



What IS Ethernet  
Anyway??

# How do you connect?



# Ethernet: High-Level Overview

- » Originally developed in 1973 by XEROX
  - Patented in 1977
- » First IEEE standard published in 1985
  - IEEE 802.3
- » Term “Ethernet” may refer to either Ethernet Version-2 (DIX) or IEEE Standard
- » Various Cabling types and Speeds supported

# The ALOHAnet...Ethernet's Precursor

- » Developed at the University of Hawaii
- » Became operational in 1971
- » Radio network for communication among the Hawaiian Islands
- » Simple mechanism
  - Transmit and wait for Acknowledgment
  - Retransmit if no Acknowledgement (assume collision)

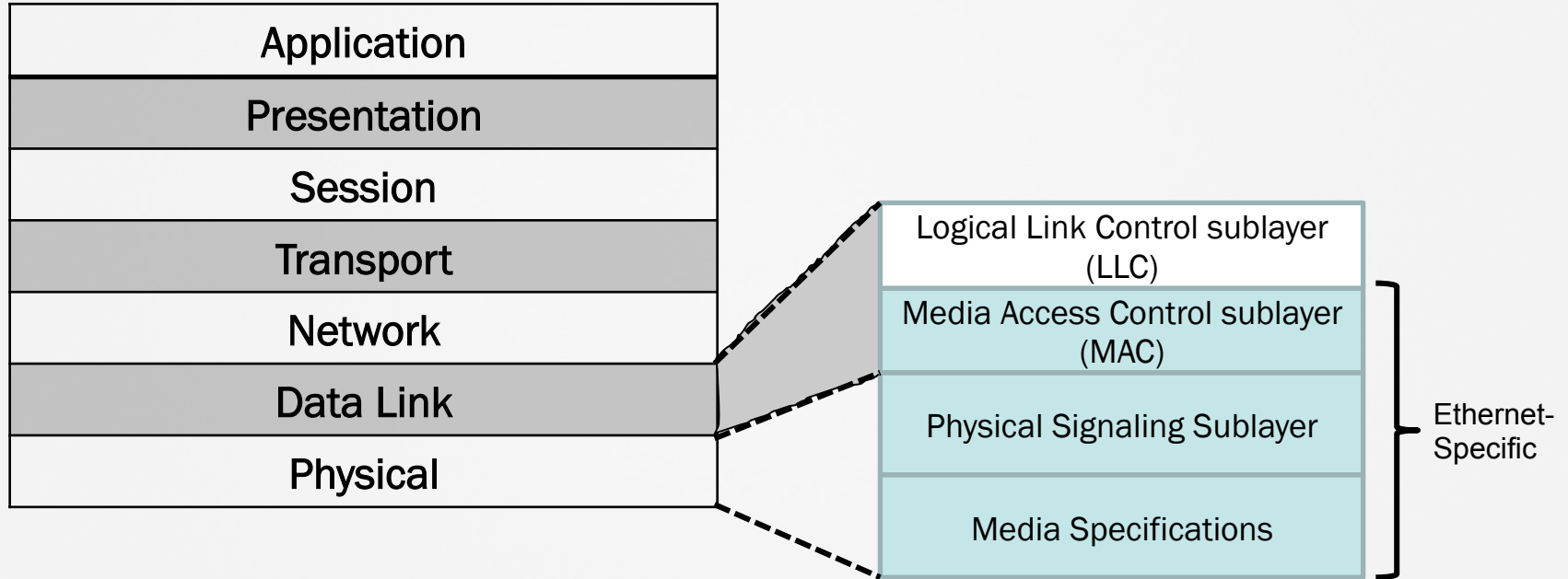
# Dr. Robert Metcalfe

- » 1973, Bob Metcalfe writes a memo on his invention called, “Ethernet”
- » Worked at XEROX PARC at the time.
- » Networking protocol that;
  - Used cables
  - Designed to interconnect LAN systems
  - Based on concepts found in the ALOHAnet
  - Arbitrated access to the network medium using CSMA/CD



The XEROX Alto

# Ethernet and the OSI Layers



# CSMA/CD

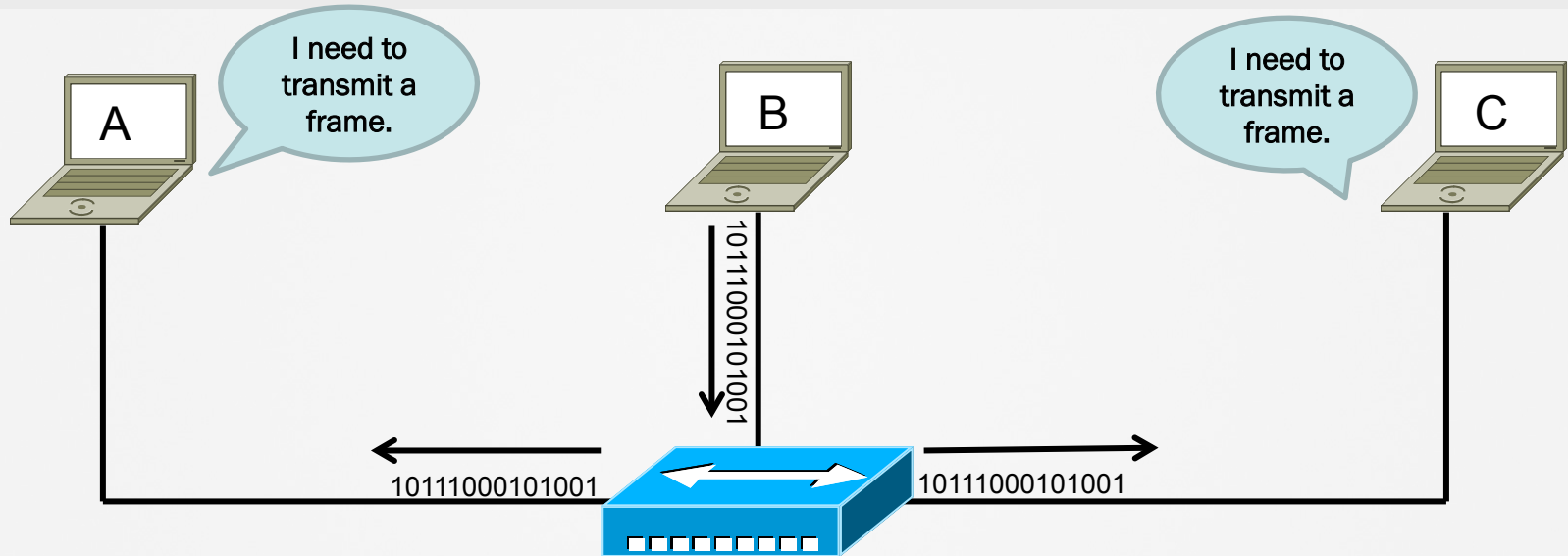
- » Half Duplex vs. Full Duplex
- » Carrier Sense

# CSMA/CD

- » Half Duplex vs. Full Duplex
- » Carrier Sense
- » Multiple Access
- » Collision Detect

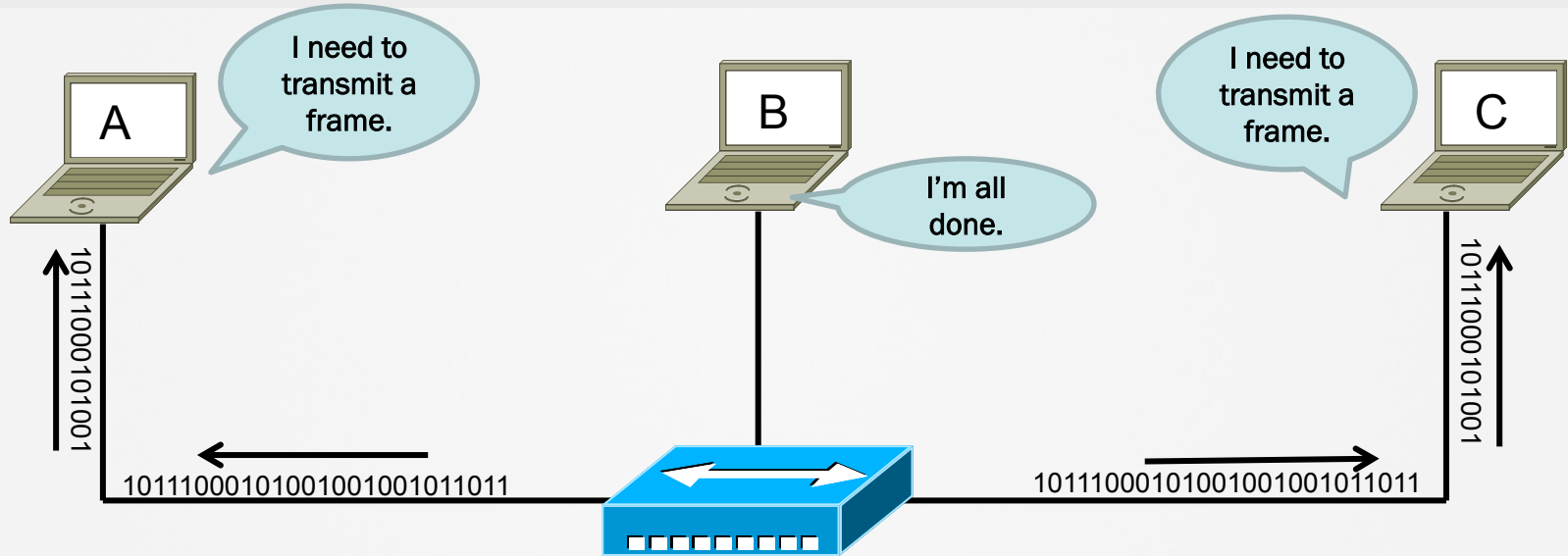


# CSMA/CD Visualized



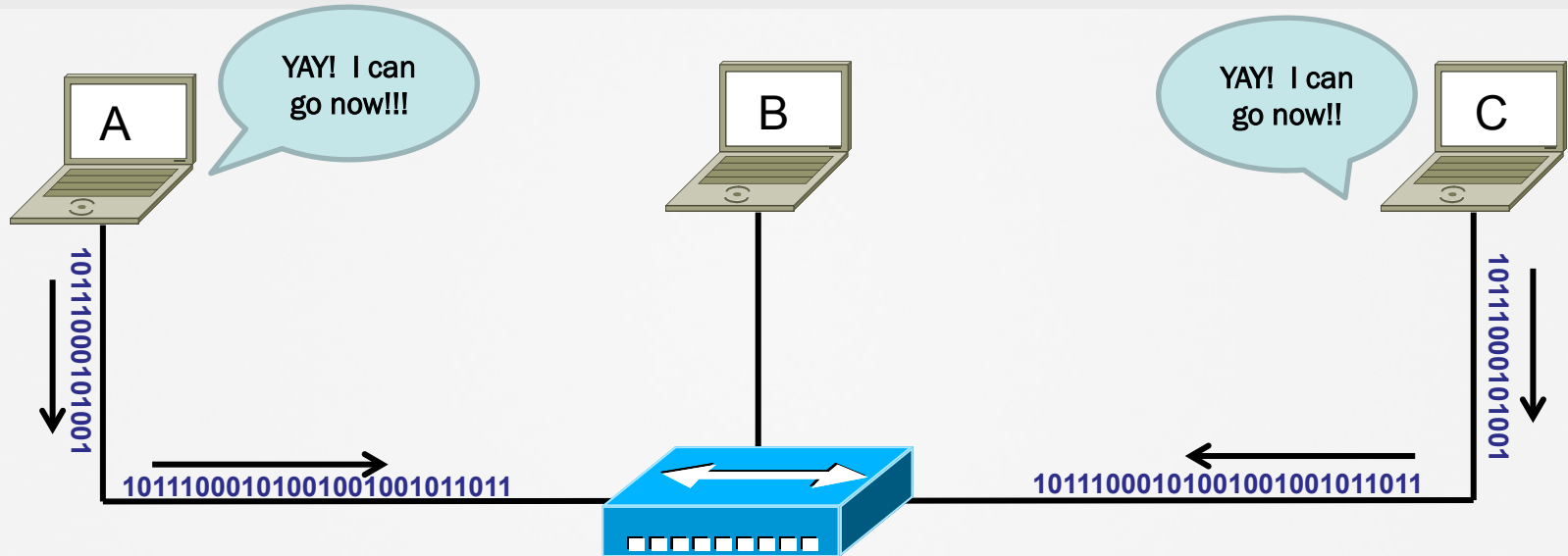
1. PC-A and PC-C both want to transmit.
2. PC-B is transmitting a frame at this time.

# CSMA/CD Visualized



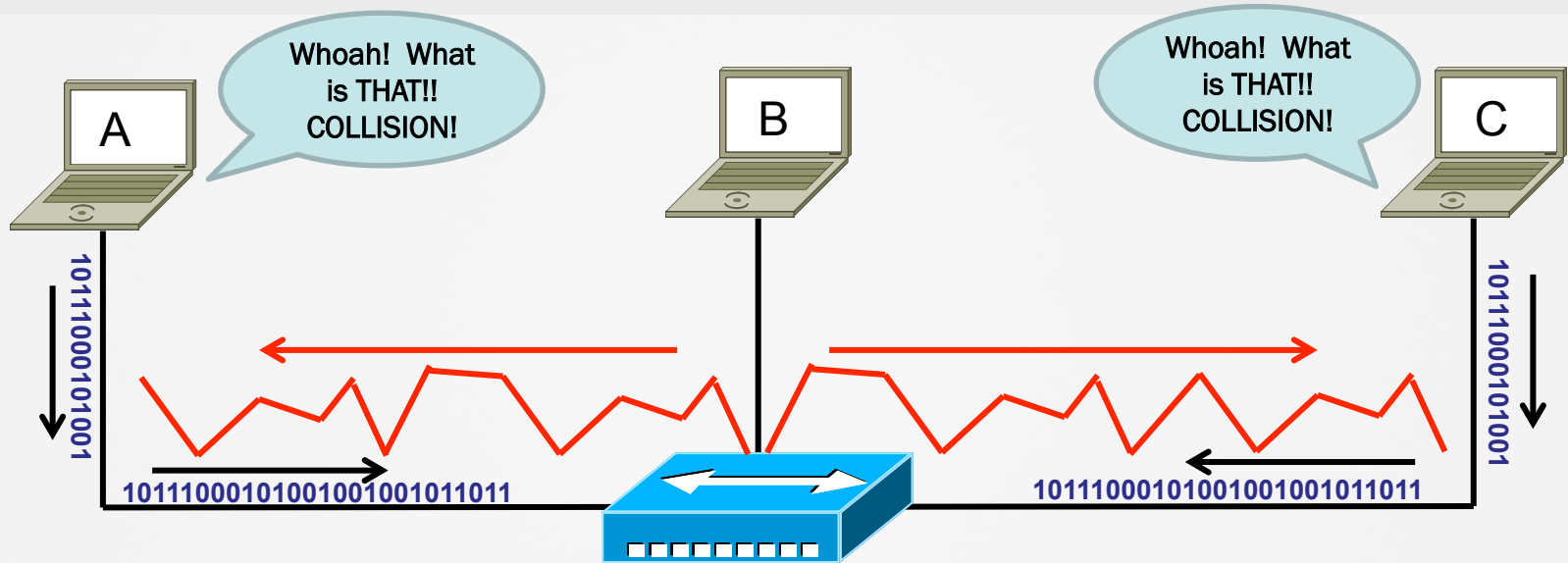
3. PC-A and PC-C place their NICs into “receive-mode” and listen for a carrier.
4. They “Sense” that another device (PC-B) is transmitting...so they continue to listen.

# CSMA/CD Visualized



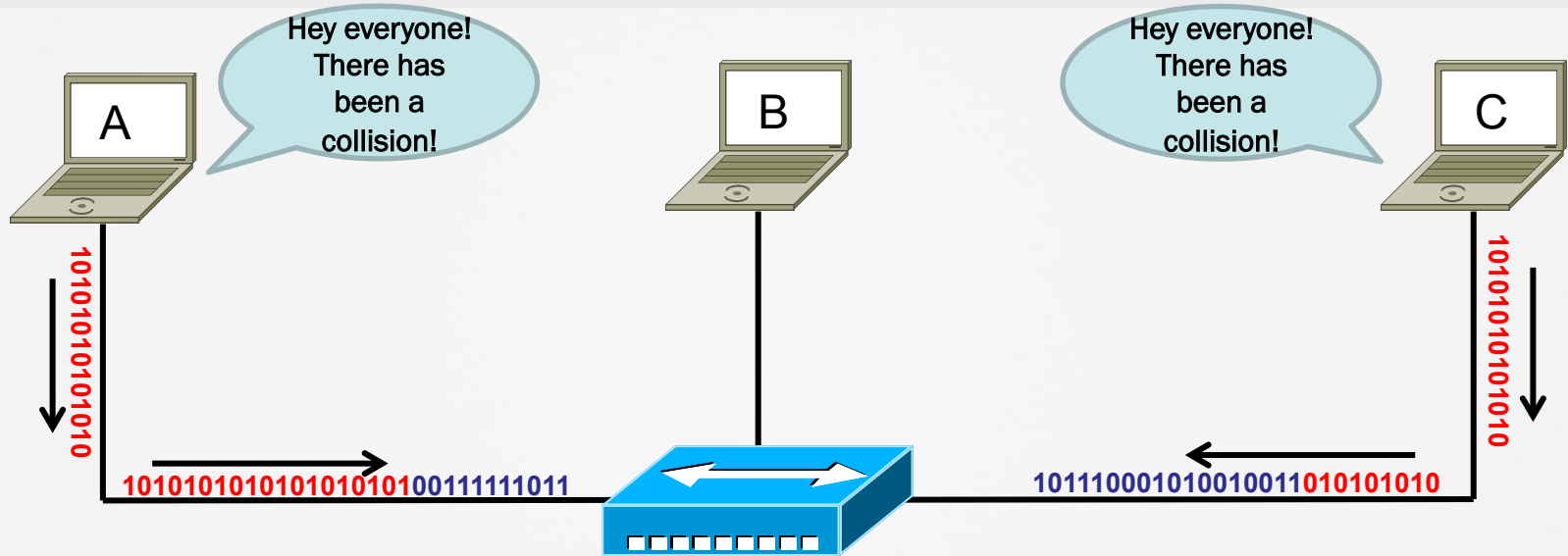
5. At exactly the same time, PC-A and PC-C sense that there is no more carrier, and both transmit their pending frame simultaneously.

# CSMA/CD Visualized



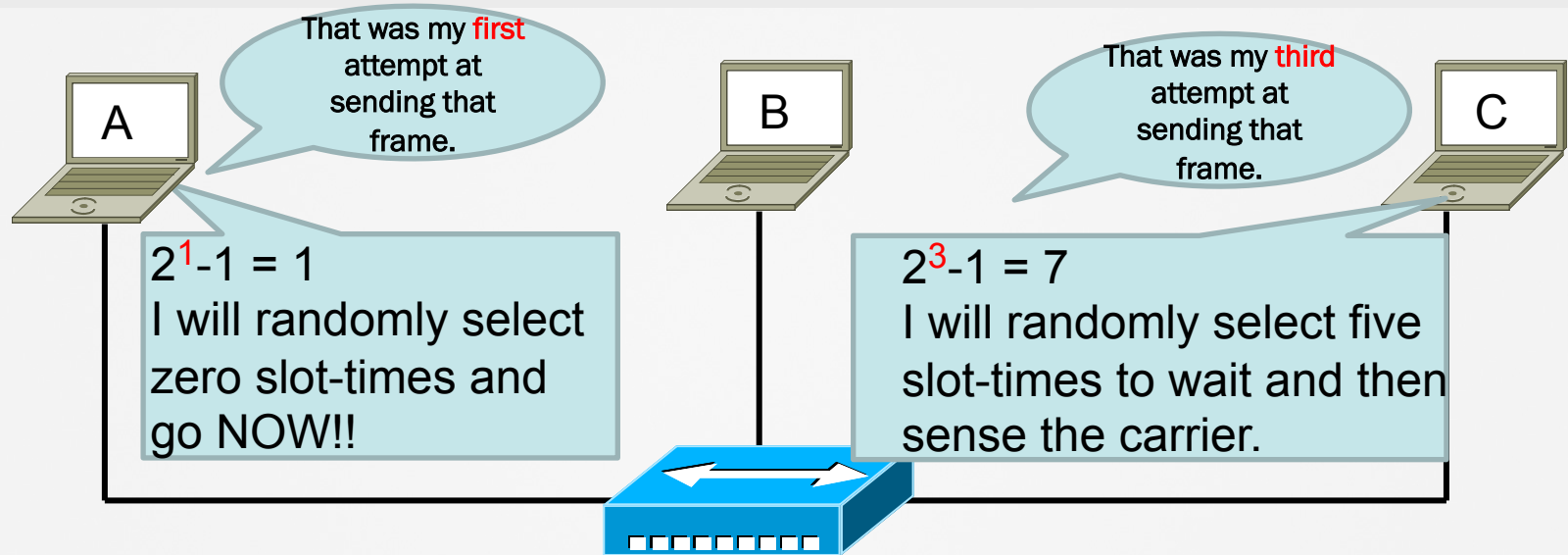
6. The electrical energy “collides” at some point, rendering the 1’s and 0’s illegible.
7. This collision is detected by PC-A and PC-C

# CSMA/CD Visualized



8. PC-A and PC-C finish transmission of their frame, replacing the remaining bits with a “Jam Sequence” of 1010101010101010

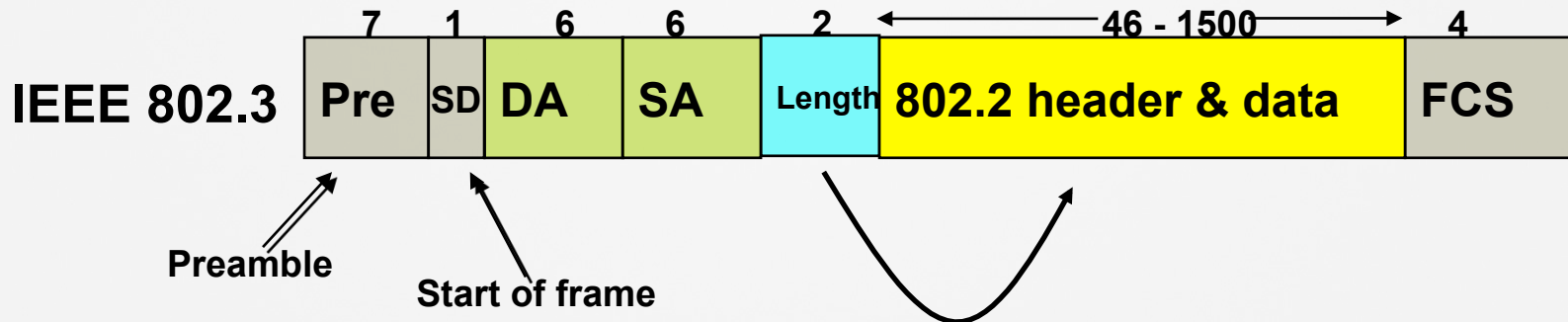
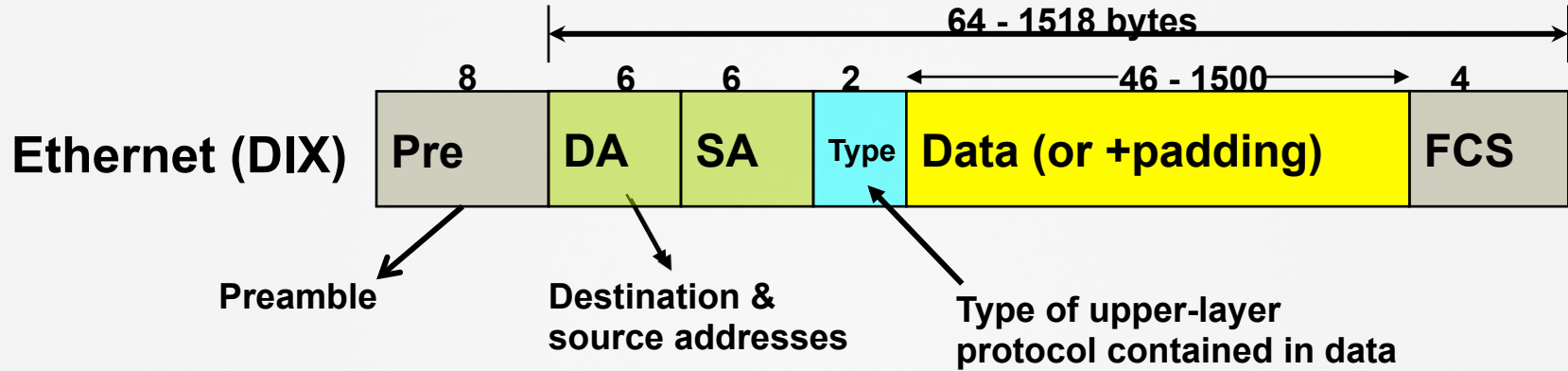
# CSMA/CD Visualized



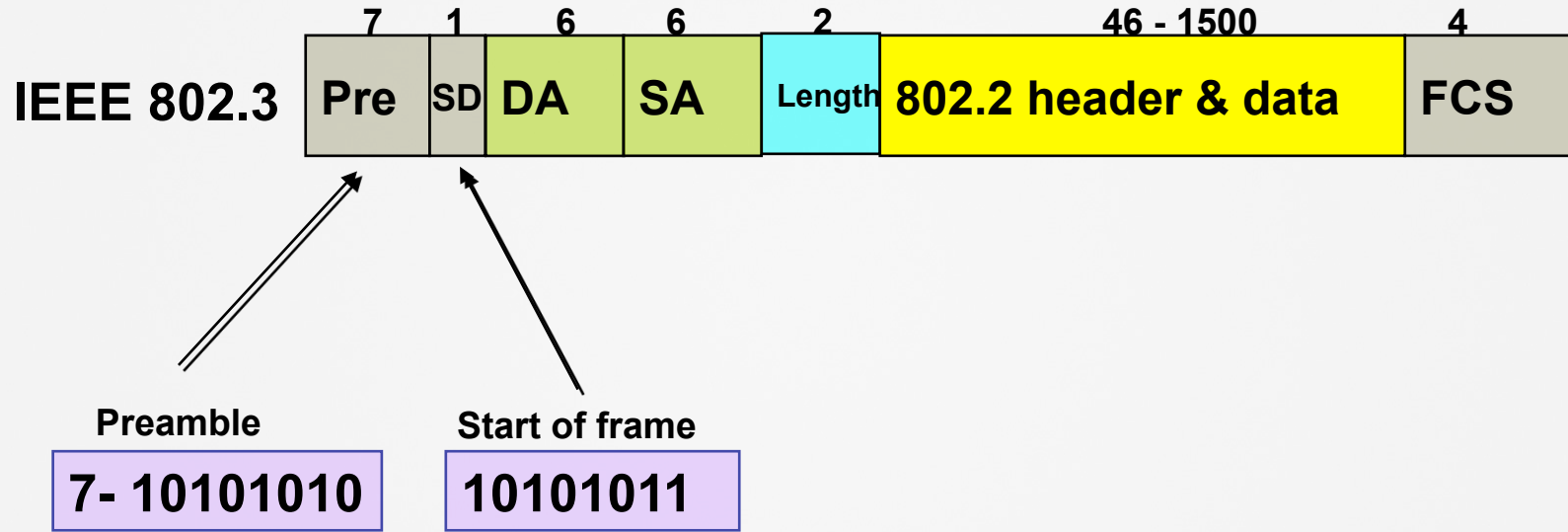
9. PC-A and PC-B wait again, using a Truncated Binary Exponential Backoff algorithm to calculate when they can retransmit again.

Select random backoff time from zero (0) to  $2^C - 1$

# Ethernet Frame Structure



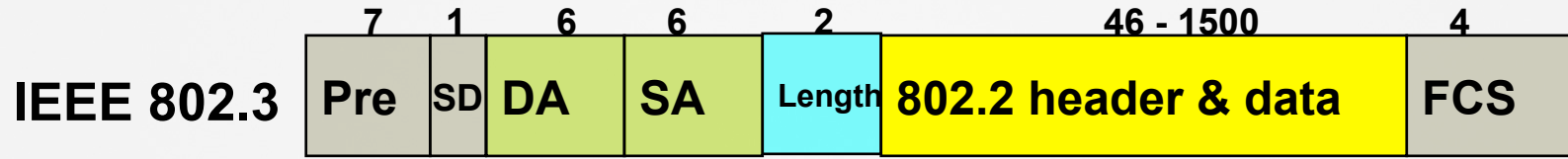
# Preamble and Start-of-Frame Delimiter



- The 5-4-3 rule



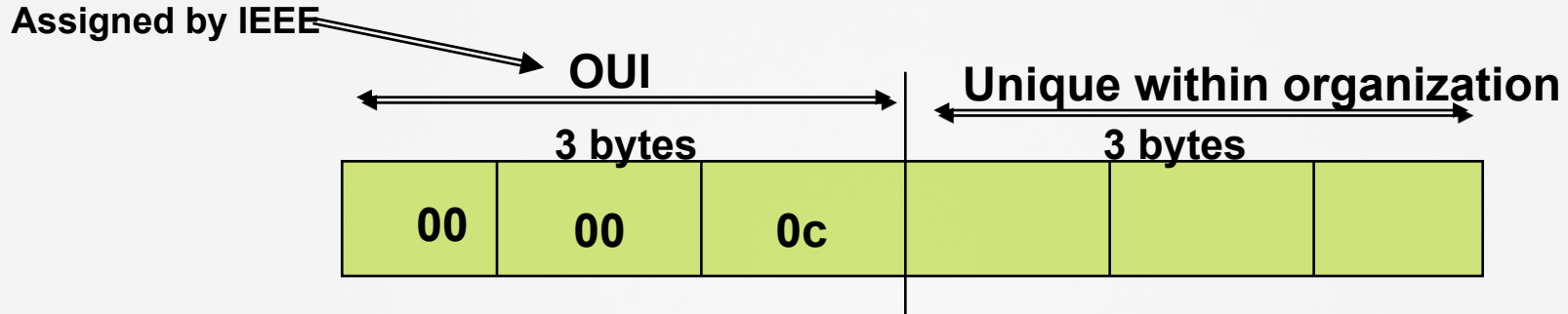
# Media Access Control Addresses



» MAC

- 48-bit addressing system
  - Example: aaaa.aaaa.aaaa
  - First 24 bits are considered OUI
  - Remaining 24 bits are considered vendor assigned

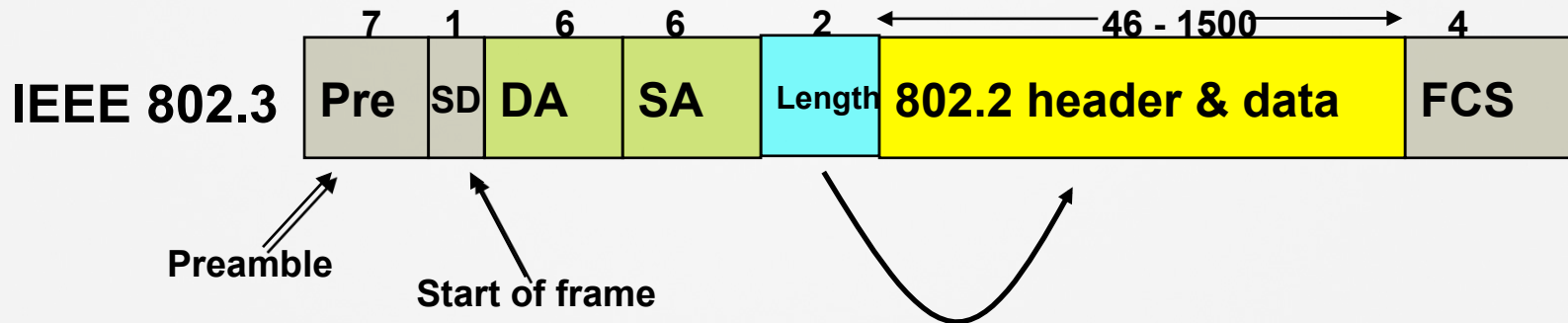
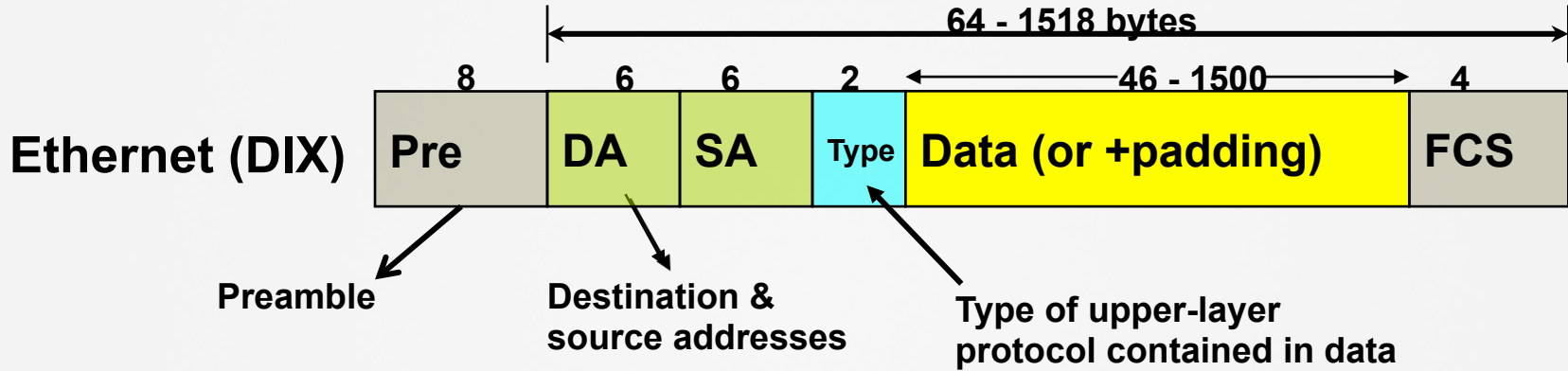
# MAC Addresses



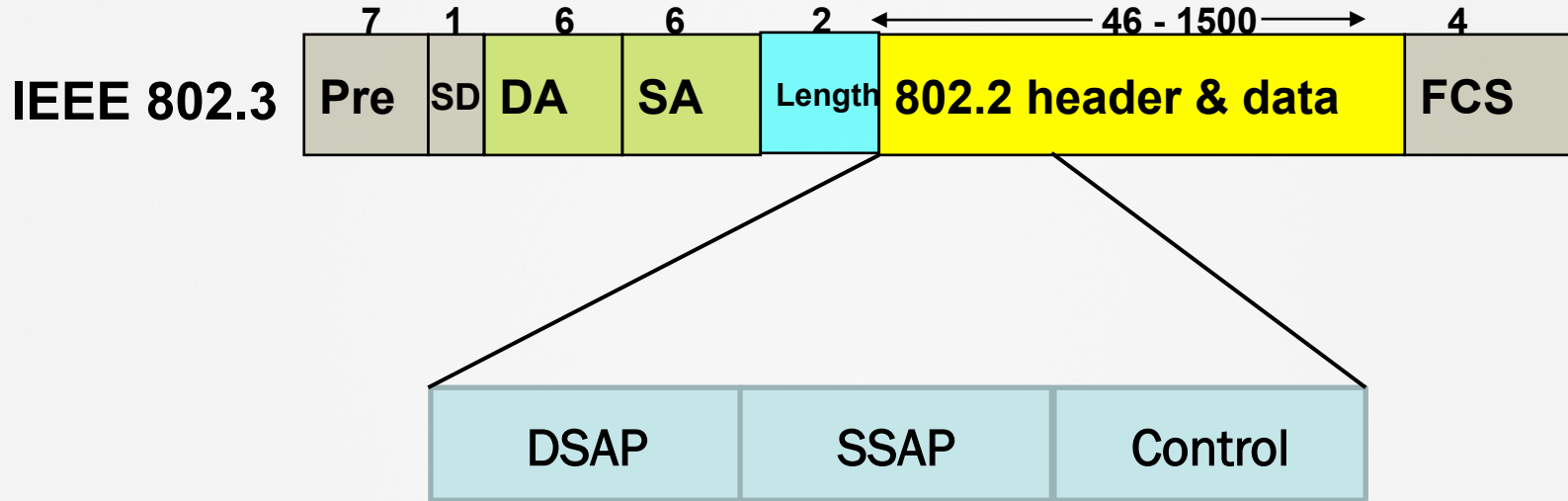
Two bits of 1st byte are very important

- bit #1 (LSB) => Individual (0) or group (1) addresses- (only for DAs)
- bit #2 => Global (0) or Local (1)- LAA bit

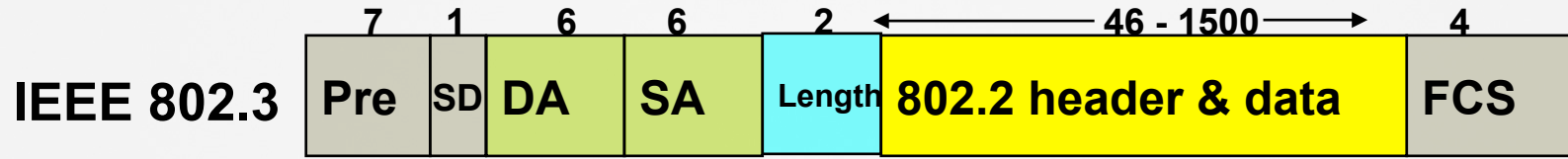
# Type and Length Fields



# 802.2 LLC



# Ethernet FCS



- » FCS = Frame Check Sequence
- » Used for “Error Detection”
- » CRC performed on entire frame and results placed in FCS field.

# Ethernet Cabling

- » Original Ethernet used Coaxial (copper) cabling.
- » Ethernet evolved over time to support different types of cables.
  - Copper
  - Fiber

# Ethernet Cabling Nomenclature

10



Identifies Speed  
in Mbps

Base



Indicates a  
network type that  
uses "Baseband"

T

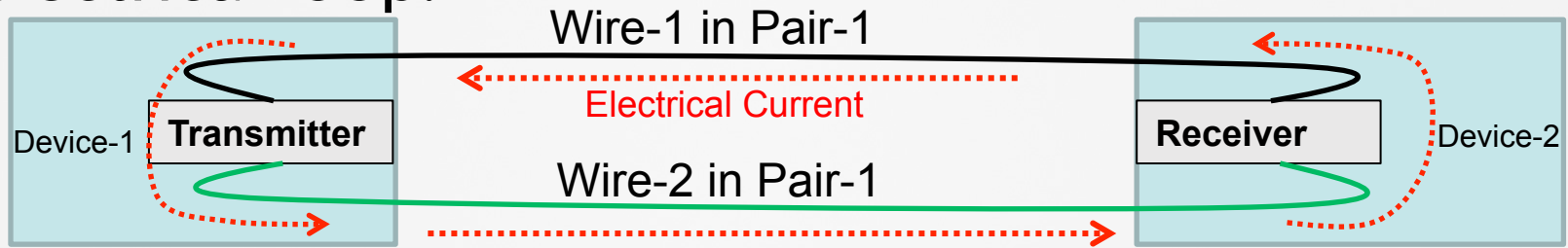


Could be a digit or a  
letter;

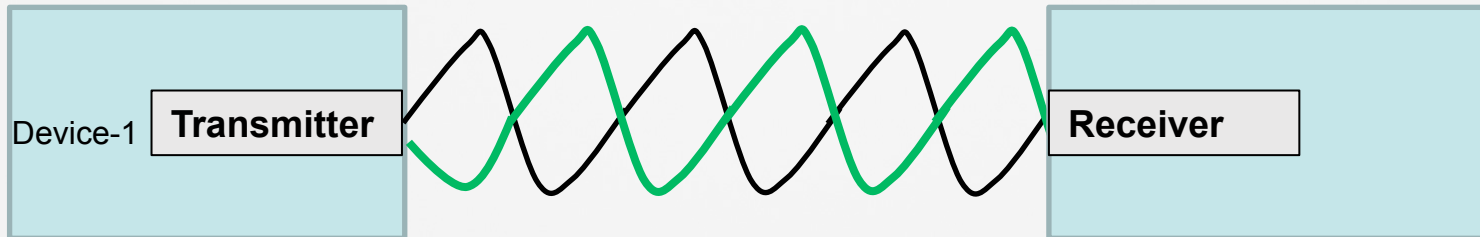
- Digit = max cable length in meters
- Letter = Cable Type

# What is “Twisted Pair”?

- » A pair of copper cables that forms a complete electrical loop.

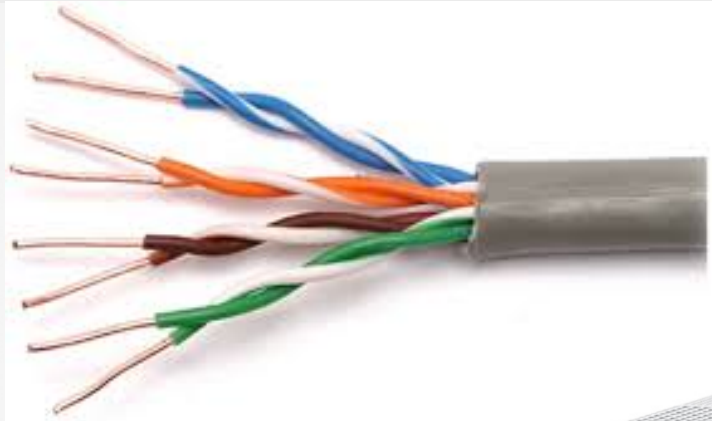


- » Each **pair** of wires is twisted around themselves to prevent EMI.

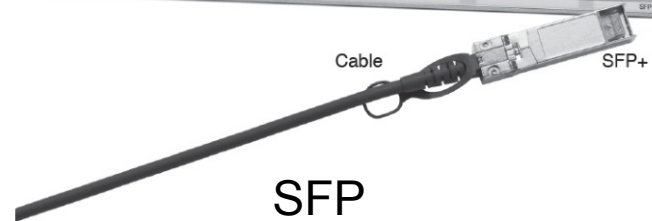
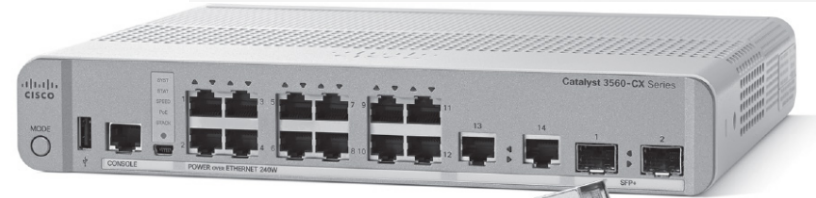




# Color Coding and Connectors



RJ-45

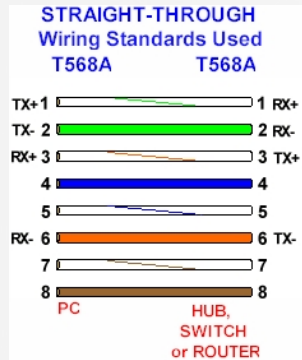


SFP

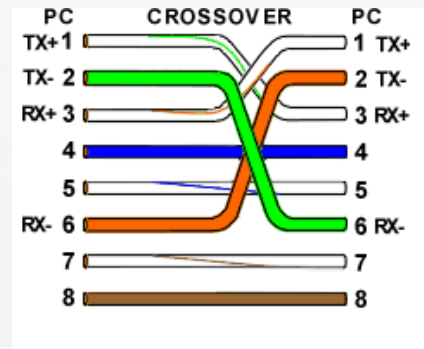
# Ethernet Cabling Details

» Twisted-pair cabling comes in three varieties:

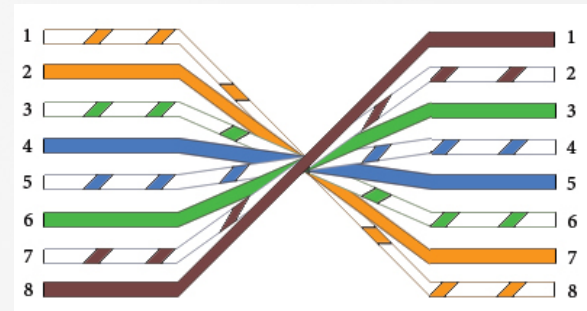
## Straight-through



## Crossover



## Rolled



# Questions?