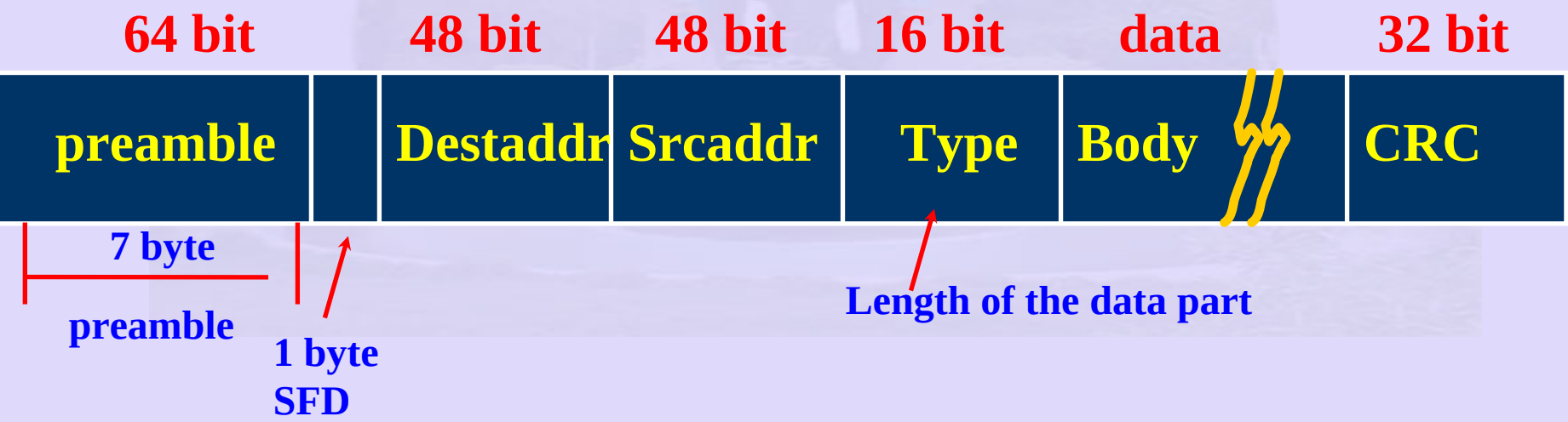
The Ethernet Frame Format



Ethernet Frame Format

- Data in each frame – maximum 1500 bytes, minimum 46 bytes
- Bit oriented protocol
- Ethernet frame: 14
- 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

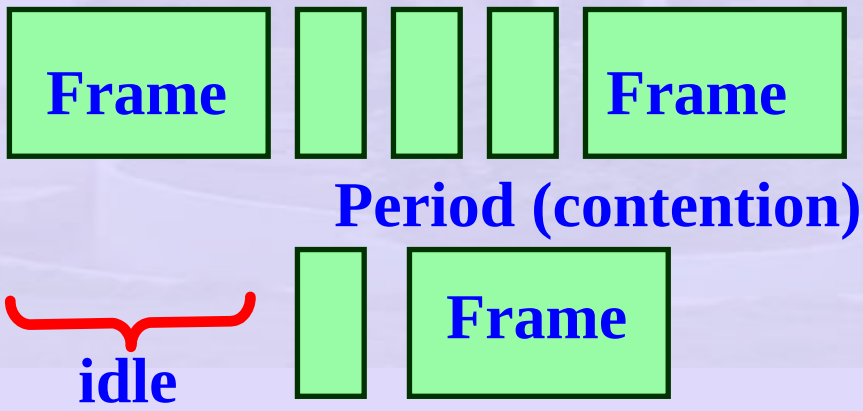
Ethernet Conventions

- **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

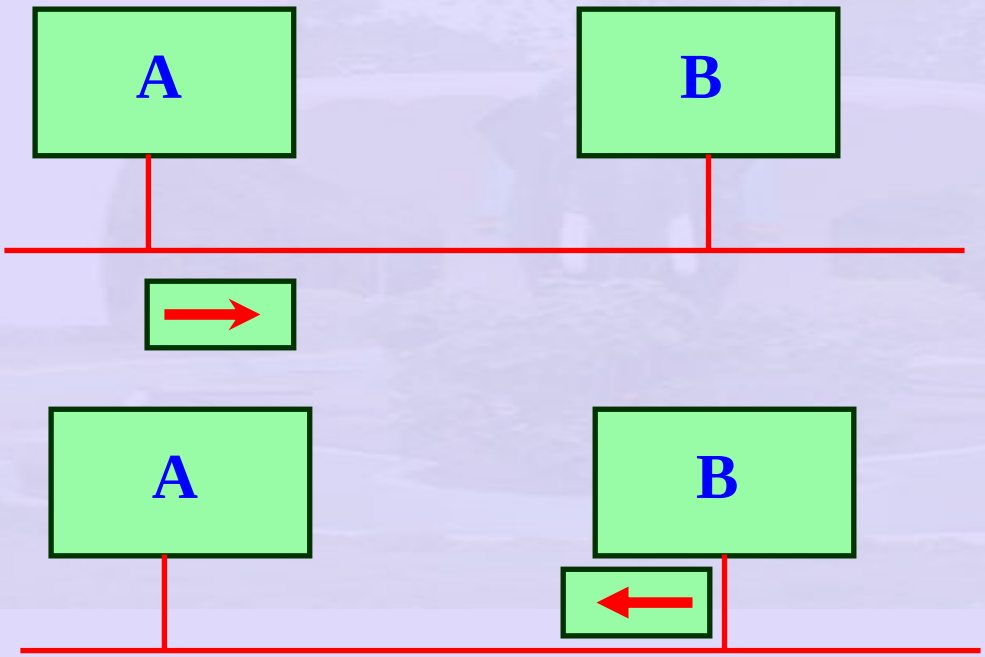
- 200 hosts / NW
- Most Ethernets shorter than 2500 m
  - delay 5 μs rather than 51.2 μs
- No routing
- No configuration
- Easy to add new hosts
- Cable cheap, adapter cheap – switch based approaches expensive

Ethernet: Overhead: Collision detection



Contention detection: Depends on propagation delay

Ethernet: Collision detection



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) collision slots followed by a success]

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

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

$$= \frac{1-A}{A} \; slots$$

Efficiency

$$time\ in\ slots\ for\ transmitting\ data\ = \frac{1}{2a}$$

$$Utilisation = \frac{\frac{1}{2a}}{\frac{1}{2a} + \frac{1-A}{A}}$$

$$k \to \infty, A \to 1/e$$

$$Utilisation = \frac{1}{1+3.44a}$$

Timing Diagram

Transmission interval 1/2a slots

Sequence of slots with no transmission or collision