

Computer Networks

Principles of Routing and Switching

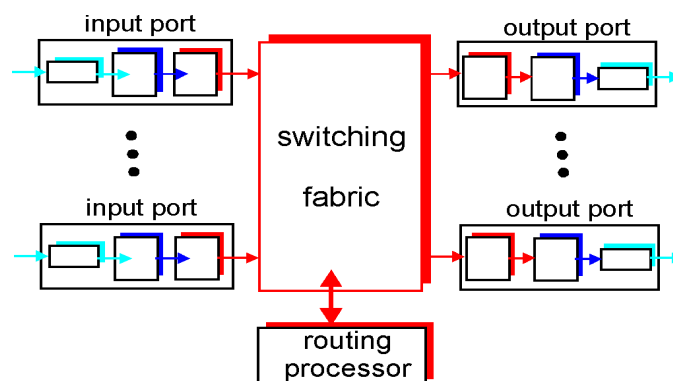
Based on Computer Networking, 4th Edition by Kurose and Ross

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Router Architecture Overview

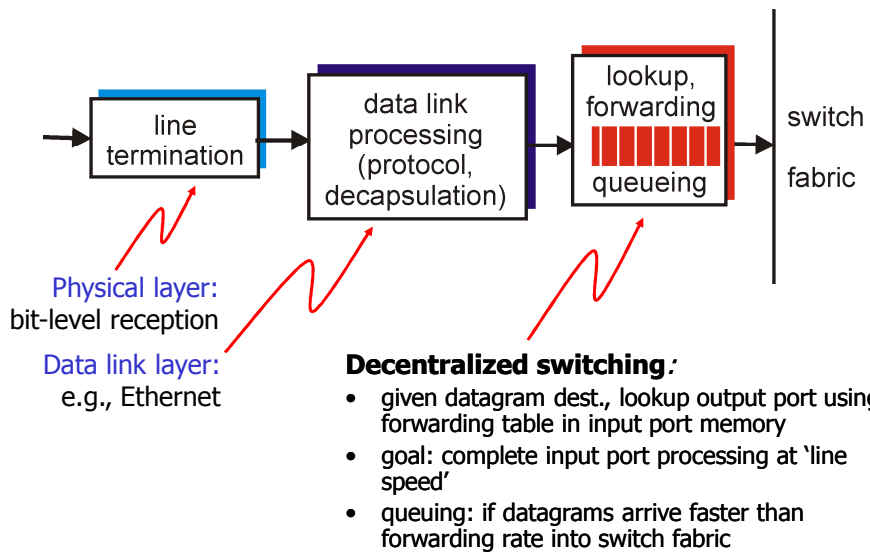
Two key router functions:

- run routing algorithms/protocol (RIP, OSPF, BGP)
- *forwarding* datagrams from incoming to outgoing link



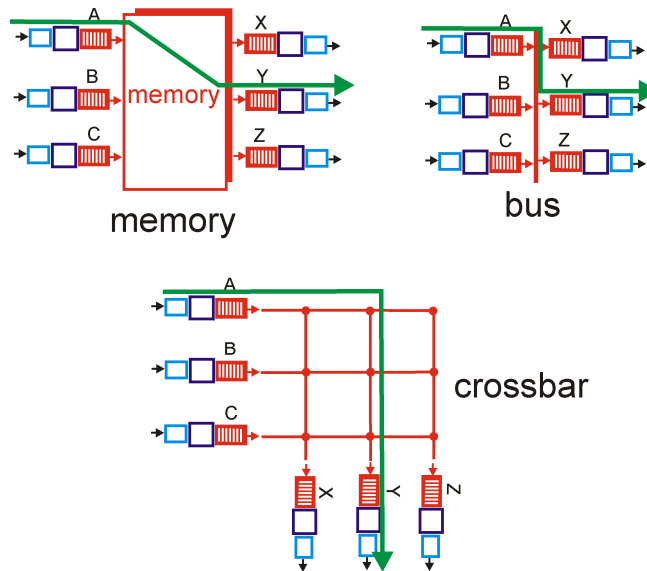
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Input Port Functions



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Three types of switching fabrics

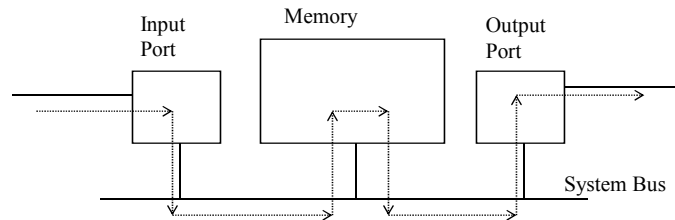


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Switching Via Memory

First generation routers:

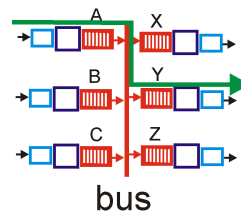
- traditional computers with switching under direct control of CPU
- packet copied to system's memory
- speed limited by memory bandwidth (2 bus crossings per datagram)



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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
- 1 Gbps bus, Cisco 1900: sufficient speed for access and enterprise routers (not regional or backbone)



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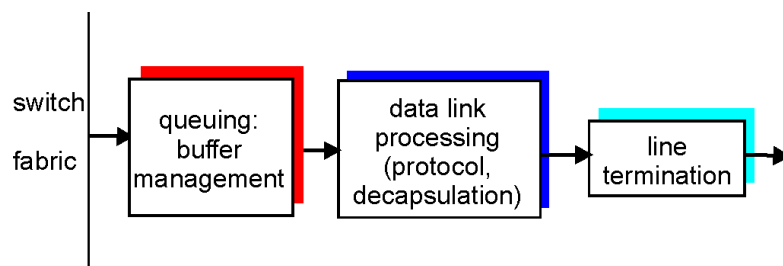
Switching via an Interconnection Network

- 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.
- Cisco 12000: switches 60 Gbps through the interconnection network

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Output Ports

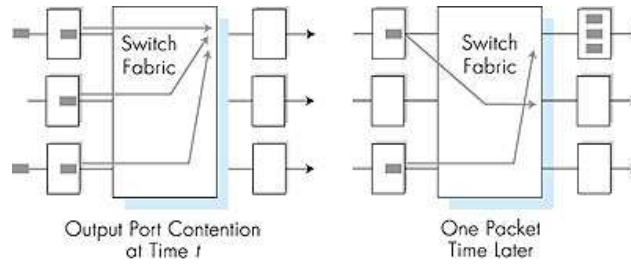
- *Buffering* required when datagrams arrive from fabric faster than the transmission rate
- *Scheduling discipline* chooses among queued datagrams for transmission



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Output port queuing

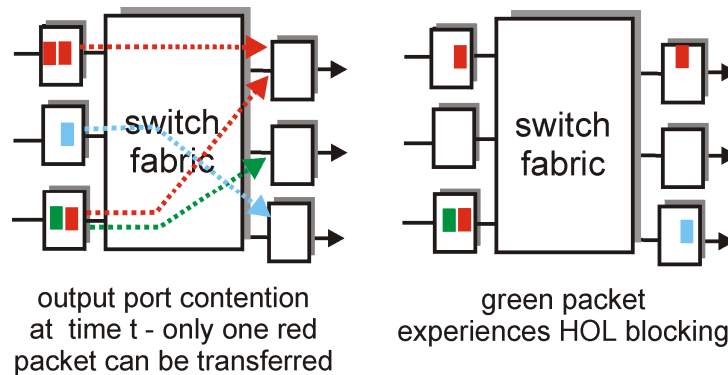
- buffering when arrival rate via switch exceeds output line speed
- *queuing (delay) and loss due to output port buffer overflow!*



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Input Port Queuing

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



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