The Cosmic Cube
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- 64 small computers (8086/8087 processor)
- Point-to-point communication network
- Binary 6-cube
- Hardware Simulation of future VLSI implementation with single-chip nodes
- Suggests scalability into 1000s of nodes
- A message passing machine
  - Compare to cc-NUMA: Pros and Cons
N-cube Architecture

- Also called hypercube (paper figure 1)
- Internode communication scales well to large number of nodes (paper figure 2)
- High aggregate bandwidth
- High bisection bandwidth
Process Programming

- Hardware structure of Cosmic Cube is difficult to target for programming
- Resident operating system a more flexible machine-independent environment for concurrent computations
- Process model of computation is quite similar to the hardware structure but is usefully abstracted from it
- Programmer formulates problems in terms of processes and virtual channels between them
- Each process has a unique global ID
- Messages have headers containing src and dest IDs and message info (e.g. type, length)
- A node can have one process or multiple processes
Programming Model

- Message passing: communication and synchronization through messages
  - Explicitly seen by the programmer
- Programming model is reflected in the hardware and operating system
- Operating system kernel in each node
  - schedule processes within node
  - Provides system calls for processes to send and receive
- Single-program, multiple-data (SPMD)
  - N-body problem (Paper figures 3 & 4)
Reading Assignment

- Babak Falsafi and David Wood, "Reactive NUMA: A Design for Unifying S-COMA and CC-NUMA," ISCA 1997 (Skim)
- Homework 3 due this Thursday
- Midterm: Thursday Oct 30