

High End Computing for National Security

Conclusions of an Integrated Process Team

Presentation to the Presidential Advisory Committee on
High Performance Computing and Communications,
Information Technology, and the Next Generation Internet
June 24, 1996

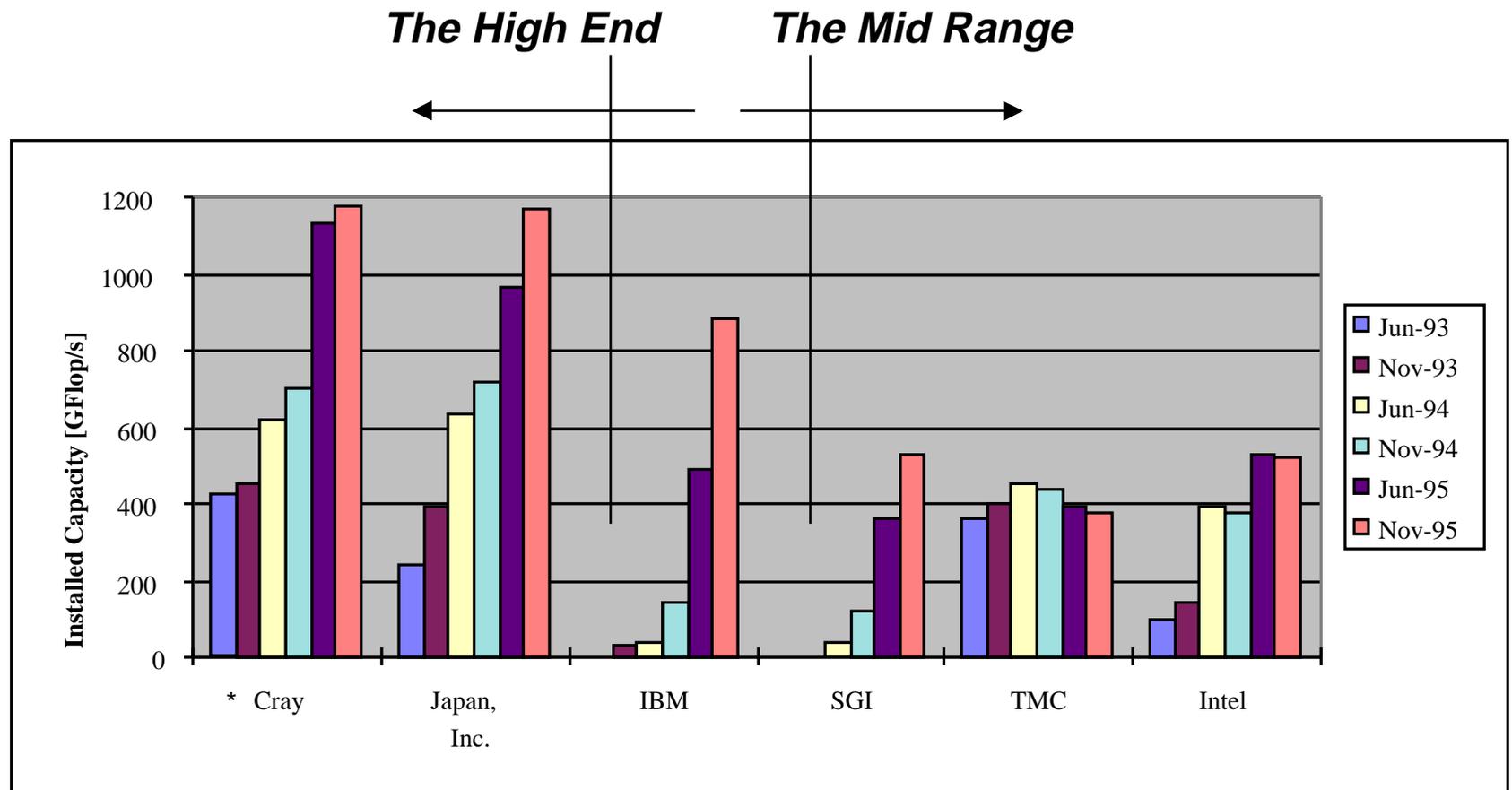
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HPC IPT Tasks Addressed by this Report

- What are the alternative future scenarios with respect to the US international lead in the high end of high performance computing?
- What is the threat to national security associated with each scenario?
- What technology advantage is necessary for the US, if any?

What Is High End Computing?

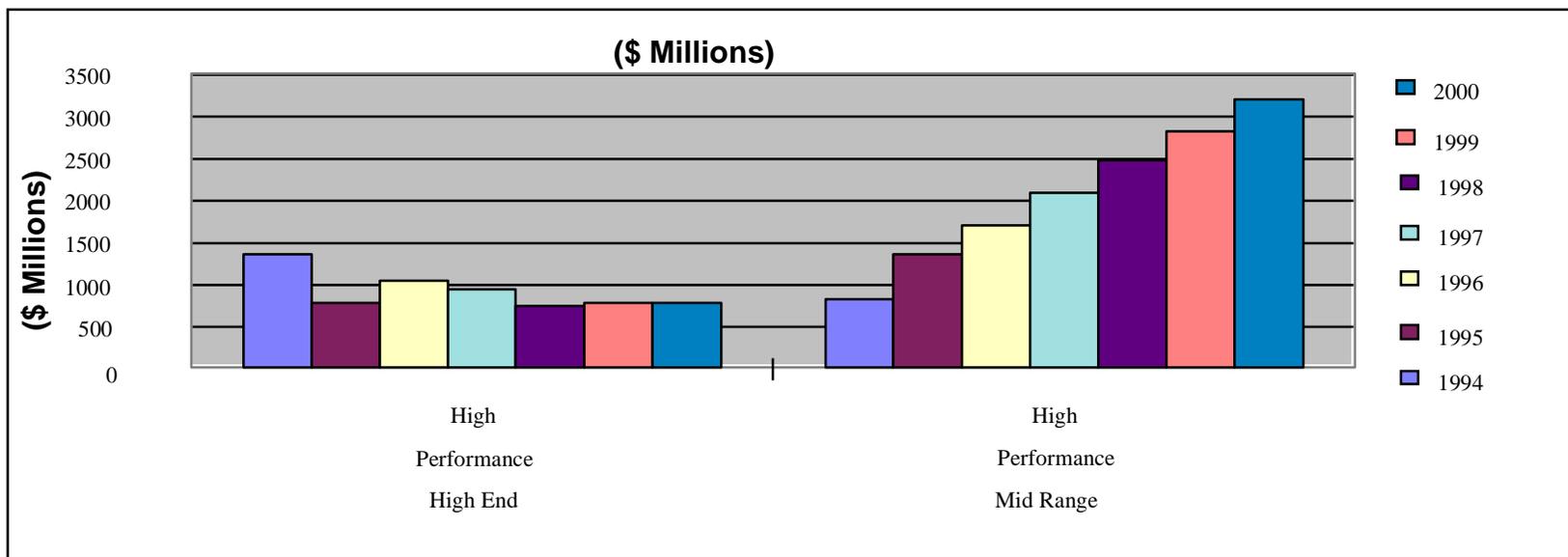
Manufacturer's Performance: A Moving Target



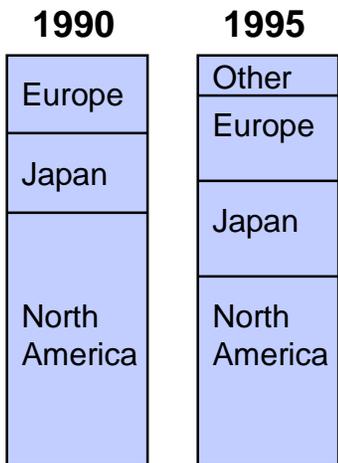
Source: Top 500 Supercomputer Sites compiled at Mannheim University
<http://www.netlib.org/benchmark/top500>

* Now SGI/Cray

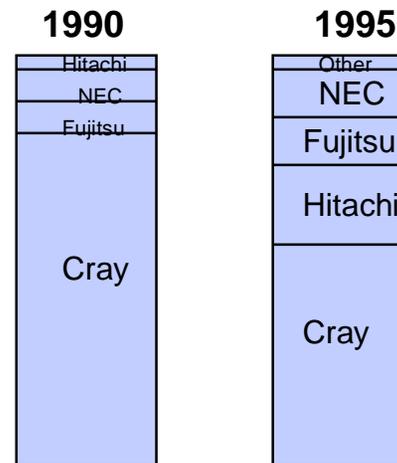
High End Market Flat; Strong Growth in the Mid-Range



% Market Distribution by Purchasing Country



% Market Distribution by Vendor



Source: International Data Corporation, 1995

Three Survivors Shipping Product: Only one with technical high end commitment

Tried and Failed

Alliant
BBN
CDC
Denelcor
Elxsi
ETA
FPS
Goodyear
Multiflow
Myrias (Canada)
Prime
SCS
Sequent
SSI

Recent High End Failures

CCC
Intel (SSD)
Kendall Square
Maspar
TMC
NCube

Mergers

SGI-CRI
HP/Convex

Others

IBM
TERA

Survivors Shipping Product

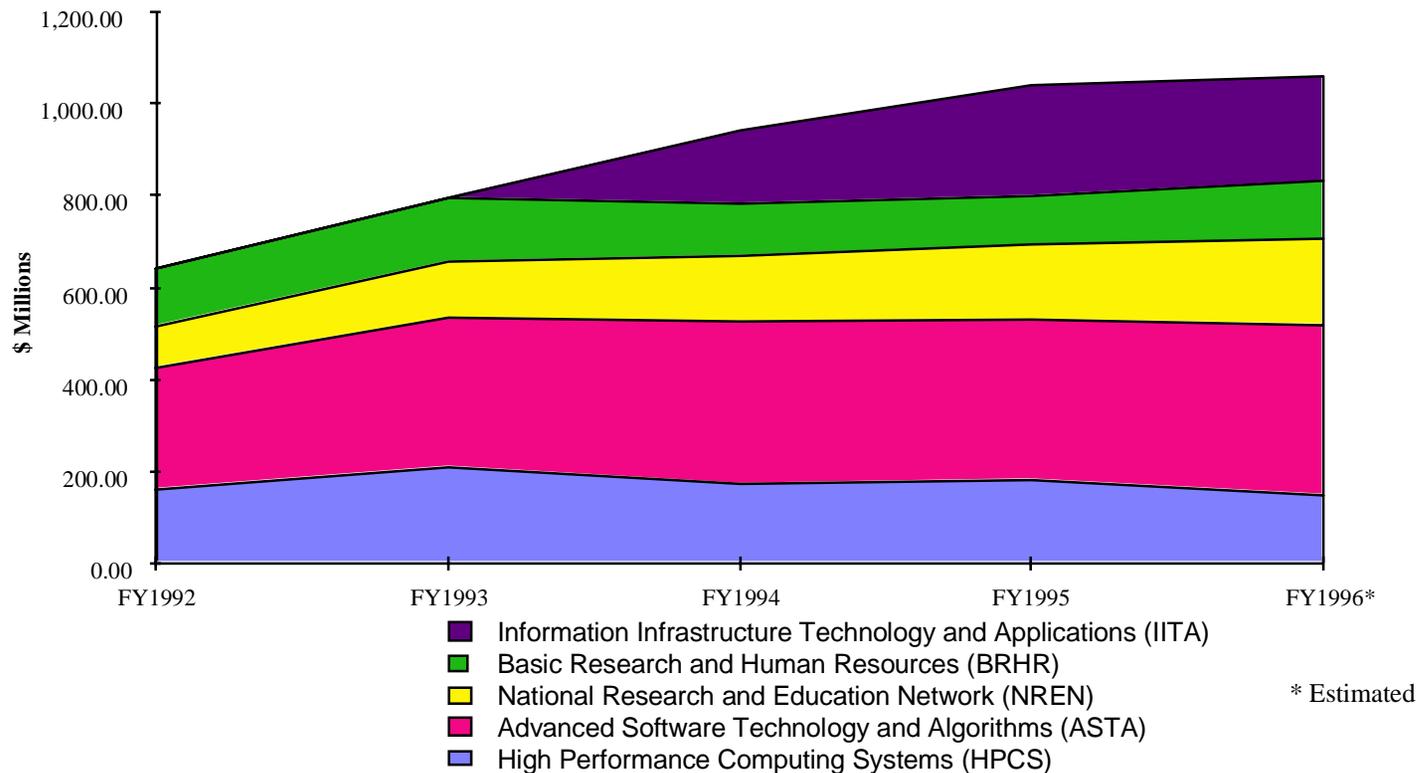
Mid Range

- Japanese making major national strategic investments
- US firms and **capital** abandoning high end market

Federal Investments Fueled Today's US Technology Success

Estimated Overall Federal High Performance Computing and Communications Program Expenditures by Components

| | FY1992 | FY1993 | FY1994 | FY1995 | FY1996 |
|-------|--------|--------|--------|----------|----------|
| HPCS | 156.80 | 205.50 | 171.20 | 177.90 | 146.70 |
| ASTA | 265.10 | 325.90 | 352.10 | 350.30 | 371.00 |
| NREN | 91.90 | 123.40 | 142.10 | 163.50 | 185.60 |
| BRHR | 124.50 | 140.40 | 116.50 | 106.30 | 128.10 |
| IITA | 0.00 | 0.00 | 156.00 | 240.00 | 228.20 |
| Total | 638.30 | 795.20 | 937.90 | 1,038.00 | 1,059.60 |



Federal R&D High End Investments Fueled Today's Technology Successes

- Established scalable parallel processing as the commercial standard for high performance computing
- Enabled the technology base for the \$2 billion middle range high performance market which expanded access to high performance computing while reducing costs to the government
- Invented and proved massively parallel systems as effective high end computing devices
- Enabled the near-term computing technology for DOE's ASCI program
- Created the scientific base for High End Computing including trained scientists and engineers, new architectural approaches and next generation technologies

National security policy-driven needs

US **requires** superiority in high end computing for:

- Superiority in weapons design
- Comprehensive test ban treaty
- Critical reaction capability/time for defense
- Battlespace dominance; revolution in military affairs

Superiority in critical defense technologies
requires

Superiority in high end computing technology.

National Security Applications

- Nuclear weapons stockpile stewardship: Weapon effects simulation to extend stockpile in era of no new design
- Wide area imagery: Near real time analysis of imagery with 3D Resolution, 100,000 sq. mile coverage and high resolution
- Cryptology: Rapid decryption of multiple messages
- Vehicle and weapons design and test
 - High performance aircraft design and test: Full 3D multi-disciplinary (aero, structures, magnetics, propulsion, controls) simulation
 - Weapons systems such as high power RF weapons: End-to-end simulation to predict complex systems response to weapons effects
 - Target discrimination: Combat identification, signature extraction and rapid target insertion for advanced platforms

National Security Applications (con't)

- Intelligence data and information extraction
 - Remote sensing exploitation: Parameter analysis of chemical species and spectral band)
 - Chemical detection (FTIR remote sensor): Infrared image generation for radiometric, thermal and emissivity analyses
 - Intelligence data and Information extraction: Reduce time for analysis of complex sensor data from two weeks to real time
- Synthetic theater of war C³: Mission rehearsal and decision support for Desert Storm size scenarios in faster than real time

Computational Speedups of 1,000-1,000,000 required by 2010

- Nuclear weapons stockpile stewardship: 100,000 - 1,000,000X
- Wide area imagery: 2,000X
- Vehicle and weapons design and test
 - High performance aircraft design and test: 10,000-100,000X
 - Weapons systems such as high power RF weapons: 1,000+X
 - Target discrimination: 3,000
- Intelligence data and information extraction
 - Remote sensing exploitation: 10,000-100,000
 - Chemical detection (FTIR remote sensor): 300,000X
 - Intelligence data / Information extraction: 3,000X
- Synthetic theater of war C³: 100,000X

Impact of High End Technology Deficit

- Nuclear weapons stockpile stewardship: US unable to extend stockpile life within “zero-yield” nuclear test ban
- Wide area imagery: Unable to provide tactical warfare information superiority
- Cryptology: US loses ability to decrypt industrial-strength message traffic

US Computer Industry Not Producing Next High End Generation to Meet National Security Needs

US computer industry unable or unwilling to invest their own resources to meet high end national security needs

- Insufficient ROI
- Opportunity Cost
- Uncertain Market Future

National Security Threats

- US technology and products may not be available to meet high end National Security needs.
- A potential collapse by withdrawal from market because of insufficient return on investment would lead to dependencies and unpredictable lead times for procurement
- Possible denial of high end systems to US Defense Programs (e.g. Nuclear)
- Expensive special purpose development systems would require years for development.
- Loss of technology base for special purpose development systems with very large costs for replacement
- Long-term technology loss in critical weapons leadership

Conclusions and Recommendations

- US has critical national security needs for high end technology and technology leadership that are not being met
- Without additional government action, US high end technology will not be available to meet national security leading edge needs
- These concerns require a proactive approach by the defense and national security community to determine an appropriate government response
- The community should implement measures to maintain technology leadership by establishing a joint, high end, national security partnership with industry