ASSEMBLING THE BITS

Understanding using the OSI model

Frames

- Bits are the reference units used at the physical layer, once entering a device they are grouped according to a predefined protocol to be read and processed
- Ethernet standards define the Ethernet Frame format for reading received bits
- A frame begins with a preamble and a frame start delimiter, and is followed by addressing information, the center of the frame contains the payload, followed by a 32 bit CRC value

Frames

- Data on Ethernet is transmitted most-significant byte first (left most byte).
- Within each byte, however, the least-significant bit is transmitted first (right most bit).

Preamble	Start of frame delimiter	MAC destination	MAC source	802.1Q tag (optional)	Ethertype (Ethernet 2) or length (802.3)	Payload	Frame check sequence (32bit CRC)	Interframe gap
7 octets	1 octet	6 octets	6 octets	(4 octets)	2 octets	42-1500 octets	4 octets	12 octets

Preamble and SFD

- The preamble and Start frame delimiter form a serie of special predefined octal values that enable communication synchronization

- Also referred to as the Syncword, it enables devices to spot the beginning of a Frame.

  - the on-the-wire bit pattern for this portion of the frame is 10101010 10101010 10101010 10101010 10101010 10101010 10101010 10101011

Frame Addressing

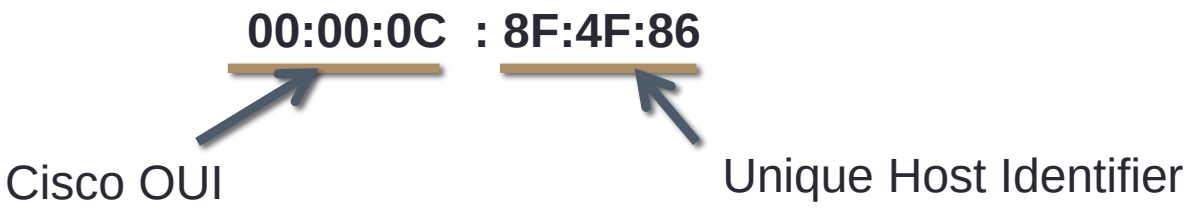
- The Destination MAC address is the first information contained in the Frame header, this uniquely identifies the destination.
- Followed with the Source MAC address identifying where the information originated.
  - MAC (Media Access Control) addresses are 48-bit values hard coded (burnt on) into the device's chip
  - Each Ethernet compliant device must own a world unique MAC address to be able to communicate

MAC Addresses

- Each device's Ethernet adapter card has a 48-bit (6 octet) address built in to the module that uniquely identifies the station. This is called the Media Access Control (MAC) address, or the hardware address.
  - Devices express MAC addresses as hexadecimal values.
    - Sometimes MAC address octets are separated by hyphens - sometimes by colons : and sometimes periods . The three following formats all specify the same host:
      - **00-00-0C-8F-4F-86**
      - **00:00:0C:8F:4F:86**
      - **0000.0C8F.4F86**

MAC Addresses Cont'd

- To help ensure uniqueness, the first three octets indicate the vendor who manufactured the interface card.
  This is known as the Organizational Unique Identifier (OUI). Each manufacturer has a unique OUI value that it acquired from IEEE, the global administrator for OUI values.
- The last three octets of the MAC address equate to a host identifier for the device.
  They are locally assigned by the vendor.
- The combination of OUI and host number creates a unique address for that device.
- Each vendor is responsible to ensure that the devices it manufactures have a unique combination of 6 octets.



MAC Addresses Cont'd

- Each device is aware of its own MAC address, and constructs a table containing the MAC addresses of the destination its been to.
- Upon receiving and reconstructing a frame, a device reads the destination MAC address first to determine if the message is destined to it or not
- If the device is the destination, the frame gets passed on for further processing, if not it is discarded

Ethertype & Payload

- EtherType is a two-octet field in an Ethernet frame. It is used to indicate which protocol is encapsulated in the payload of an Ethernet Frame.

EtherType	Protocol
0x0800	Internet Protocol, Version 4 (IPv4)
0x0806	Address Resolution Protocol (ARP)
0x0842	Wake-on-LAN Magic Packet
0x8035	Reverse Address Resolution Protocol (RARP)
0x8100	VLAN-tagged frame (IEEE 802.1Q) & Shortest Path Bridging IEEE 802.1aq
0x814C	Simple Network Management Protocol (SNMP)
0x86DD	Internet Protocol, Version 6 (IPv6)

- The minimum payload is 42 octets when 802.1Q tag is present and 46 octets when absent, the maximum payload is 1500 octets.

Frame Check Sequence & Gap

- The frame check sequence is a 4-octet cyclic redundancy check which allows detection of corrupted data within the entire frame.

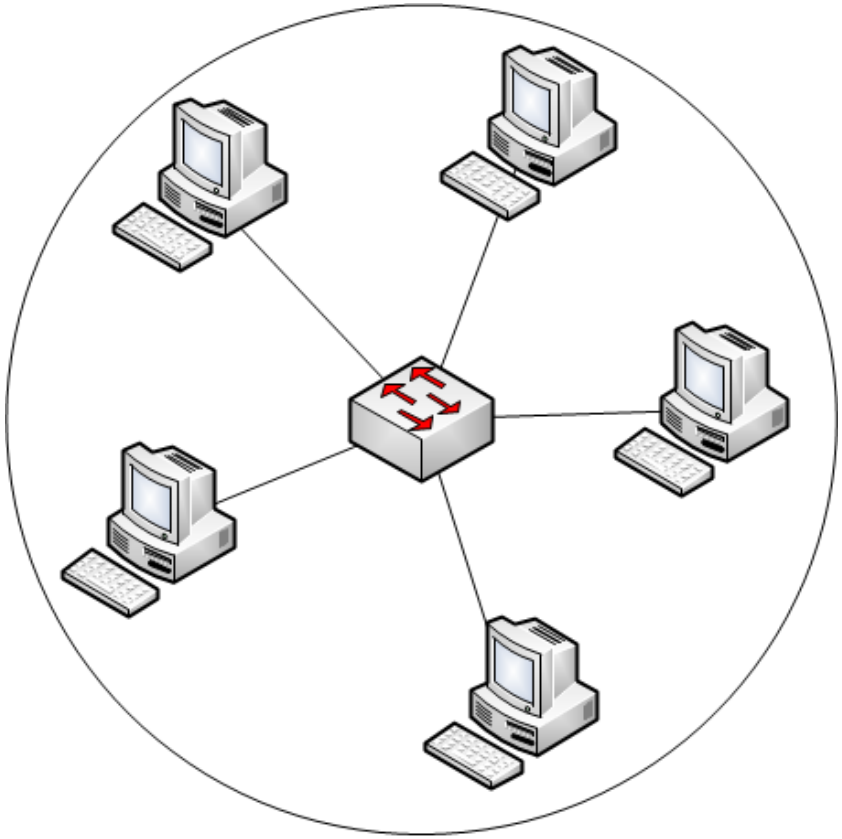
- The interframe gap is an idle time between frames. After a frame has been sent, transmitters are required to transmit a minimum of 96 bits (12 octets) of idle line state before transmitting the next frame.

Broadcast Domain

- Frames enable devices to communicate with each other by addressing them selves by hardware addresses,
  - How far a part can devices be whilst still being able to talk ?
  - With humans, direct communication is only possible within the same room,
  - With network devices, direct communication is only possible within the same “virtual room” which we call broadcast domain
- The Broadcast domain is, by analogy, if I shout how far away you can be and still communicate with me, if you leave the “room” / network we can no longer directly communicate

Broadcast Domain Cont'd

- Every device in the same broadcast domain can directly communicate with one another



Single Broadcast domain