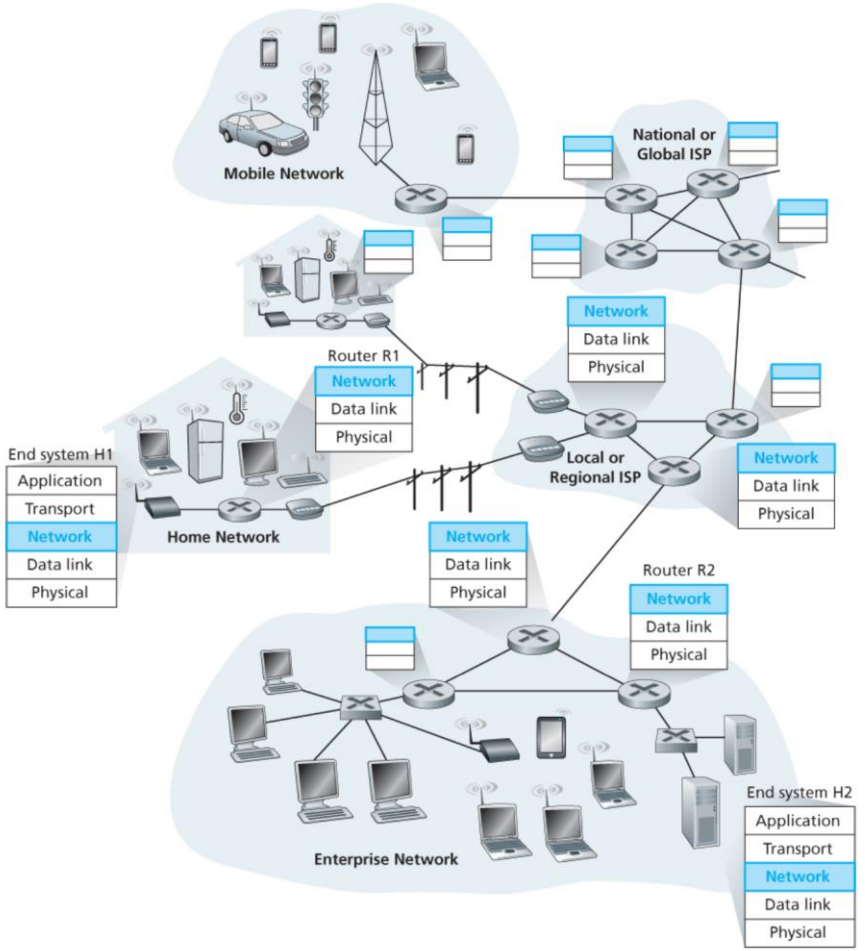
A Top-Down Approach

Chapter 3.8 ~ 4.2

발표자: 박지원

4.1 Overview of Network layer

- 3장까지는 transport 계층
- 네트워크 계층은 출발지의 transport 계층부터
- 도착지의 transport 계층까지
- 라우터에 관한 이야기

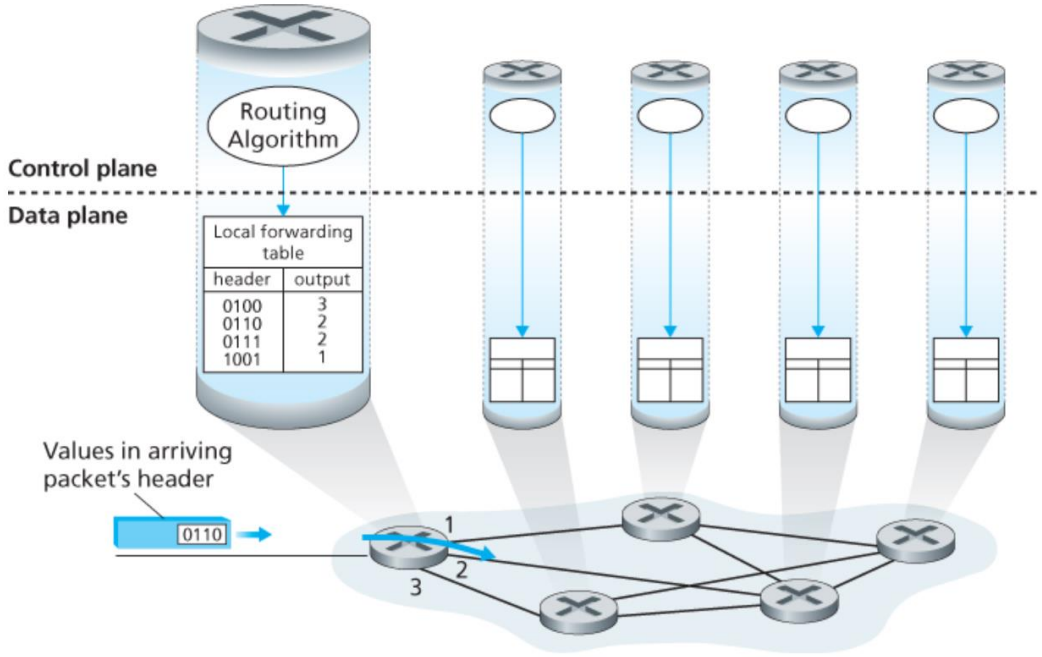


4.1 Overview of Network layer

- Data plane(데이터 평면): input line에서 output link로 datagram을 전달
- Control plane(제어 평면): datagram을 송신 host에서 수신 host까지 전달되도록 forwarding
- Forwarding: packet을 input link에 도달하였을 때, 적절한 output link로 전달하는 것(hardware level)
- Routing: packet path를 결정하는 것 ,routing algorithm (software level)

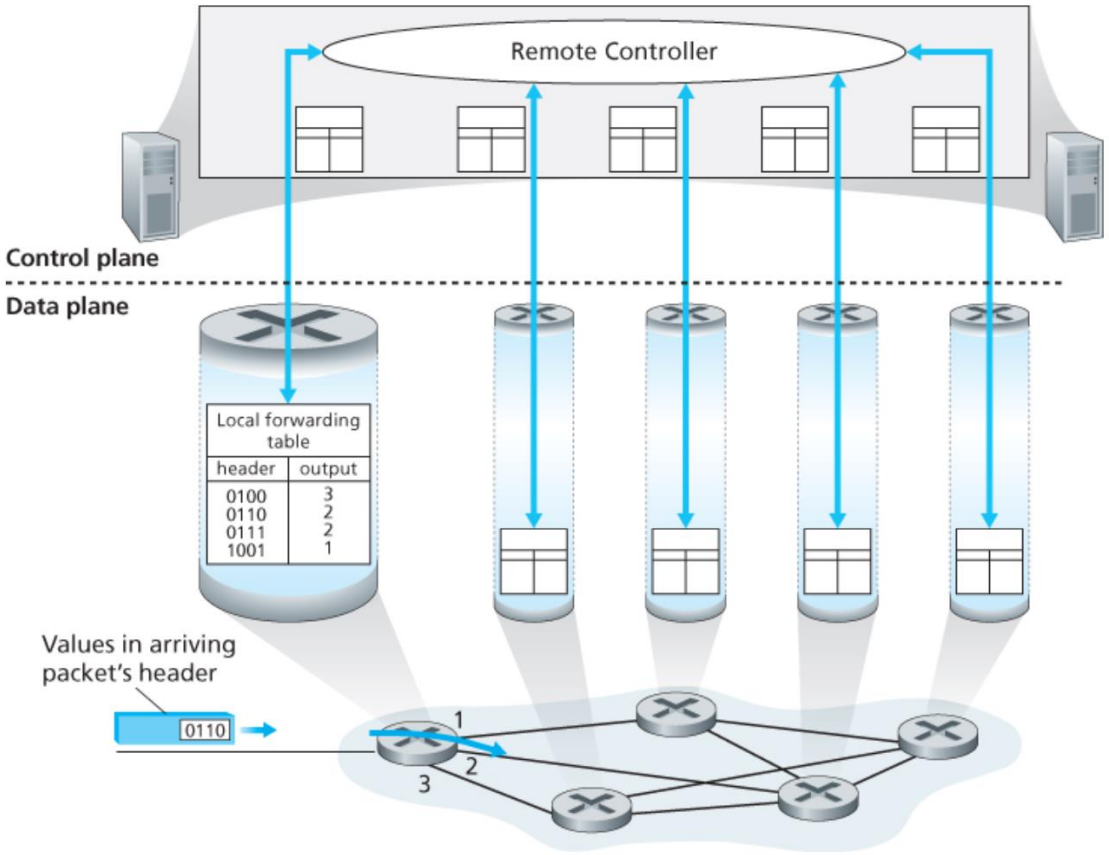
4.1 Overview of Network layer

- forwarding table: packet header 값을 통해 indexing



4.1 Overview of Network layer

- SDN(Software Defined Network
- Control과 forwarding을 분리



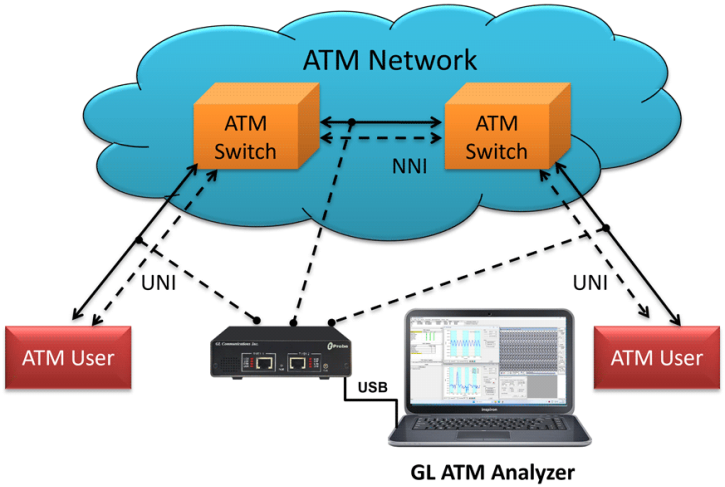
4.1 Overview of Network layer

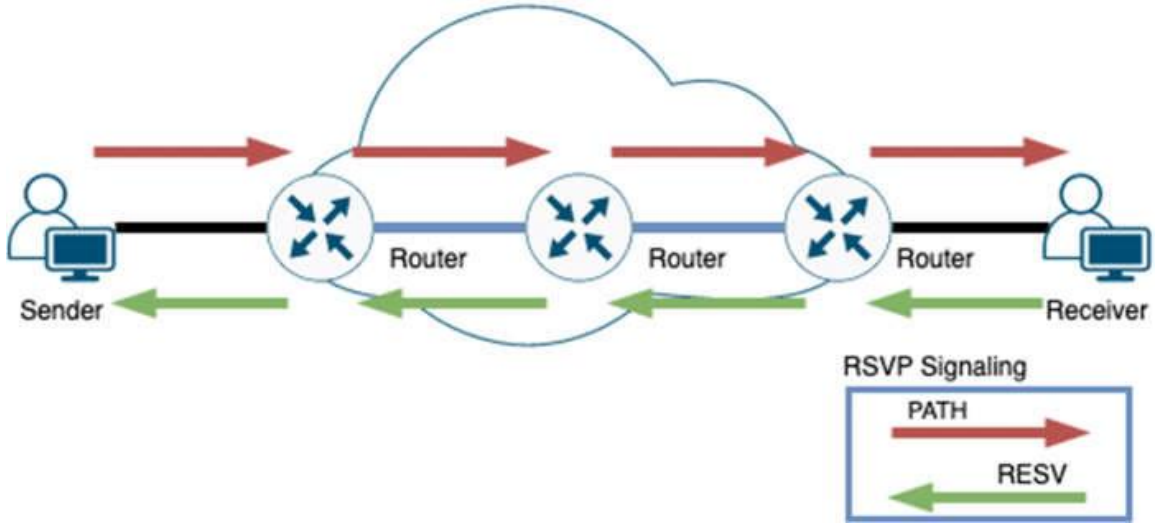
- Network layer의 역할

1. Guaranted delivery
2. Bound delay
3. In-order packet delivery
4. Guaranted minimal bandwidth

4.1 Overview of Network layer

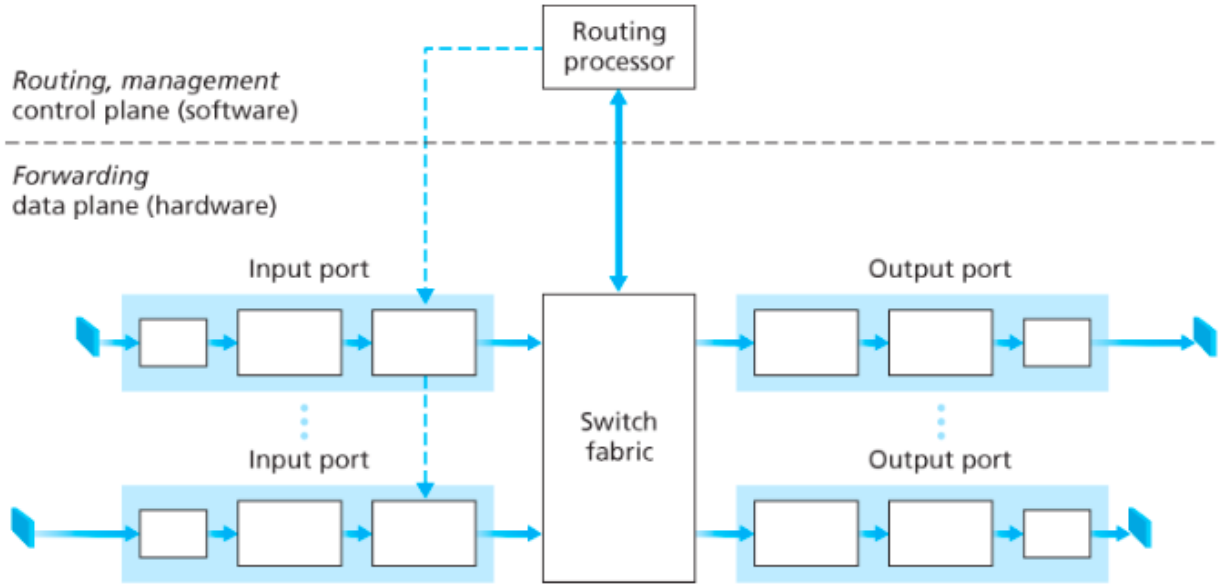
- ATM network architecture: delay, bandwidth
- Intserv architecture: delay, congestion free





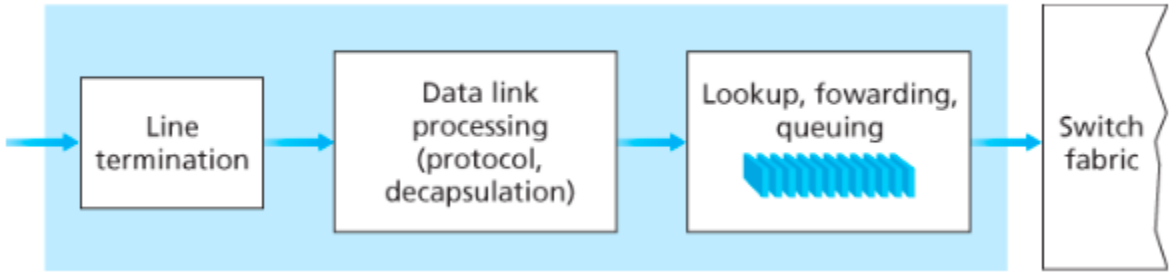
4.2 What's Inside a Router?

- Input port (line card)
- Switch
- Output port
- Routing processor



4.2 What's Inside a Router?

- Forwarding table을 복사하여 사용한다??



- Line termination: bit layer to link layer
- Link layer
- Look up : output port를 결정? -> 라우팅 프로세서에 의해(forwarding table copy)

4.2 What's Inside a Router?

- Forwarding table, prefix table
- **Longest prefix matching rule**

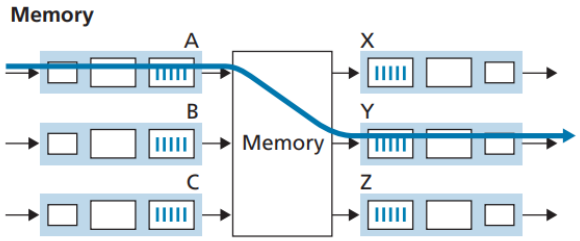
Destination Address Range	Link Interface
11001000 00010111 00010000 00000000 through 11001000 00010111 00010111 11111111	0
11001000 00010111 00011000 00000000 through 11001000 00010111 00011000 11111111	1
11001000 00010111 00011001 00000000 through 11001000 00010111 00011111 11111111	2
Otherwise	3

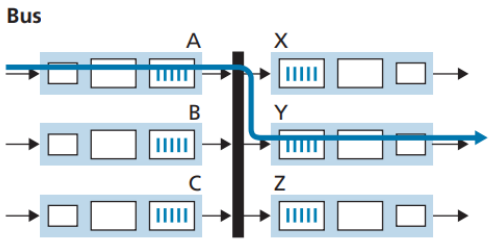
Prefix	Link Interface
11001000 00010111 00010	0
11001000 00010111 00011000	1
11001000 00010111 00011	2
Otherwise	3

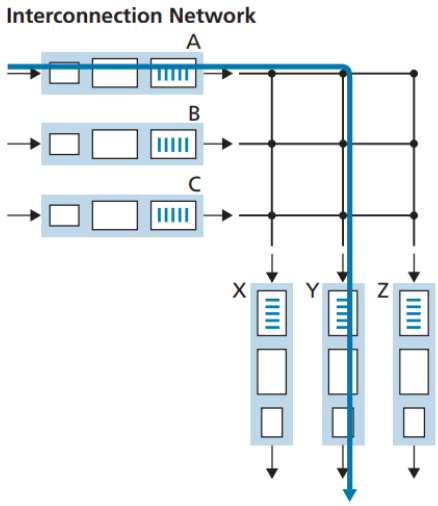
발표자: 박지원

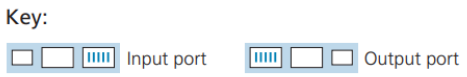
4.2 What's Inside a Router?

- Switching
- Memory: forwarding 대역폭 b/2?







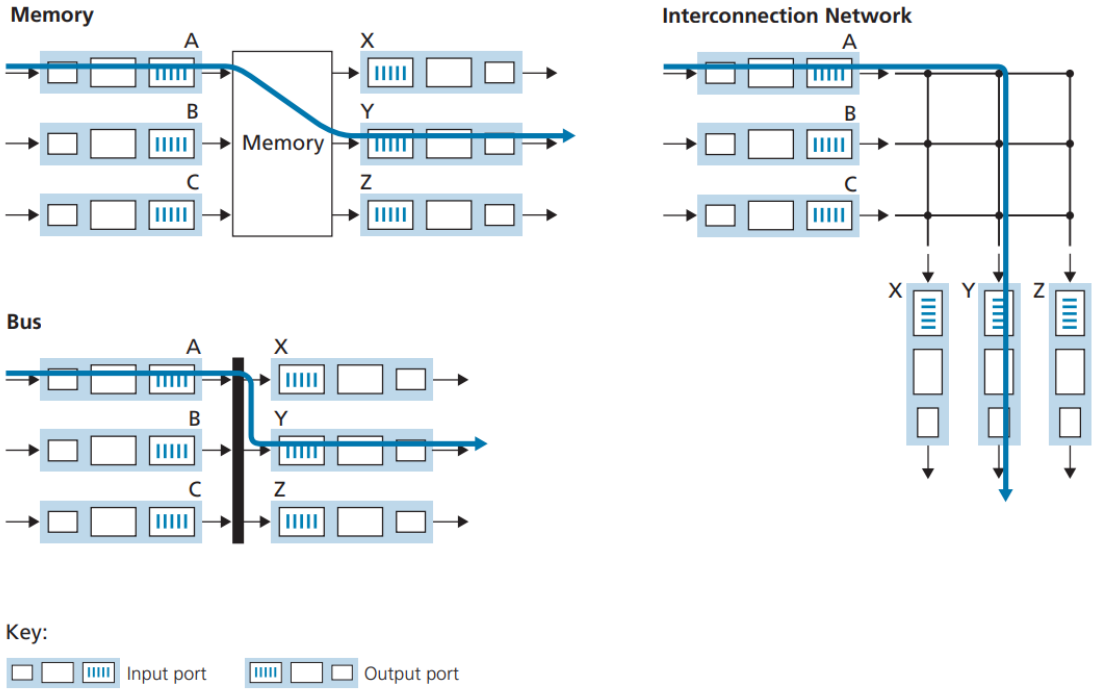


In this scenario, if the memory bandwidth is such that a maximum of B packets per second can be written into, or read from, memory, then the overall forwarding throughput (the total rate at which packets are transferred from input ports to output ports) must be less than B/2. Note also that two packets cannot be forwarded at the same time, even if they have different destination ports, since only one memory read/write can be done at a time over the shared system bus.

발표자: 박지원

4.2 What's Inside a Router?

- Bus based switching
- Crossbar switch

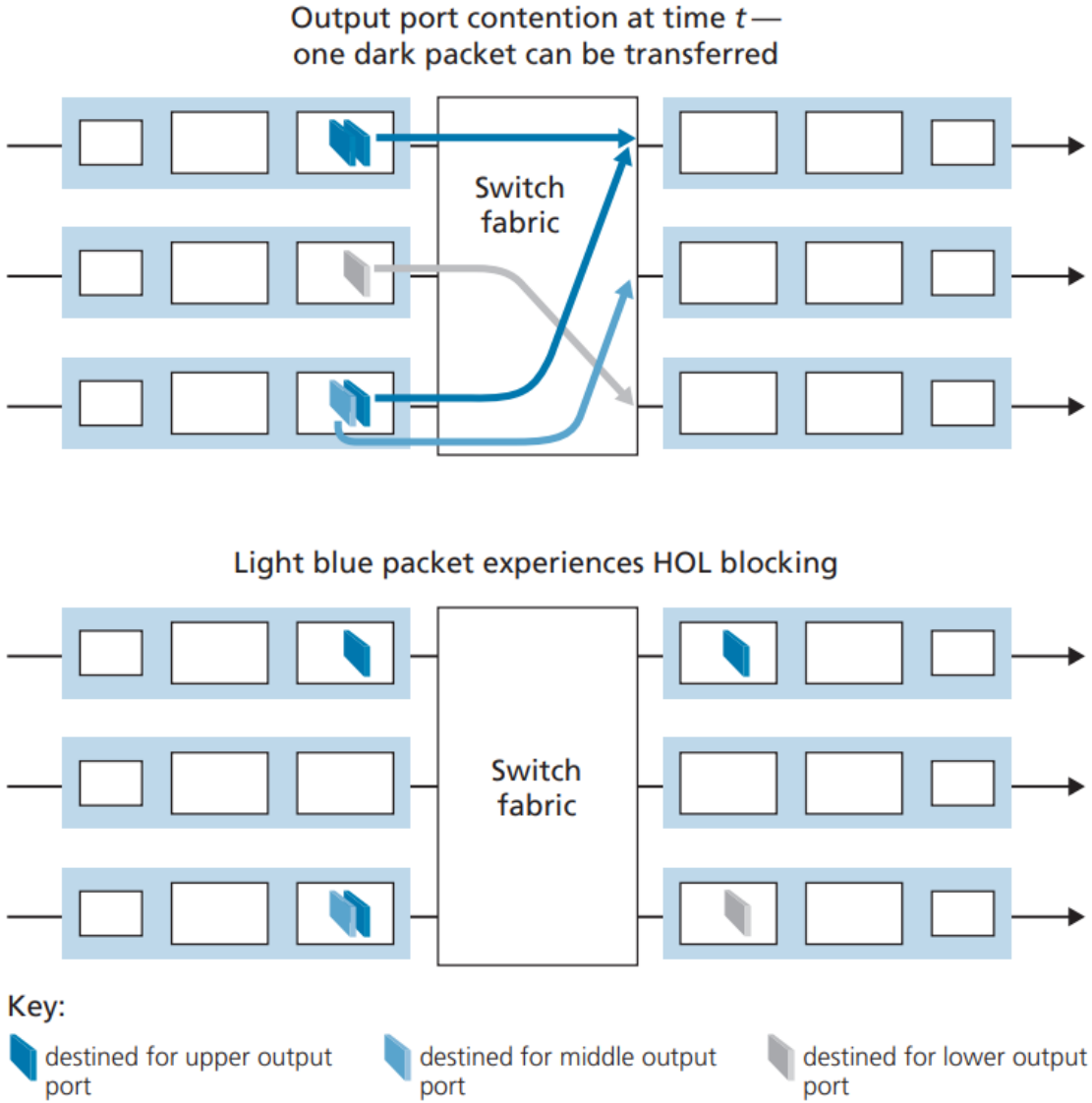


발표자: 박지원

4.2 What's Inside a Router?

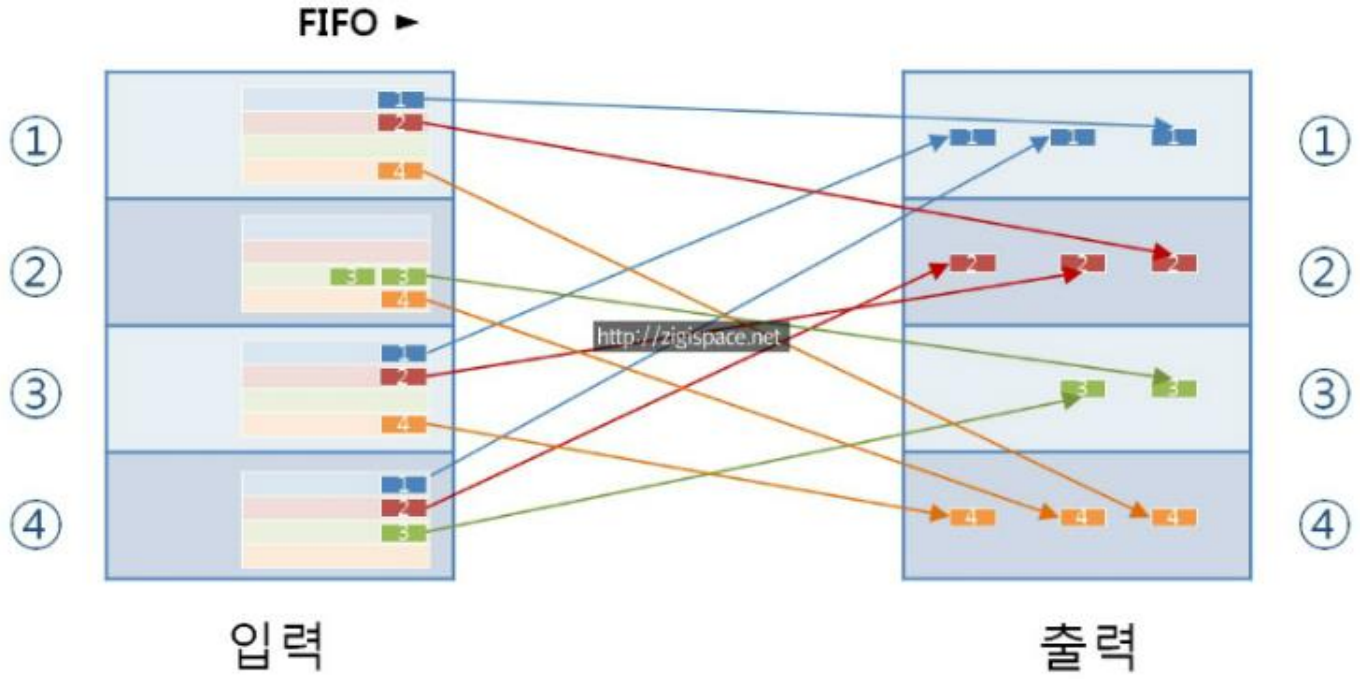
- Input queuing delay
- HOL 문제

- Output queuing delay(유실문제)



4.2 What's Inside a Router?

- Active queue management
- 유실 정책
- Random Early Detection(RED)



4.2 What's Inside a Router?

- Buffer bloat
- Buffering = RTT * C(링크 용량)
- B = RTT x C / √N
- TCP에서의 병목 예시

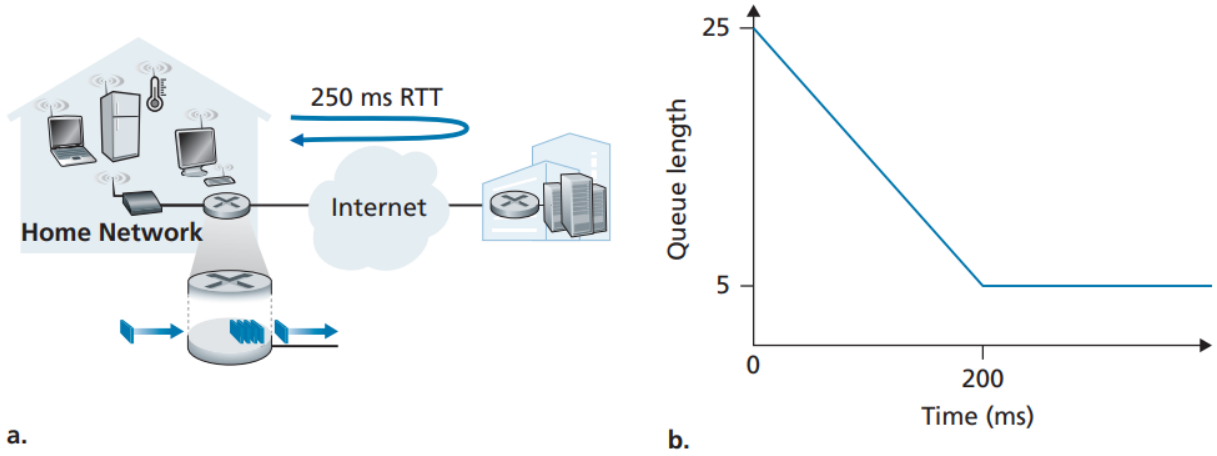
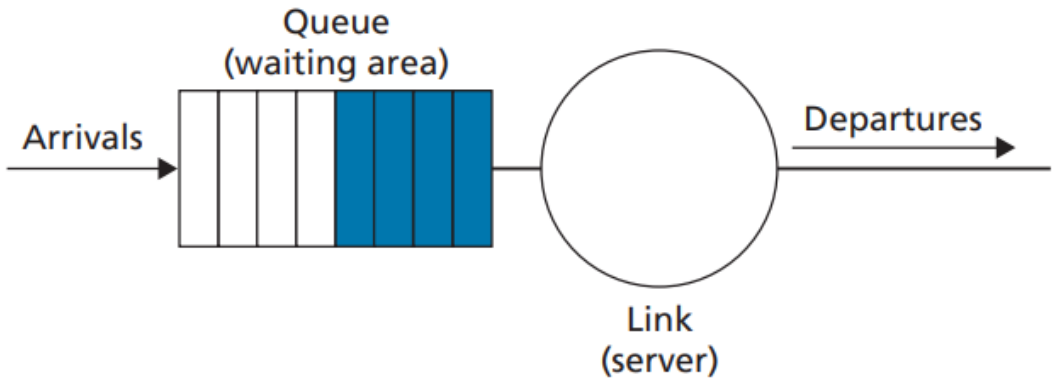
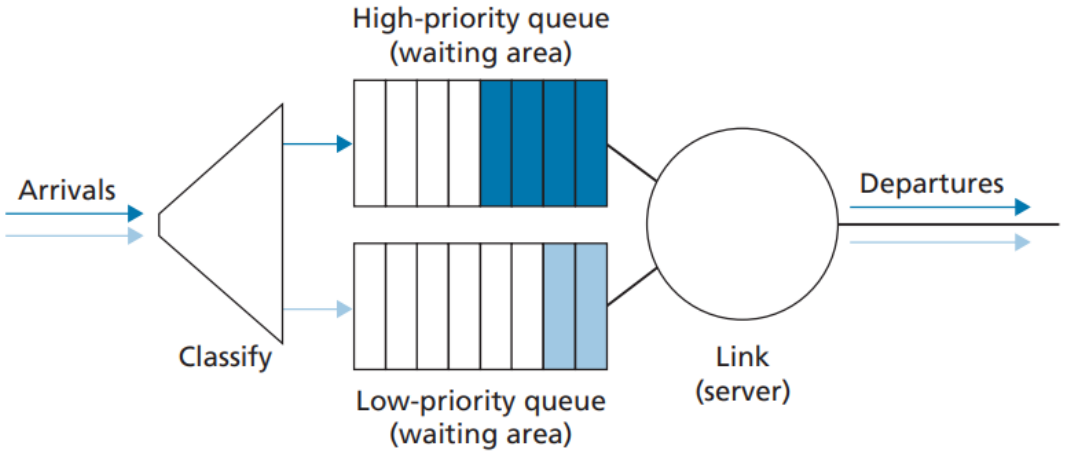


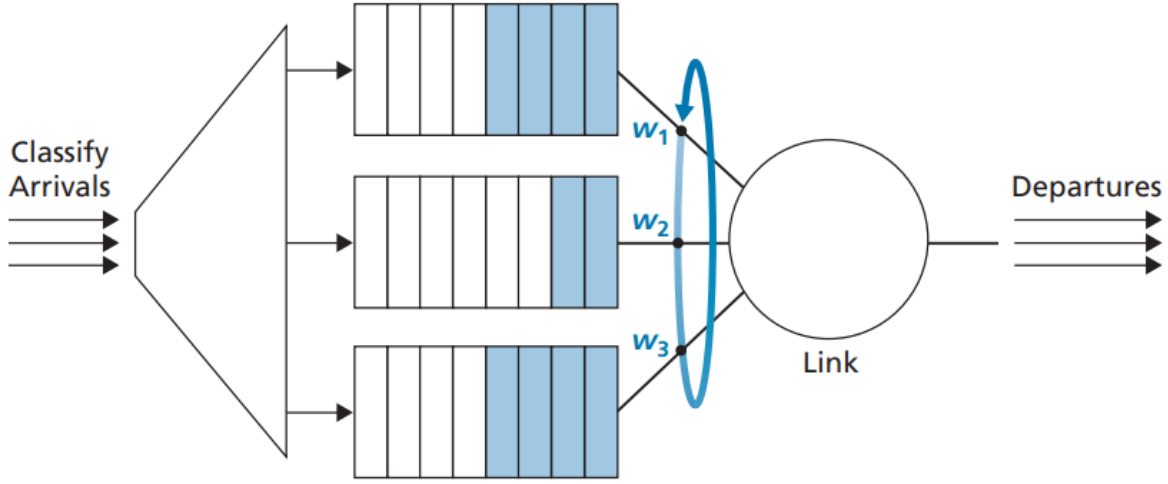
Figure 4.10 ♦ Bufferbloat: persistent queues

4.2 What's Inside a Router?

- FIFO
- Priority queue (패킷을 뜯어 볼 수 있나?)
- Round robin







4.2 What's Inside a Router?

- Weighted Fair Queuing wfa
- WFQ (R*w(i)/w(i..)