



TNE10006/TNE60006: Networks and Switching



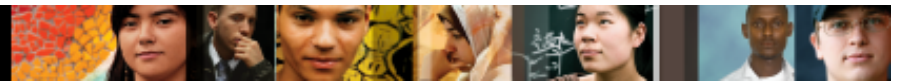
Ethernet

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Outline

- Ethernet History
- Ethernet in the OSI Stack
- Ethernet MAC – CSMA/CD and CSMA/CA
- Ethernet Addressing
- Ethernet Encapsulation
- Ethernet Unicast and Broadcast



Ethernet – History

- Original concept via ALOHA net
 - Radio-based network connecting various campuses in Hawaii
 - Original wireless network
- Radio waves are the obvious shared medium
- Need to control access to minimise collisions



Ethernet Operation

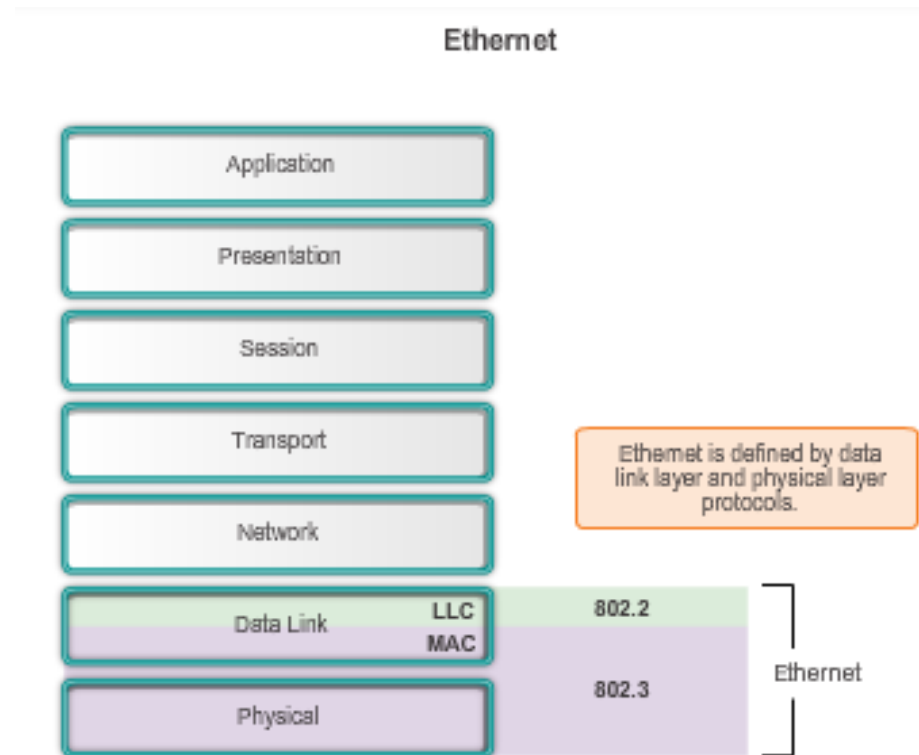
LLC and MAC Sublayers (cont.)

LLC

- Handles communication between upper and lower layers

MAC

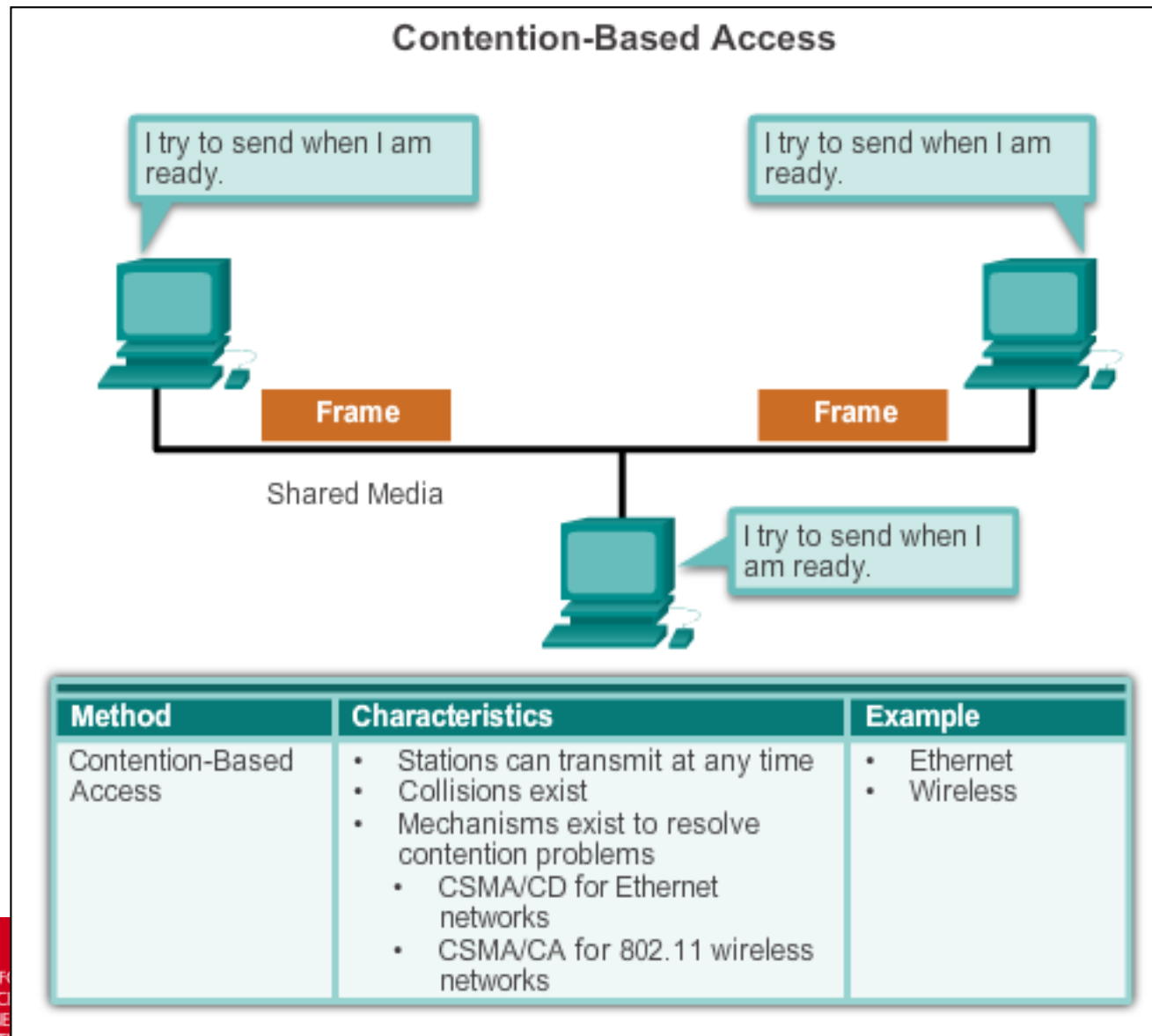
- Constitutes the lower sublayer of the data link layer
- Implemented by hardware, typically in the computer NIC
- Two primary responsibilities:
 - Data encapsulation
 - Media access control





Ethernet MAC Layer

Media Access Control

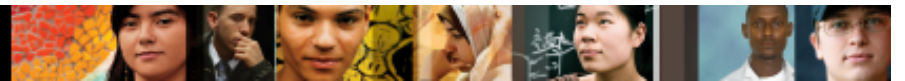




Ethernet MAC Layer

CSMA/CD

- Carrier Sense Multiple Access with Collision Detection
- Multiple Access
 - Bus topology
 - Shared Medium
- Carrier Sense
 - Listen to medium
 - Don't send until medium is free
- Collision Detection
 - Detect when collisions occur



Ethernet MAC Layer

CSMA/CD

- Listen on the wire
 - Shared medium
 - Can hear any signals currently being transmitted
- When there are no transmissions taking place
 - And we wish to send a frame
 - Then we begin to send
- Collisions can still occur
 - Two (or more) stations transmit at same time
 - Speed of electricity is not infinite



Ethernet MAC Layer

CSMA/CD

- When a collision is detected

Stop sending

Send jamming signal – why?

Wait to retransmit

- Retransmission delays

Fixed time?

Random time?

Change delays?



Wireless Ethernet MAC Layer

CSMA/CA

- Carrier Sense Multiple Access with Collision Avoidance
- Collision Avoidance

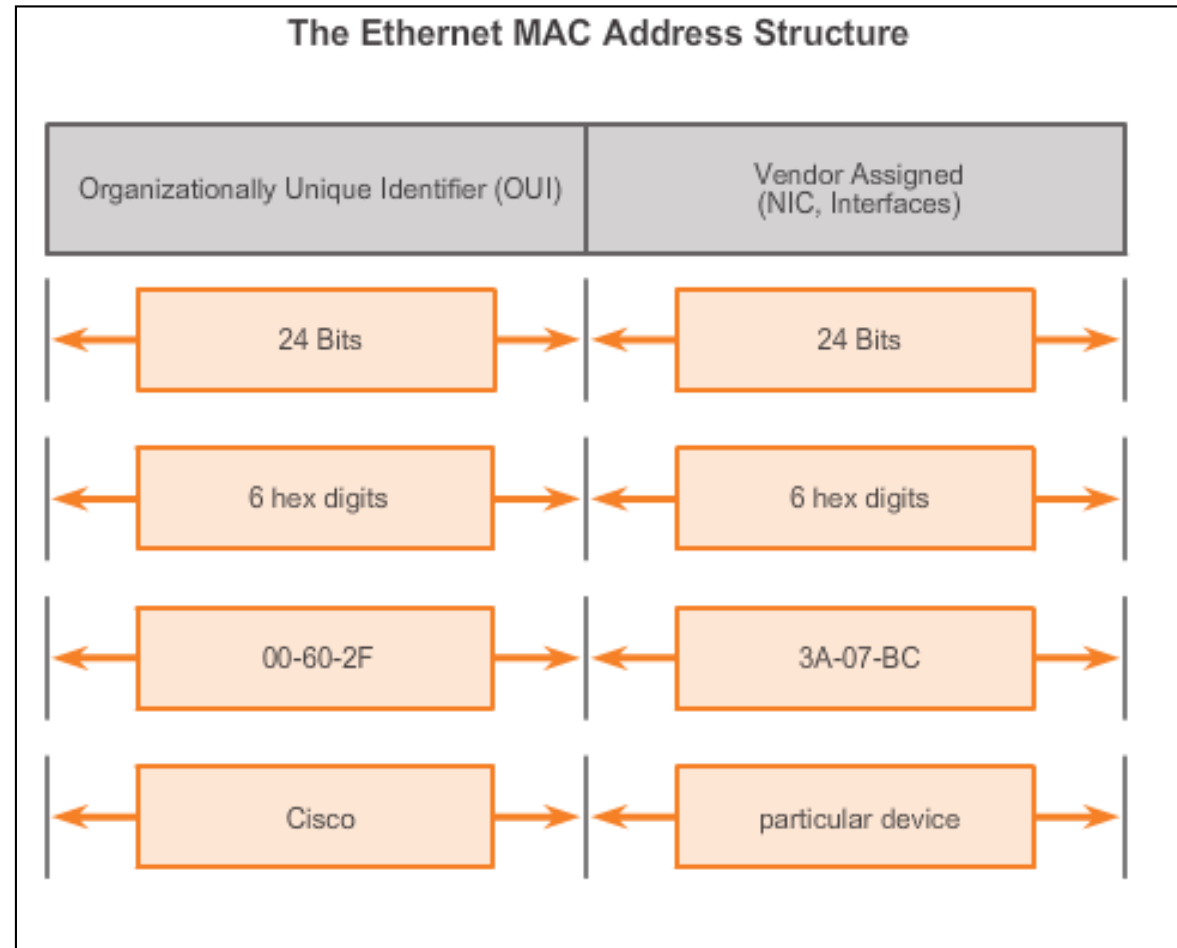
After media is free – send notification of stations intent to use medium
 Wait for response from controller
 Transmit



Ethernet Operation

MAC Address: Ethernet Identity

- Layer 2 Ethernet MAC address is a 48-bit binary value expressed as 12 hexadecimal digits
- IEEE requires a vendor to follow these rules:
 - First 3 bytes are the vendor's assigned OUI
 - Last 3 bytes are unique NIC identifier





Ethernet Frame

Ethernet Encapsulation

- Early versions of Ethernet were slow at 10 Mb/s.
- Now operate at 10 Gb/s per second and faster.
- Ethernet II is the Ethernet frame format used in TCP/IP networks.

Comparison of 802.3 and Ethernet II Frame Structures and Field Size

IEEE 802.3

7	1	6	6	2	46 to 1500	4
Preamble	Start of Frame Delimiter	Destination Address	Source Address	Length	802.2 Header and Data	Frame Check Sequence

Ethernet II

8	6	6	2	46 to 1500	4
Preamble	Destination Address	Source Address	Type	Data	Frame Check Sequence

Field size in bytes



Ethernet Frame

Ethernet Encapsulation

- Preamble

Synchronisation signal (0101010...)

Allows receivers to synchronise clocks for rest of frame

- Addresses

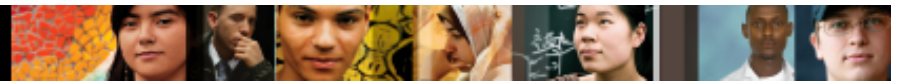
Who is sending/receiving this frame

- Type

Tells Ethernet layer what Network Layer Protocol is carried in Data

- Frame check

Check for errors



Ethernet Frame

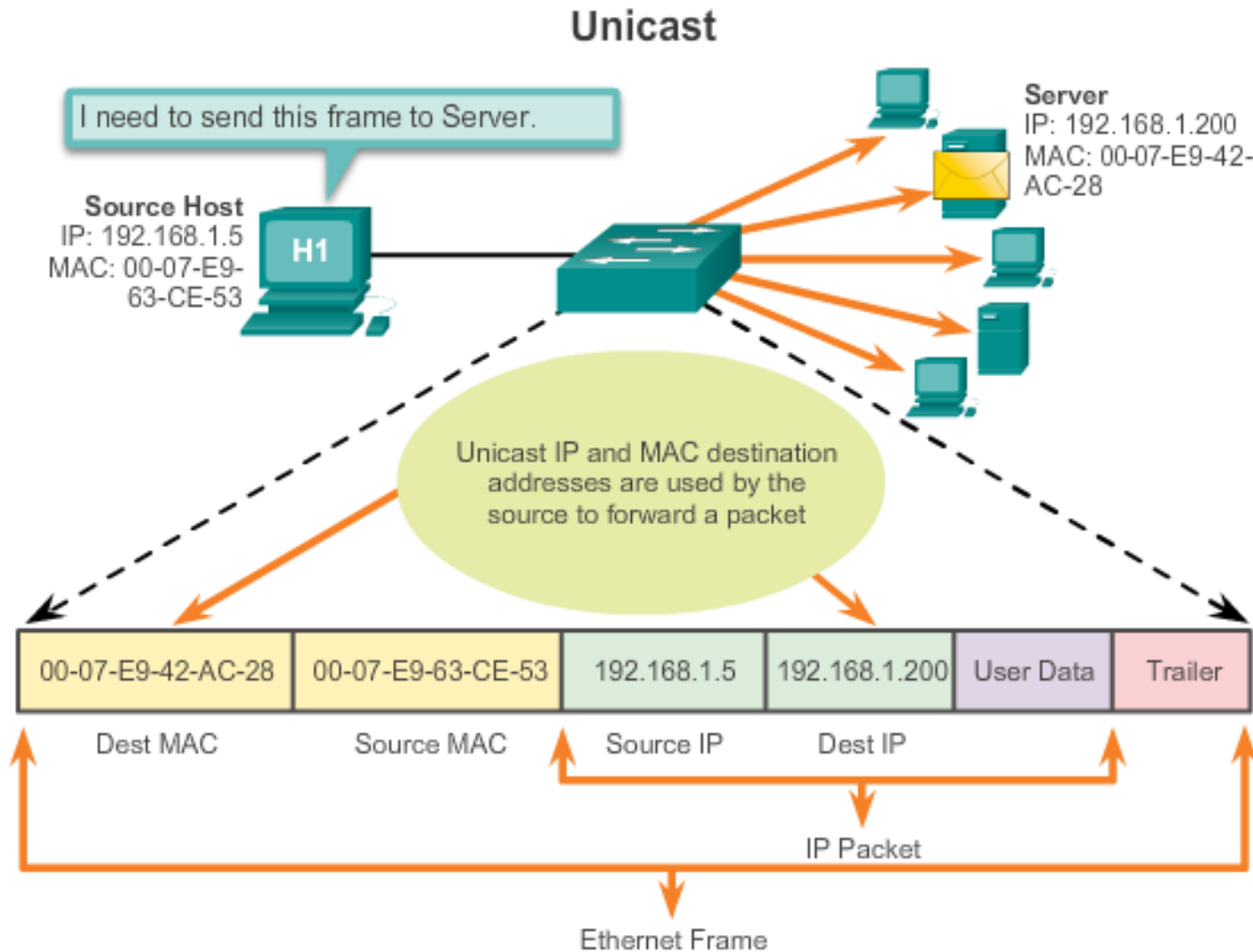
Ethernet Encapsulation

- Data
 - 46-1500 bytes
- Why have a minimum?
- Why have a maximum?
- These restrictions are no longer valid but backwards compatibility require that they remain



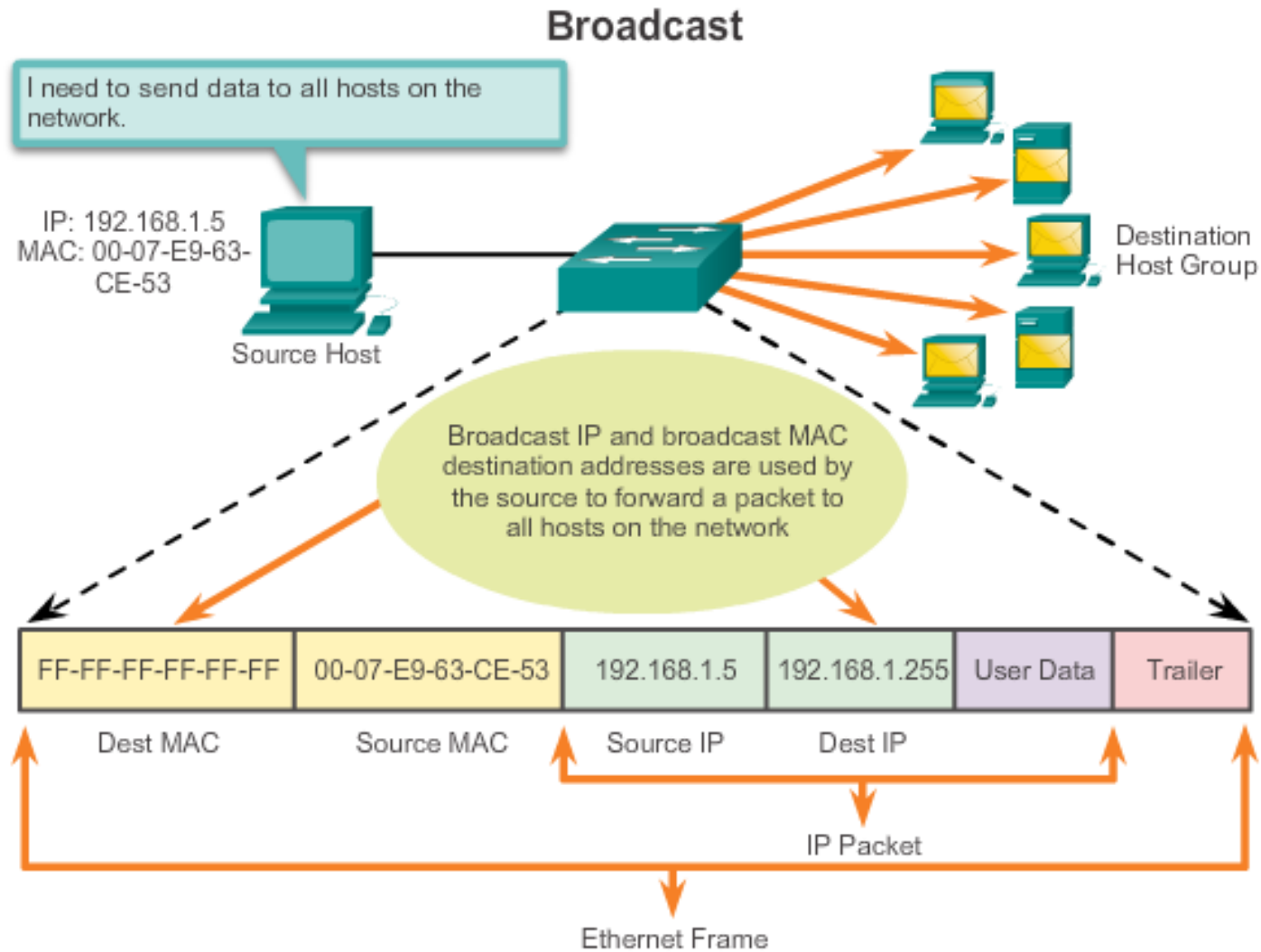
Ethernet MAC

Unicast MAC Address





Ethernet MAC Broadcast MAC Address





Ethernet Summary

In this lecture, we covered:

- Ethernet History
- Ethernet in the OSI Stack
- Ethernet MAC – CSMA/CD and CSMA/CA
- Ethernet Addressing
- Ethernet Encapsulation
- Ethernet Unicast and Broadcast