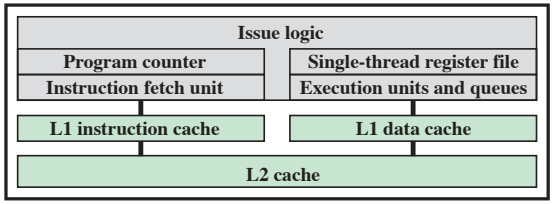
电子科技大学
格拉斯哥学院
Glasgow College, UESTC

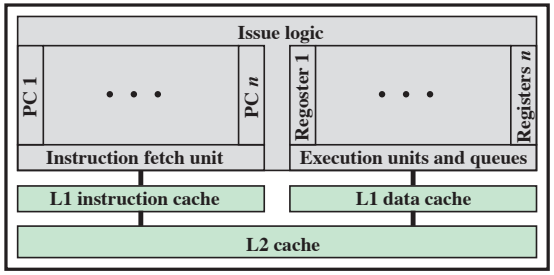
UESTC4019: Real-Time Computer Systems and Architecture

Lecture 20
Multicore Computers

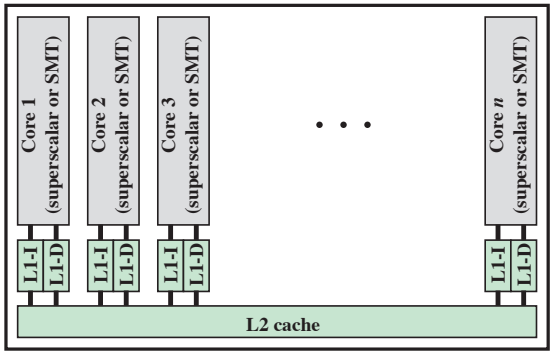
Alternative Chip Organizations



(a) Superscalar

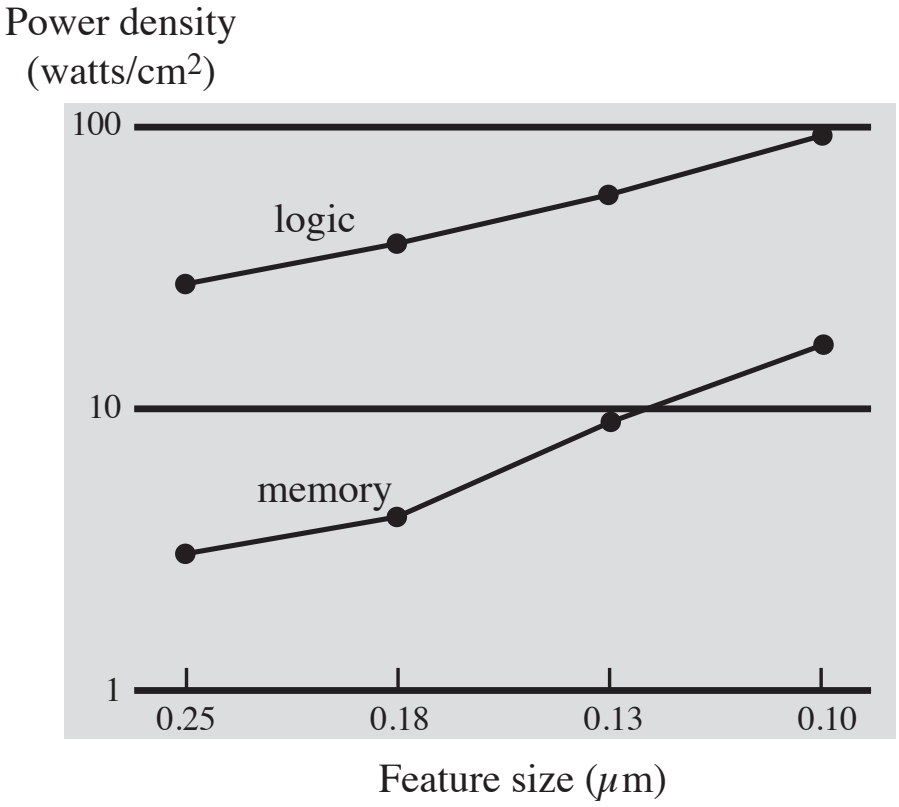


(b) Simultaneous multithreading

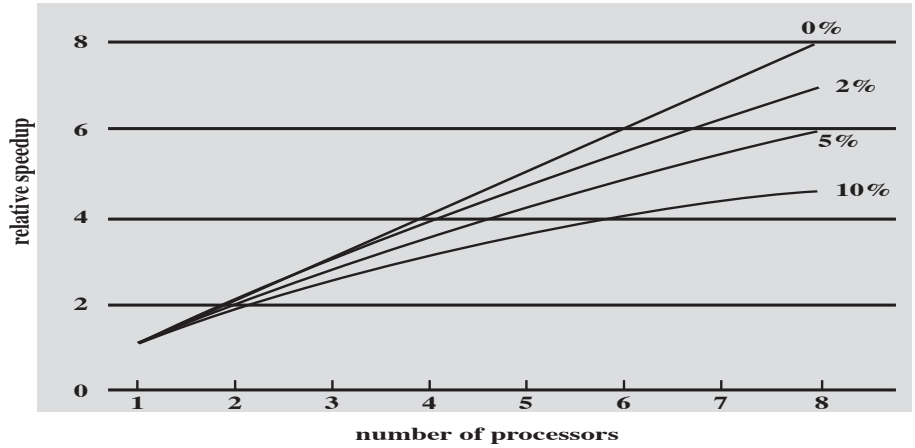


(c) Multicore

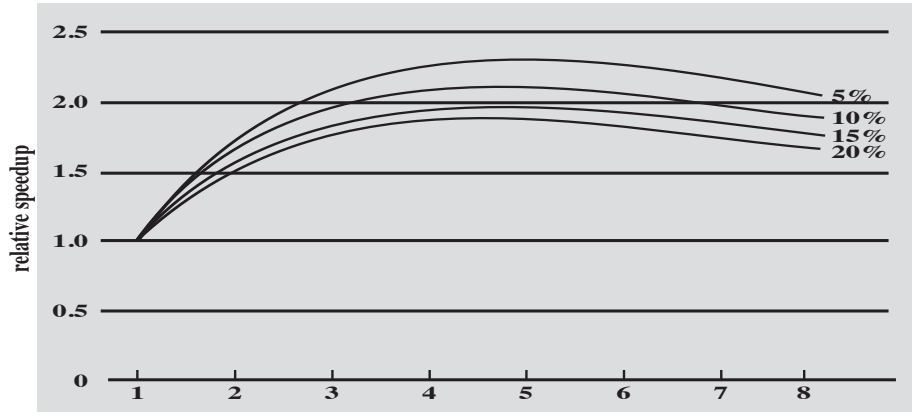
Power and Memory Considerations



Performance Effect of Multiple Cores

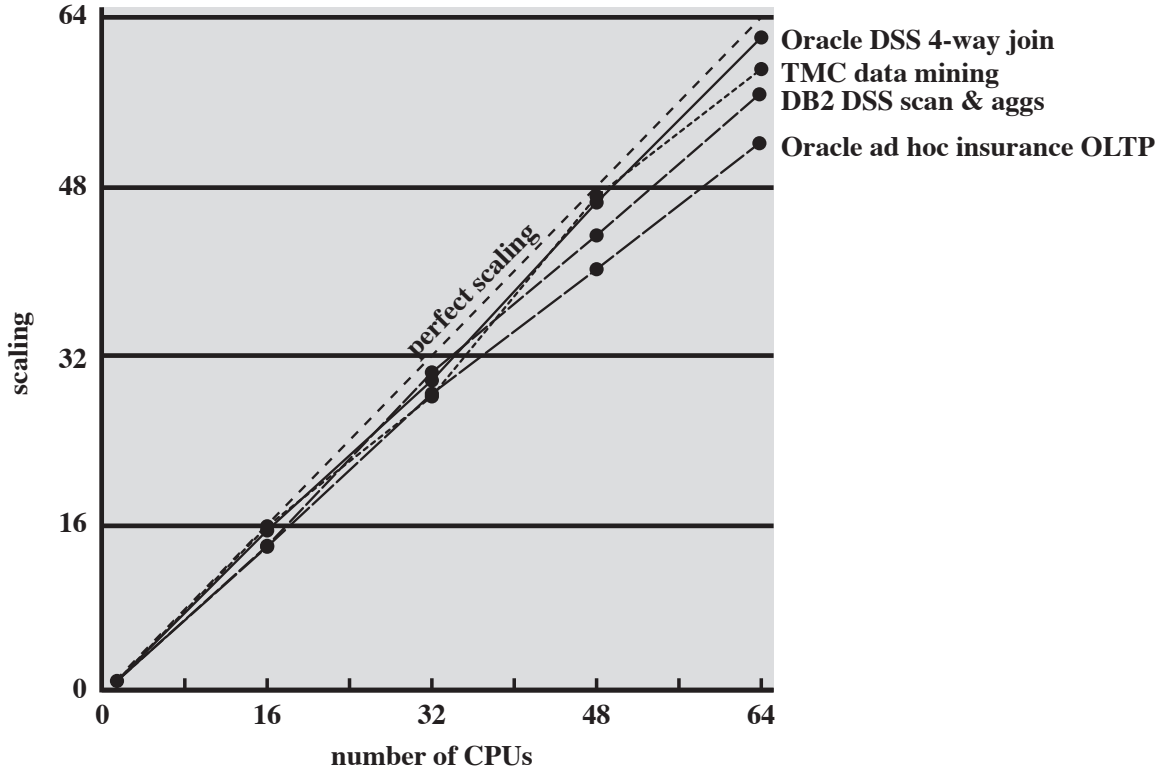


(a) Speedup with 0%, 2%, 5%, and 10% sequential portions



(b) Speedup with overheads

Scaling of Database Workloads on Multiple-Processor Hardware



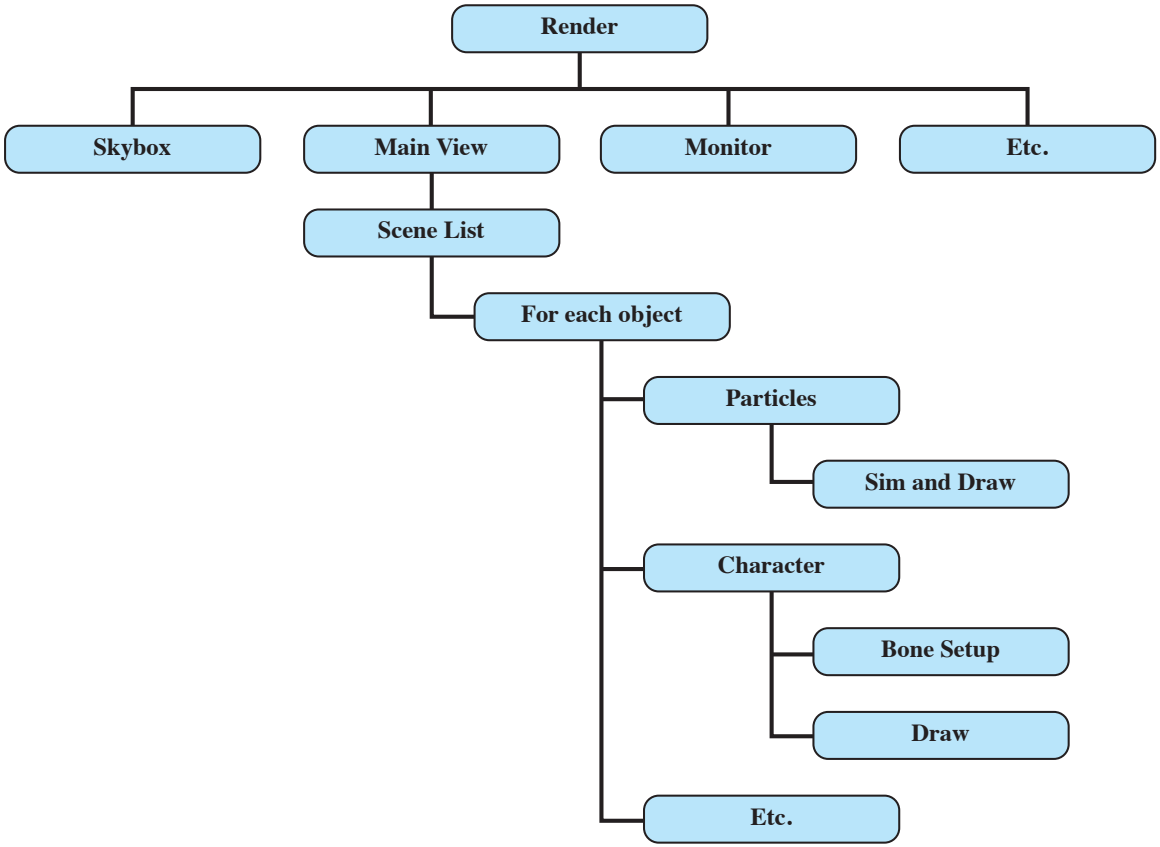
Effective Applications for Multicore Processors (1 of 2)

- **Multi-threaded native applications**
  - Thread-level parallelism
  - Characterized by having a small number of highly threaded processes
- **Multi-process applications**
  - Process-level parallelism
  - Characterized by the presence of many single-threaded processes

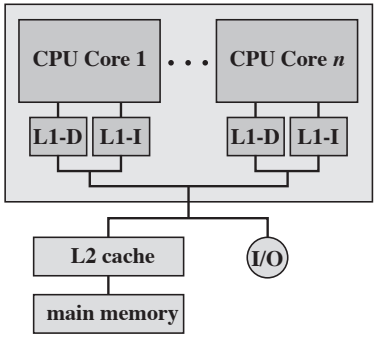
Effective Applications for Multicore Processors (2 of 2)

- **Java applications**
  - Embrace threading in a fundamental way
  - Java Virtual Machine is a multi-threaded process that provides scheduling and memory management for Java applications
- **Multi-instance applications**
  - If multiple application instances require some degree of isolation, virtualization technology can be used to provide each of them with its own separate and secure environment

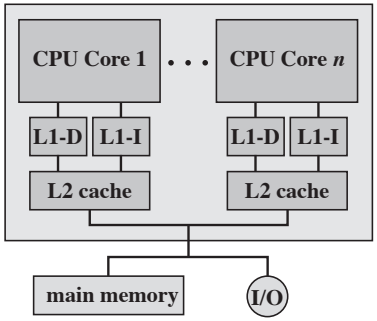
Hybrid Threading for Rendering Module



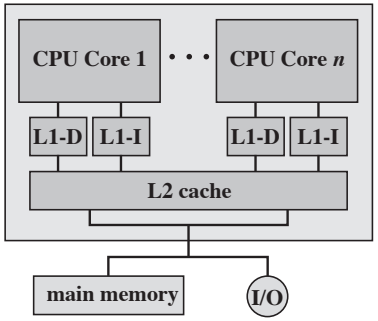
Multicore Organization Alternatives



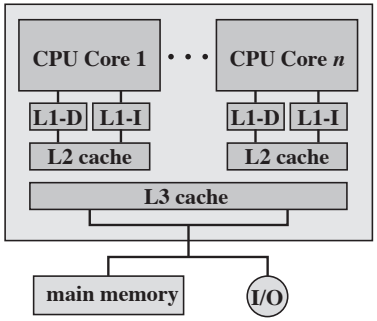
(a) Dedicated L1 cache



(b) Dedicated L2 cache



(c) Shared L2 cache

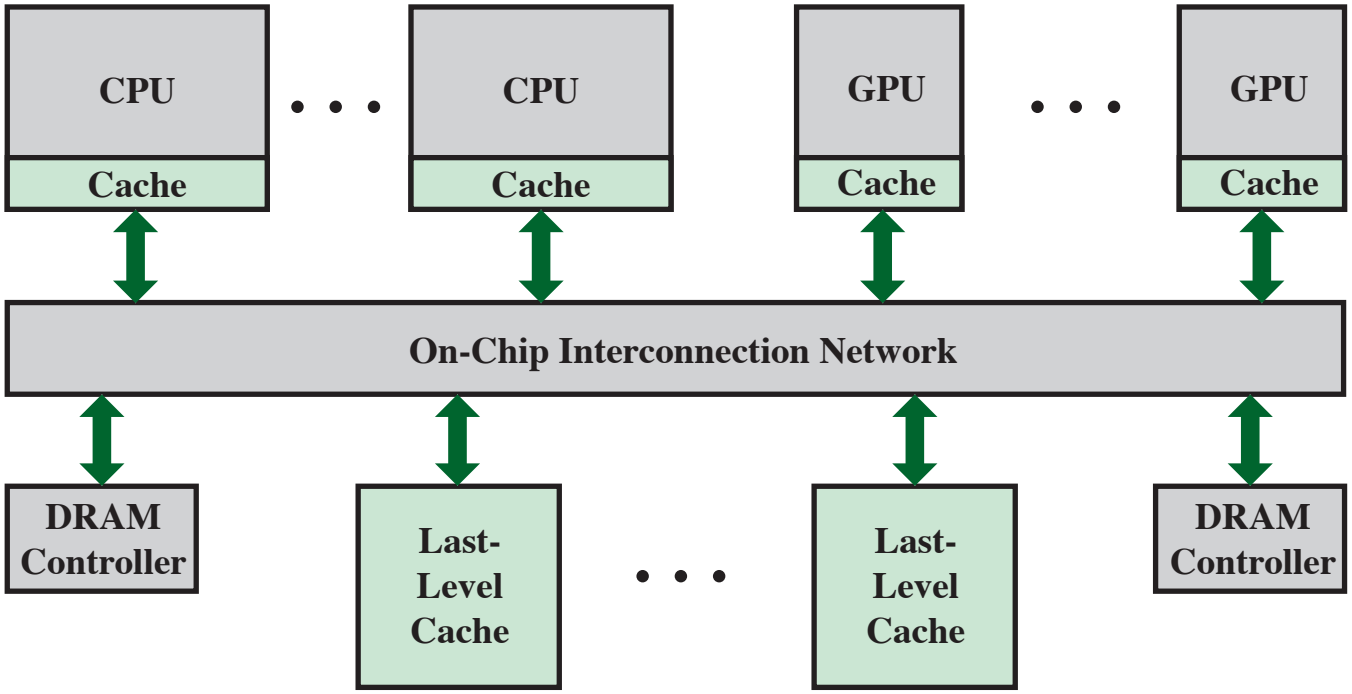


(d) Shared L3 cache

Heterogeneous Multicore Organization

- Refers to a processor chip that includes more than one kind of core
- The most prominent trend is the use of both CPUs and graphics processing units (GPUs) on the same chip
  - This mix however presents issues of coordination and correctness
- GPUs are characterized by the ability to support thousands of parallel execution trends
- Thus, GPUs are well matched to applications that process large amounts of vector and matrix data

Heterogenous Multicore Chip Elements



Heterogeneous System Architecture (HSA)
(1 of 2)

- Key features of the HSA approach include:
  - The entire virtual memory space is visible to both CP U and GPU
  - The virtual memory system brings in pages to physical main memory as needed
  - A coherent memory policy ensures that CPU and GP U caches both see an up-to-date view of data
  - A unified programming interface that enables users to exploit the parallel capabilities of the GPUs within programs that rely on CPU execution as well

Heterogeneous System Architecture (HSA)
(2 of 2)

- The overall objective is to allow programmers to write applications that exploit the serial power of CPUs and the parallel-processing power of GPUs seamlessly with efficient coordination at the OS and hardware level

Texas Instrument 66AK2H12 Heterogenous Multicore Chip

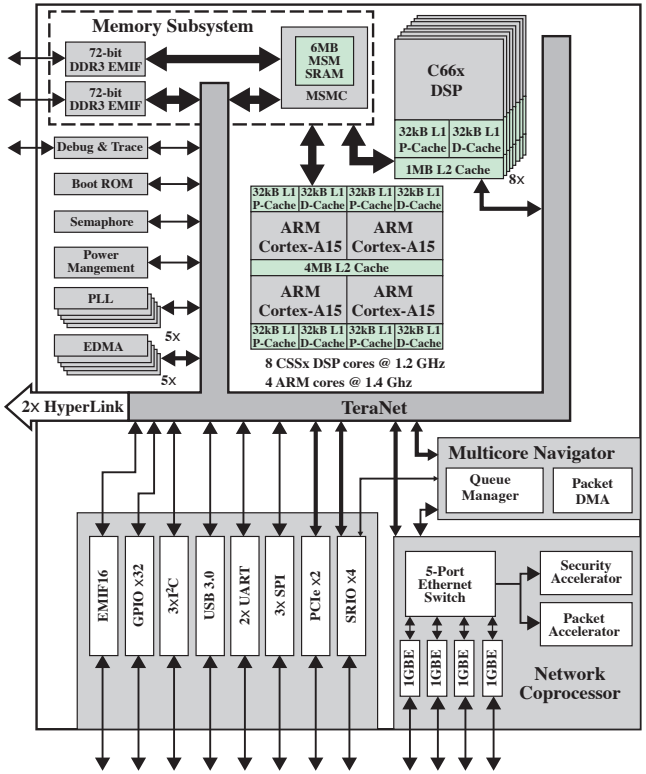


Figure 18.8 Texas Instruments 66AK2H12 Heterogenous Multicore Chip

Big Litte Chip Components