A View from DC

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CRA Snowbird
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Outline

- CISE and NSF
  - Initiatives
  - Management
  - Budget
- Federal Picture: NITRD
- International

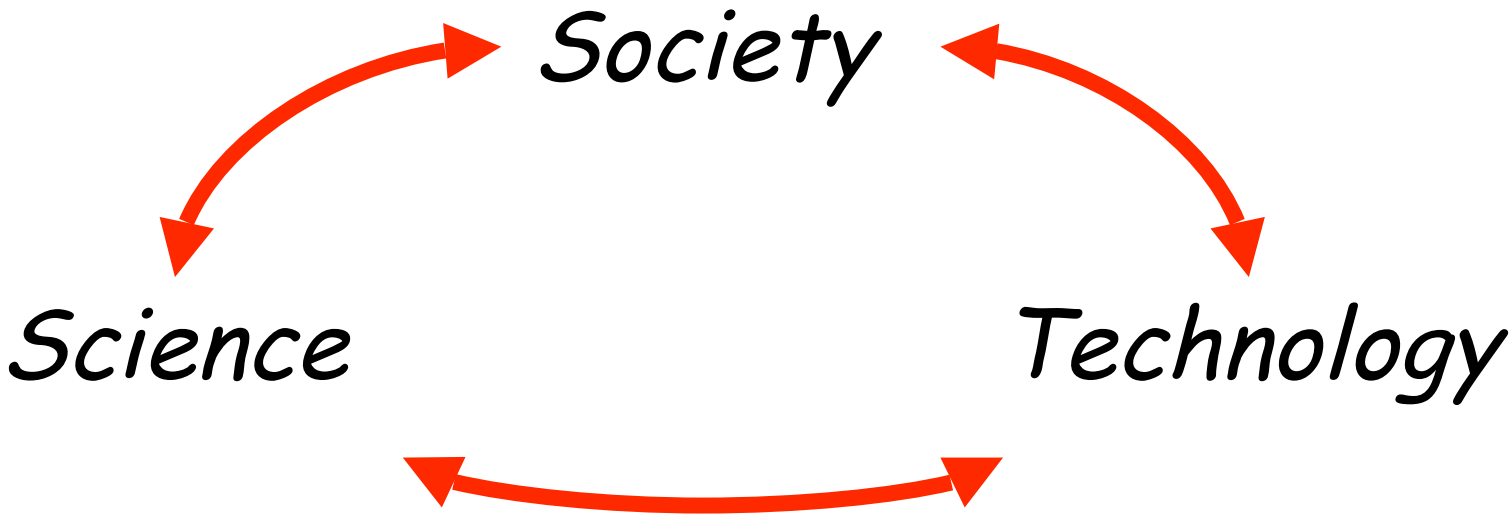
- Final Remarks

CISE

CISE FY09 Research Initiatives

- New Initiatives
  - Data-Intensive Computing
  - Cyber-Physical Systems (joint with ENG)
- Enhanced Initiatives
  - Network Science and Engineering
  - Trustworthy Computing
- Continued from FY08
  - Cyber-enabled Discovery and Innovation
  - Expeditions

Drivers of Computing



Data Intensive Computing

How Much Data?

- NOAA has ~1 PB climate data (2007)
- Wayback machine has ~2 PB (2006)
- CERN's LHC will generate 15 PB a year (2008)
- HP is building WalMart a 4PB data warehouse (2007)
- Google processes 20 PB a day (2008)
- "All words ever spoken by human beings" ~ 5 EB
- Int'l Data Corp predicts 1.8 ZB of digital data by 2011

Slide source: Jimmy Lin, UMD

Convergence in Trends

- Drowning in data
- Data-driven approach in computer science research
  - graphics, animation, language translation, search, …, computational biology
- Cheap storage
  - Seagate Barracuda 1TB hard drive for $195

- Growth in huge data centers
- Data is in the "cloud" not on your machine
- Easier access and programmability by anyone
  - e.g., Amazon EC2, Google+IBM cluster, Yahoo! Hadoop

Data-Intensive Computing Sample Research Questions

Science

- What new abstractions (including models, languages, algorithms) are needed for data-intensive, rather than process-intensive computing?
- What new metrics are needed to evaluate performance of data-intensive computations?

Technology

- How can we automatically manage the hardware and software of these data-intensive computing systems at scale?
- How can we provide security and privacy for simultaneous mutually untrusted users, for both processing and data?
- How can we reduce these systems' power consumption?

Society

- What (new) uses and users might arise from our ability to process large scale datasets?

Cyber-Physical Systems

Smart Cars

A BMW is "now actually a network of computers"

[R. Achatz, Seimens, Economist Oct 11, 2007]

Credit: PaulStam

Cars drive themselves

Smart parking

Credit: Dash Navigation, Inc.

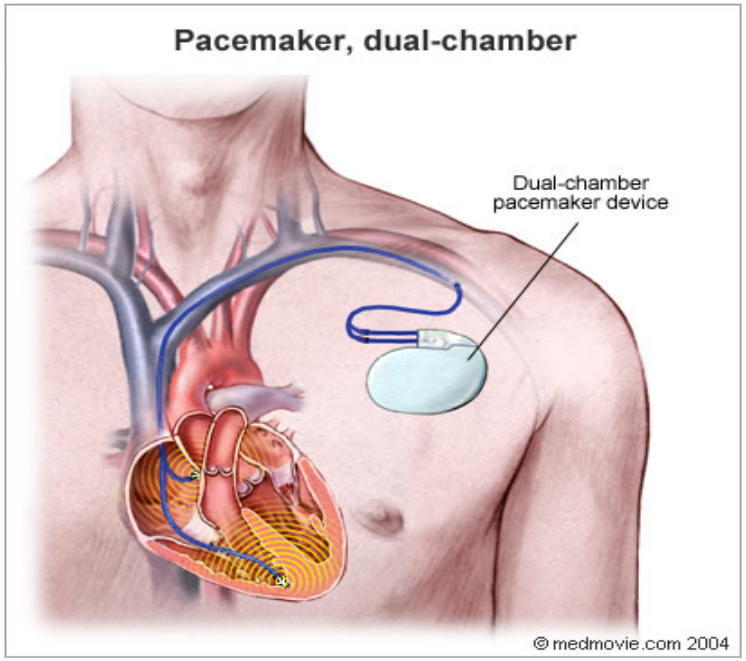
Dash Express:
Cars are nodes in a network

Lampson's Grand Challenge:

Reduce highway traffic deaths to zero.

[Butler Lampson, Getting Computers to Understand, Microsoft, *J. ACM* 50, 1 (Jan. 2003), pp 70-72.]

Embedded Medical Devices

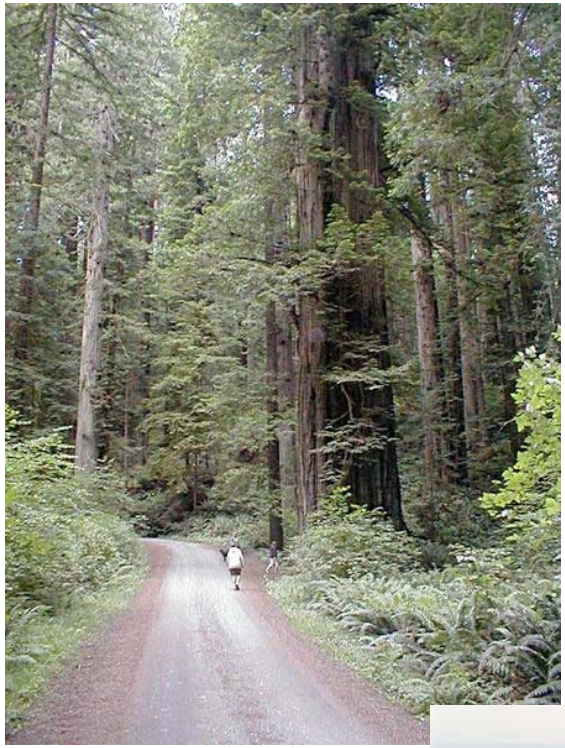


pacemaker

infusion pump

scanner

Sensors Everywhere



Sonoma
Redwood Forest

Credit: Arthur Sanderson at RPI

Hudson River Valley

Kindly donated by Stewart Johnston

smart buildings

Credit: MO Dept. of Transportation

smart bridges

Robots Everywhere

Credit: Honda

At work: Two ASIMOs working together in coordination to deliver refreshments

Credit: Paro Robots U.S., Inc.

At home: Paro, therapeutic robotic seal

Credit: Carnegie Mellon University

At home/clinics: Nursebot, robotic assistance for the elderly

At home: iRobot Roomba vacuums your house

U.S Broader Research Agenda and Priorities

Dan Reed and George Scalise, editors
August 2007

#1 Priority: Cyber-Physical Systems

Our lives depend on them.

Credit: http://www.ostp.gov/pdf/nitrd_review.pdf

Cyber-Physical Systems
Sample Research Challenges

Science

- Co-existence of Booleans and Reals
  - Discrete systems in a continuous world
- Reasoning about uncertainty
  - Human, Mother Nature, the Adversary

Technology

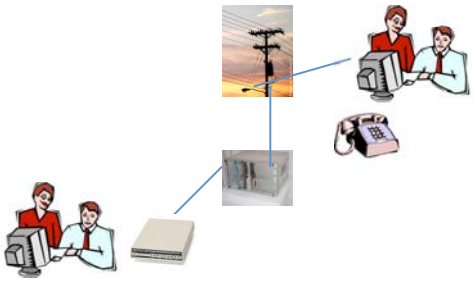
- Intelligent and safe digital systems that interact with the physical world
  - Self-monitoring, real-time learning and adapting

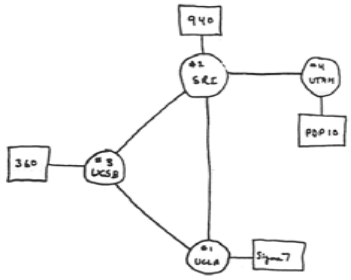
Society

- Systems need to be unintrusive, friendly, dependable, predictable, …

Enhanced Initiatives

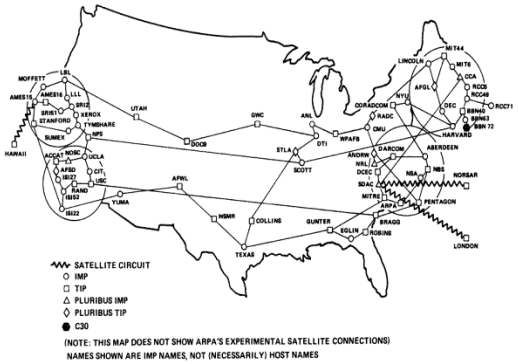
Our Evolving Networks are Complex





THE ARPA NETWORK

1970



1980

1999

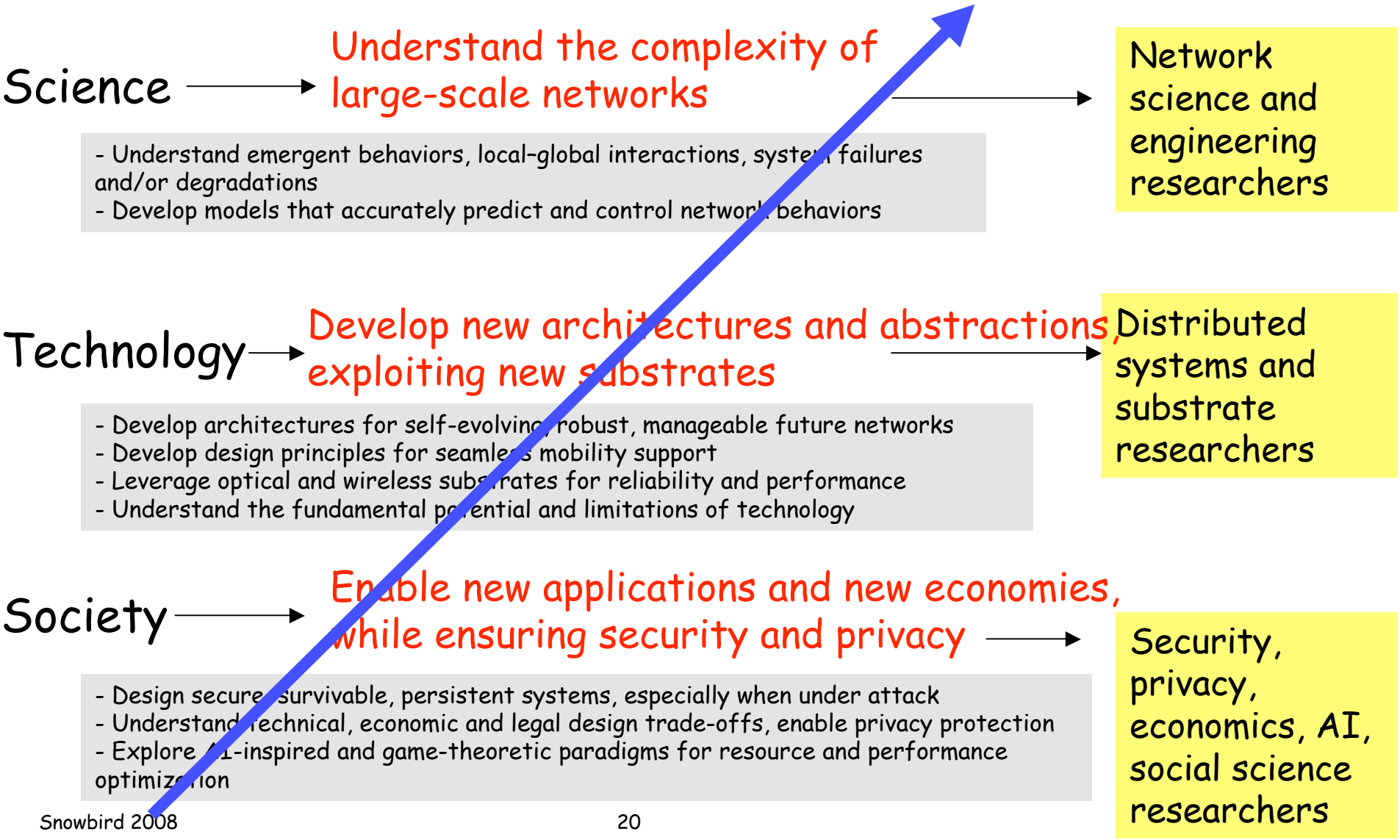
Network Science and Engineering

- Fundamental Question: Is there a science for understanding the complexity of our networks such that we can engineer them to have predictable behavior?

- Deepen and broaden research agenda of original GENI concept

- Includes CISE's current networking programs: SING, FIND, NGNI

Network Science and Engineering Sample Research Challenges



Trustworthy Computing

- Trustworthy = reliability, security, privacy, usability
- Deepen and broaden Cyber Trust
- Three emphases for FY09
  - Foundations of trustworthy
    - Models, logics, algorithms, metrics
  - Privacy
  - Usability

Continued from FY08

CDI: Cyber-Enabled Discovery and Innovation

Computational Thinking for Science and Engineering

- Paradigm shift
  - Not just our metal tools (transistors and wires) but also our mental tools (abstractions and methods)
- It's about partnerships and transformative research.
  - To innovate in/innovatively use computational thinking; and
  - To advance more than one science/engineering discipline.
- Three dimensions
  - From Data to Knowledge
  - Understanding Complexity in Natural, Built, and Social Systems
  - Virtual Organizations
- FY08: $47.9M for ~30 awards
  - 1900 LOIs, 1300 preliminary proposals, 200 final proposals

Expeditions

- Bold, creative, visionary, high-risk ideas
- Whole >> $\sum_i$ part $_i$
- Solicitation is deliberately underconstrained
  - Tell us what YOU want to do!
  - Response to community
    - Loss of ITR Large, DARPA changes, support for high-risk research, large experimental systems research, etc.
- FY08: ~3 awards, each at $10M for 5 years
  - 122 LOI, 75 prelim, 20 final, 7 reverse site visits

Others

Please see website www.cise.nsf.gov for full list.

- Creative IT, CRCNS, DataNet, HECURA, …
- Research infrastructure: CRI, MRI
- Education: CPATH, BPC

- Science and Technology Centers

- …

Research Ideas in the Works

Clickworkers
Collaborative Filtering
Collaborative Intelligence
Collective Intelligence
Crowdsourcing
eSociety
Human-Based Computation
Recommender Systems
Reputation Systems
Social Commerce
Socially Intelligent Computing
Swarm Intelligence
Wikinomics
Wisdom of the Crowds

eSociety: Computing BY and FOR Society

- Examples
  - Individual Memexes, personalized robots, social networks, Second Life++, human computation (e.g., ESP Game)
- Multiple dimensions
  - Numbers and types of people
  - Numbers and types of devices and services
  - Numbers and types of communications and interactions
- Question: Can we harness these capabilities to make humans and computers work effectively in harmony, solving problems neither can solve alone?

Green IT

IT as part of the problem and IT as part of the solution

- IT as a consumer of energy
  - 2% (and growing) of world-wide energy use due to IT
- IT as a helper to solve problems
  - Direct: reduce energy use, recycle, repurpose, …
  - Indirect: e-commerce, e-collaboration, telework -> reduction travel, …
  - Systemic: computational models of climate, species, … -> inform science and inform policy
- Broader context: Sustainability, Energy, Climate Change, Economy, Human Behavior

Education

Education

Challenge to Community: What is an effective way of teaching (learning) computational thinking to (by) K-12?

- Computational Thinking for Children
  - National Academies Computer Science and Telecommunications Board (CSTB)
    - Workshops on CT for All
    - Collaborating with Board on Science Education
  - Internal working group at NSF
    - CISE, EHR, SBE, OCI, MPS

Education

- CS AP (AB) Exam
  - It's an opportunity for us!
  - Goal: Let's try to speak loudly and with one voice.

Important Issues

- Broadening Participation in Computing
  - How do we effect institutional change?
    - Does your university/lab/department have a strategic plan for diversity?
  - How can we improve the image of computing?

- CISE Highlights
  - Your research highlights matter!
  - To Dept Heads and Deans: Recognize the prestige by having Highlights included in faculty C.V.s.

Management

Back to Basics

- NSF is about basic science and engineering.
  - Preserve CISE core.
- It's all about good ideas and good people.
- It's about long term impact.
  - Impact may be far in the future.
  - Impact is long-lasting (that is real science).
  - Impact can create new economies and change societal behavior.
  - Promote new, emerging areas of computing.
  - Support interdisciplinary and collaborative research.

Staffing News

- Sampath Kannan joined us July 1 as Division Director of Computer and Communications Foundations (CCF)
- Haym Hirsh is staying for a third year as Division Director of Information and Intelligent Systems (IIS)
- Ty Znati joined last September as Division Director of Computer and Network Systems (CNS)

…and the hardest working and most dedicated program directors and administrative staff at NSF.

I feel lucky—I have a great team!

Coordinated and Cross-Directorate Solicitations

- Rationale: To inform you of the breadth of interests across CISE, to de-confuse you, to help you plan your proposal writing, to be timely and nimble to new ideas, and to improve the review process.

CCF	CNS	IIS
Core	Core	Core
•Algorithmic F'ns •Communications and Information F'ns •Software and Hardware F'ns	• Computer Systems • Network Systems	• Human-Centered • Information Integration & Informatics • Robust Intelligence

Cross-Cutting

- Data-intensive Computing
- Network Science and Engineering
- Trustworthy Computing

Budget

Civics 101

President

1. Request

2. Appropriate

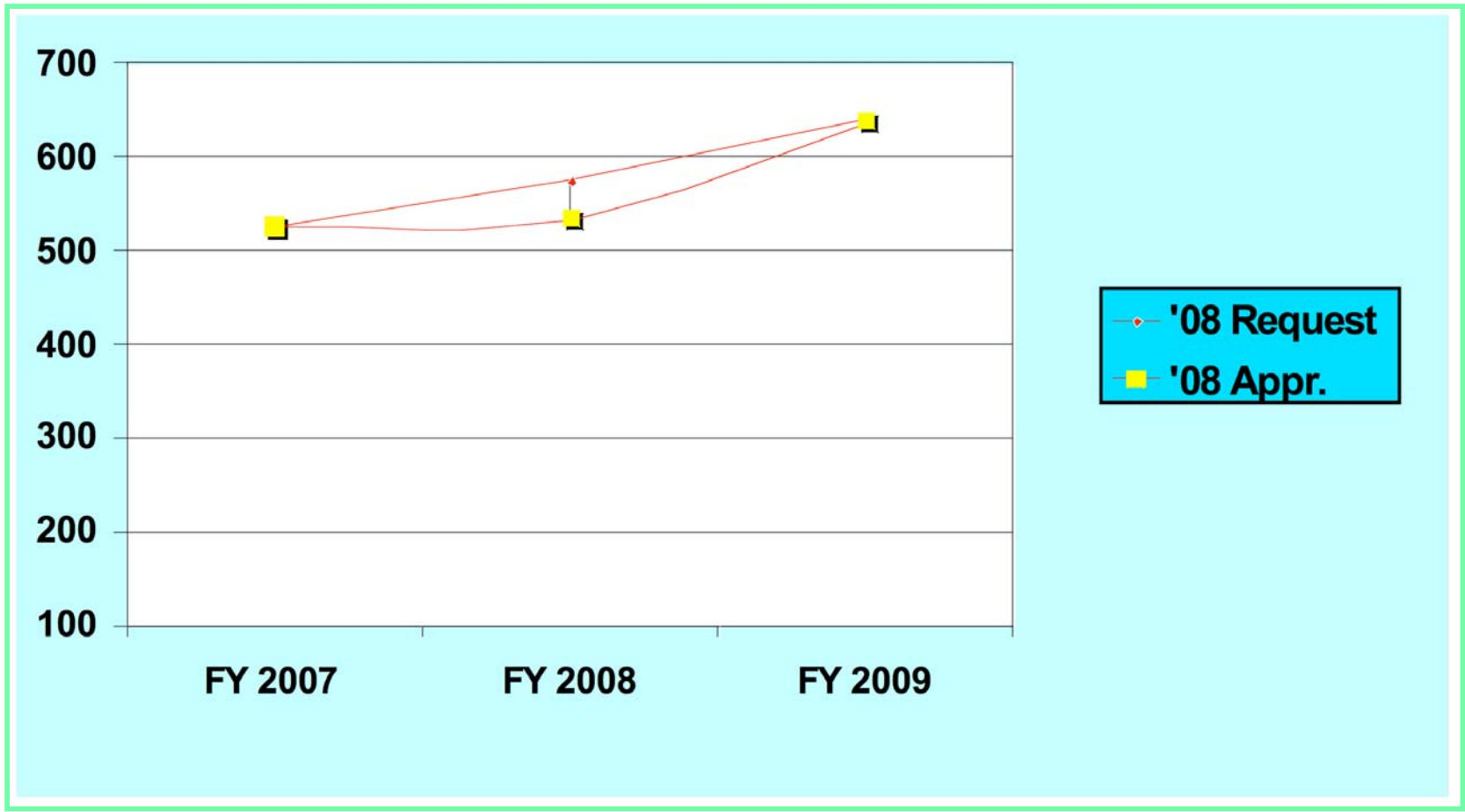
Congress

NSF

FY08 and FY09 CISE Funding

- FY08 (FY began 10/1/07)
  - CISE Request was $574 million, a **9%** increase over FY07
  - CISE Appropriate is $535 million, only a 1.5% increase
  - Missed opportunities of $39 million
    - E.g, ~325 awards or 400 grad students
- FY09 (FY begins 10/1/08)
  - CISE Request totals $639 million
  - Reflects a **$104** million increase, or **19.5%** over FY08 level.

CISE FY07 to FY09



Reality

- FY09 (starts 10/1/08)
  - Lots of uncertainty now:
    What will Congress do for FY09's budget?
    Who will be our next President?
  - New Administration January 2009
- FY10 (starts 10/1/09)
  - Planning now

Glimmers of Hope

- America Competes Act, August 2007
  - Double NSF's budget in 7 years
- War Supplement
  - $62.5M for NSF, ~$17.5M for Research

Federal Picture: NITRD

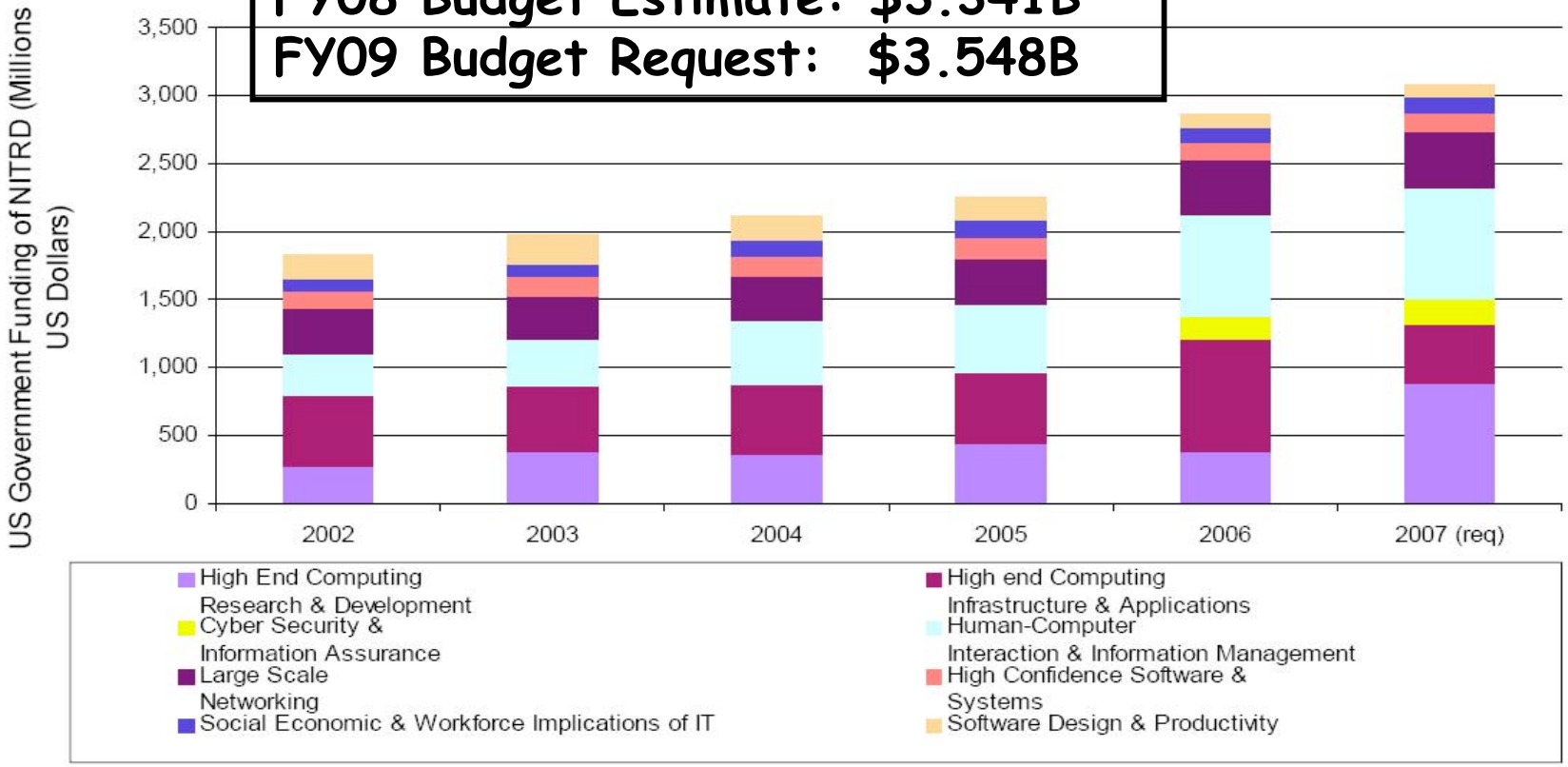
What is NITRD?

- Networking and Information Technology Research and Development
- Established by High-Performance Computing Act 1991
- Co-chairs: Chris Greer (NCO) and Jeannette Wing (NSF)
- Agencies (in order of investment): NSF, DARPA, OSD and DoD, NIH, DOE/SC/NE/FE, NSA, NASA, NIST, AHRQ, DOE/NNSA, NOAA, EPA, NARA
- 8 Program Component Areas

U.S. public funding of unclassified NIT R&D has been growing

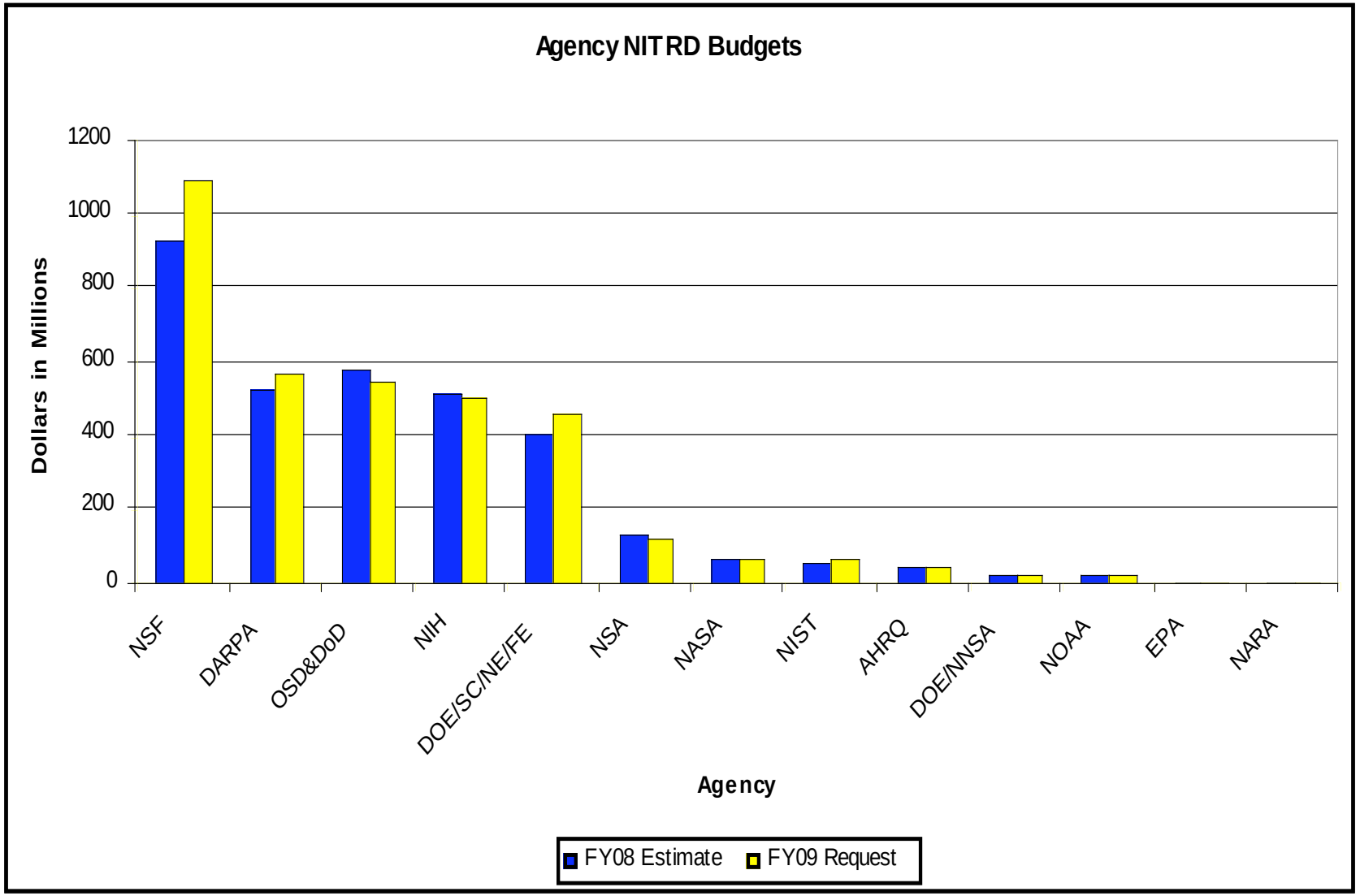
IDA STPI

FY08 Budget Estimate: $3.341B
FY09 Budget Request: $3.548B

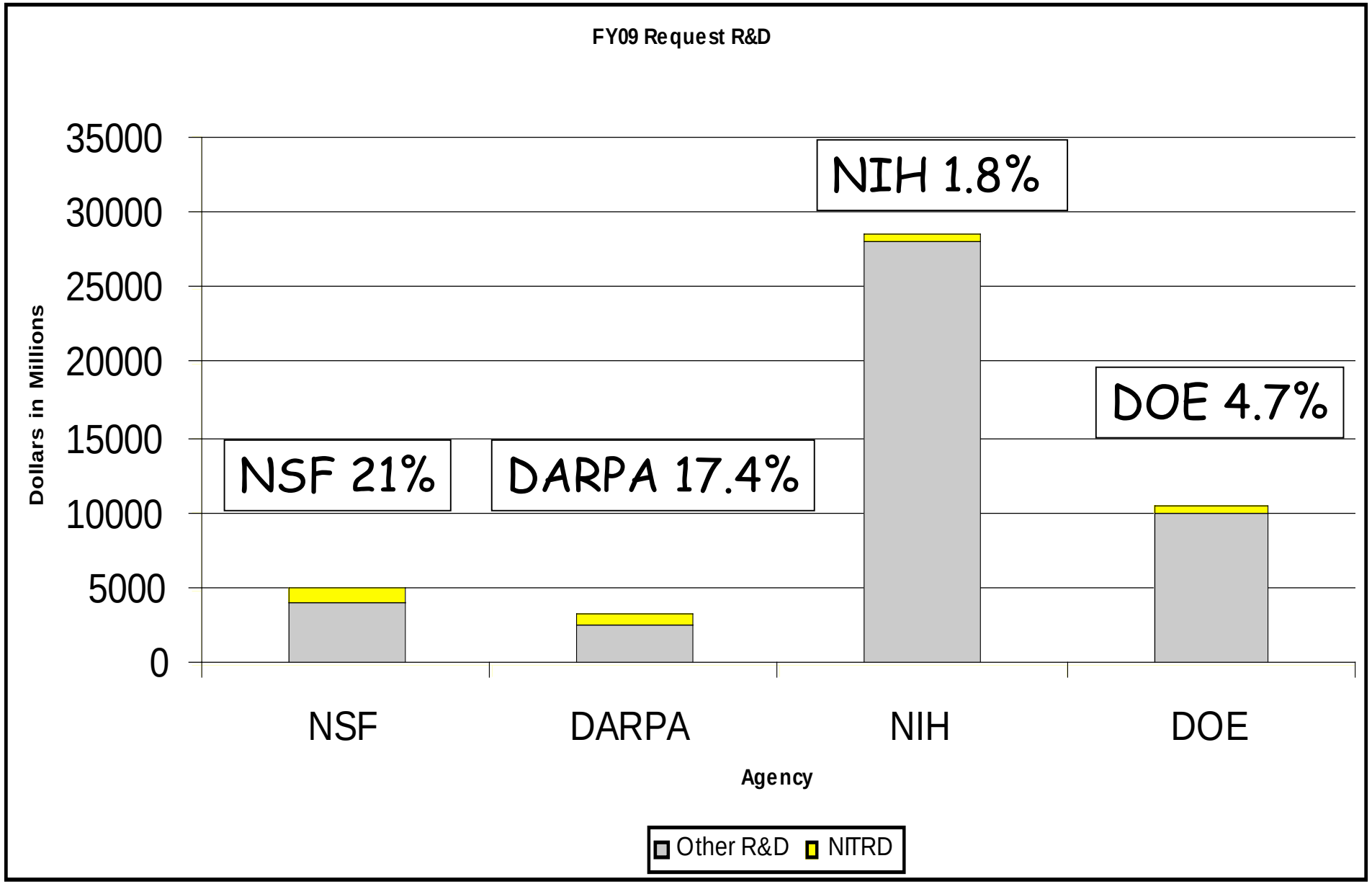


Source: NITRD NCO, 2002-2006

FY08 Estimates and FY09 Requests by Agency



NITRD as Percent of Total R&D FY09 Request

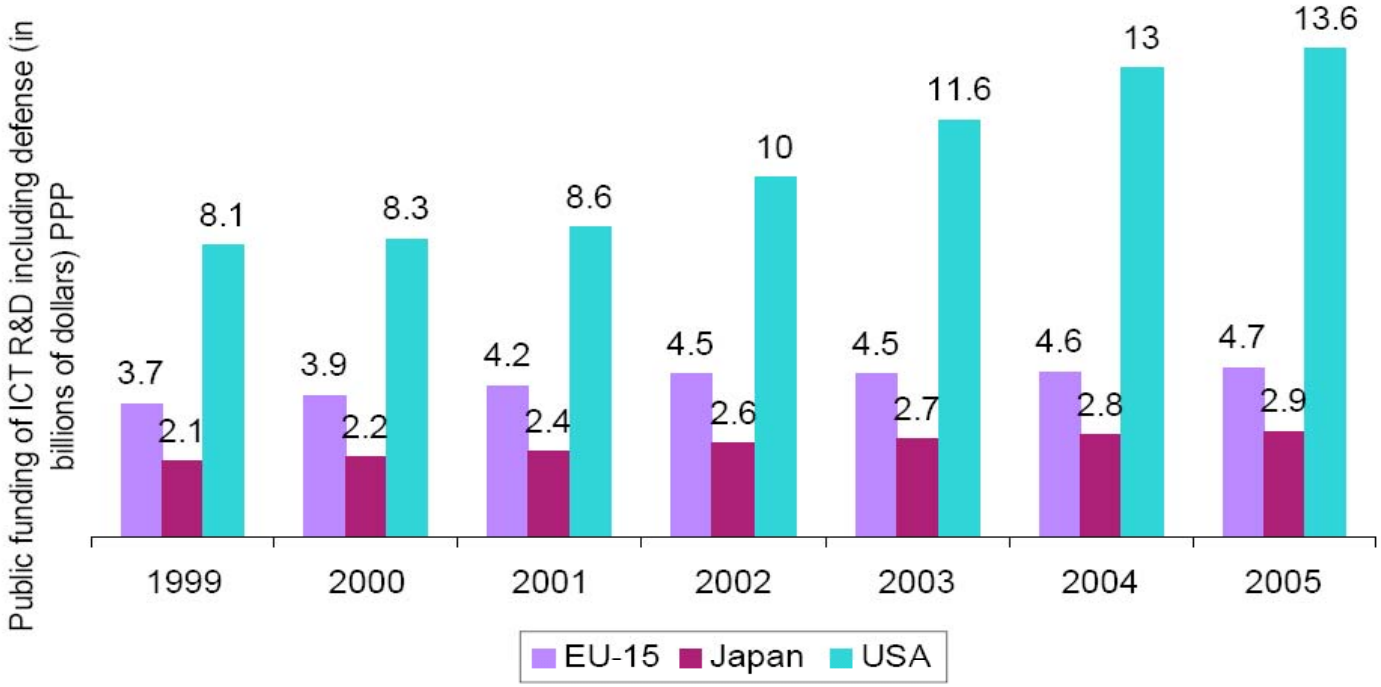


Strategic Plan Process Underway

- Why?
  - Last Strategic Plan was 2002-2006
  - PCAST/NITRD August 2007 report
  - New Administration January 2009
- Focus: Goals and capabilities that can only be achieved through interagency cooperation and coordination
- Vision-driven
- Community input welcome!
  - Request for Input (July)
  - Workshop (November)
  - Feedback on draft (early next year)

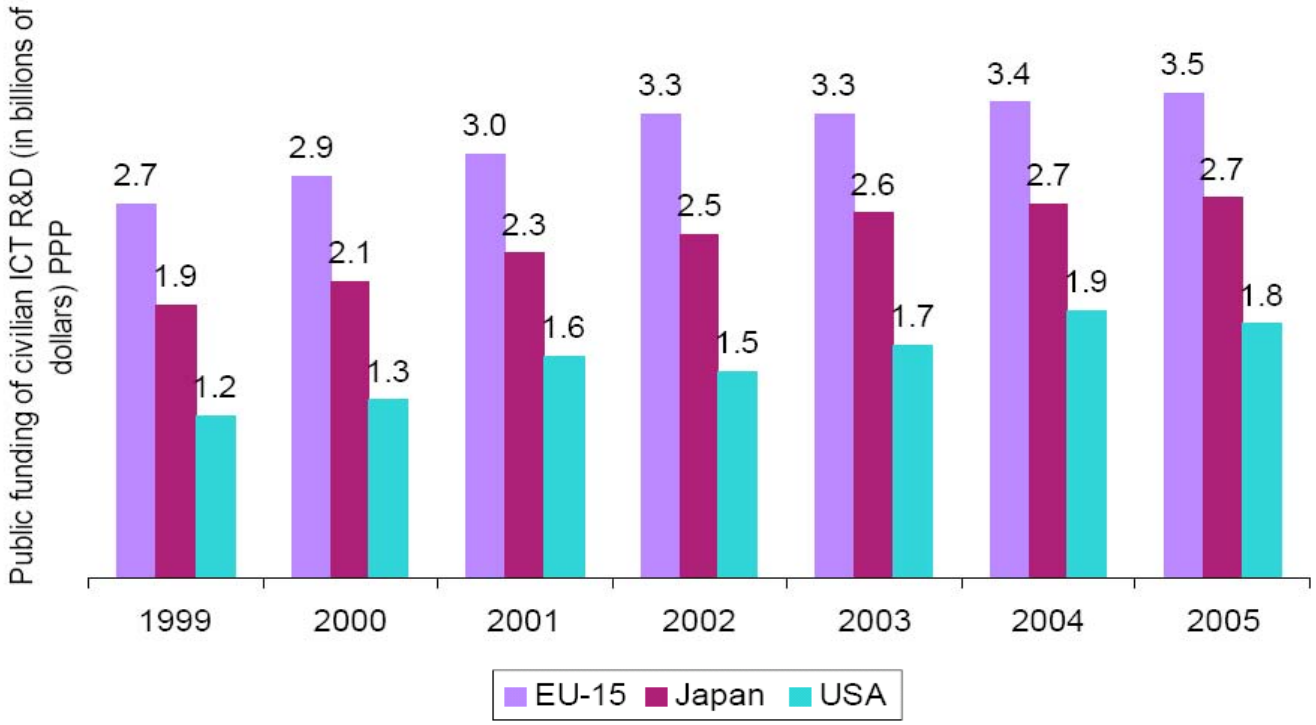
International

Federal funding of ICT R&D – including defense - in the United States is well ahead of other economies of interest



Source: Research And Development In Information Science and Technology In Large Industrialised Countries, Commissioned By The Ministère Délégué À L'enseignement Supérieur Et À La Recherche, Summary Report April 2006

Excluding defense, Federal U.S. ICT funding may be lower than other economies of interest



Source: Research And Development In Information Science and Technology In Large Industrialised Countries, Commissioned By The Ministère Délégué À L'enseignement Supérieur Et À La Recherche, Summary Report April 2006

What the EU is Spending in ICT

- European Community Framework 7
- Four ICT calls for proposals for 7-year projects

	Total EC+Nat'l € M	Equivalent to US$M***
Advanced Research and Technology for Embedded Intelligent Systems (ARTEMIS)* ["Cyber-Physical Systems"]	243**	379.9
Future and Emerging Technologies	65	102.6
European Technology Platform for Nanoelectronics	90	142.1
Ambient Assisted Living	57	90.0
Total	**455**	**718.4**

*10-yr budget €1.1B public funds, €1.6B private funds

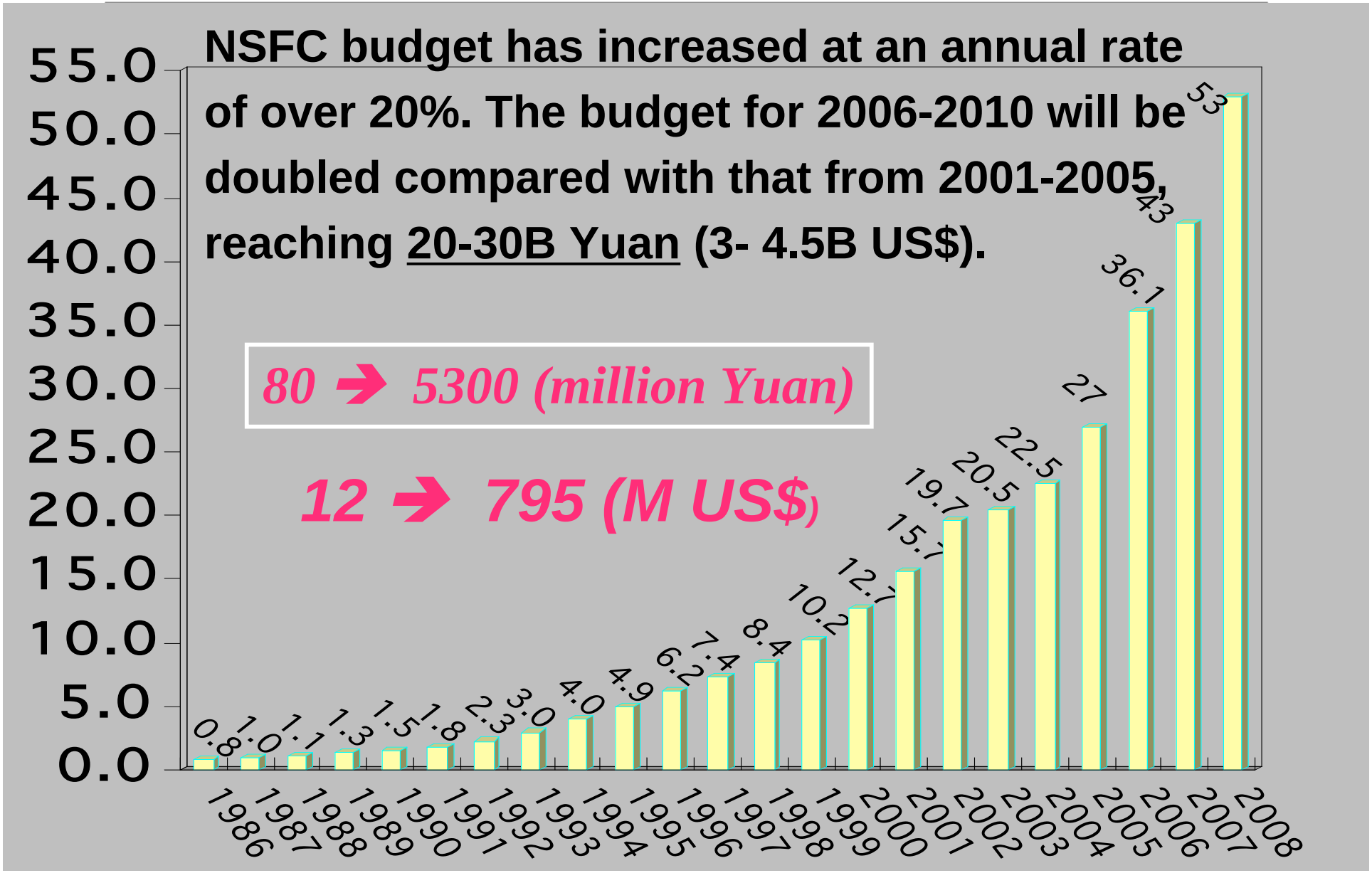
** Includes €144M in private funds

***€1 = 1.5788 US$

Source: Wayne Patterson, NSF OISE

Unit: 100 million Yuan

China: Annual Budget of NSFC



Penultimate Word

CISE Needs Good People

- Quality of program directors
  - ⇒ Affects quality of reviewers chosen for panels and ad hoc reviews
    - ⇒ Affects quality of reviews PIs receive
  - ⇒ Affects funding decisions
    - ⇒ Affects the nature and content of our research
  - ⇒ Affects the frontiers of our discipline!

Quote from Dr. Arden Bement, Director of NSF:
"Send us talent."

What You Can Do for Computing

In increasing order of comfort:

- Service counts: Discuss at your institution how to include service as part of the evaluation, promotion, and tenure process.
- Names, names, names: Have your department head/dean/lab director send us (1) a list of qualified reviewers, (2) a list of potential program directors, division directors, assistant directors.
- Support the field, support your colleagues: Our self-hypercriticalness hurts us when we compete at the foundation level (e.g., MRI, PECASE, S&TCs, ERCs, IGERT, CDI).
- Most importantly: Do great research!
  - Be creative, innovative, bold, visionary. As senior members of the community, set an example for and mentor the junior members.
  - Send us your good ideas. Send us your good people.

It's a Collective Effort

We are in this together!

- ACM, CCC, CRA, CSTB, IEEE Computer, NSF/CISE, …
- Government—Academia—Industry ecosystem

Last Word:
The Future of Computing is Bright!

Drivers of Computing

Society

6A's
Anytime
Anywhere
Access to
Anything by
Anyone
Authorized.

Science

- What is computable?
- P = NP?
- (How) can we build complex systems simply?
- What is intelligence?
- What is information?

Technology

J. Wing, "Five Deep Questions in Comp[illegible]," CACM J[illegible]

Thank You!

Credits

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