



# Computer Networks Advanced Course

Data Link Layer – Ethernet, MAC

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Based on “Computer Networks”  
Rosenboim, Gonen, Hod

# Topics

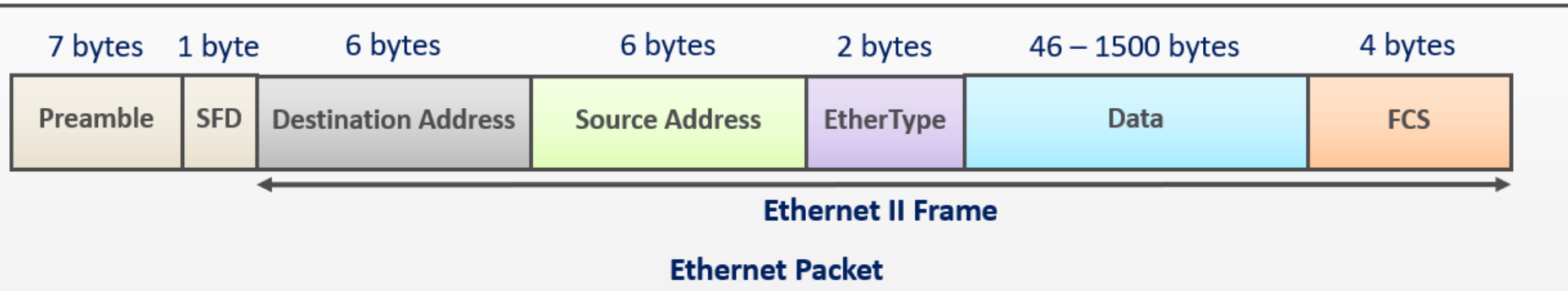
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- ▶ Ethernet protocol
- ▶ MAC addresses
- ▶ ARP



# Ethernet

- ▶ Ethernet packet adds two fields before the actual Ethernet frame

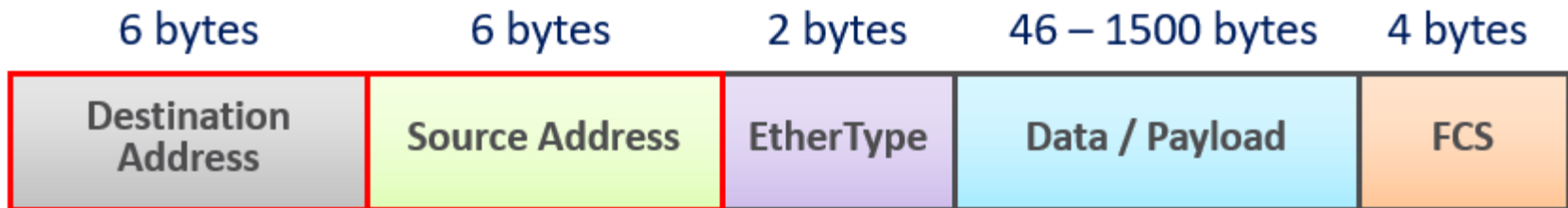


- ▶ Preamble – 56 bits (7 bytes) of alternating 1's and 0's (10101010...10)
  - Used to synchronize receiving clocks
- ▶ SFD – Start Frame Delimiter – 10101011
  - Makes the last bit 1 instead of 0 to indicate the start of the frame
- ▶ FCS – Frame Check Sequence

# Ethernet Addresses

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- ▶ MAC (Media Access Control) address
- ▶ 6 bytes == 48 bits
  - 01:23:45:67:89:AB
  - 01-23-45-67-89-AB
- ▶ 3 MS bytes– Vendor ID
  - 01:23:45
- ▶ 3 LS bytes – Host ID
  - 67:89:AB

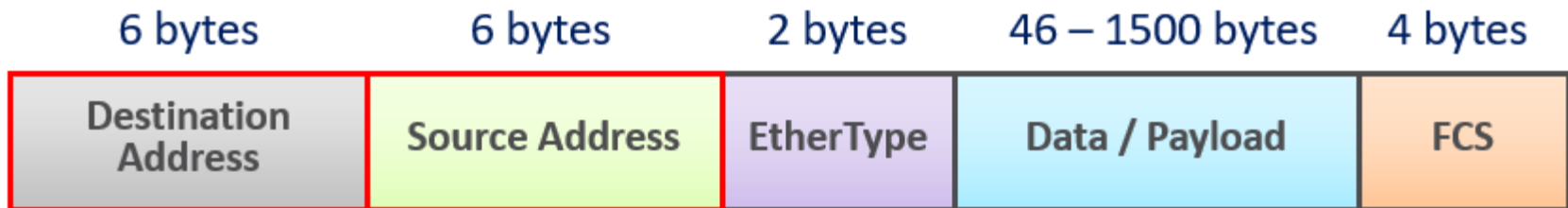


**Ethernet II Frame**

# MAC Addresses Types

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- ▶ Unicast – only one receiver
- ▶ Multicast – several receivers
  - First byte LS bit == 1
- ▶ Broadcast – everyone
  - All bits are 1s

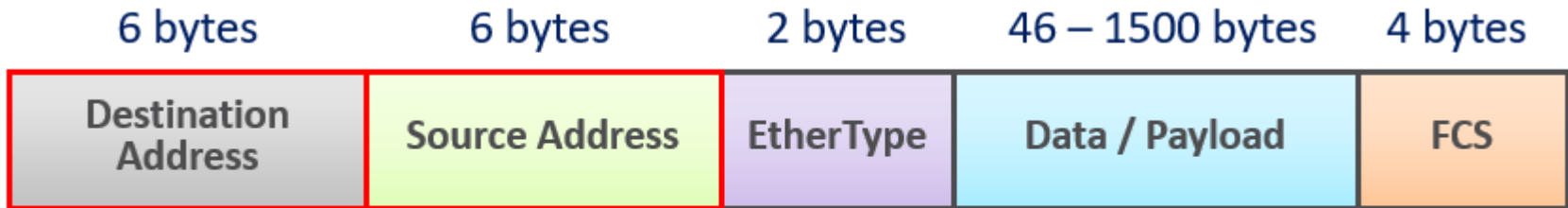


**Ethernet II Frame**

# Ether Types

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- ▶ Layer 3 protocol Identifier
- ▶ How payload should be processed
- ▶ Internet Protocol version 4 (IPv4)
  - 0x0800
- ▶ Address Resolution Protocol (ARP)
  - 0x0806
- ▶ IPv6
  - 0x86DD
- ▶ etc



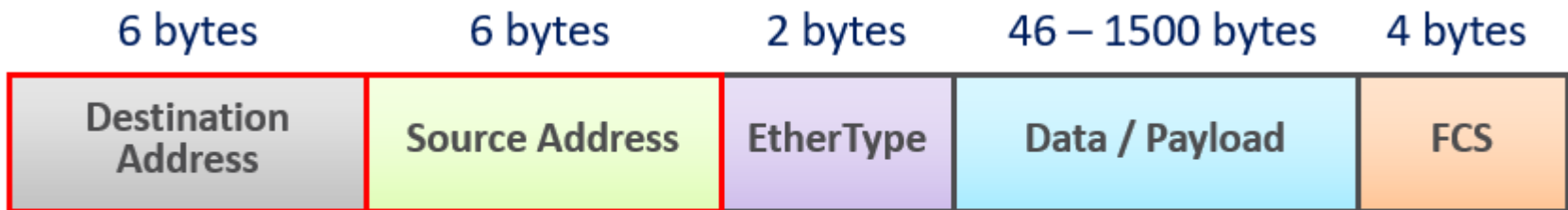
**Ethernet II Frame**



# Data Payload

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- ▶ The Protocol Data Unit (PDU) of the upper layer
- ▶ Minimum – 46 bytes
  - What if layer 3 PDU is 1 to 45 byte?
    - Padding of 0 is added
- ▶ Maximum – 1500 bytes
  - What if layer 3 PDU contains more data?
    - Upper layer responsibility to split it to smaller chunks

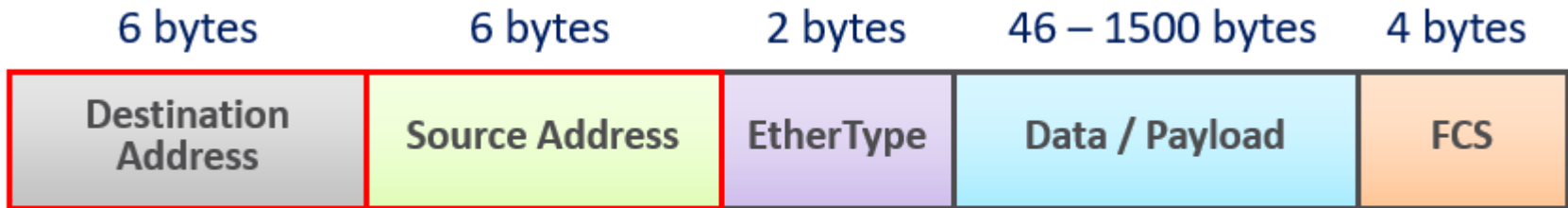


**Ethernet II Frame**

# Data Payload

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- ▶ Minimum size
  - For collisions – packet should be long enough so the sender will detect collision while still sending and send jam signal
- ▶ Maximum Size
  - Longer the maximum size → Longer the delay for others on a shared medium
  - Increased probability that one or more bits will be received in error
  - Bigger frames require the device to have more buffer memory
  - Checksum calculations are simpler on smaller amount of bytes



**Ethernet II Frame**



# ARP

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- ▶ Address Resolution Protocol
- ▶ Goal: match IP to MAC
- ▶ Find ARP in Wireshark
- ▶ Review own ARP table
  - `arp -a`
  - `arp -d IP`

# ARP Practice

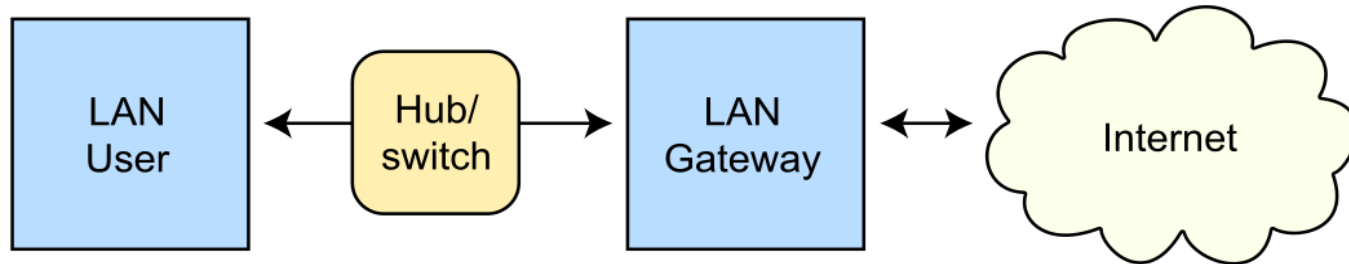
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- ▶ Create ARP packet
  - `P = Ether(...)`
  - Use `sendp` or `srp1` (instead of `send` or `sr1`)
- ▶ Exercise: Map your local network
  - List all IP's and MAC's

# ARP Poisoning

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## Routing under normal operation



## Routing subject to ARP cache poisoning

