Router Architecture Overview

Two key router functions:
- run routing algorithms/protocol (RIP, OSPF, BGP)
- *switching* datagrams from incoming to outgoing link

Input Port Functions

Input Port Functions

Decentralized switching:
- given datagram dest., lookup output port using routing table in input port memory
- goal: complete input port processing at ‘line speed’
- queueing: if datagrams arrive faster than forwarding rate into switch fabric

Physical layer:
bit-level reception

Data link layer:
e.g., Ethernet
see chapter 5

Physical layer:
bit-level reception

Data link layer:
e.g., Ethernet
see chapter 5

Input Port Queuing

- Fabric slower than input ports combined -> queueing may occur at input queues
- Head-of-the-Line (HOL) blocking: queued datagram at front of queue prevents others in queue from moving forward
- queueing delay and loss due to input buffer overflow!

Switching Via Memory

First generation routers:
- packet copied by system’s (single) CPU
- speed limited by memory bandwidth (2 bus crossings per datagram)

Modern routers:
- input port processor performs lookup, copy into memory
- Example: Cisco Catalyst 8500
Switching Via Bus

- datagram from input port memory to output port memory via a shared bus
- **bus contention:** switching speed limited by bus bandwidth
- 1 Gbps bus, (example: Cisco 1900): sufficient speed for access and enterprise routers (not regional or backbone)

Switching Via An Interconnection Network

- overcome bus bandwidth limitations
- Banyan networks, other interconnection nets initially developed to connect processors in multiprocessor
- Advanced design: fragmenting datagram into fixed length cells, switch cells through the fabric.
- Example: Cisco 12000: switches Gbps through the interconnection network

Output Ports

- **Buffering** required when datagrams arrive from fabric faster than the transmission rate
- **Scheduling discipline** chooses among queued datagrams for transmission

Output port queueing

- buffering when arrival rate via switch exceeds output line speed
- queueing (delay) and loss due to output port buffer overflow!
Three types of switching fabrics

- Memory
- Bus
- Crossbar

4: Network Layer 4b-29