Information Technology R&D
Crosscut for the President's FY2001 Budget

February 25, 2000

Dr. Ruzena Bajcsy
Assistant Director
Computer and Information Sciences & Engineering,
National Science Foundation

Chair, Interagency Working Group for IT R&D
National Science and Technology Council

FY2001 IT R&D

- The President's FY2001 Budget Request includes a $594M (35%) increase over the FY2000 Enacted levels for IT R&D
- The FY2001 IT R&D budget:
  - Builds on HPCC, IT^2, and ASCI activities
  - Merges the HPCC and IT^2 programs into a single multi-agency coordinated activity
  - Responds to PITAC recommendations - the PITAC report, IT^2 review, and NGI review
  - Addresses agency mission needs for IT
  - Continues to emphasize long-term, innovative research
  - Funds research activities to maintain the flow of new ideas in IT and to train the next generation of IT professionals

FY2001 IT R&D Budget

- Activities leading to the FY2001 IT R&D Budget:
  - HPCC/CIC Programs - FY1992 through FY2000
  - President's Information Technology Advisory Committee Report
  - IT^2 Initiative in FY2000 Budgets
  - President's Information Technology Advisory Committee Review of NGI and IT^2
  - Subcommittee on CIC R&D and IT^2 Working Group assessment of R&D portfolio
  - Agency mission needs
  - Interagency working groups meetings and discussions

PITAC Report
Information Technology Research: Investing in Our Future, February 1999

Recommendations:

- Increase the Federal IT R&D investment by approximately $1.4 billion per year by 2004
  - Ramp up over five years
  - Focus on increasing fundamental research
- Invest in the following research priorities
  - Software
  - Scalable Information Infrastructure
  - High End Computing
  - Socioeconomic Issues
- Develop a coherent management strategy
  - Establish high level management attention and focus for IT R&D
  - Diversify modes of support

PITAC Proposed Increases for IT R&D

In Millions

Area	FY2000	FY2001	FY2002	FY2003	FY2004
Software	$112	$268	$376	$472	$540
SII	$60	$120	$180	$240	$300
High End Research	$180	$205	$240	$270	$300
High End Acquisitions	$90	$100	$110	$120	$130
Socioeconomic	$30	$40	$70	$90	$100
Total	$472	$733	$976	$1192	$1370

Increment to the FY1999 HPCC Programs

PITAC Review of IT^2 September 8, 1999

Summary of Comments:

- More attention to advanced applications and the middleware necessary to build them
- Expand application focus to include new general purpose applications
- Engage non-IT^2 agencies in discussions to understand their requirements
- Essential that funding to NSF to provide research community access to high end facilities be more in line with the PITAC recommendations in order to enable NSF to carry out this role
- The IT^2 Implementation Plan does not address the issue of multi-agency funding of centers
- Funding for SEW is relatively small
- Additional cross-agency investments in research in vital SEW areas
- Important that workforce training and distance learning utilizing IT and the network be given attention

Coordination/Management Structure For IT R&D Programs

Principals Group

President's Science Advisor (chair), DoC, DoD, DOE, EPA, NASA, NEC, NIH, NSF, OMB

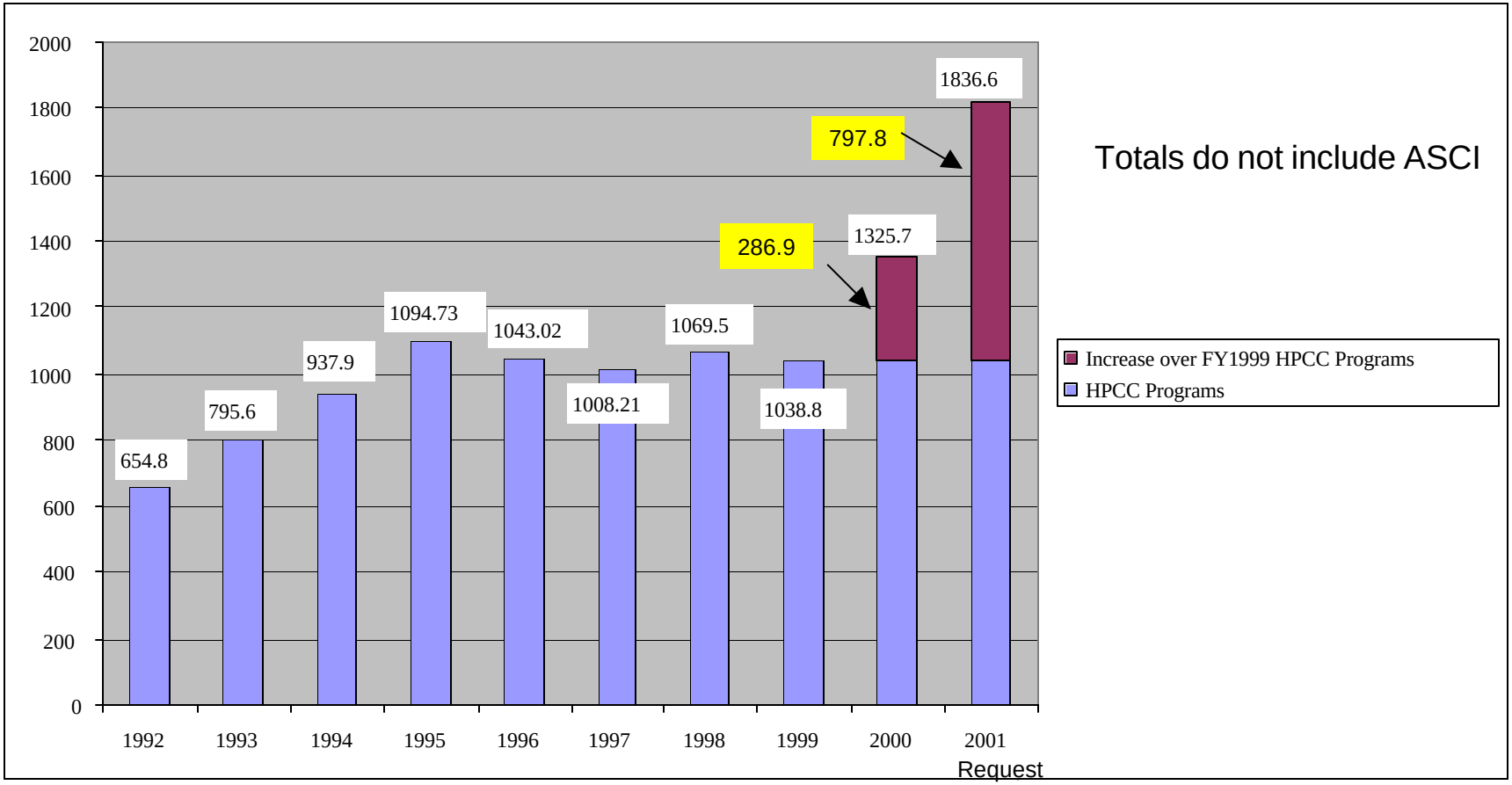
Working Group

NSF/CISE (chair), AHCPR, DARPA, DOE (SC), DOE (DP), DUSD(S&T), EPA, NASA, NIH, NIST, NSA, NSF/MPS, NOAA

(all agencies reporting in the crosscut of the President's Budget)

- Software Design and Productivity
- High Confidence Software and Systems
- Human Computer Interface and Information Management
- Large Scale Networking
- High End Computing and Computation:
  High End Computing Research and Development
  High End Computation Applications and Infrastructure
- Social, Economic, and Workforce Implications of IT and IT Workforce Development
- Federal Information Services and Applications Council

Total HPCC/IT R&D Budgets



FY1999 and FY2000 HPCC Budgets include all PCAs
Informal PCA budgets are estimates

IT R&D Budgets by Agency
FY2000 Enacted/FY2001 Request

Dollars in Millions

Agency	FY2000 Enacted	FY 2001 Request	Increase Over FY 2000 Enacted	Increase Over FY 2000 Enacted
NSF	$517	$740	$223	43%
NASA	$174	$230	$56	32%
Defense[3]	$282	$397	$115	41%
DARPA	$195	$307	$113	58%
NSA (includes ARDA)	$77	$80	$3	3%
URI	$10	$10	$0	0%
DOE	$517	$667	$150	29%
Office of Science	$120	$190	$70	58%
ASCI[4]	$397	$477	$80	20%
HHS	$191	$233	$42	22%
NIH	$183	$217	$34	19%
AHRQ	$8	$16	$8	94%
DOC	$36	$44	$8	22%
NOAA	$18	$20	$2	10%
NIST	$18	$24	$6	33%
EPA	$4	$4	$0	0%
Total	**$1,721**	**$2,314**	**$594**	**35%**

IT R&D by Program Component Area

Dollars in Millions

PCA	FY2000 Enacted	FY2001 Request
LSN (includes NGI)	$276	$334
NGI	$82	$94
HEC R&D	$181	$255
HEC A&I	$442	$630
HCSS	$92	$98
HCI & IM	$230	$335
SDP	$59	$120
SEW	$45	$65
Subtotal	**$1,325**	**$1,837**
DoE ASCI	$397	$477
Total	**$1,722**	**$2,314**

LSN	Large Scale Networking
NGI	Next Generation Internet
HEC R&D	High End Computing Research and Development
HEC A&I	High End Computing Applications and Infrastructure
HCSS	High Confidence Software and Systems
HCI & IM	Human Computer Interaction and Information Managemei
SDP	Software Design and Productivity
SEW	Social, Economic, and Workforce Implications

FY2001
Large Scale Networking Activities

Program Goals

- Ubiquitous connectivity, deeply networked systems, increase capacity and services

Research Topics

- Protocols enabling greater ease and reliability; modeling and analysis of large scale distributed networks, connecting wireless, wired, air, and undersea media; network group collaboration; network security, including protocols for insecure and jammable networks and security of high speed networks; prototype access networks; optical networking protocols for WDM over IP

Budget

FY2000 Enacted:	$ 276M
FY2001 Request:	$ 334M
FY2001 Request Increase:	$ 58M

Benefits of Above Guidance Budget

- New generation of very high performance network access techniques for mobile, remote, or unwired sites
- Integration of sensors with computation and networks
- Improved connectivity to homes and small businesses
- New approaches to network reliability and management

FY2001 Software Design and Productivity Activities

Program Goals

- Well-founded and more cost-effective software engineering to create efficient, reliable, and useful software; significantly improve the concepts, techniques, and tools that underpin our software infrastructure

Research Topics

- Research in the science and engineering of software; define and validate usable software construction processes; develop innovative approaches for automating the engineering process; system/software co-design, co-simulation and analysis environments; new methods for system/code composition; frameworks and middleware to provide higher level programming abstractions

Budget

FY2000 Enacted:	$ 59M
FY2001 Request:	$ 120M
FY2001 Request Increase:	$ 61M

Benefits of Requested Increase

- Improve quality and predictability of software and productivity of the development process especially for very large (one million lines of code), complex systems
- Reduce integration cost for embedded systems
- Maintain U.S. leadership in software technology
- Lessen demand for software professionals

FY2001 High Confidence Software and Systems Activities

Program Goals

- Confidence in software and systems and the ability to understand and predict behavior of the information technology infrastructure

Research Topics

- Interoperable formal methods for modeling and reasoning; modeling and simulation to analyze and predict behavior; robust system design, modeling, analysis, and validation; high confidence systems for safety critical systems

Budget

FY2000 Enacted:	$ 92M
FY2001 Request:	$ 98M
FY2001 Request Increase:	$ 6M

Benefits of Requested Increase

- Systems and software with greater availability, reliability, safety, and survivability
- Technologies to support safety critical applications such as telesurgery, air traffic systems
- Safer services and enhanced productivity through automation
- Reliable, secure networks and software

FY2001 Human-Computer Interface and Information Management Activities

Program Goals

- Easy access to computers/information for all people; user interfaces that depend less on textual interfaces and manual dexterity; information that will come to us in anticipation of our needs

Research Topics

- User interaction methodologies for networked information resources; telepresence; tele-immersion; computer-aided access facilitation for the elderly; hands off interaction with portable or omnipresent computers; dynamic caching of data, data provisioning systems, and aggregation of temporally evolving data

Budget

FY2000 Enacted:	$ 230M
FY2001 Request:	$ 335M
FY2001 Request Increase:	$ 105M

Benefits of Requested Increase

- Improved accessibility and usability of computers
- Reduction in work time and improvement in productivity
- Technologies to augment human capabilities - see better, hear better, better recall
- Improving quality of life for aging and disabled

FY2001
High End Computing R&D

Program Goals

- Research and technology development to improve the usability and effectiveness of teraflops-scale systems; leading-edge research for future generations of computing; and prototype demonstration systems

Research Topics

- Computational topology; problem solving environments; reconfigurable computing; large simulator design; multiple technologies on a chip; large scale software and data visualization research; quantum and biological computing

Budget

FY2000 Enacted:	$ 181M
FY2001 Request:	$ 255M
FY2001 Request Increase:	$ 74M

Benefits of Requested Increase

- Delivery of larger fractions of peak hardware performance; improved portability and ease of use
- Better balanced systems; component/architecture improvements needed by Federal R&D community
- Architectures for computation, hardware and software with the fault tolerant and self-organizational character of biological systems

FY2001 High End Computing Applications and Infrastructure

Program Goals

- Advanced applications addressing Nationally important needs
- Research facilities built on large scale test systems and on large scale, high performance computational grids and networks

Research Topics

- Infrastructure to support advanced applications including acquisition of high performance computing systems/terascale systems
- Leading-edge science and engineering problems requiring large scale computation-intensive or data-intensive operations; representative examples: Global Change Research/Mesoscale Modeling, Protein Folding, Advanced Weather Forecasting, National Security, Testing of Complex Engineered Systems such as Aircraft; Telesurgery and Tele-medicine

Budget

FY2000 Enacted:	$ 442M
FY2001 Request:	$ 630M
FY2001 Request Increase:	$ 188M

Benefits of Requested Increase

- Fundamental advances in both information and disciplinary science by developing and applying advanced computational methods to leading-edge science and engineering problems

FY2001 Social, Economic, and Workforce Implications and Workforce Development

Program Goals

- Expand understanding of the impact of social, ethical, economic, political, and legal factors on the development of IT and vice versa in order to mitigate negative socio-economic impacts of IT; develop a more skilled American workforce

Research Topics

- National network of distributed resources for experimental IT; introduction of graduate students and upper-level undergrads to K-14 learning environments; scholarships to encourage achievement of baccalaureate degrees in IT; studies of extensively computerized or information intensive environments; studies on the interdependence of IT groups; methods to improve education and training of the future IT workforce; methods to facilitate participation of citizens in the new information-based society

Budget

FY2000 Enacted:	$ 45M
FY2001 Request:	$ 65M
FY2001 Request Increase:	$ 20M

Benefits of Requested Increase

- Facilitate governmental and private policy establishment
- Identify technology solutions to address social effects
- Increase number of students prepared for high tech careers

FY2001 IT R&D Budget Summary
Total Request (1)

- Increased investments in Software
  - Software development methods and component technologies
  - Technology to improve the availability, reliability, safety, security, and survivability of software and systems
  - Research in human sensory-motor systems, perception, attention, pattern recognition, and decision-making to make dramatic improvements in the interaction of people and machines
  - Research in information management techniques to capture, organize, process, analyze, and explain information and to make information available for many uses
- More attention to advanced applications
  - Increased investments in multidisciplinary teams to develop advanced applications
- Increased investments in SEW
  - Funding of additional research studies
  - Workforce development activities

FY2001 IT R&D Budget Summary
Total Request (2)

- Increased investments in Scalable Information Infrastructure
  - New options for the “last mile” to the Internet
  - Network capabilities to handle greater volumes of information, greater diversity of service types
  - Technologies to reduce the performance gap between wire and wireless systems
- Increased access to high end facilities for research community
  - Upgrade to NSF FY2000 terascale system
  - 1 additional terascale system acquisition planned

Highlights of Agency FY2001 IT R&D Budget Requests

NSF - Ruzena Bajcsy

DoE - Fred Johnson

NIH - Carol Dahl

NOAA - Bill Turnbull

NIST - Jerry Lynn