

Router Construction

Outline

Switched Fabrics

IP Routers

Extensible (Active) Routers

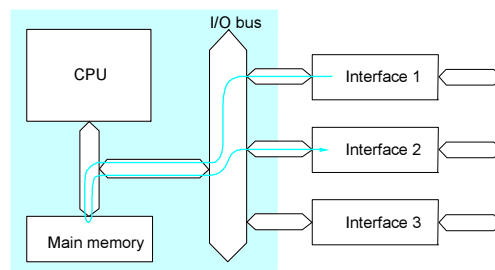
Spring 2000

CS 461

1

Workstation-Based

- Aggregate bandwidth
 - 1/2 of the I/O bus bandwidth
 - capacity shared among all hosts connected to switch
 - example: 800Mbps bus can support 8 T3 ports
- Packets-per-second
 - must be able to switch small packets
 - 100,000 packets-per-second is achievable
 - e.g., 64-byte packets implies 51.2Mbps



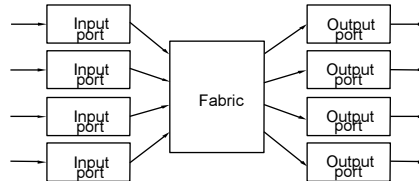
Spring 2000

CS 461

2

Switching Hardware

- Design Goals
 - throughput (depends on traffic model)
 - scalability (a function of n)



- Ports
 - circuit management (e.g., map VCIs, route datagrams)
 - buffering (input and/or output)
- Fabric
 - as simple as possible
 - sometimes do buffering (internal)

Spring 2000

CS 461

3

Buffering

- Wherever contention is possible
 - input port (contend for fabric)
 - internal (contend for output port)
 - output port (contend for link)
- Head-of-Line Blocking
 - input buffering

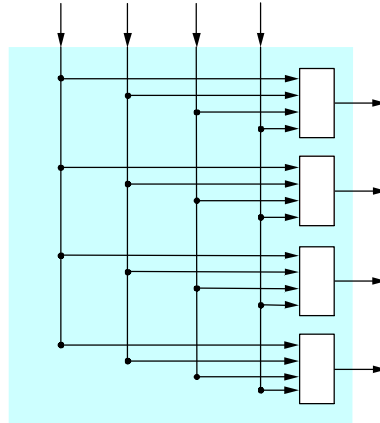


Spring 2000

CS 461

4

Crossbar Switches



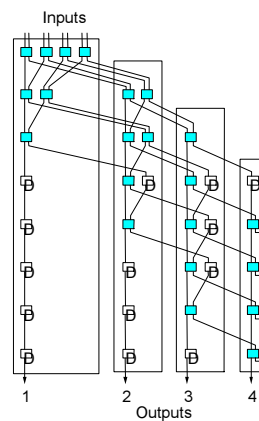
Spring 2000

CS 461

5

Knockout Switch

- Example crossbar
- Concentrator
 - select l of n packets
- Complexity: n^2



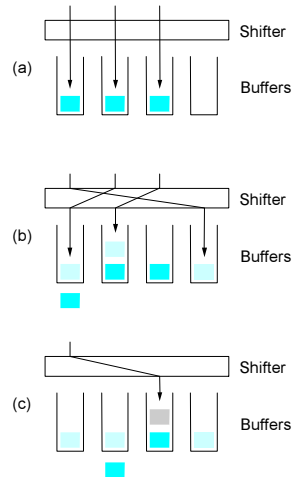
Spring 2000

CS 461

6

Knockout Switch (cont)

- Output Buffer



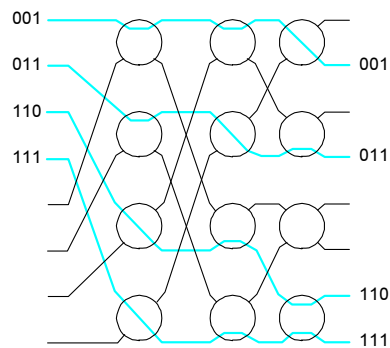
Spring 2000

CS 461

7

Self-Routing Fabrics

- Banyan Network
 - constructed from simple 2×2 switching elements
 - self-routing header attached to each packet
 - elements arranged to route based on this header
 - no collisions if input packets sorted into ascending order
 - complexity: $n \log_2 n$



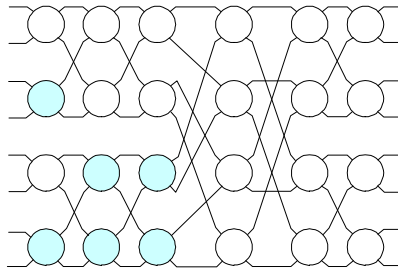
Spring 2000

CS 461

8

Self-Routing Fabrics (cont)

- Batcher Network
 - switching elements sort two numbers
 - some elements sort into ascending (clear)
 - some elements sort into descending (shaded)
 - elements arranged to implement merge sort
 - complexity: $n \log^2_2 n$



- Common Design: Batcher-Banyan Switch

Spring 2000

CS 461

9

High-Speed IP Router

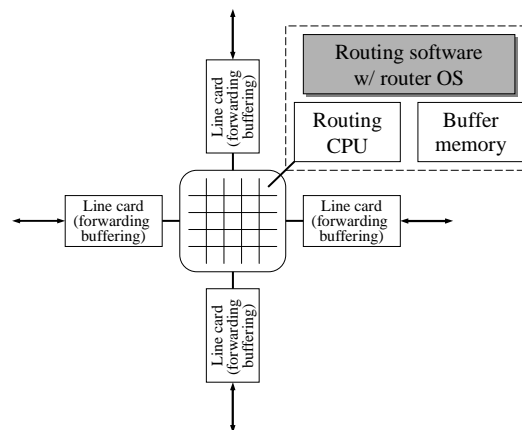
- Switch
- Line Cards + Forwarding Engines
 - link interface
 - router lookup (input)
 - common IP path (input)
 - packet queue (output)
- Network Processor
 - routing protocol(s)
 - exceptional cases

Spring 2000

CS 461

10

High-Speed Router

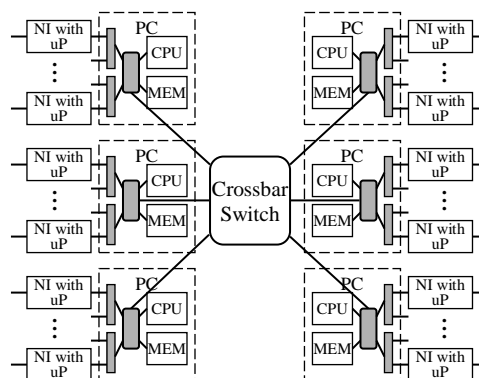


Spring 2000

CS 461

11

Alternative Design

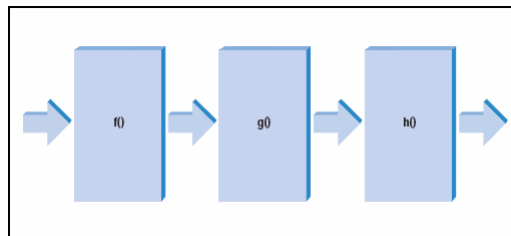
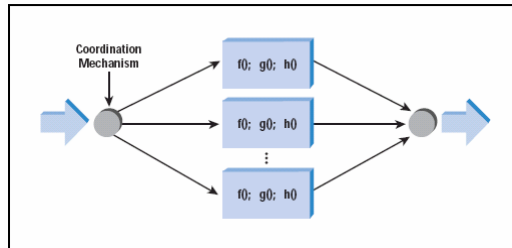


Spring 2000

CS 461

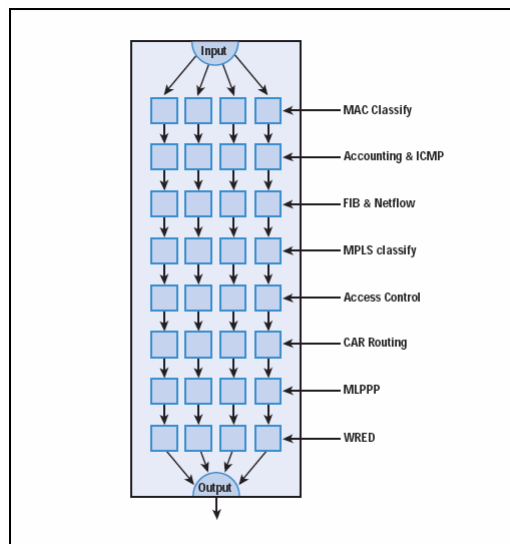
12

Parallel Architectures



Spring 2000

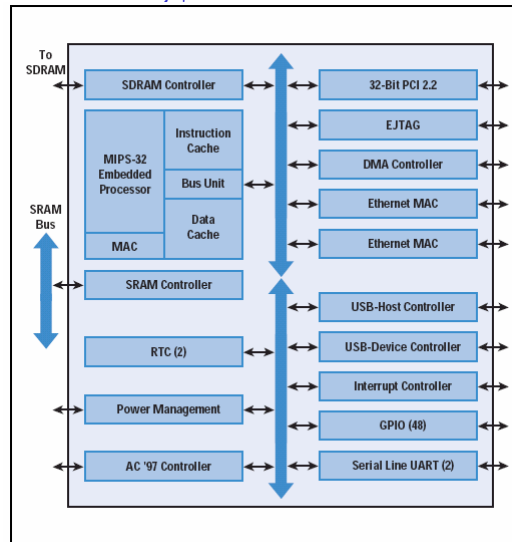
Pipeline Architectures



Spring 2000

14

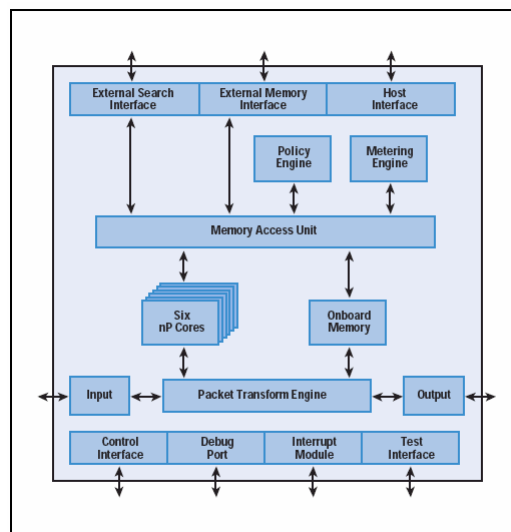
Network Processors – AMD Augmented RISC



Spring 2000

15

Network Processors – AMCC Use special-purpose coprocessor



Spring 2000

16