링크계층2

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Link layer, LANs: outline

5.1 introduction, services
5.2 error detection, correction
5.3 multiple access protocols
5.4 LANs
- addressing, ARP
- Ethernet
- switches
- VLANS

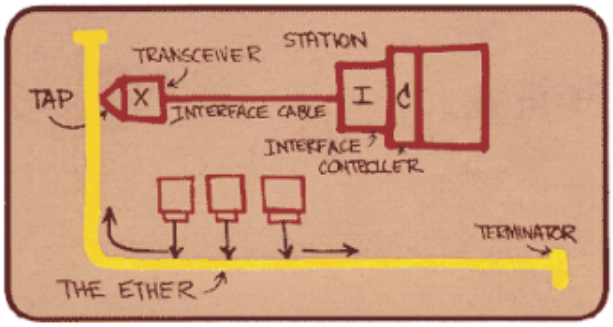
5.5 link virtualization: MPLS
5.6 data center networking
5.7 a day in the life of a web request

Link Layer 5-35

Ethernet

"dominant" wired LAN technology:

- cheap $20 for NIC
- first widely used LAN technology
- simpler, cheaper than token LANs and ATM
- kept up with speed race: 10 Mbps – 10 Gbps

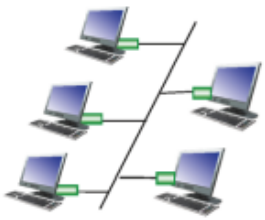


Metcalfe's Ethernet sketch

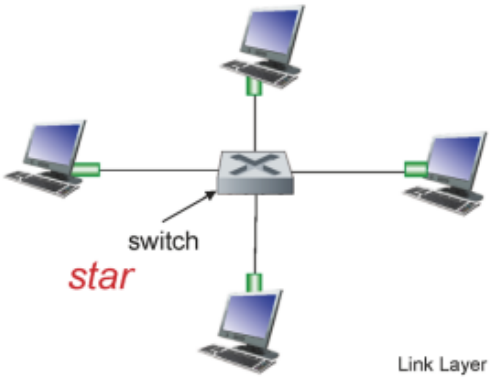
Link Layer 5-36

Ethernet: physical topology

- *bus:* popular through mid 90s
  - all nodes in same collision domain (can collide with each other)
- *star:* prevails today
  - active *switch* in center
  - each "spoke" runs a (separate) Ethernet protocol (nodes do not collide with each other)



bus: coaxial cable



Link Layer 5-37

Ethernet frame structure

sending adapter encapsulates IP datagram (or other network layer protocol packet) in Ethernet frame

preamble:

- 7 bytes with pattern 10101010 followed by one byte with pattern 10101011
- used to synchronize receiver, sender clock rates

Link Layer 5-38

frame link에서 쌓여서 나가는 것

CSMA/CD : collision detect를 안했으면 방금 쏜 frame이 도착했다고 판단 collision이 발생했는데 detect를 못했으면 큰 문제

TCP 재전송 : source와 저 멀리 있는 destination 서버 그 관계에 의해서 ACK가 오지 않았을 때

Ethernet uses CSMA/CD

- No slots
- adapter doesn't transmit if it senses that some other adapter is transmitting, that is, carrier sense
- transmitting adapter aborts when it senses that another adapter is transmitting, that is, collision detection
- Before attempting a retransmission, adapter waits a random time, that is, random access

Ethernet CSMA/CD algorithm

1. Adaptor receives datagram from net layer & creates frame
2. If adapter senses channel idle, it starts to transmit frame. If it senses channel busy, waits until channel idle and then transmits
3. If adapter transmits entire frame without detecting another transmission, the adapter is done with frame !
4. If adapter detects another transmission while transmitting, aborts and sends jam signal
5. After aborting, adapter enters **exponential backoff**: after the mth collision, adapter chooses a K at random from $\{0,1,2,\ldots,2^m-1\}$. Adapter waits K·512 bit times and returns to Step 2

Question

- Is it possible that:

A collision happens in Ethernet
But is not detected at the MAC layer

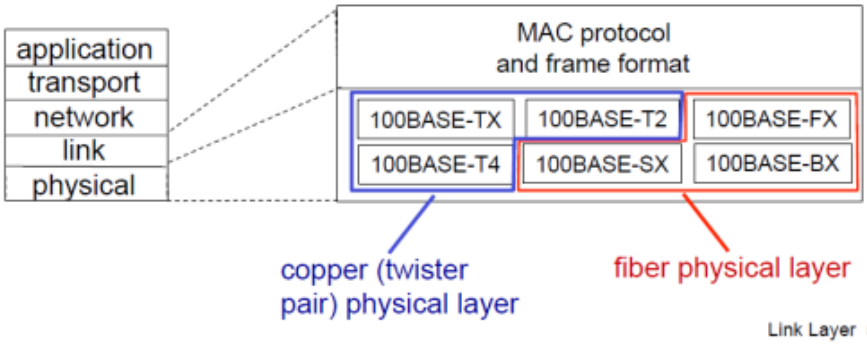
Remember: CSMA/CD does not use MAC layer ACKs

5: DataLink Layer 5-43

A야 너가 말 좀 더 길게 해 할 말이 많이 없어도 어느정도 말을 해야한다 너무 짧으면 겹쳤는지 아닌지 모르니까 minimum frame size : 64byte 1byte일 때는 padding

802.3 Ethernet standards: link & physical layers

- *many* different Ethernet standards
  - common MAC protocol and frame format
  - different speeds: 2 Mbps, 10 Mbps, 100 Mbps, 1Gbps, 10G bps
  - different physical layer media: fiber, cable



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MAC addresses and ARP

- 32-bit IP address:
  - *network-layer* address for interface
  - used for layer 3 (network layer) forwarding
- MAC (or LAN or physical or Ethernet) address:
  - function: *used 'locally" to get frame from one interface to another physically-connected interface (same network, in IP-addressing sense)*
  - 48 bit MAC address (for most LANs) burned in NIC ROM, also sometimes software settable
  - e.g.: 1A-2F-BB-76-09-AD

hexadecimal (base 16) notation
(each "number" represents 4 bits)

Link Layer 5-47

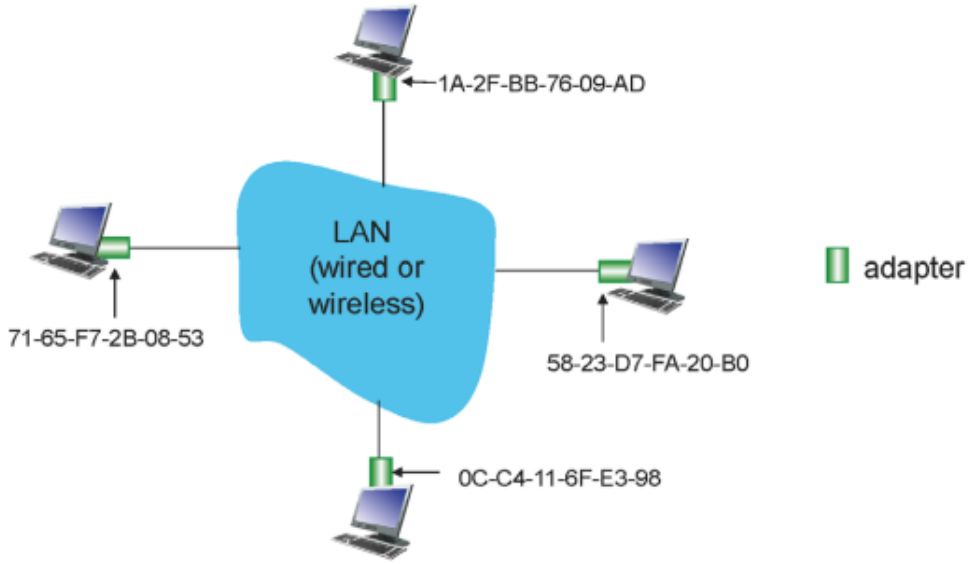
48 bit 라서 24bit씩 끊어서 앞에는 제조회사 뒤에는 interface 고유번호

host name, IP address : 바꿀 수 있음

MAC address : 바꾸지 못함 network interface가 공장에서 나올 때 찍혀서 나옴

LAN addresses and ARP

each adapter on LAN has unique *LAN* address



Link Layer 5-48

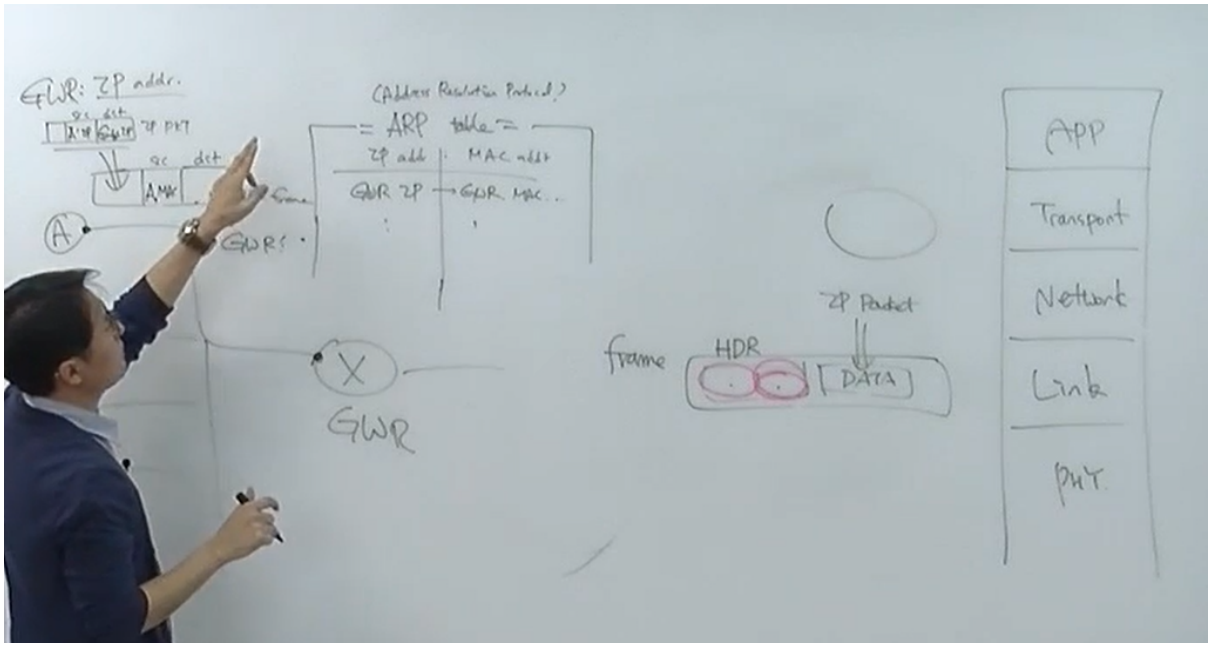
컴퓨터에서 젤 첫번째로 보내는 객체 GateWayRouter ip packet이 나가는게 아니라 그것을 감싼 Frame이 나감

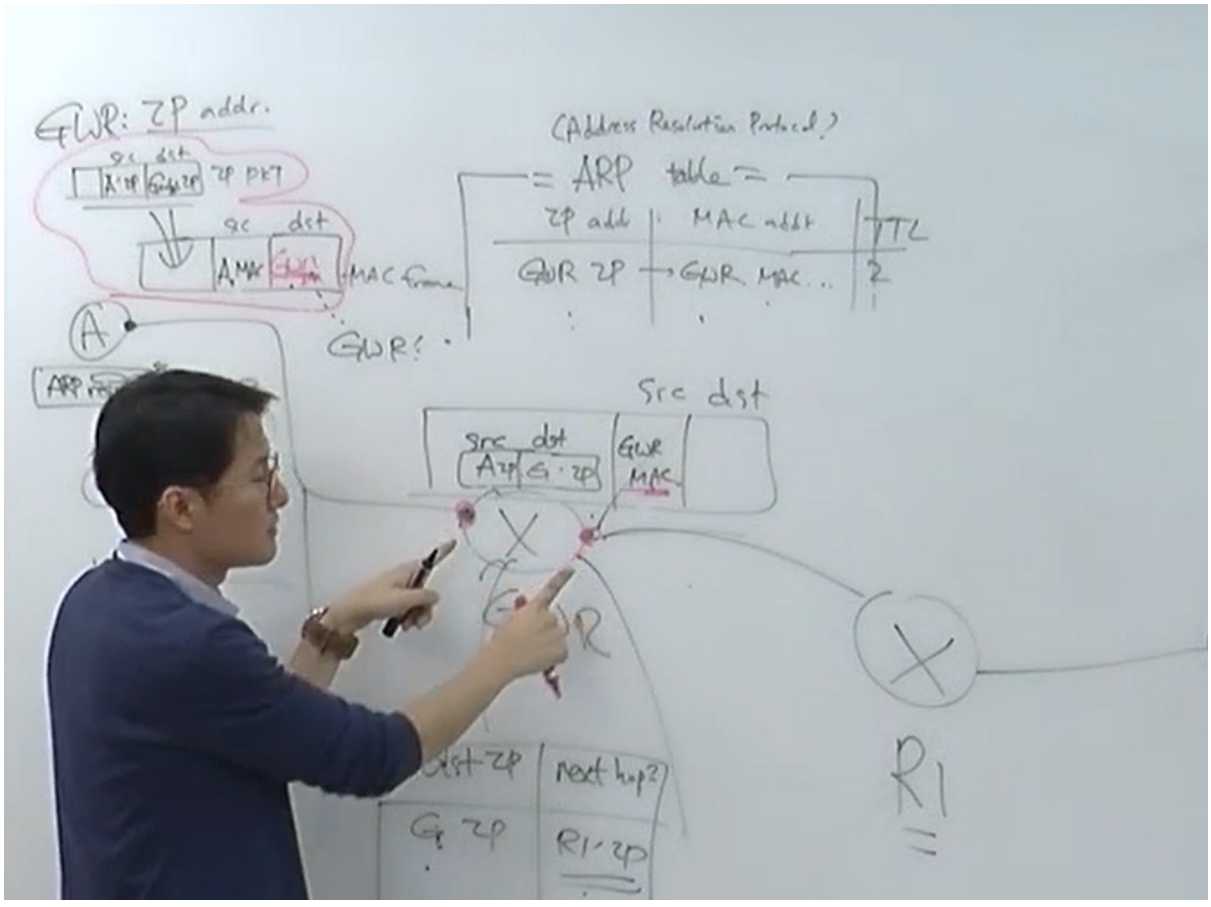
GateWayRouter ip주소

ip packet의 source는 나 / google의 ip 을 frame으로 감싸서 가는데 Source A의 MAC address dst에는 GWR's MAC address

ARP (Address Resolution Protocol) table 에 적혀있음 - cache테이블이라 2시간 이내 사라짐

IP에 해당하는 MAC address를 모를 때, ARP request를 통해서 MAC address를 알아올 수 있다.


GWR: IP addr.
(Address Resolution Protocol)
= ARP table =
IP addr
MAC addr
GWR IP
GWR MAC..
GWR?
GWR
frame
HDR
DATA
IP Packet
APP
Transport
Network
Link
PHY


GWR: IP addr.
(Address Resolution Protocol)
= ARP table =
IP addr
MAC addr
TTL
GWR IP
GWR MAC..
2
IP PKT
MAC frame
GWR?
src dst
src dst
GWR MAC
R1
next hop?
R1 IP

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