COMPUTER COMMUNICATION NETWORKS

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NETWORK LAYER

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Switching Fabric

- Transfer packet from input buffer to appropriate output buffer
- **Switching rate** is the rate at which packets can be transferred from inputs to outputs

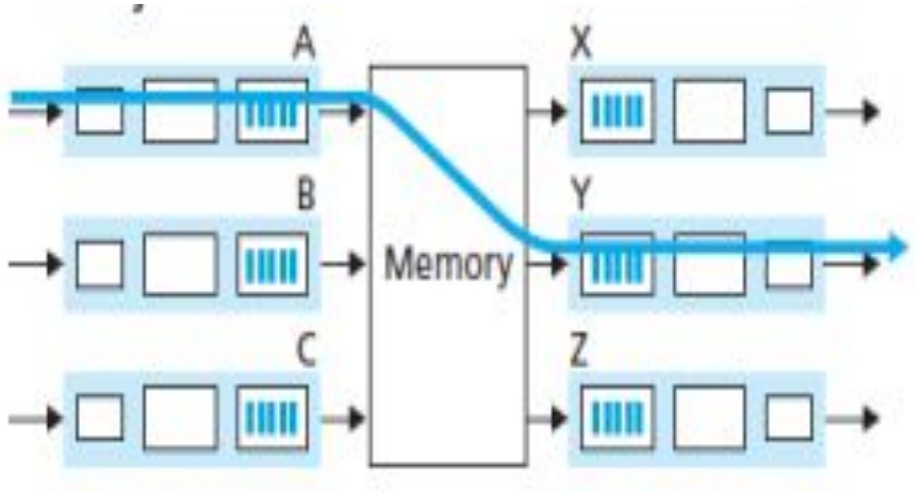
- Three types of switching fabrics:

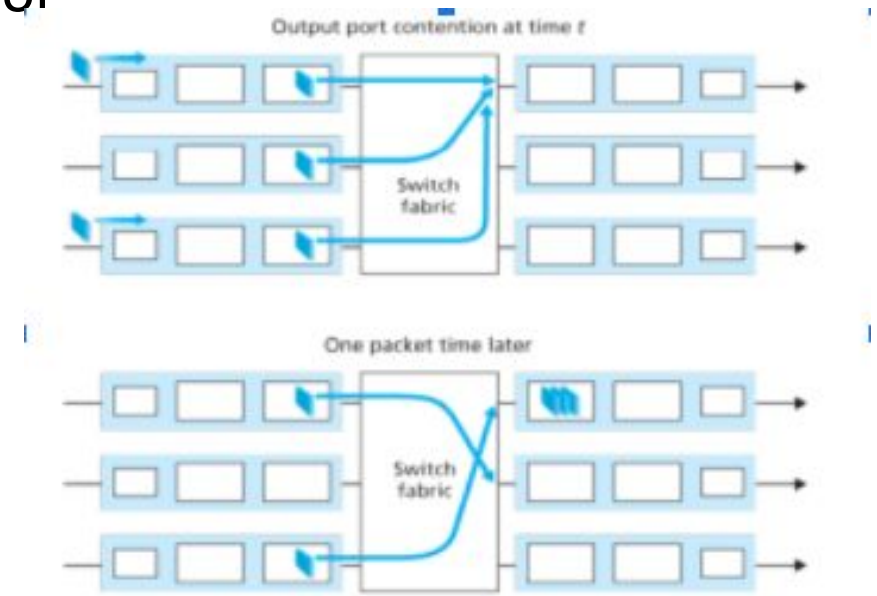
a) Switching via memory
b) Switching via a bus
c) Switching via an interconnection network (crossbar)

Internal organization of router and Functions of router

Switching via Memory

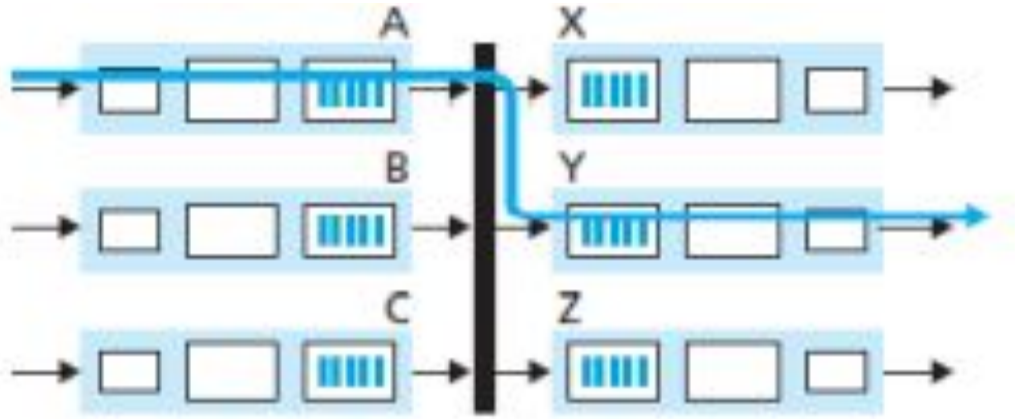
- Similar to memory access in computers
- Packet copied to system's memory
- CPU extracts destination address from packet's header, looks up output port in forwarding table, copies to output port
- Speed limited by memory and processor
- One packet at a time





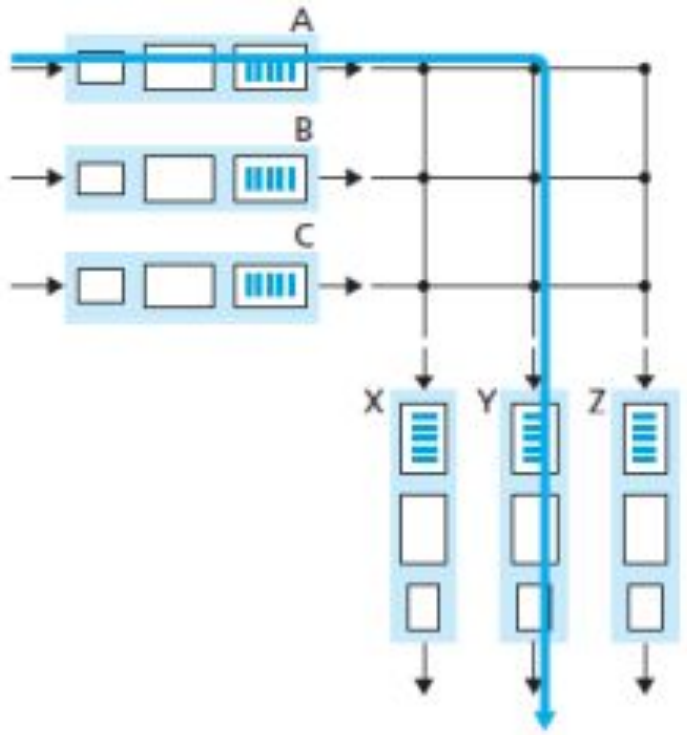
Switching via Bus

- Datagram from input port memory to output port memory via a shared bus
- Bus contention: switching speed limited by bus bandwidth
- One packet a time
- 32 Gbps bus, cisco 5600: sufficient speed for access and enterprise routers



Switching via an Interconnection Network

- Forwards multiple packets in parallel
- When packet from port A needs to forwarded to port Y, controller closes cross point at intersection of two buses



Output Port Processing

- Buffering required when datagrams arrive from fabric faster than the transmission rate from output port
- Queue builds up when the output rate is slower than input rate. This can happen at the input port as well.

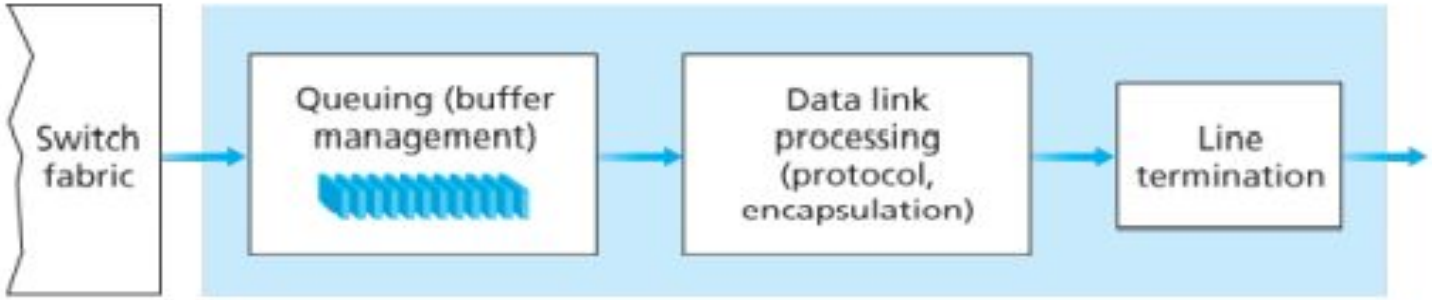


Figure 4.7 Output port processing

Output Port Queueing

- Queue piles up at an output port's buffer when the switching fabric delivers more datagrams than the link rate of that output port.

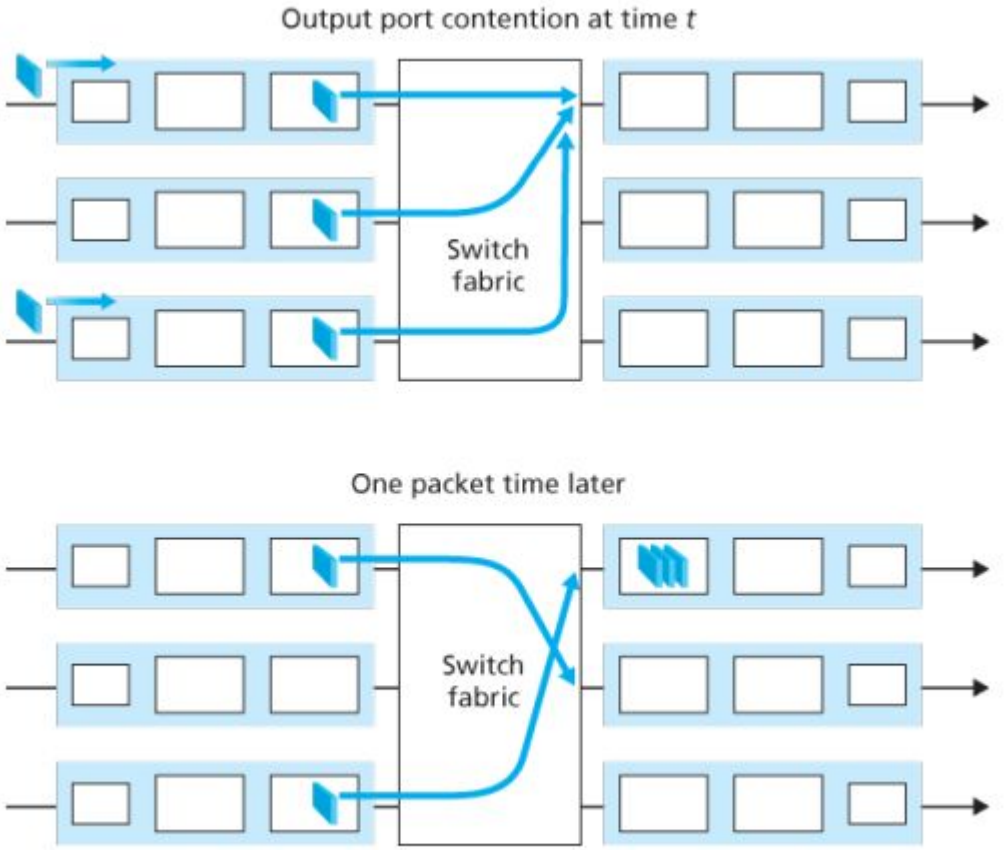
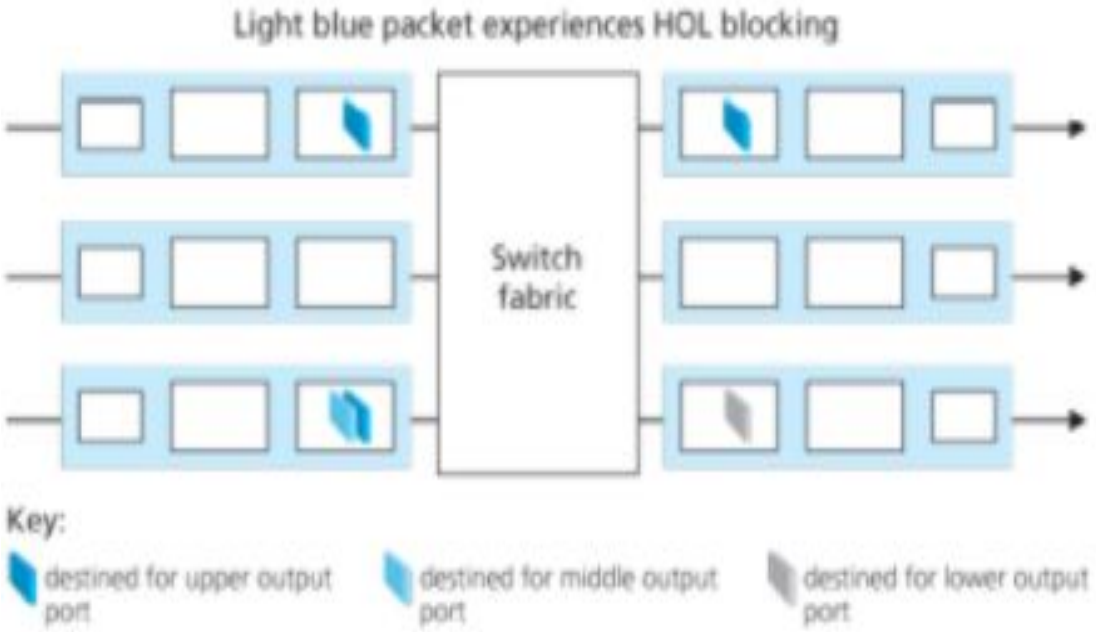


Figure 4.9 Output port queueing

Input Port Queueing

- Queue piles up at input port when switching fabric rate is slower than the data rate at the input port.
- Head-of-the-line (hol) blocking: queued datagram at front of queue prevents others in queue from moving forward

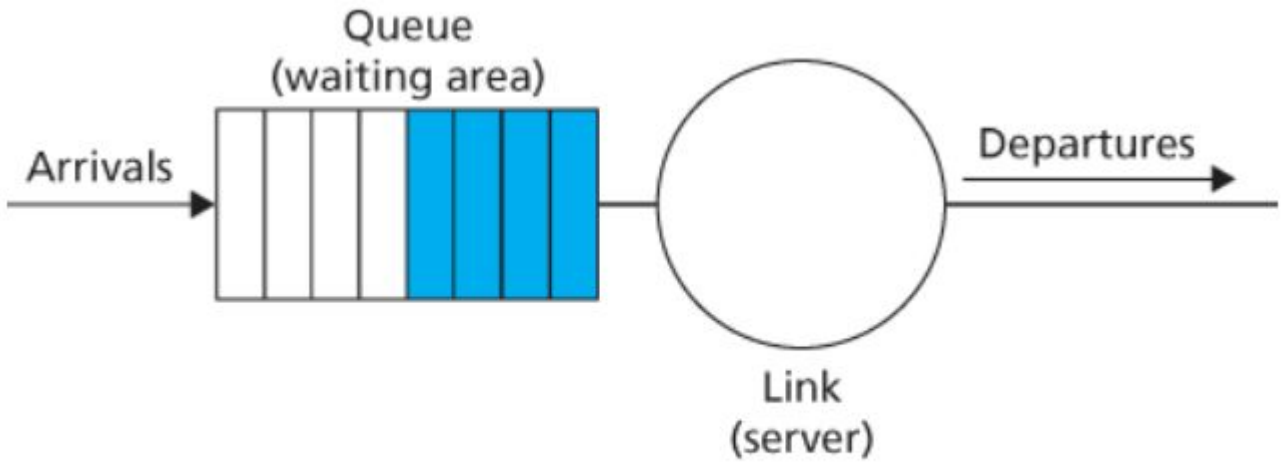


Packet Scheduling

- First-in-First-Out (FIFO)
- Priority Queuing
- Round Robin
- Weighted Fair Queuing (WFQ)

Internal organization of router and Functions of router

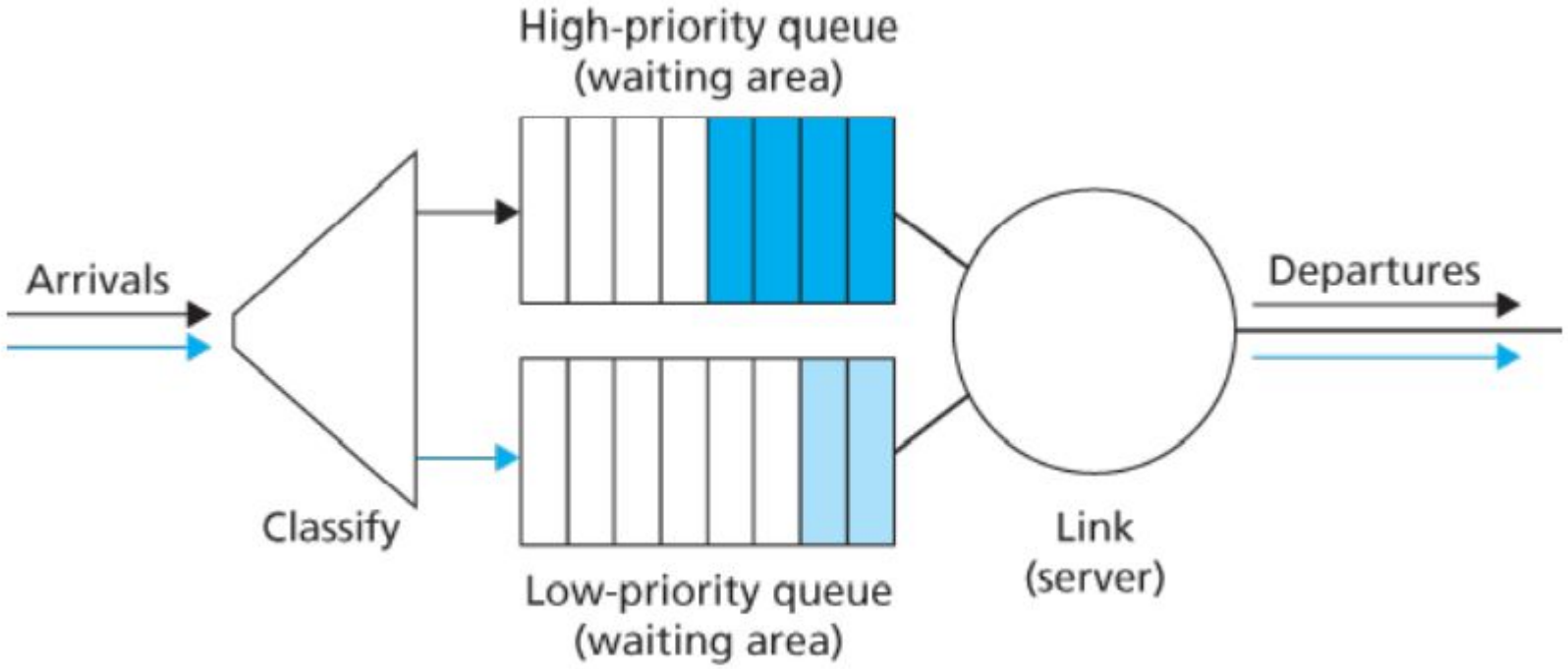
The FIFO (also known as first-come-first-served, or FCFS) scheduling discipline selects packets for link transmission in the same order in which they arrived at the output link queue



FIFO queueing abstraction

Internal organization of router and Functions of router

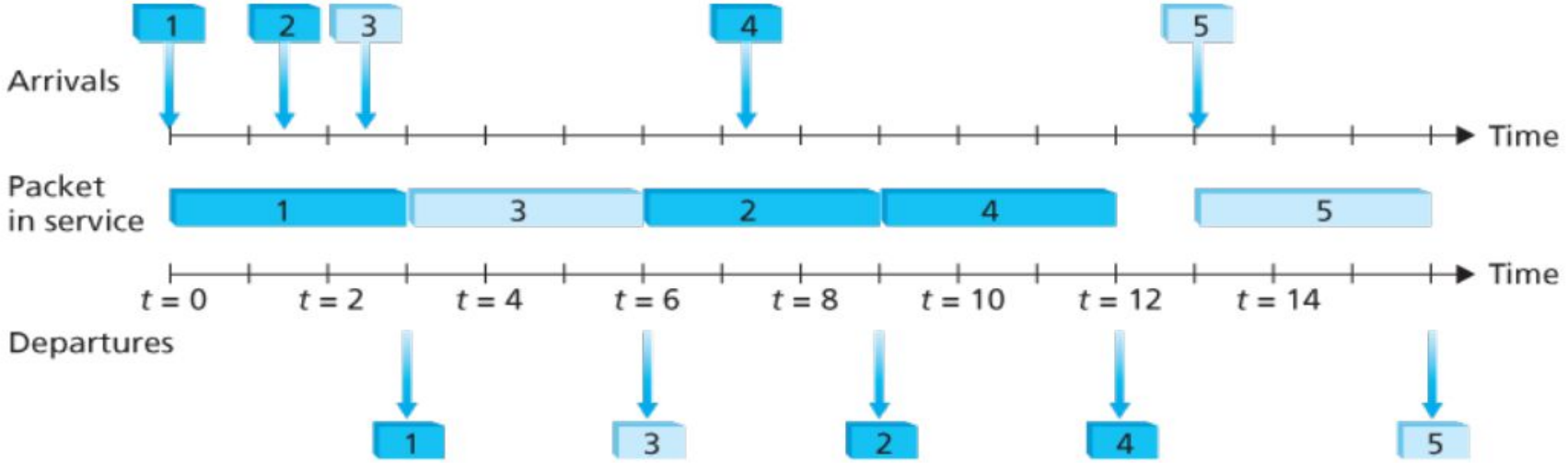
Under priority queuing, packets arriving at the output link are classified into priority classes upon arrival at the queue.



The priority queueing model

Internal organization of router and Functions of router

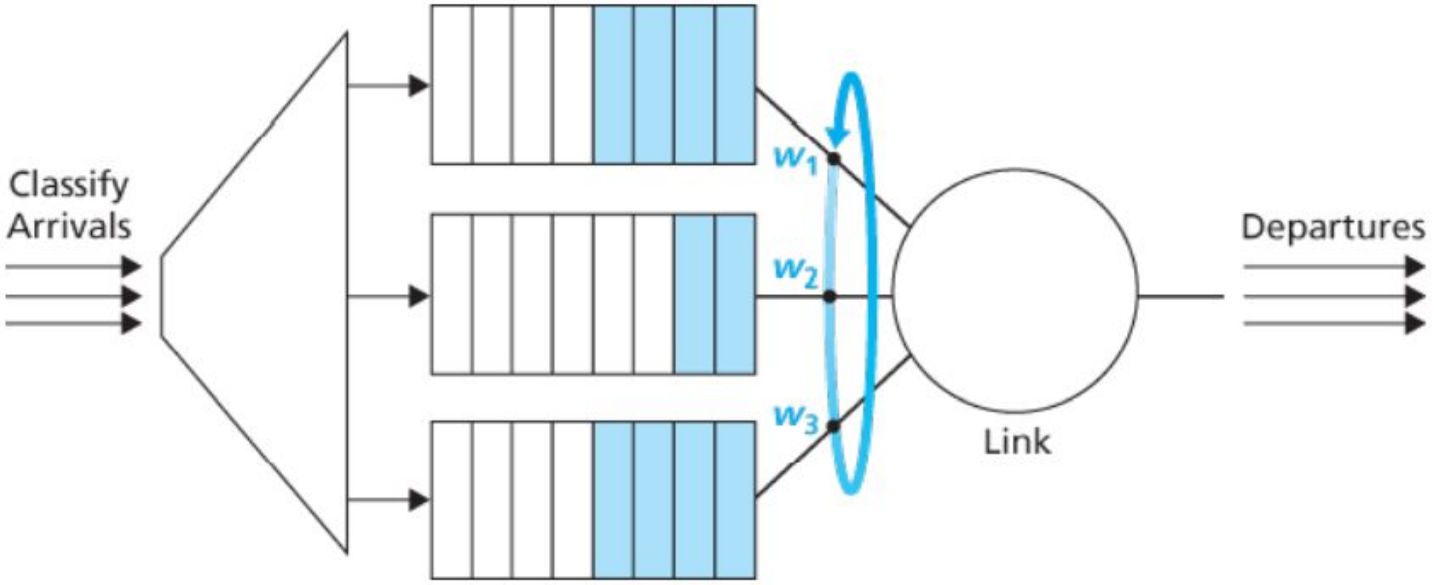
Under the round robin queuing discipline, packets are sorted into classes as with priority queuing. In the simplest form of round robin scheduling, a class 1 packet is transmitted, followed by a class 2 packet, followed by a class 1 packet, followed by a class 2 packet, and so on. A so-called work-conserving queuing discipline will never allow the link to remain idle whenever there are packets (of any class) queued for transmission.



The two-class robin queue in operation

Internal organization of router and Functions of router

In weighted fair queuing (WFQ) discipline ,arriving packets are classified and queued in the appropriate per-class waiting area. WFQ scheduler will serve classes in a circular manner— first serving class 1, then serving class 2, then serving class 3, and then (assuming there are three classes) repeating the service pattern.



Weighted fair queueing

THANK YOU

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