



What Will Have the Greatest Impact in 2010: The Processor, the Memory or the Interconnect?

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Panel discussion

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Which area needs the most new ideas?

- In increasing order:

- CPUs

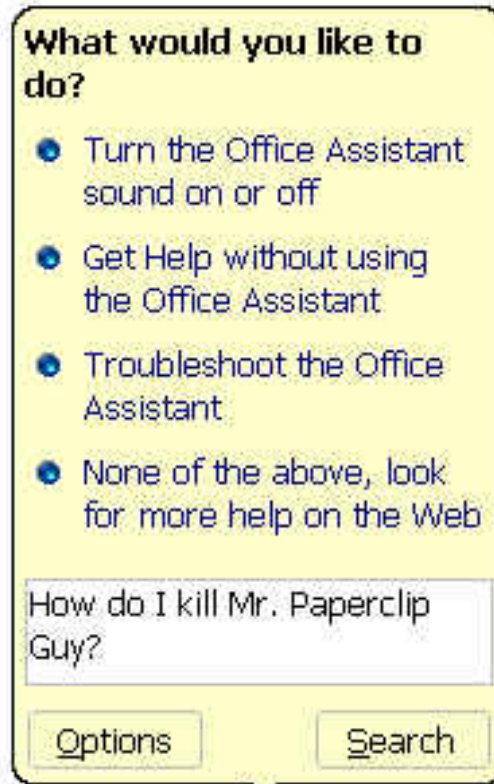
- Interconnect

- Memory hierarchy (including storage)

CPUs

- Have everything going in their favor
 - Moore's law scaling
 - Parallelism at many levels (pipelining, instruction level, multi-threading, clustering, grid computing)
 - Giga\$ investment in R&D
 - All should be well for the next decade (until the atomic countdown)

Irrefutable evidence that CPU cycles are not the problem



Even Microsoft may be running out of ways to waste CPU cycles!

Interconnect

- Bandwidth is not a problem with fiber and WDM
- Latency is reduced with protocols that eliminate store-and-forward
- System Area Networks
 - One network for storage and networking
 - Will come into their own before 2010
 - Many think this means Infiniband will be king
 - Infiniband is to Ethernet what RISC was to x86
 - Ethernet (1-10-100 Gbit) may be the prevailing SAN
 - Driven by Ethernet block storage (iSCSI)



Memory/Storage

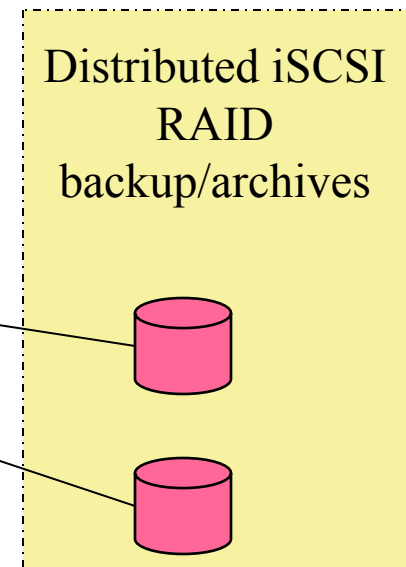
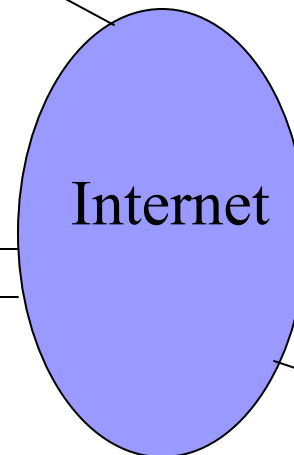
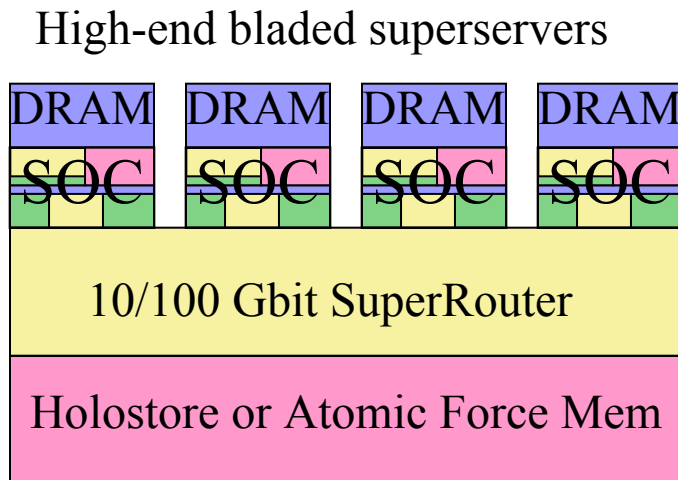
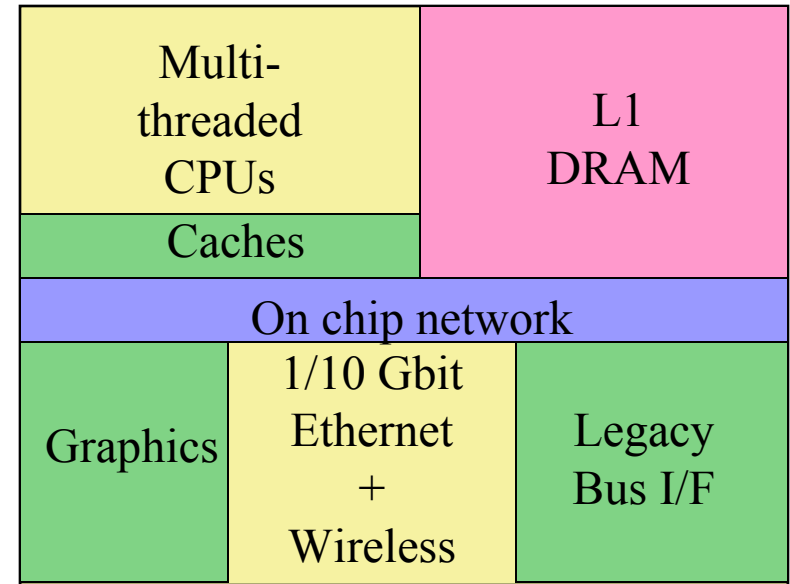
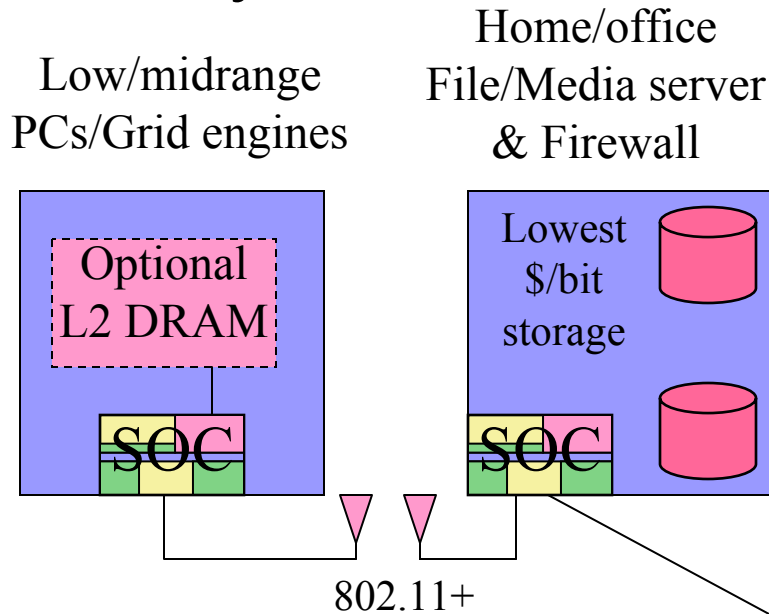
- Problem in memory hierarchy is storage performance
- Both sequential and random falling behind
- Internet-sized data sets too large to cache well
- Storage density CAGR 60%/year since 1991
- Random disk access has fallen little in 10 years (still 10 ms for commodity drives)

Storage performance improvements

- Recent high end disks improved with...
 - Faster motors! 5400-7200-10000-15000 RPM
 - Terrible solution. Increased power, noise and failure rate
- Non-magnetic storage may finally emerge.
 - Holographic
 - Atomic force
- Archival storage moves to networked disks, replacing tape

2010 System Architecture

Commodity System On a Chip



Conclusions

- Need to pay more attention to total system architecture, not individual pieces
- Just like Amdahl's law, non-scalable pieces will eventually limit the architecture scaling
- Key technologies are ones that compensate for or replace storage performance problems