Future Technologies that may Facilitate Science Breakthroughs

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Panelists

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The Fun Stuff

• Cool Hardware
  • New Memory Technologies
    • Density
    • Latency
    • Bandwidth
    • Non-volatile
  • New Processors
    • Cell
    • FPGAs
  • New Interconnects
    • Cost effective optical
    • “Proximity Communication”
Millipede

- 10nm process
- 1.2 Terabit/in² (25 DVDs)
- Slow (but could compete with Flash memory)
Nanotube Memory

- Electrostatic forces hold nanotubes in place
  - Multiple tubes are used to enhance manufacturability
- Claims 2GHz (0.5 ns) operation
- Nonvolatile
Exotic Technologies

- And molecular computing, quantum computing, …
Cell Processor

- 256 (SP) GFlops/chip
  - +8 for PowerPC processor
- 8 “SPE”s
  - No cache
  - Software managed memory
- Extremely low latency interconnect between adjacent SPEs
- Billions and Billions to be made…
- And put four of these into your laptop and you have a TeraFlop 😊
Personal Supercomputers

• Orion Multisystems
  • Desktop cluster is 10x a single processor
  • Deskside cluster is 100x a single processor
• … if you have parallel software
Stuff That Matters

- **Software**
  - Better match of problem concepts to language abstractions
    - Multilevel and/or domain-specific languages
  - “Parallel Matlab”
  - Domain-specific “languages” and problem solving environments

- **Algorithms**
  - Multiscale and multi-science
  - Error guarantees

- **Software that supports new algorithms**
  - Optimizing for existing applications means optimizing for applications and software developed for machines slower than my laptop
Put the Science First

- **Technology Driven**
  - What could we do?
  - What can’t we do?
  - Can it help applications?

- **Application Driven**
  - What stands in the way of applications?
    - Managing complexity of modern software
    - Managing the datasets
      - Consequence of data densities is that 40GB is small
  - (one thing that does not stand in the way — the ability to write simple codes quickly that must run with high parallel performance)
New Question

• In 2025, what technologies **will have been created** to enable scientific breakthroughs?
  • In other words, what problems do we face *now* that we must solve, and what might that solution be?