Basic Networking

HDLC--high level data link control--old layer 2 frame protocol--can be synchronous or asynchronous. Nowadays used as the basis for PPP.

FLAG	Address	Control	Data	FCS	FLAG
0x7E 01111110					0x7E 01111110

Frame Check Sequence—error detecting code (calculated very differently but same general idea as a checksum)—uses Cyclic Redundancy Check (CRC) algorithm (often CSC-32, 32 bits)

<u>Control:</u>

- I-frames—information frames (data) –have sequence numbers
- U-frames—unnumbered frames—two examples are RSET (reset the link), FRMR (reject a frame with a bad format)
- S-frames—supervisory frames—can have piggybacked ACKs
    - RR—Receive Ready—receiver is ready to receive more data
    - RNR—Receive Not Ready—receiver is not ready to receive any data
    - REJ—Reject--retransmit frames starting at the given sequence number
    - SREJ—Selective Reject—Retransmit the frame with the given sequence number

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PPP—Point to Point Protocol—layer 2—provides a direct connect between two devices

FLAG	Address	Control	Protocol	Data	Padding	FCS	FLAG
0x7E	0xFF (broadcast)	0x03	PPPID				0x7E

Control field 0x03 indicates a U-frame.

PPP ID field says what kind of packet is being carried—0x0021 for IP, 0x0029 Apple Talk, etc.

Ethernet

Preamble	Start of Frame Delimiter	Destination MAC Address	Source MAC Address	VLAN 802.1Q (optional)	Ethertype	Payload	FCS	12 octets of idle line
Seven octets	10101011							

Preamble = 7 octets = 10101010 10101010 10101010 10101010 10101010 10101010 10101010

Some selected Ethertype values:

- 0x0800—IP v4
- 0x0806—ARP—Address Resolution Protocol
- 0x86dd—Ipv6
- 0x8847—MPLS unicast
- 0x8848—MPLS multicast
- Among several others

MAC addresses

- EUI-48—Extended Unique Identifier-48 bits—6 octets
    - Example: 00:25:96:12:34:56
- EUI-64—Extended Unique Identifier-64 bits—8 octets
    - Example: 00:25:96:FF:FE:12:34:56

Manufacturers buy ranges of MAC addresses from the IEEE.
MAC addresses in virtual devices are automatically generated.

Collision Domains:

- Collision—if two Ethernet devices on the same wire start transmitting at the same time, then they detect a collision
    - In a wired setup, the collision is detected using CSMA/CD-Carrier Sense Multiple Access/Collision Detection.

    - in a wireless (wi-fi) setup a collision is detected when a frame is not acknowledged.
    - When they detect a collision they wait a random amount of time and retry.

- In the past multiple Ethernet devices were connected to a single coaxial cable, so collisions were common.
    - Collisions are rare in a wired setup nowadays because now devices are typically connected direct to a switch using a twisted pair.
    - Twisted pair is used point-to-point and does not have mid cable attachments.
    - Collisions can still commonly happen in a wireless setup, such as wi-fi.

- A "Collision domain" is a single Ethernet network segment.

<u>Ethernet Standards:</u>

- Wired Ethernet standards—IEEE 802.3 (there are several variants, for example, in 1999 IEEE 802.3ab was defined: 1000BASE-T Gbit/s Ethernet over twisted pair at 1 Gbit/s.
- Wi-fi—IEEE 802.11 (there are several variants, for example, in 2012 IEEE 802.11ad is an defines a new physical layer to operate in the 60 GHz millimeter wave spectrum.

100BASE-T means 100 megabits per second over twisted pair

100BASE-TX means 100 megabits per second over category 5 (or better)

1000BASE-T means 1 gigabit per second (1000 Megabits per second) over twisted pair

1000BASE-X means 1 gigabit per second (1000 Megabits per second) over optical fiber (there are several variants based primarily on transmission type, distance, and optical fiber type: one example is 1000BASE-LX which uses a long wavelength laser for up to 5 kilometers over 10 μm single-mode fiber.

RJ45 is the type of connector/wall jack used for twisted pair Ethernet.
