb Robotics
- Ingersoll Milling Machine Co.
- NIST
- Ohio State University
- Sandia National Laboratories
- United Technologies Research Center/Pratt & Whitney
- University of Florida
- University of Maryland

Additional Hexapod User Group Partners

- Allied Signal Corp.
- Eaton Corporation
- Giddings and Lewis
- Hexel Corporation
- Massachusetts Institute of Technology
- NASA Johnson Space Flight Center
- Oak Ridge National Laboratory

USERS & USES

Industry and university researchers are working with NIST to investigate the hexapod's potential performance advantages — from lower production costs to faster methods for making parts, molds, and dies.

NGI RESEARCH NEEDS

Real-time, full-motion video plus 15 Mbps bandwidth in a dedicated, secure environment — technology not widely available and currently prohibitively expensive for most organizations that can contribute to and benefit from network-enabled manufacturing research collaborations.

Primary Contact: Albert Wavering, NIST/MEL

Web Site: *http://www.nist.gov/mel/namt/*

For additional information on the NGI, visit:

http://www.ngi.gov

Next Generation Internet (NGI) Initiative Home

Next Generation Internet Initiative

NGI Initiative Home Page

Revised January 1999

Site structure

- White House on the NGI
- NGI publications
- NGI endorsements
- NGI legislation and testimony
- NGI funding opportunities
- NGI grants, awards, projects, and researchers
- Search this site
- Future NGI workshops
- NGI presentations
- Past NGI events
- Potential NGI applications
- Related NGI sites

Highlights

Announcements of DOE Office of Science (formerly Office of Energy Research) funding opportunities including solicitations for Next Generation Internet Initiative grant applications for (1) research in basic technologies, (2) applications, network technology, and network testbed partnerships, and (3) university network technology testbeds.* Preapplications due by February 12, 1999, formal applications due by March 31, 1999.

- Research in basic technologies
- Applications, Network Technology, and Network Testbed Partnerships
- University Network Technology Testbeds

NCO Research Exhibit and NGI Demonstrations at the SC98 Conference (November 1998)

- NCO: Your Gateway to Federally-funded Information Technology R&D
- NCO News
- About the NGI Initiative
- How You Can Participate in the NGI Initiative
- Next Generation Internet Architecture
- Supernet Testbed
- SC98 NGI Exhibits Posters
- SC98 NGI Exhibitor Contacts
- Federal NGI Contacts
- Organization Chart

NASA Research and Education Network (NREN) Workshop on Quality of Service, NASA Ames Research Center, Moffett Field, California (August 18-19, 1998)

NGI Implementation Plan (February 1998)

Home | White House on NGI | Publications | Endorsements | Legis/testimony
Funding opportunities | Grants and awards | Search this site | Future workshops | Presentations
Past events | Potential apps | Solicitations | Related sites | Feedback

President's Information Technology Advisory Committee
Report to the President
February 1999

- Key findings and recommendations:
  - The total Federal IT R&D investment is seriously inadequate given growing importance of IT to our Nation
  - Establish a strategic initiative in long-term R&D
  - Increase the Federal IT R&D investment by approximately $1.4B per year by 2004 (current programs are approximately $1.5B)
  - Four priority research areas:
    - Software
    - Scalable information infrastructure
    - High End Computing
    - Impacts of IT on society and the economy

Information Technology for the 21st Century: A Bold Investment in American's Future

- Proposed in the President's FY2000 Budget
- Responds to recommendations from the President's Information Technology Advisory Committee (PITAC)
- IT^2 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

Major IT^2 Investments

- IT^2 will increase Federal investments in:
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Information Technology for the 21st Century: 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

Information Technology for the 21st Century: Advanced Computing for Science, Engineering, and the Nation (1)

- IT^2 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

Information Technology for the 21st Century: 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

Information Technology for the 21st Century: 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

Information Technology for the 21st Century: 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

Information Technology for the 21st Century Proposed FY 2000 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	$100M	$ 36M	$ 10M	$146M
Total	$228M	$123M	$ 15M	$366M