Router Architecture Overview

Two key router functions:
- run routing algorithms/protocol (RIP, OSPF, BGP)
- forwarding datagrams from incoming to outgoing link
Input Port Functions

Physical layer: bit-level reception
Data link layer: e.g., Ethernet see chapter 5

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

Principles of Routing and Switching 4-3

Three types of switching fabrics

Principles of Routing and Switching 4-4
Switching Via Memory

First generation routers:
- traditional computers with switching under direct control of CPU
- packet copied to system’s memory
- speed limited by memory bandwidth (2 bus crossings per datagram)

![Diagram of Switching Via Memory](image)

Switching Via a Bus

- datagram from input port memory to output port memory via a shared bus
- **bus contention**: switching speed limited by bus bandwidth
- 32 Gbps bus, Cisco 5600: sufficient speed for access and enterprise routers

![Diagram of Switching Via a Bus](image)
Switching Via An Interconnection Network (crossbar)

- 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.
- Cisco 12000: switches 60 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!

input port queueing

- 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!