

Advanced Computer Systems Architecture

Chip-Multiprocessors: Applications and Architectures

CSE 526M

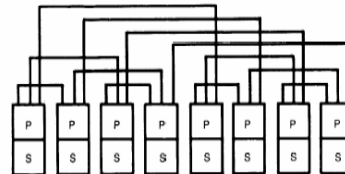
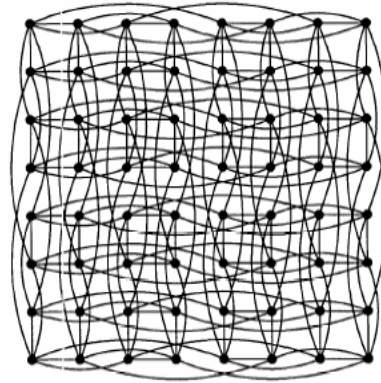
Prof. Patrick Crowley

Plan for Today

- Announcements
 - We **will** meet during the final exam slot
 - Monday, May 10, 1-3pm
- Questions
- Today's discussion
 - Cosmic Cube, abridged
 - 15-minute Perspective
 - Discussion
 - Course in review
 - Evaluations

Cosmic Cube

- Large-scale message-passing multicomputer designed for scientific applications
- Does not use shared memory



Cosmic Cube



The nodes are packaged as one circuit board per node in the long card frame on the bench top. The six communication channels from each node are wired in a binary 6-cube on the backplane on the underside of the card frame. The separate

units on the shelf above the long 6-cube box are the power supply and an "intermediate host" (IH) that connects through a communication channel to node 0 in the cube.

FIGURE 6. The 64-Node Cosmic Cube in Operation

Interconnect

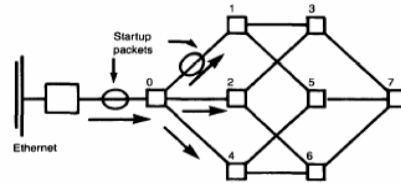
- Six-dimensional hypercube
 - Binary, 6-cube
 - $N = k^n$, k-ary, n-cube: n dimensions, k nodes per
 - When $k=2$, it's a hypercube
 - $64 = 2^6$
- Direct point-to-point links, no switches
- Scales to many nodes
- Question
 - When $N=64$, what is the maximum distance between any two nodes?

Programming Model

- Communicating sequential processes
- OS provides send/receive primitives
- Process distribution directed by programmer; programmer maps solution onto network
- Good fit for modeling physical systems, where physically distinct computations exist

Hardware

- Node
 - Intel 8086/8057, 5-6 MHz
 - 128KB RAM
 - 8KB read-only initialization memory
 - 2 Mbps links
- Cube would be attached to a host
- Note: far more reliable than C.mmp/Hydra
- Seitz considered this to be a simulation of a future single-chip node



Perspective

Intellectual Digestion

- Is the interconnect strategy described scalable?
- Is the cosmic cube programming model more or less complex than that of the IXP? How so?
- What aspect of the Cosmic Cube was the most interesting to you? Is it also the most significant aspect?

Course in Review

- In this course, you have
 - Learned to program the IXP
 - Designed, implemented and reported on a small-scale IXP project over a 6 week period
 - Read 9 important research papers
 - Completed 16 written commentaries
 - Given 2 presentations
 - Cultivated a mature understanding of and an informed perspective on the emerging trend of chip-multiprocessors