Error Detection on Ethernet

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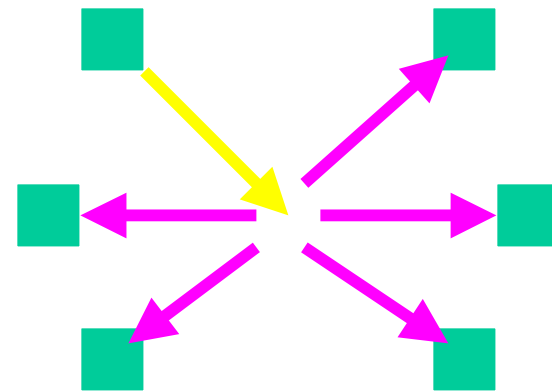**Illinois Institute of Technology**

Presentation for U. of Cincinnati- Raymond Walter College

Presentation Outline

- Medium Access Control

- IEEE 802.3 CSMA/CD

- Collision detection

- Frame format

- Bit error detection & CRC

- Summary for Ethernet

Medium Access Control (MAC)

- Uses in broadcast networks: e.g. LANs
- Key issue: How to determine who gets to use the channel

- If only one channel is available for multiple users, channel allocation protocol must be carefully studied.
- Referred to as Multiaccess channels, random access channels

FRAME COLLISION

collision

t_0 $t_0 + t$ $t_0 + 2t$ $t_0 + 3t$

Vulnerable period
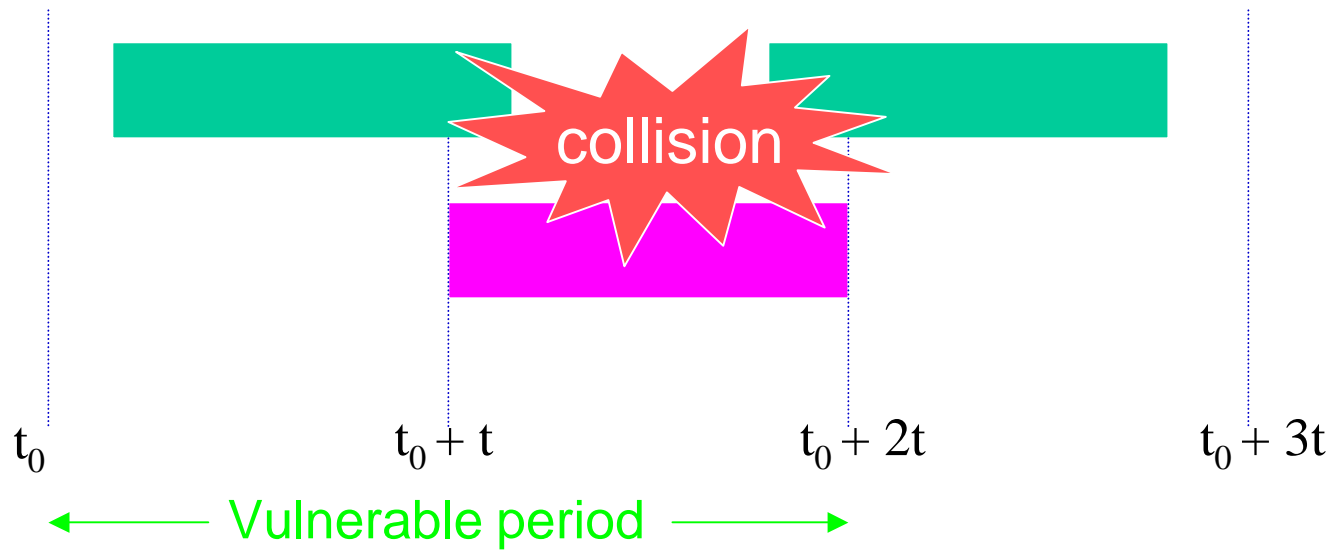
CSMA/CD

- Carrier Sense Multiple Access with Collision Detection
- No predictable or scheduled time for any station to transmit
  ⇨ station transmissions are ordered randomly
- Early techniques for random access: ALOHA, slotted ALOHA
- CSMA
  - 1. If the medium is idle, transmit (immediately).
  - 2. If the medium is busy, continue to listen until the channel is sensed idle.
  - If two or more stations are waiting to transmit, a collision is unavoidable.
- CD
  - 3. If a collision is detecting during TX, transmit a brief jamming signal and then cease transmission.
  - 4. After sending jamming signal, wait a random amount of time (repeat from step 1).
- Advantage with CD
  - Shorten the damaged frames' transmission time.
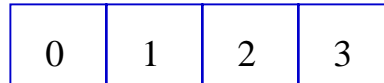
CSMA/CD Operation

station
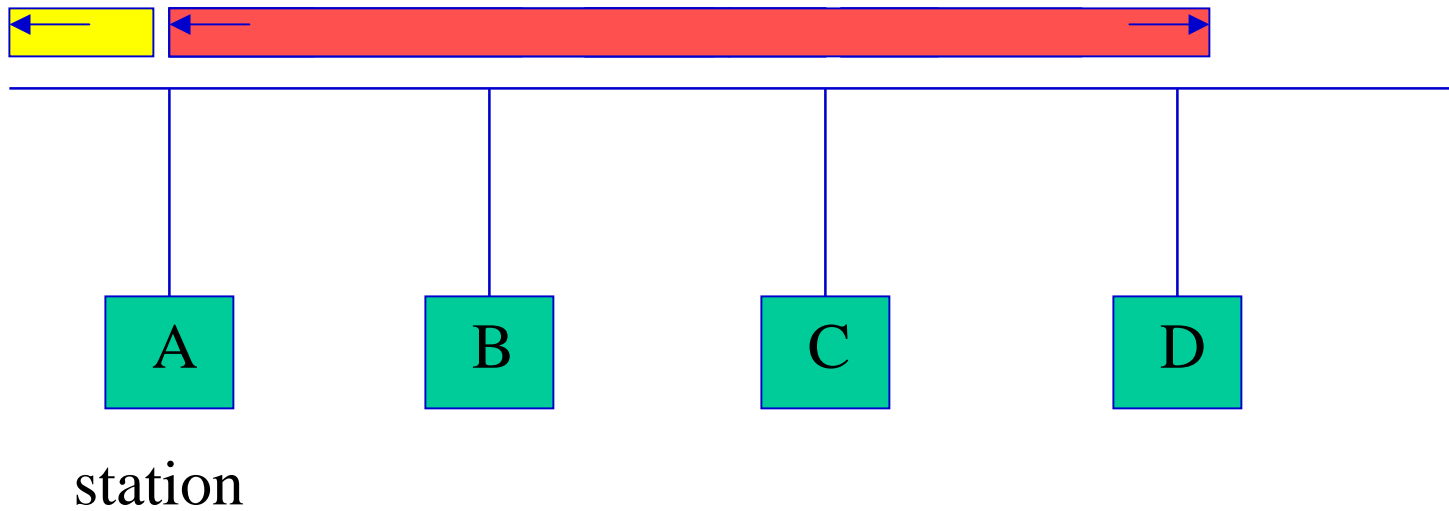
IEEE 802.3 & Ethernet

• Xerox PARC built a 2.94 Mbps CSMA/CD system (1976).

• Xerox, DEC, and Intel drew up a standard for a 10 Mbps Ethernet.

• This standard formed the basis for 802.3.

• Minor differences exist between Ethernet and 802.3:

  e.g: 10 Mbps fixed speed vs. 1-10 Mbps,
        frame header indication

Binary Exponential Backoff Algorithm

- How to decide random amount of waiting time after collision.
- After collision, slot time is applied.
    e.g: 2.5 km network span has 51.2 μsec
- The i th collided station picks random slot between 0 and $2^i - 1$

0	1

0	1	2	3

0	1	2	3	4	5	6	7

0	1	2	3	•••	•••	1022	1023

GIVE UP

Frame Format

| Preamble | | Dest address | Source address | | Pad or Data | FCS |

Frame check sequence
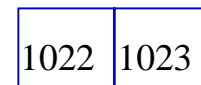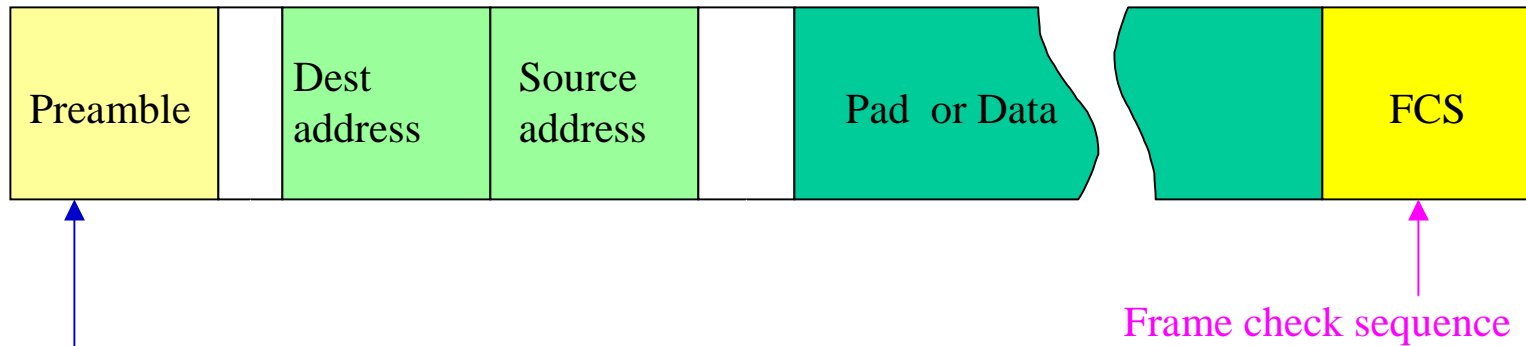
To allow the receiver's clock to synchronize with sender's: 10101010...

Maximum frame size: 1518 bytes (6 + 6 + 2 + 1500 + 4)

* excluding preamble and SOF

Bit Error Detection (1)

• Uses CRC (Cyclic Redundancy Code)

Polynomial Code: K bit frame is represented to polynomial with k terms.
x^{k-1} to $x^0 \Rightarrow$ can be said to be of degree k - 1.
e.g: $110001 \Rightarrow x^5 + x^4 + x^0$

Generator polynomial G(x): code agreed between TX and RX.
Both high and low order bits must be 1.

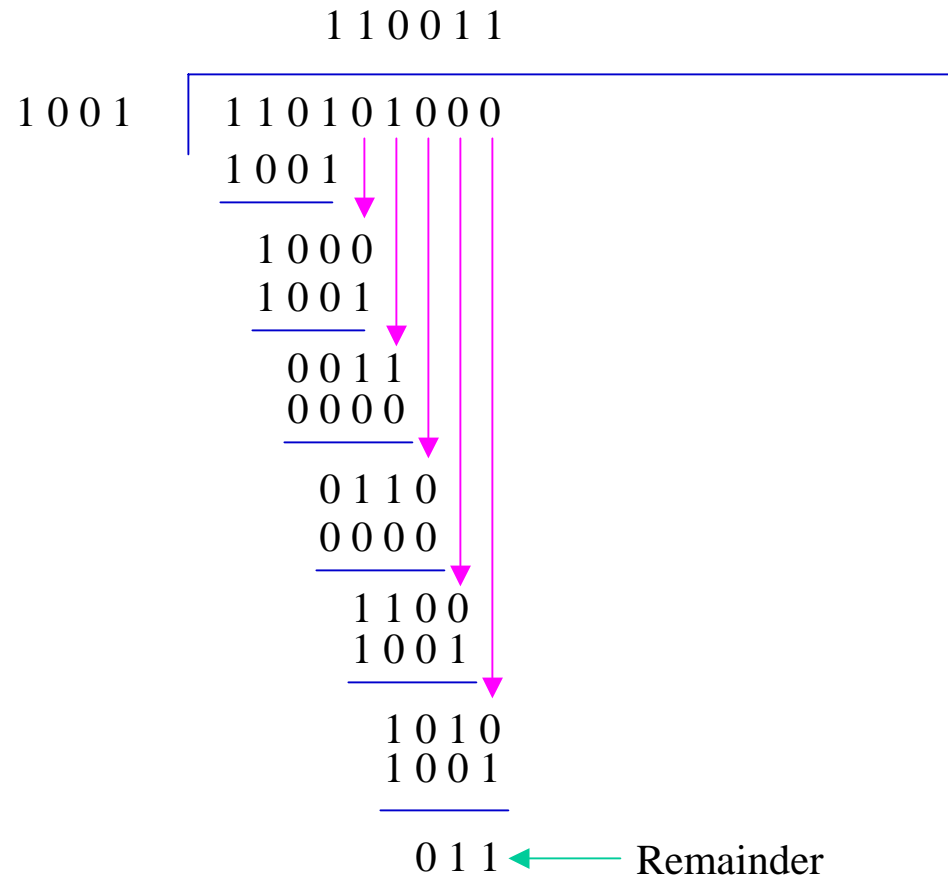Message polynomial M(x): frame poly + r zero bits
r = 1 bit less than G(x)

Transmitted frame = frame bit + {M(x) $\oplus$ G(x)} : Remainder

Bit Error Detection (2)

Frame: 110101

Generator: 1001

M(x): 110101000

```
                          1 1 0 0 1 1
          1 0 0 1   | 1 1 0 1 0 1 0 0 0
                      1 0 0 1
                      ─────
                        1 0 0 0
                        1 0 0 1
                        ─────
                          0 0 1 1
                          0 0 0 0
                          ─────
                            0 1 1 0
                            0 0 0 0
                            ─────
                              1 1 0 0
                              1 0 0 1
                              ─────
                                1 0 1 0
                                1 0 0 1
                                ─────
                                  0 1 1  ◄──────  Remainder
```

Transmitted frame: 110101000011

Summary

- Ethernet is currently the most popular LAN systems.

- It has MAC sublayer and CSMA/CD protocol.

- It listens medium status and detects idle or busy status.

- When the channel is idle, data ready stations immediately transmit data.

- If a collision is detected, stations stop transmission and waits a random amount of time with binary backoff.

- LLC layer manages bit errors with CRC and the receiver requests retransmission to the sender for error frame.