# The Ethernet Frame Format

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
<th>Bit Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>preamble</td>
<td>Pre-packet signal</td>
<td>64 bit</td>
</tr>
<tr>
<td>Destaddr</td>
<td>Destination Address</td>
<td>48 bit</td>
</tr>
<tr>
<td>Srcaddr</td>
<td>Source Address</td>
<td>48 bit</td>
</tr>
<tr>
<td>Type</td>
<td>Frame Type</td>
<td>16 bit</td>
</tr>
<tr>
<td>Body</td>
<td>Data</td>
<td>32 bit</td>
</tr>
<tr>
<td>CRC</td>
<td>Cyclic Redundancy Check</td>
<td>32 bit</td>
</tr>
</tbody>
</table>

- **7 byte preamble**
- **1 byte SFD**
- **Length of the data part**
Ethernet Frame Format

- Data in each frame – maximum 1500 bytes, minimum 46 bytes
- Bit oriented protocol
- Ethernet frame: 14 bytes
  - header (6 byte dest + 6 byte src + 2 byte type)
- Adapter – attaches preamble, CRC, postamble before transmitting and receiving adapter, removes them
Ethernet Frame Format

• Every ethernet host has a unique address
  – 48 – bit address:
  – Example: 8 : 0 : 2b : e4 : b1 : 2
  – 4 bit nibbles
  – each manufacturer of Ethernet device is allocated a fix prefix (24 bit)
    – Example: AMD: 24 bit 8 : 0 : 20
  – manufacturer ensures suffix is unique
  – frame transmitted is received by every adapter connected to Ethernet
Adapter Functions

- adapter recognises frame meant for itself passes to host (unicast address)
- adapter runs in promiscums mode
  - listen to all frames
  - adapter must be programmed to do this
- adapter accepts frames with multicast address
  - provided adapter has been programmed to listen that address
Adapter Functions

- No centralised control
- Two station begin transmitting at the same time
- Each sender can detect collisions – receiver detects collision sends
- A 32 bit jamming sequence is sent to indicate a collision
Ethernet Conventions

- **Minimal transmission:**
  - 64 bit + 32 = 96 bit
- **Preamble jamming sequence**
- **To ensure frame did not collide with another send**
  - 14 bytes header + 46 bytes data + 4 byte CRC = 512 bits
Ethernet Example

- 2500 m + 4 repeaters
- 10 Mbps – delay 51.2 μs
- = 512 bits
- collision detected –
  - use binary exponential backoff
- First: 0, 51.2 μs
- Second: 0, 51.2, 102.4 μs
Ethernet Conventions

• **Collision again**
  • wait \( k \times 51.2 \ \mu s \)
  • for \( 0, 2^3 - 1 \)
  • randomly select \( k \) between \( 0 - 2^n - 1 \)
  • \( n \) – number of collision experienced
  • retry upto 16 times
Popularity of Ethernet

- 200 hosts / NW
- Most Ethernets shorter than 2500 m
  - delay 5 $\mu s$ rather than 51.2 $\mu s$
- No routing
- No configuration
- Easy to add new hosts
- Cable cheap, adapter cheap – switch based approaches expensive
Ethernet: Overhead: Collision detection

Contention detection: Depends on propagation delay
Ethernet: Collision detection

A

B

A

B Transmits
Ethernet Analysis

• B detects collision
  – sends jammer to A
  – Jammer takes $2a$ time to reach A

• frame size 1

• $2a$ – end to end propagation delay

• CSMA / CD : medium organised as slots
  – length is $2a$
Ethernet Analysis

• slot time - max time from start of frame to detect collision = $2a$.

• CSMA analysis: Assumptions
  – infinite population
  – Poisson arrival
  – unslotted non persistent
  – fixed frame size
Ethernet Analysis

\[ P[success] = e^{-aG} \]

Offered Load \( S = Ge^{-aG} \)

a is the propagation delay

Frame time is 1
CSMA – \( p \)-persistent

- Station acquires a slot
- \( p \)- probability of transmission during a slot
- Let \( k \) be the number of stations
- The probability that only one station transmits in a slot is
- \[ P = kp(1-p)^{k-1} \]
CSMA – $p$-persistent

- Mean length of contention interval

\[ E[(i-1) \text{ collision slots followed by a success}] \]

\[ = \sum_{i=1}^{\infty} iP^{i-1}(1-P) \]

\[ = \sum_{i=1}^{\infty} i(1-A)^{i-1} A \]

\[ = \frac{1-A}{A} \text{ slots} \]
Efficiency

\[
\text{time in slots for transmitting data} = \frac{1}{2a}
\]

\[
\text{Utilisation} = \frac{1}{\frac{2a}{1} + \frac{1 - A}{A}}
\]

\[
k \rightarrow \infty, A \rightarrow 1/e
\]

\[
\text{Utilisation} = \frac{1}{1 + 3.44a}
\]
Timing Diagram

Transmission interval $\frac{1}{2a}$ slots

Sequence of slots with no transmission or collision