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# Long-Term Information Technology Research

## The Proper Role of the US Government

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<http://www.cs.rice.edu/~ken/Presentations/JapanPITAC.pdf>

# Question

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  - Other than ensuring that commerce flows freely

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- **Is the Federal Government Doing This Well?**
  - This is the question that the President's Information Technology Advisory Committee (PITAC) was asked to address.

# PITAC Charter

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- The Committee shall provide an independent assessment of:
  - Progress made in implementing the High-Performance Computing and Communications (HPCC) Program;
  - Progress in designing and implementing the Next Generation Internet (NGI) initiative;
  - The need to revise the HPCC Program;
  - Balance among components of the HPCC Program;
  - Whether the research and development undertaken pursuant to the HPCC Program is helping to maintain United States leadership in advanced computing and communications technologies and their applications;
  - Other issues as specified by the Director of the Office of Science and Technology.
    - Review of the entire IT investment strategy — is it meeting the nation's needs

# PITAC Membership 97-99

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- **Co-Chairs:**

- Bill Joy, Sun Microsystems

- Ken Kennedy, Rice

- **Members:**

- Eric Benhamou, 3Com

- Ching-chih Chen, Simmons

- Steve Dorfman, Hughes

- Bob Ewald, SGI

- Sherri Fuller, U of Washington

- Susan Graham, UC Berkeley

- Danny Hillis, Disney, Inc

- John Miller, Montana State

- Raj Reddy, Carnegie Mellon

- Larry Smarr, UIUC

- Les Vadasz, Intel

- Steve Wallach, Centerpoint

- Vinton Cerf, MCI

- David Cooper, LLNL

- David Dorman, AT&T

- David Farber, Penn

- Hector Garcia-Molina, Stanford

- Jim Gray, Microsoft

- Robert Kahn, CNRI

- David Nagel, AT&T

- Ted Shortliffe, Columbia

- Joe Thompson, Miss. State

- Andy Viterbi, Qualcomm

- Irving Wladawsky-Berger, IBM

# Methodology

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- Evaluation of Federal Research Investment Portfolio
  - Plans reviewed for each of the major areas:
    - High End Computing and Computation
    - Large Scale Networking
    - Human Centered Computer Systems
    - High Confidence Systems
    - Education, Training, and Human Resources
- Review of Balance in Federal Research Portfolio
  - Fundamental versus Applied
    - Based on our own definition of these terms
  - High-Risk versus Low-Risk
  - Long-Term versus Short-Term

# Principal Finding

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  - Agencies pressed by the growth of IT needs
    - IT R&D budgets have grown steadily but not dramatically
    - IT industry has accounted for over 30 percent of the real GDP growth over the past five years, but gets only 1 out of 75 Federal R&D dollars
    - Problems solved by IT are critical to the nation—engineering design, health and medicine, defense

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    - Natural and correct to favor the short-term needs of the mission
- This Trend Must Be Reversed
  - Continue the flow of ideas to fuel the information economy and society

# Remedy

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  - Scalable Information Infrastructure
  - High-End Computing
  - Social, Economic, and Workforce Issues

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  - Scalable Information Infrastructure
  - High-End Computing
  - Social, Economic, and Workforce Issues
- **Develop a Coherent Management Strategy**
  - Establish clear organizational responsibilities
  - Diversify modes of support

# Software

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- Recommendations
  - Make fundamental software research an absolute priority
  - Invest in key area needing attention
    - Improving programmer productivity
      - Ameliorate the shortage of IT professionals
    - Improving reliability and robustness of software
    - Improving usability through human interface innovations
    - Improving capabilities for information management
  - Make software research a substantive component of every major information technology research initiative.

# Scalable Information Infrastructure

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- **Research Needed:**
  - Understanding the behavior of the global-scale network.
  - Physics of the network, including optical and wireless technologies such as satellites, and bandwidth issues.
  - Scalability of the Internet.
  - Information management, information and services survivability
  - Large-scale applications and the scalable services they require.
    - National digital library, Next-generation world-wide web
  - Fund a balanced set of testbeds that serve the needs of networking research, research in enabling information technologies and advanced applications, and Internet research.

# High-End Computing

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- Findings:
  - High-end computing is essential for science and engineering research
  - High-end computing is an enabling element of the United States national security program
  - New applications of high-end computing are ripe for exploration
  - Suppliers of high-end systems suffer from difficult market pressures
    - High-end market not large
  - Advances in high-end computing eventually find their way to desktop
- Recommendation
  - Fund high-end computing research (architecture, software, and applications, and testbeds) because it is important to the government and the health, welfare, and security of the population

# Social, Economic, Workforce Issues

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- Invest in Four Areas:
  - IT-literate population
  - IT workforce
    - More workers, more underrepresented groups
  - Use of IT in education
  - Understanding economic and policy implications of technology
- An Observation on IT Workforce
  - Research investment in universities is critical
    - Without it, faculty leave
    - Without it, grad students do not go → no new faculty
    - Without faculty, we cannot produce more BS graduates

# Good News

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- **Administration Budget**
  - Proposed additional \$366 million in FY 2000
    - Appropriated: \$226 million
  - Proposed \$605 million increase for FY 2001
  - Successive years unclear
- **Congress**
  - Sensenbrenner NITR&D Act from House Science Committee
    - 5 years of funding at PITAC-recommended levels
    - Permanent R&D investment tax credit
    - Passed with near-unanimous support
    - Only partially reflected in the Senate authorization bills
  - Appropriations are year-to-year

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  - Thurow:
    - Private rate of return on research — 24%
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  - Industry is not good at funding and developing disruptive technologies
  - Federal Government funding creates fuel for the venture capital system

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- **The Internet as Problem-Solving Engine\***
  - GrADS Project

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- **One Strategy: Make the End User a Programmer**
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  - users integrate components using:
    - problem-solving environments (PSEs)
    - scripting languages (possibly graphical)

examples: Visual Basic, Tcl/Tk, AVS, Khoros

# Programming Productivity

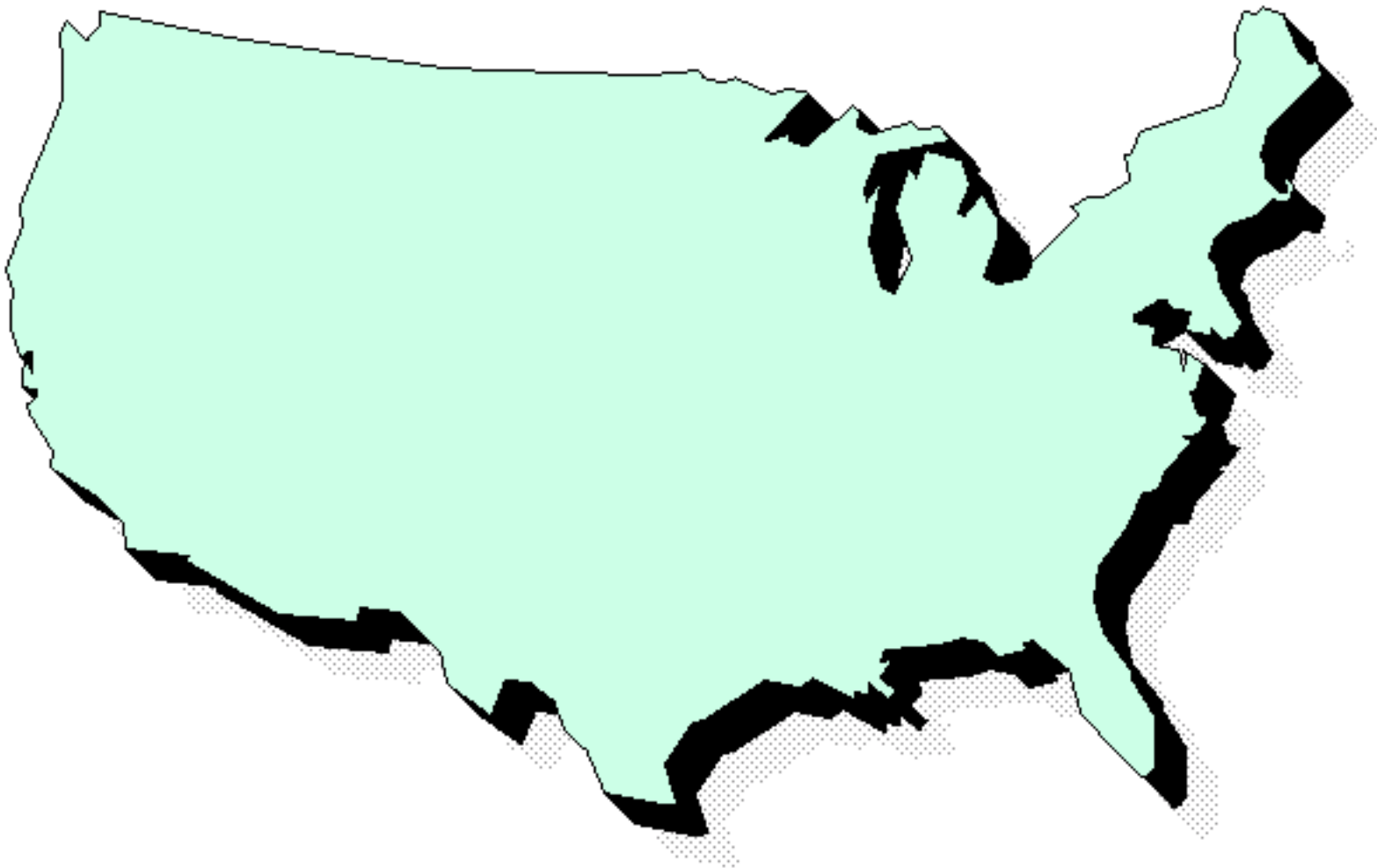
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- **Compilation for High Performance**
  - new technologies in whole program analysis and compilation
  - precompilation of base libraries to reduce script compilation time

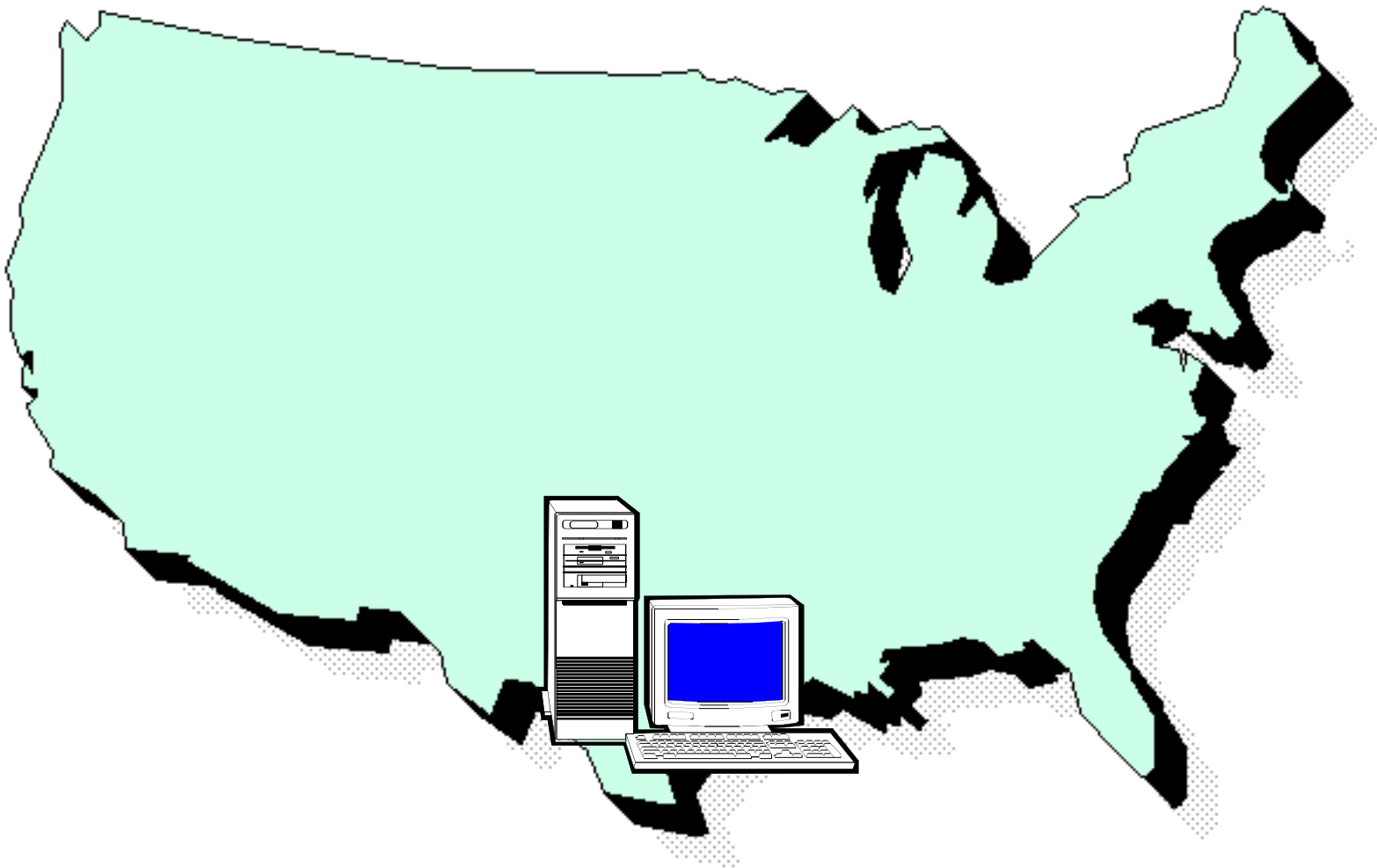
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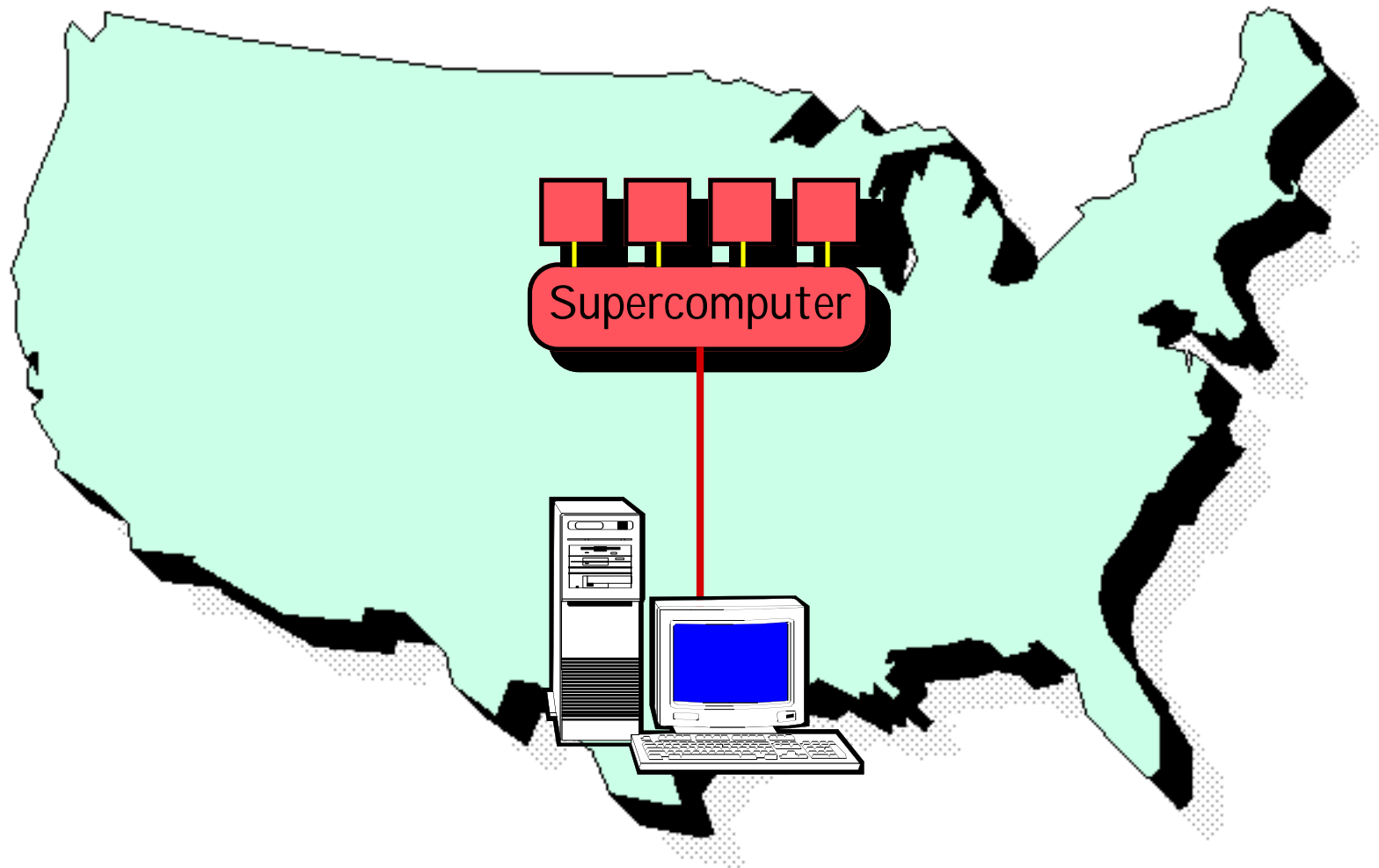
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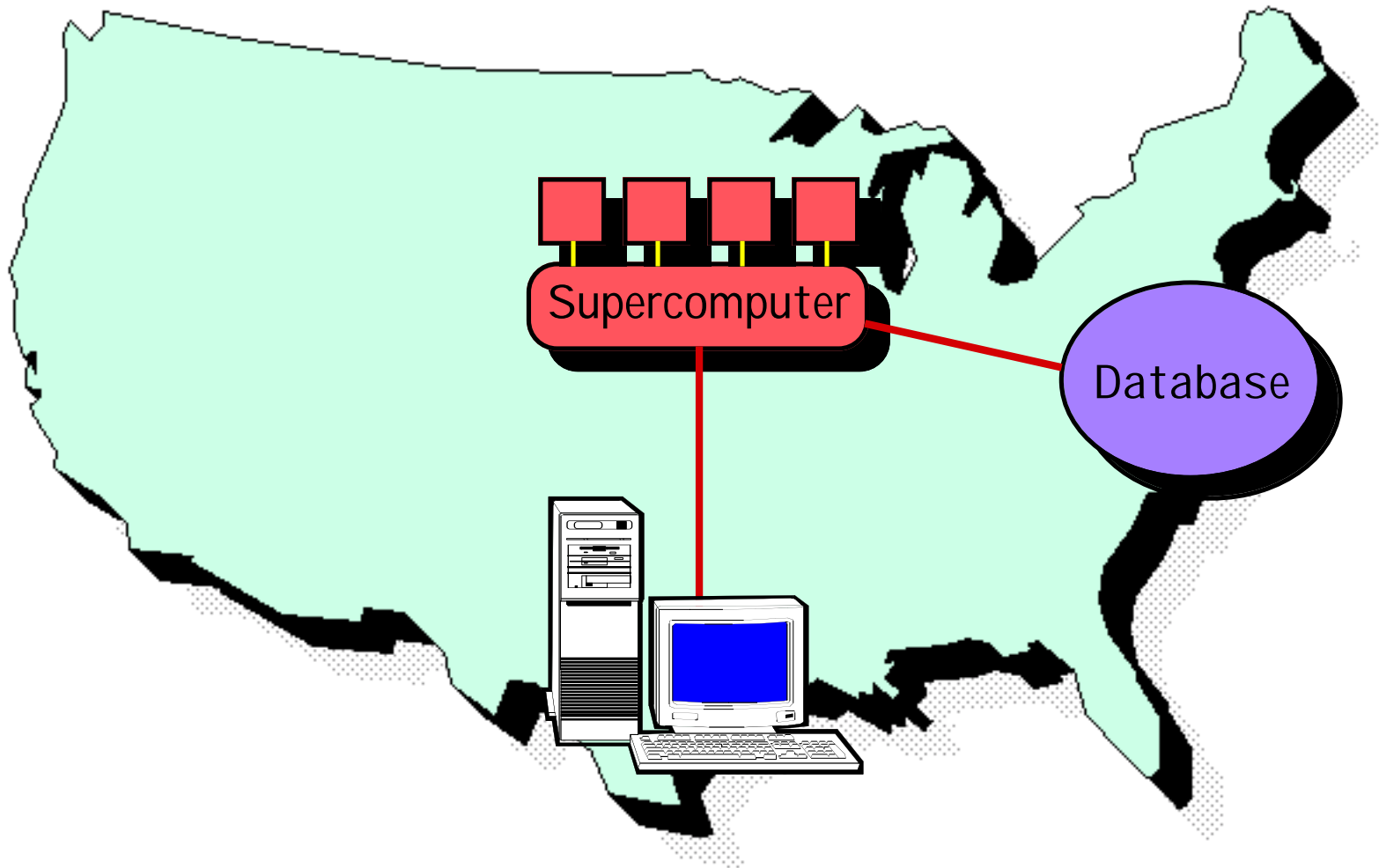
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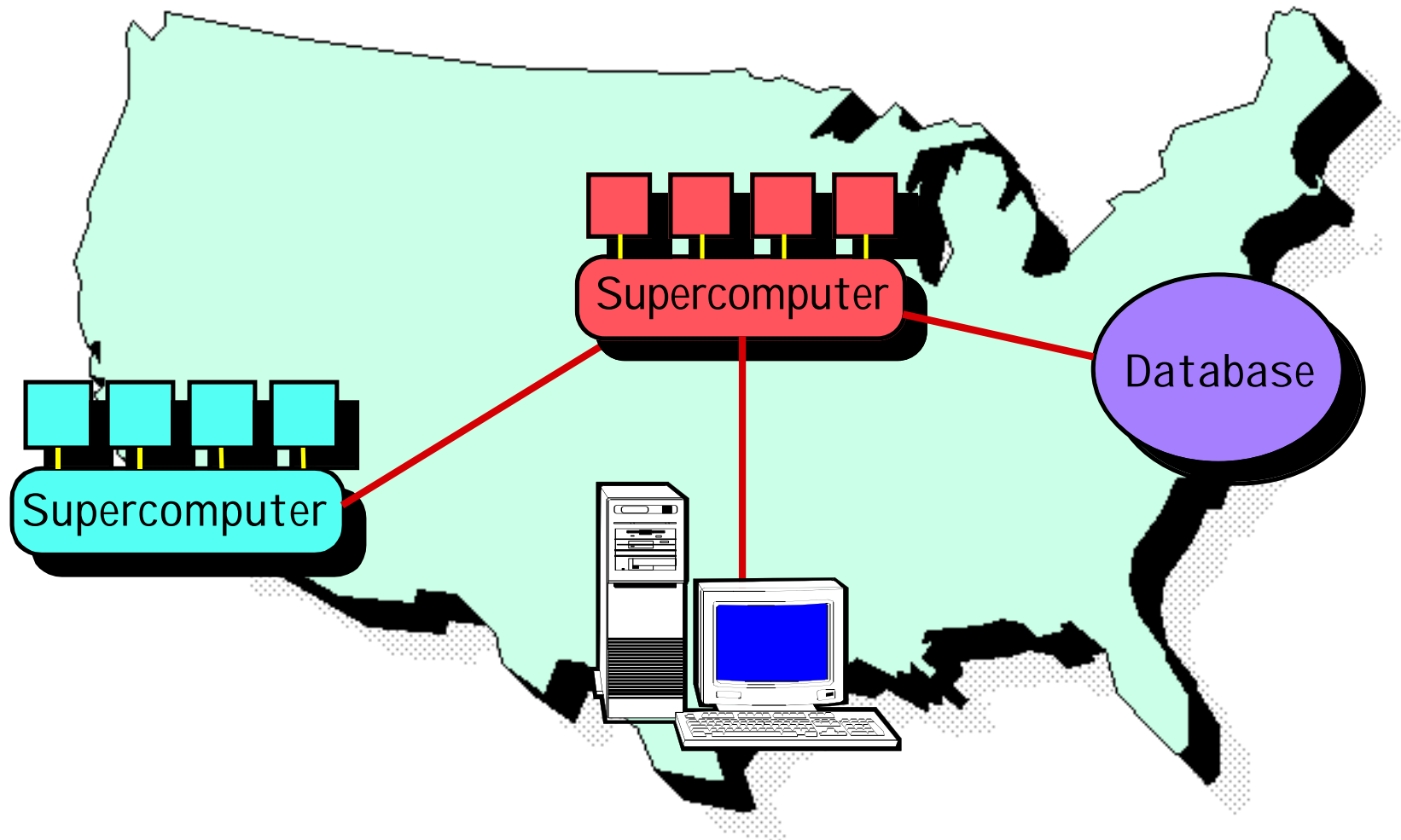
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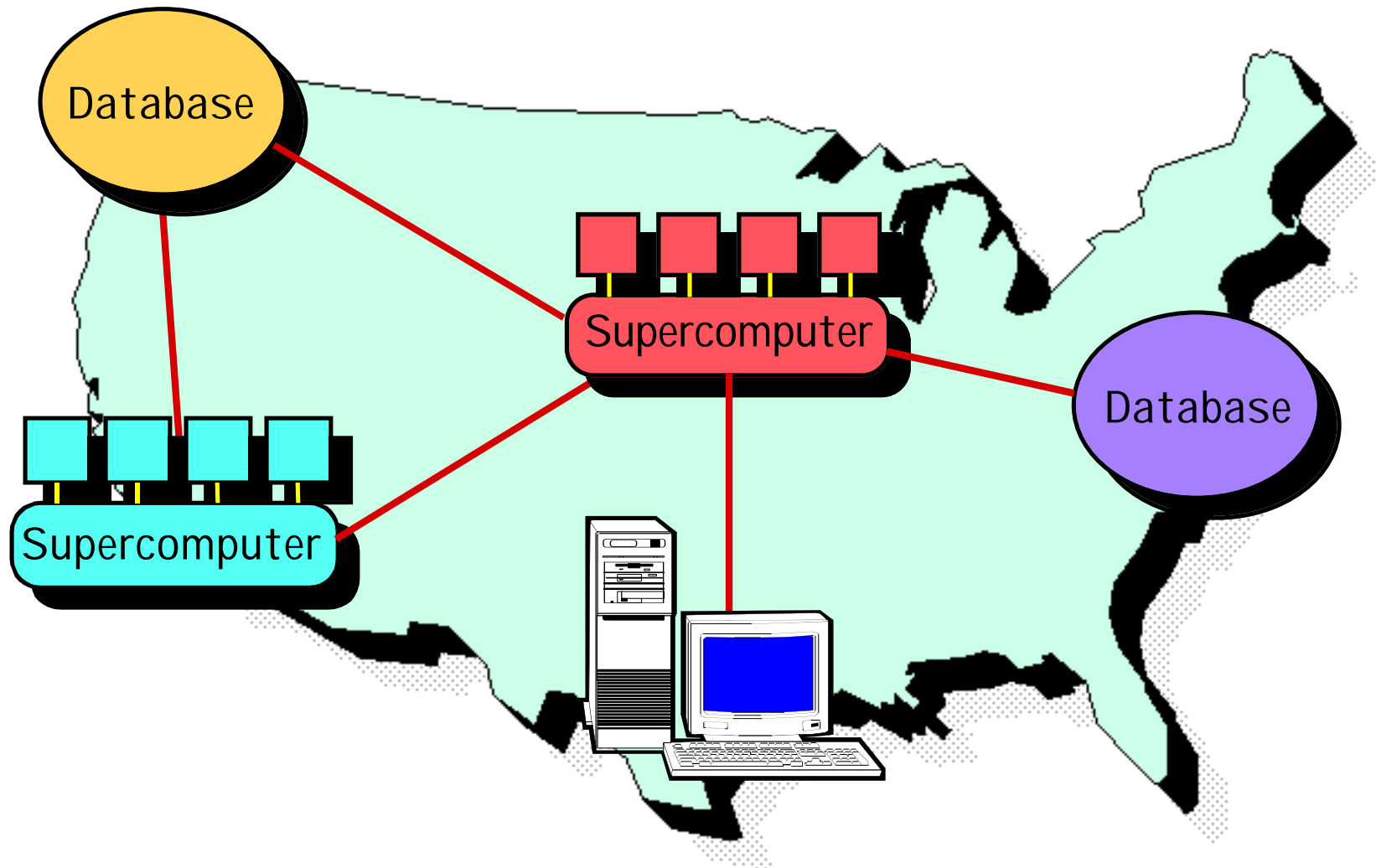
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# Conclusions

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- U. S. leadership in Information Technology **research** provides an essential foundation for commerce, education, health care, environmental stewardship, and national security in the 21st century.
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- Increased investment in long-term research is needed to continue the flow of ideas and people from universities into the the IT industry.
  - Revitalize university research (and education) in IT
- This is a unique responsibility of the Federal Government
  - Companies must focus on short term product development