What IS Ethernet Anyway??

How do you connect?

The image cannot be displayed. Your computer may not

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

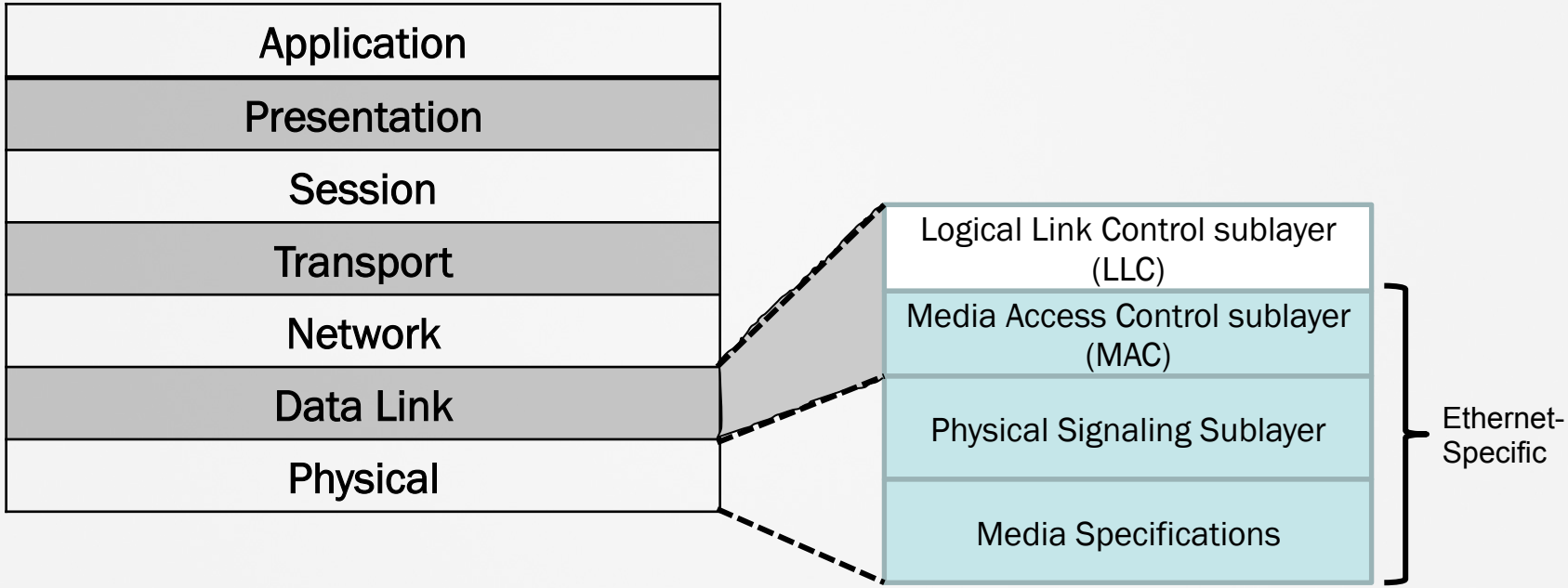
- Developed at the University of Hawaii
- Became operational in 1971
- Radio network for communication among the Hawaiian Islands
- Simple mechanism
  - Transmit and wait for Acknowledgment
  - Retransmit if no Acknowledgement (assume collision)

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



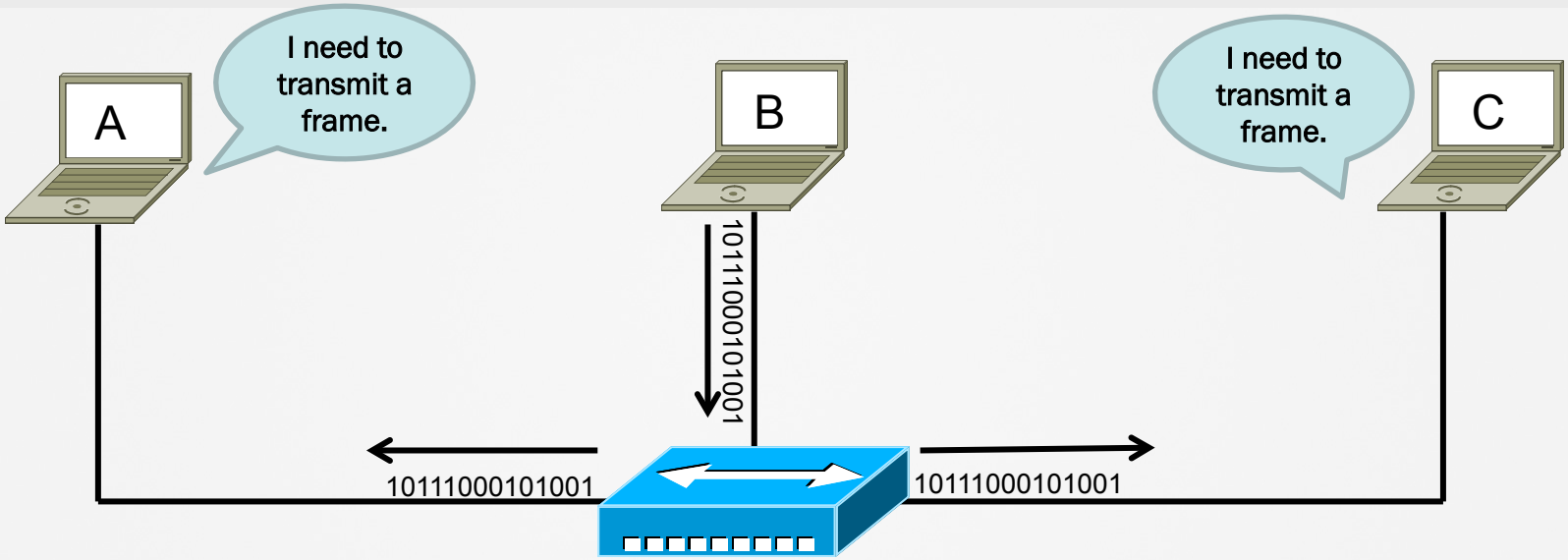
CSMA/CD

- Half Duplex vs. Full Duplex
- Carrier Sense

CSMA/CD

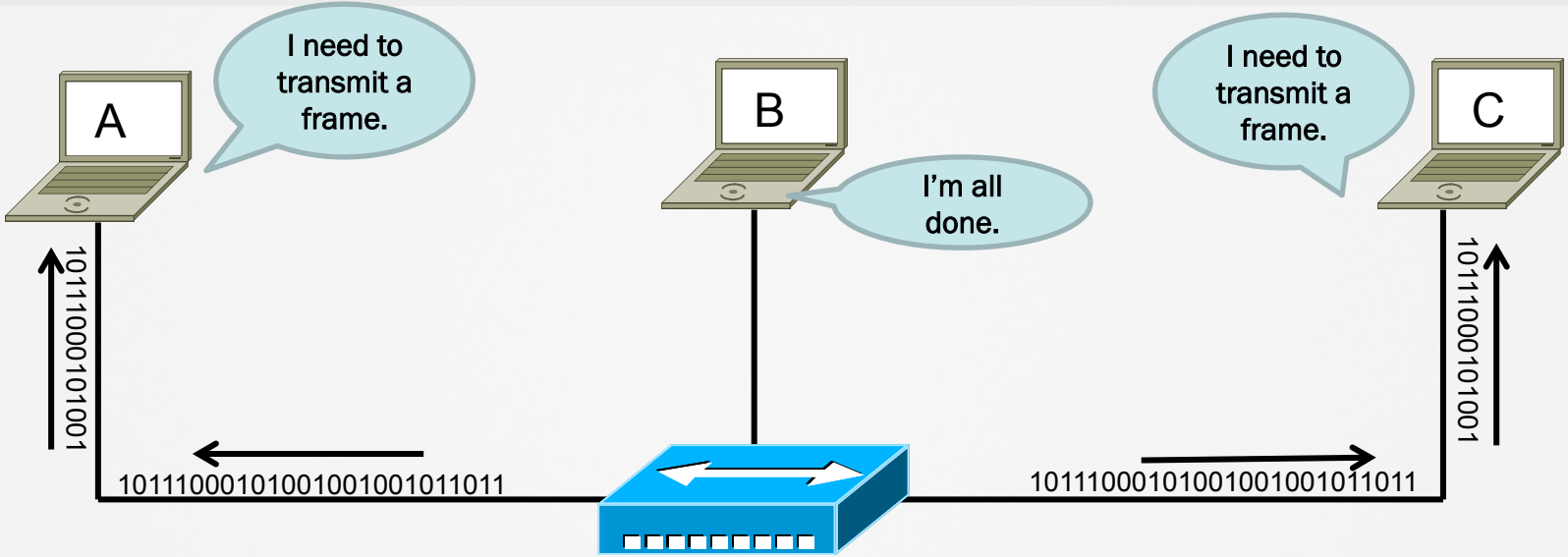
- Half Duplex vs. Full Duplex
- Carrier Sense
- Multiple Access
- Collision Detect

CSMA/CD Visualized



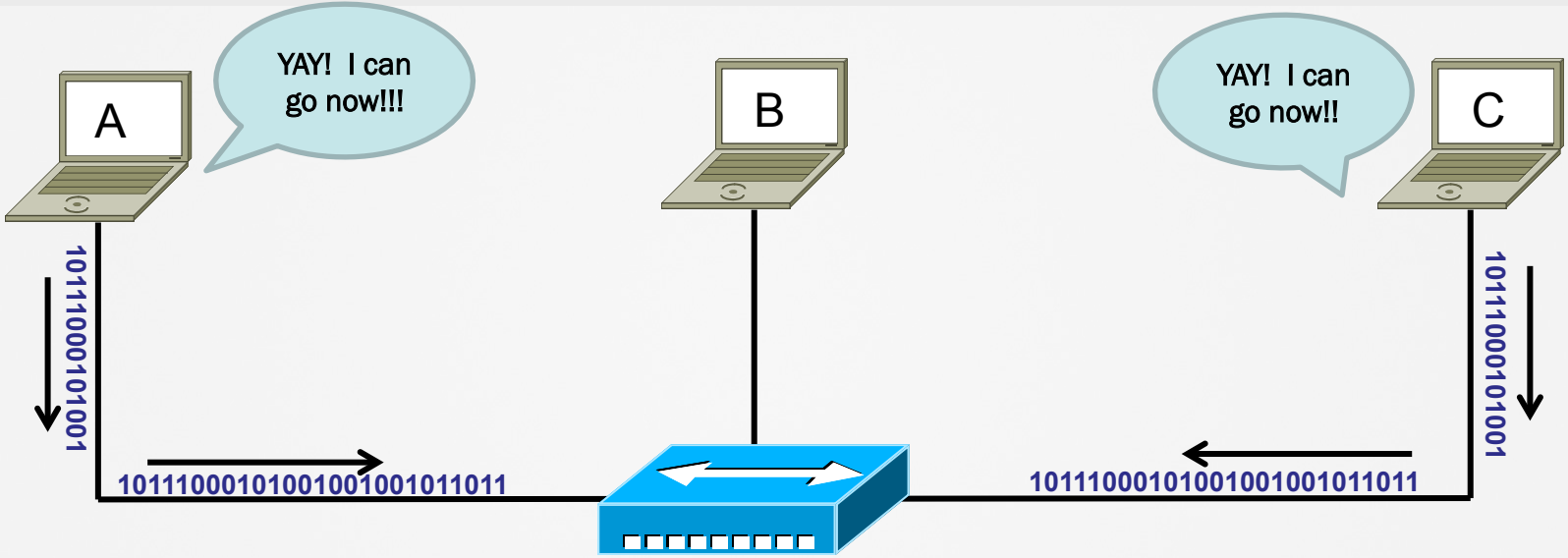
1. PC-A and PC-C both want to transmit.
2. PC-B is transmitting a frame at this time.

CSMA/CD Visualized



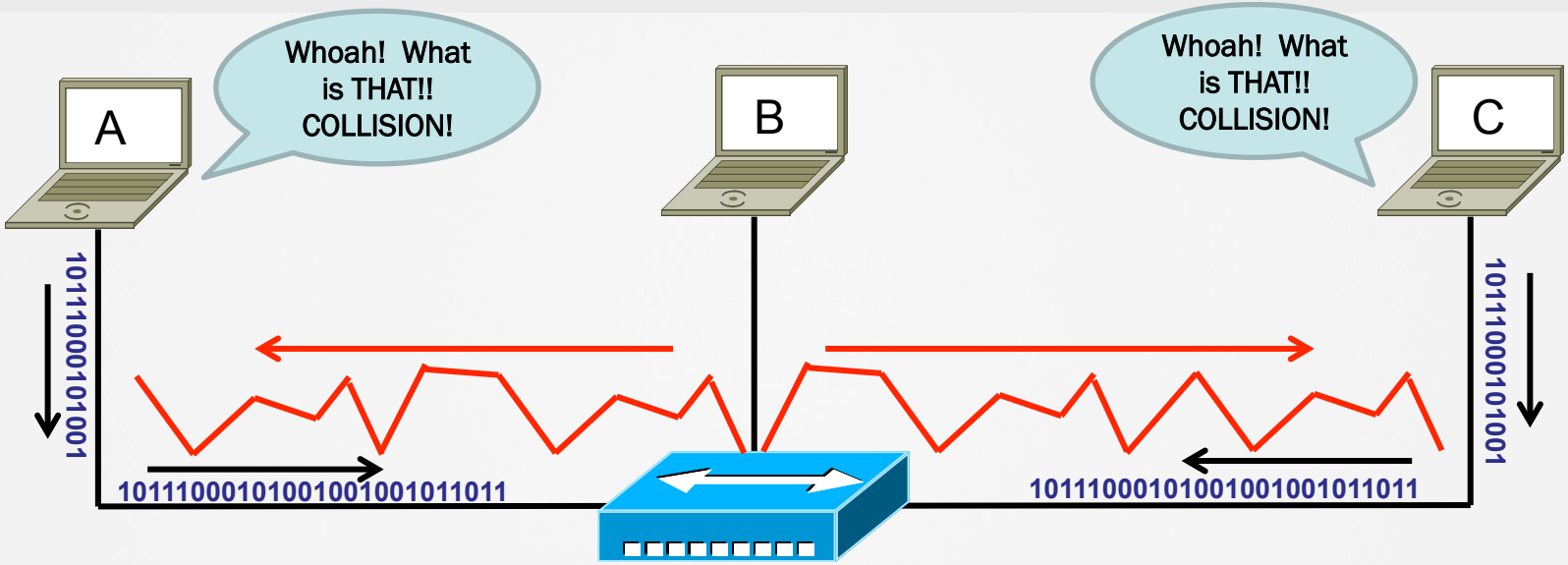
3. PC-A and PC-C place their NICs into "receive-mode" and listen for a carrier.
4. They "Sense" that another device (PC-B) is transmitting…so they continue to listen

CSMA/CD Visualized



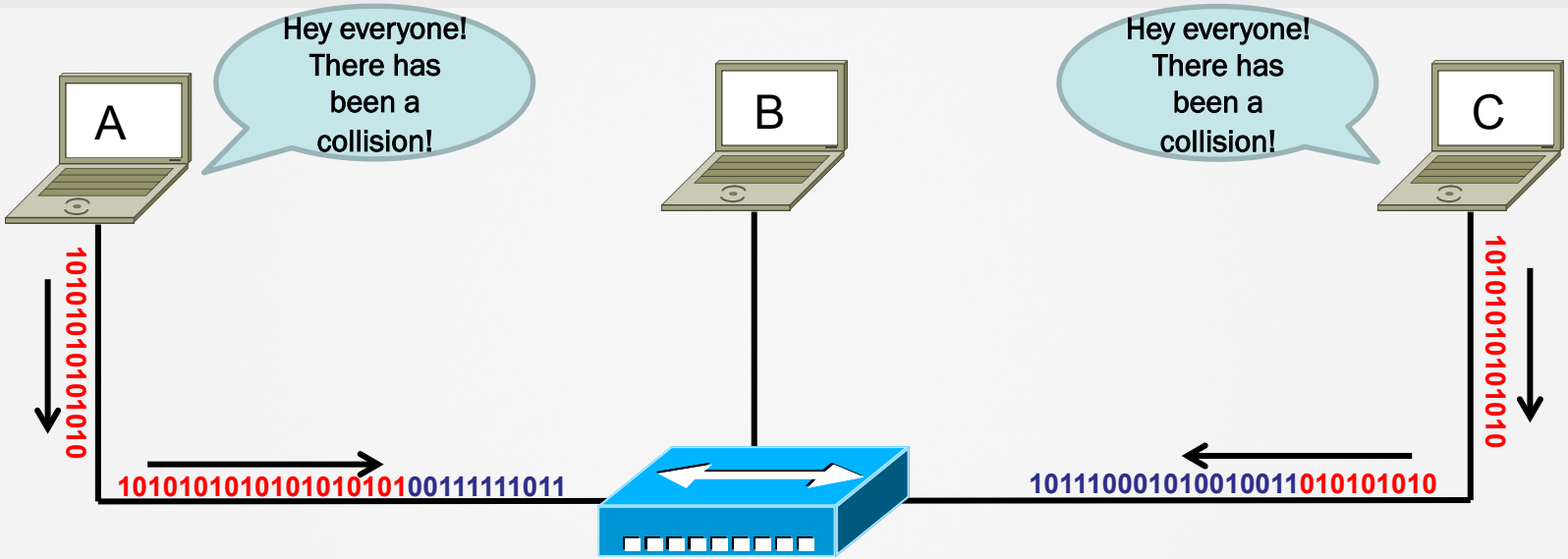
5. At exactly the same time, PC-A and PC-C sense that there is no more carrier, and both transmit their pending frame simultaneously.

CSMA/CD Visualized



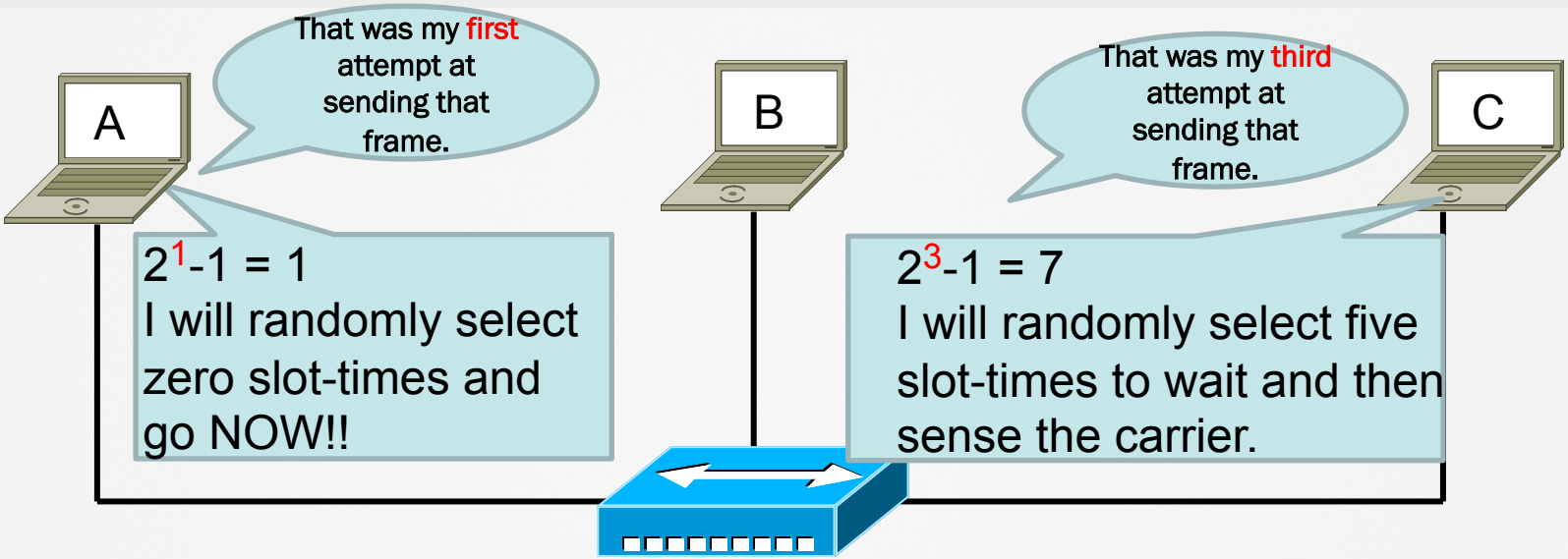
6. The electrical energy “collides” at some point, rendering the 1’s and 0’s illegible.
7. This collision is detected by PC-A and PC-C

CSMA/CD Visualized



8. PC-A and PC-C finish transmission of their frame, replacing the remaining bits with a “Jam Sequence” of 10101010101010101010

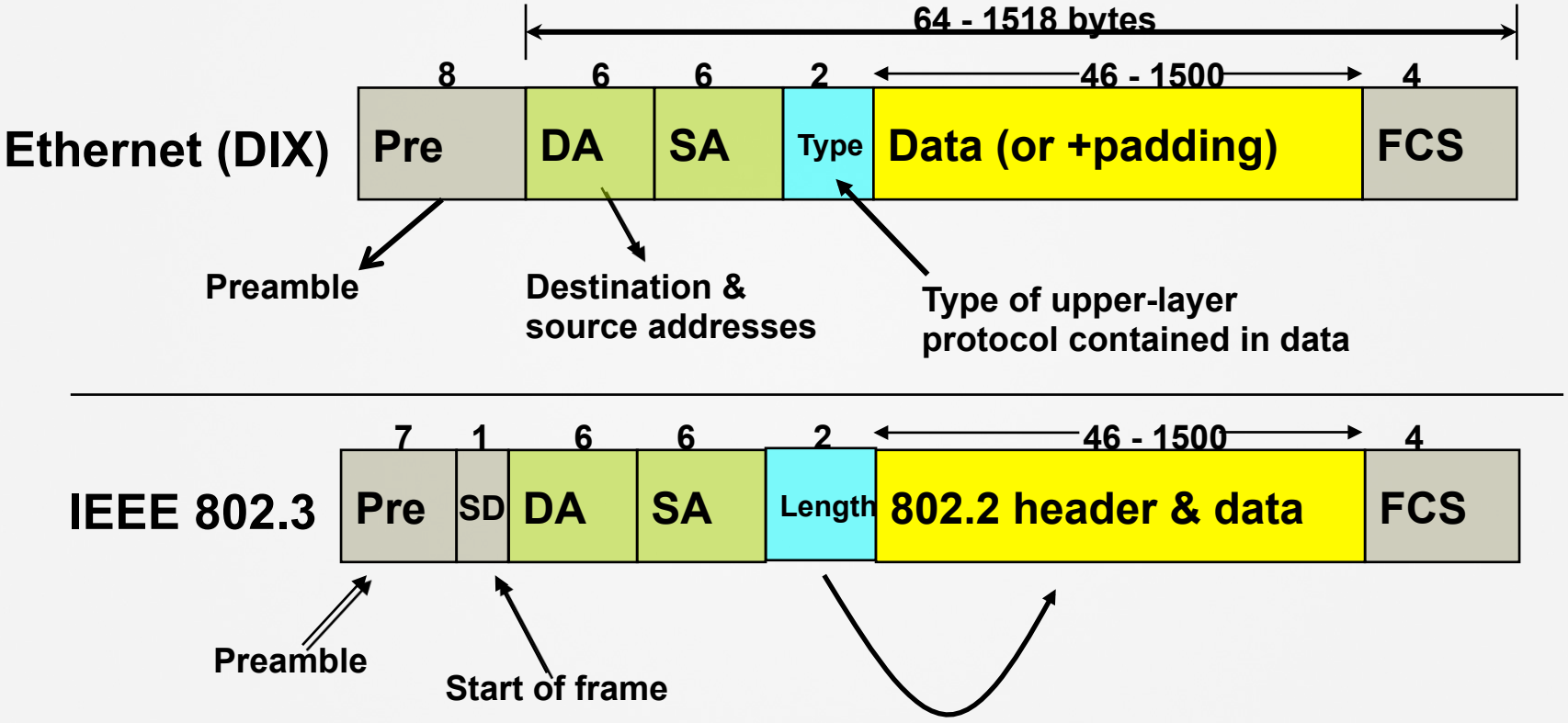
CSMA/CD Visualized



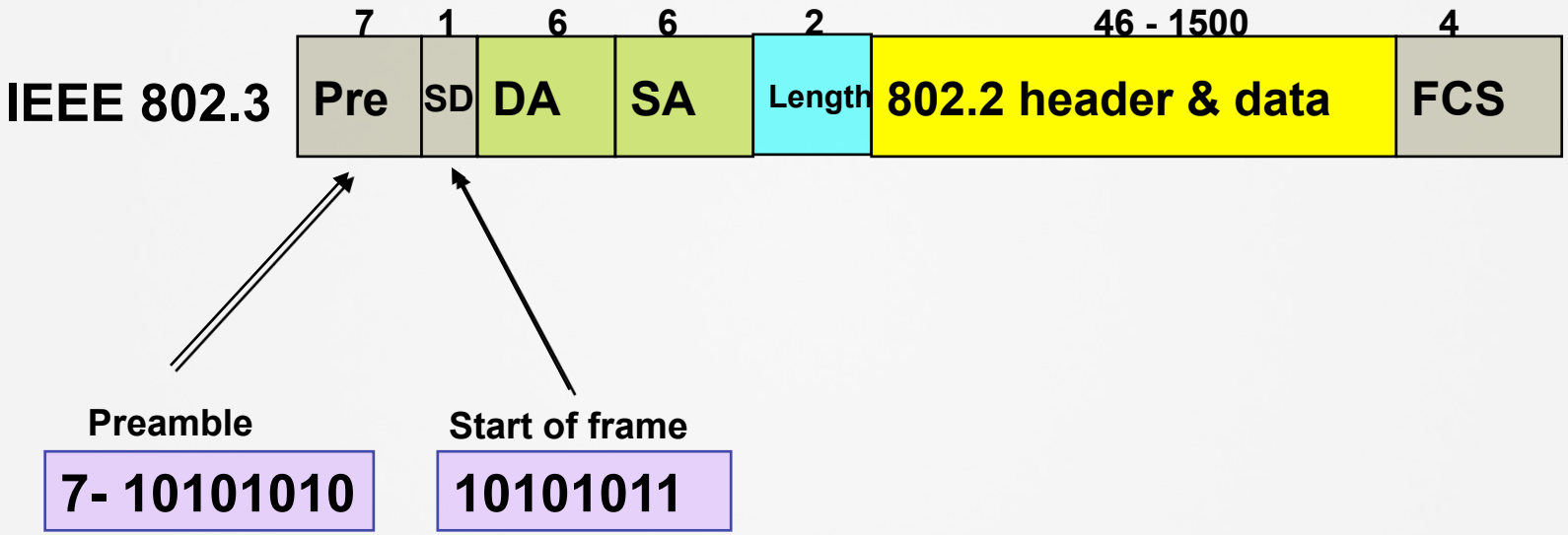
9. PC-A and PC-B wait again, using a Truncated Binary Exponential Backoff algorithm to calculate when they can retransmit again.

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

Ethernet Frame Structure

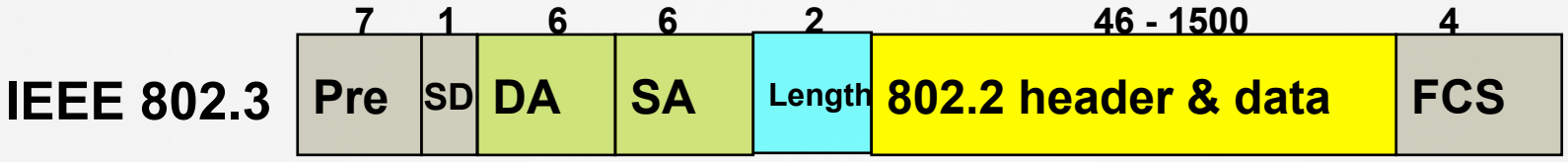


Preamble and Start-of-Frame Delimiter



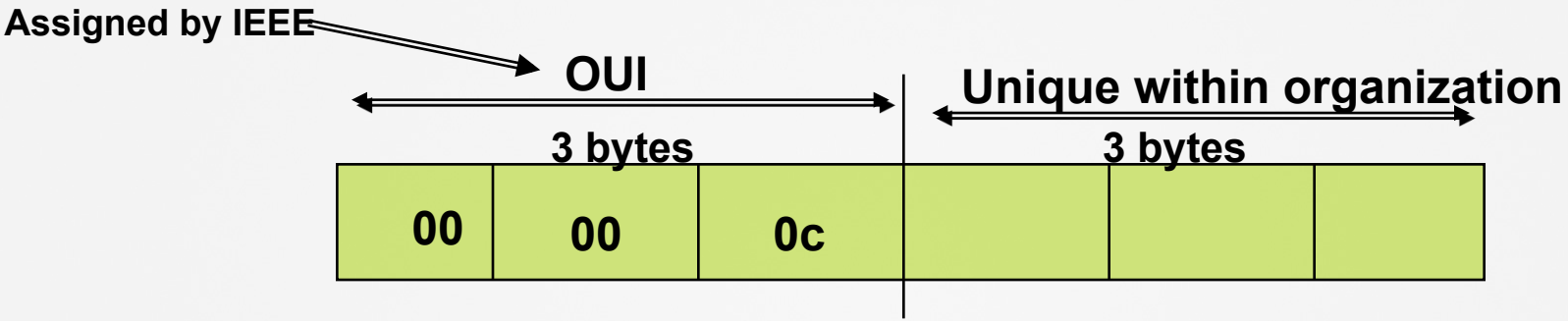
- The 5-4-3 rule

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

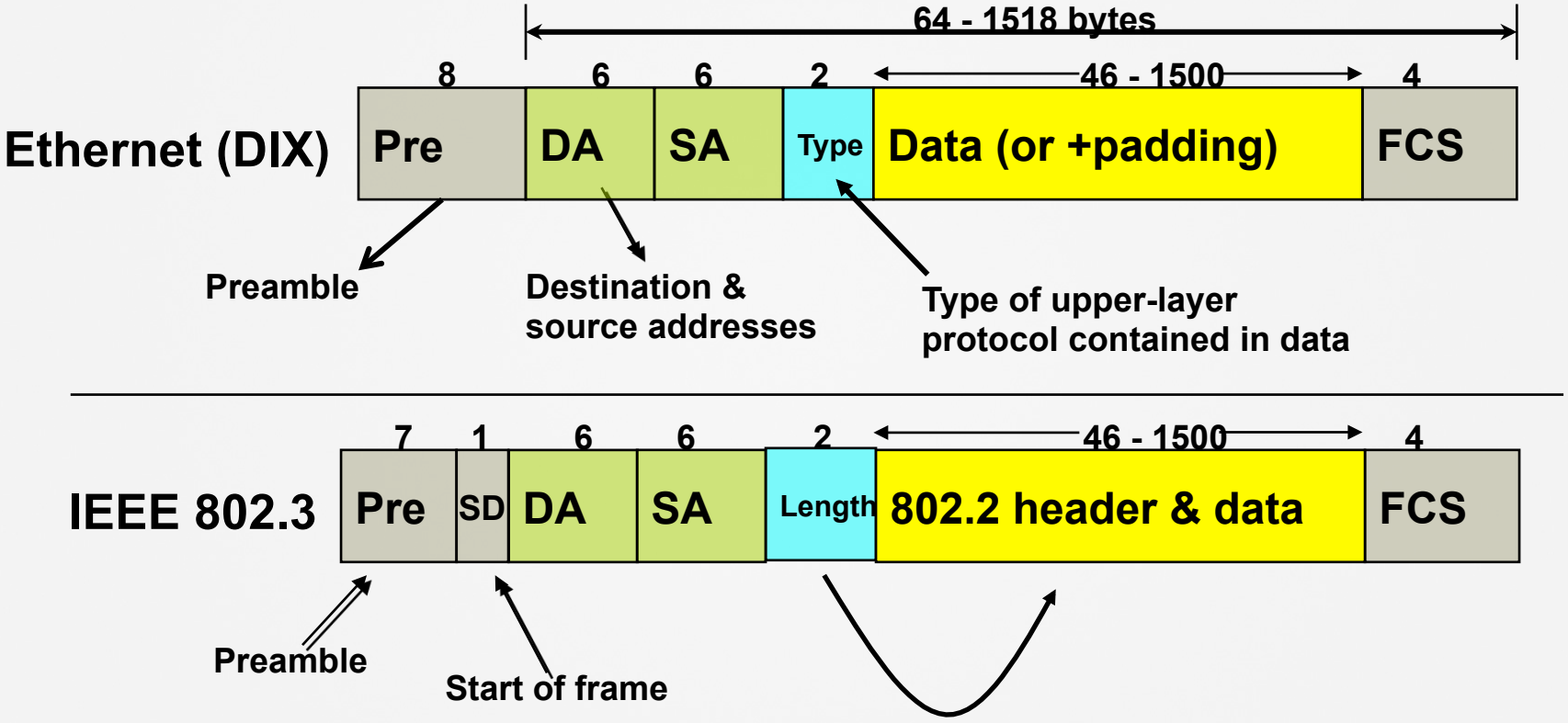
MAC Addresses



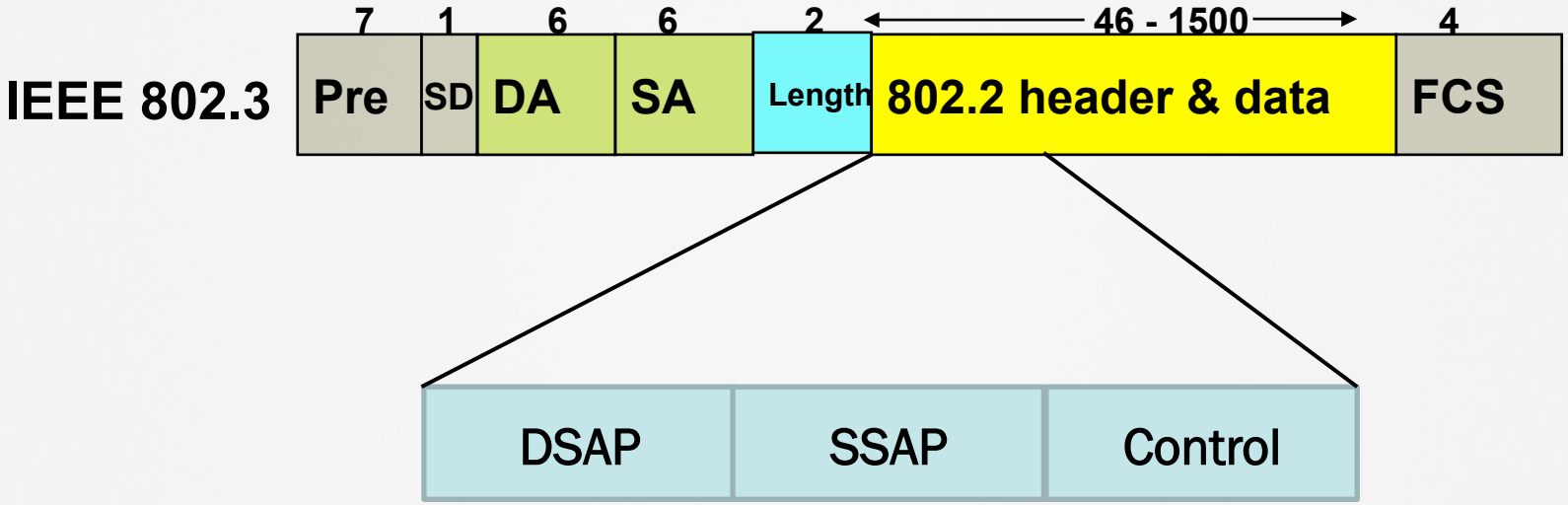
Two bits of 1st byte are very important

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

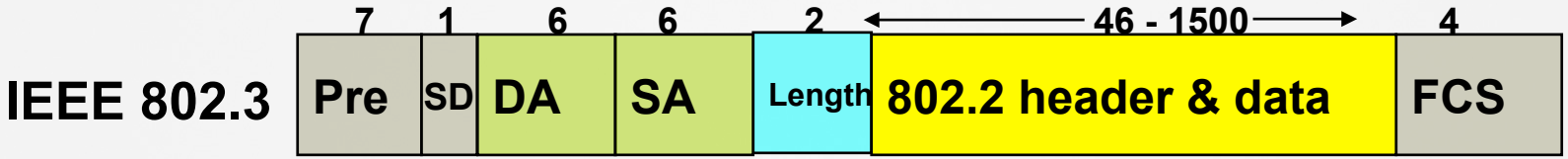
Type and Length Fields



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”

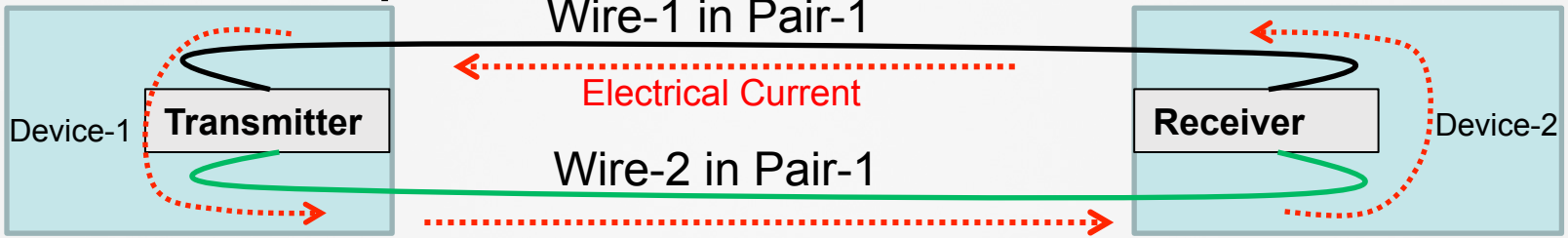
T

Could be a digit or a letter;

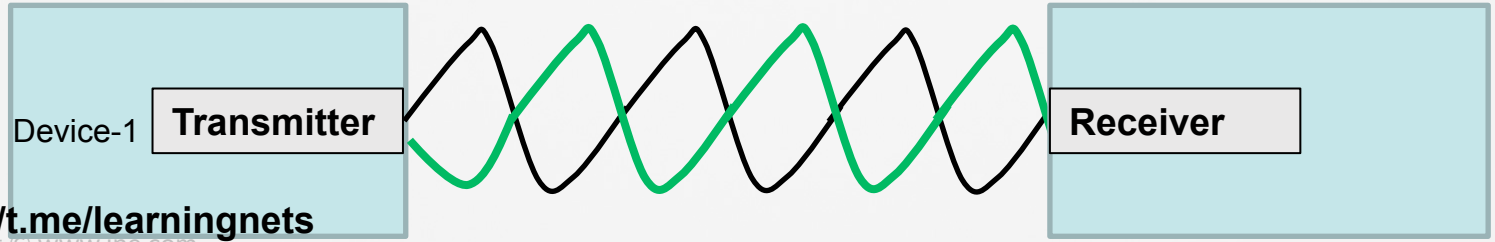
- Digit = max cable length in meters
- Letter = Cable Type

What is “Twisted Pair”?

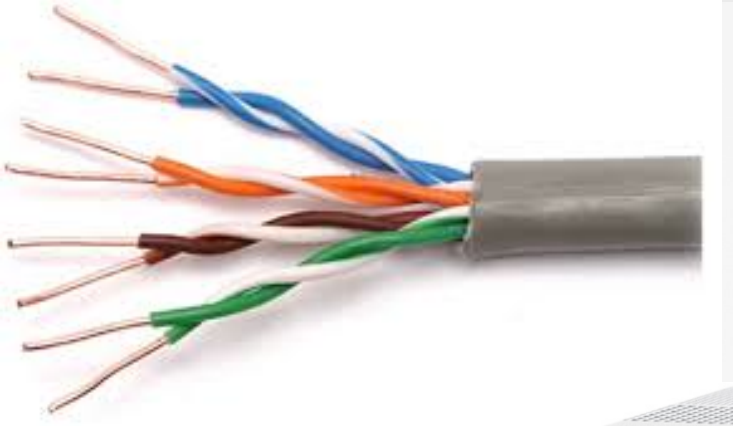
- A pair of copper cables that forms a complete electrical loop.

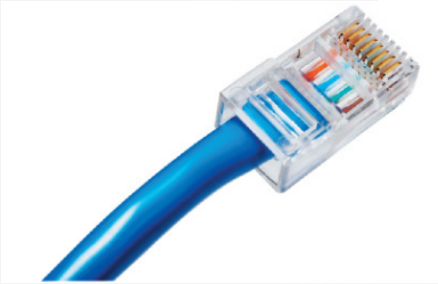


- Each pair of wires is twisted around themselves to prevent EMI.



Color Coding and Connectors





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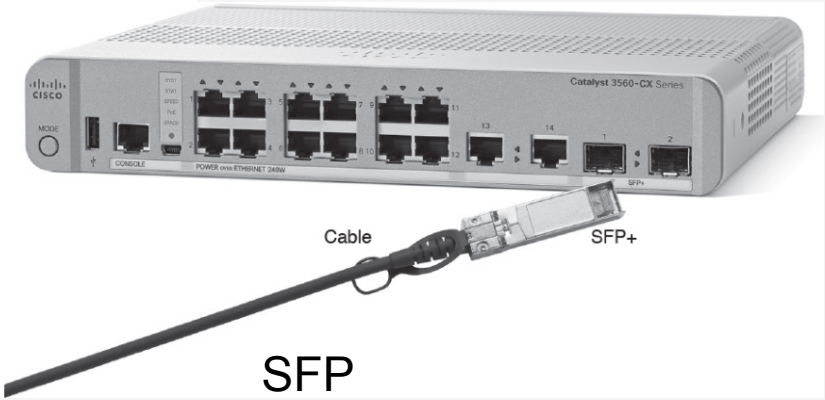
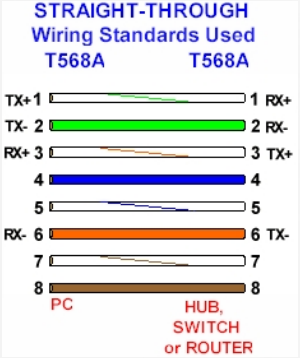


SFP

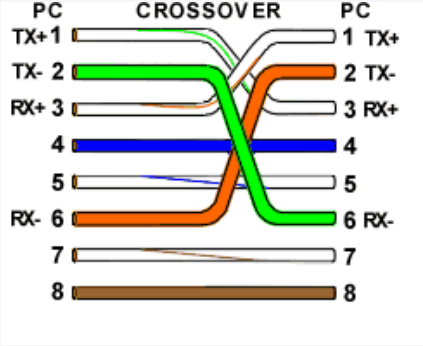
Ethernet Cabling Details

- Twisted-pair cabling comes in three varieties:

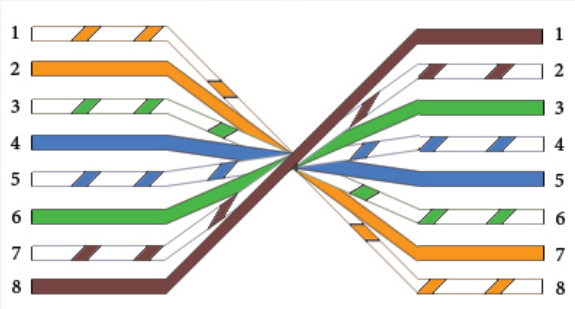
Straight-through



Crossover



Rolled



Questions?