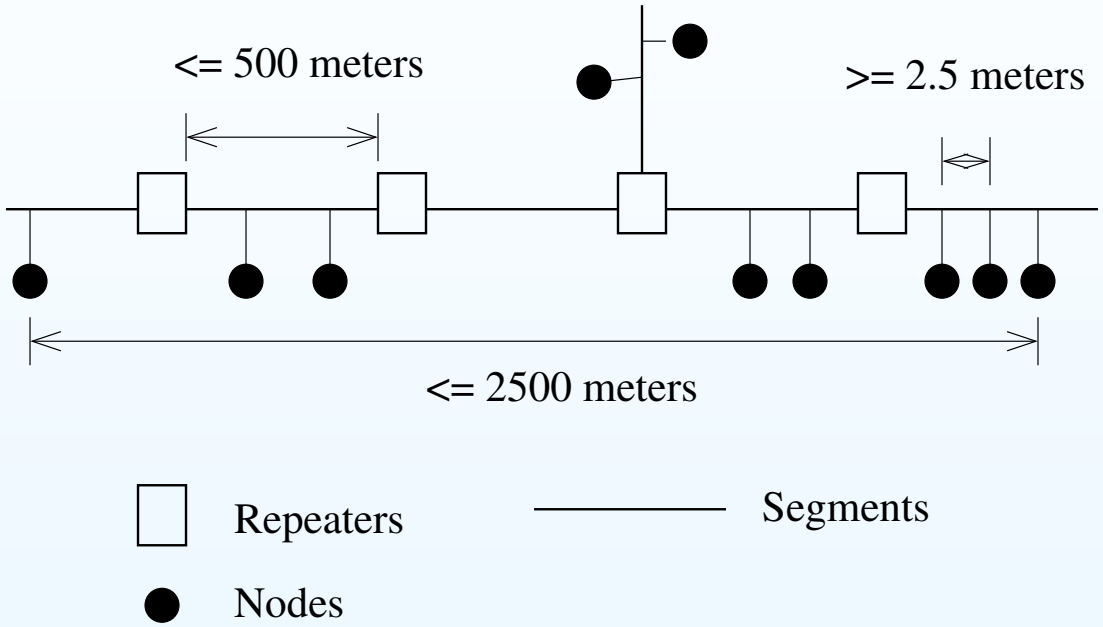
# CSMA/CD Networks

- Ethernet is a standard for a specific type of Carrier Sense Multiple Access with Collision Detection network.
- Most Ethernets are actually IEEE 802.3 networks.
- An Ethernet network uses contention to allocate the capacity between nodes connected on a bus topology network.
- Advantages are minimal control, low overhead and high scalability.
- The **signaling method** uses Manchester encoding with +0.85 for high and -0.85 for low.
- The **physical media** uses 10Base5 coaxial cable with
  - 500 meter segments
  - 2500 meter total length
  - A nominal 100 nodes per segment

# Topology




Traditional Ethernet Topology

## Thin Lan

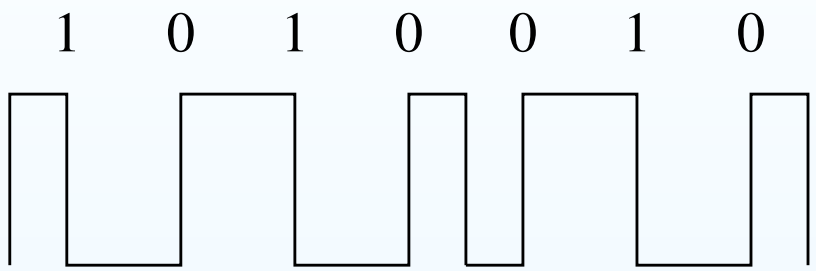
In order to reduce costs and improve flexibility a different standard developed:

- RG-58 coaxial cable
- 200 meter segments
- 1000 meter total length
- A nominal 30 nodes per segment

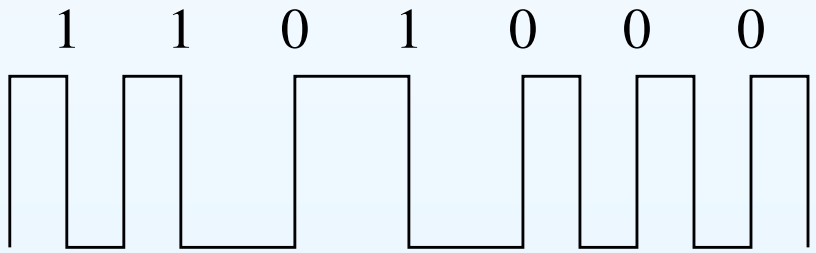
## Access Method

- Carrier Sense Multiple Access with 1-persistence
  1. Listen to the cable
  2. If busy, wait
  3. Send the message
  4. If a collision is detected, execute the Binary Exponential Backoff Algorithm unless the number of collisions exceeds 15, then quit.
  5. Go to 1
- Binary Exponential Backoff waits a random number of slots picked from $[0 - 2^n - 1$, where n is the collision count for a message, $1 \leq n \leq 10$.

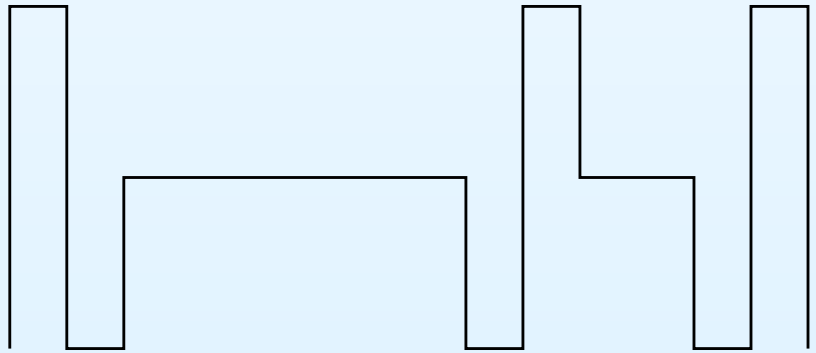
# Signal Collisions




Signal 1

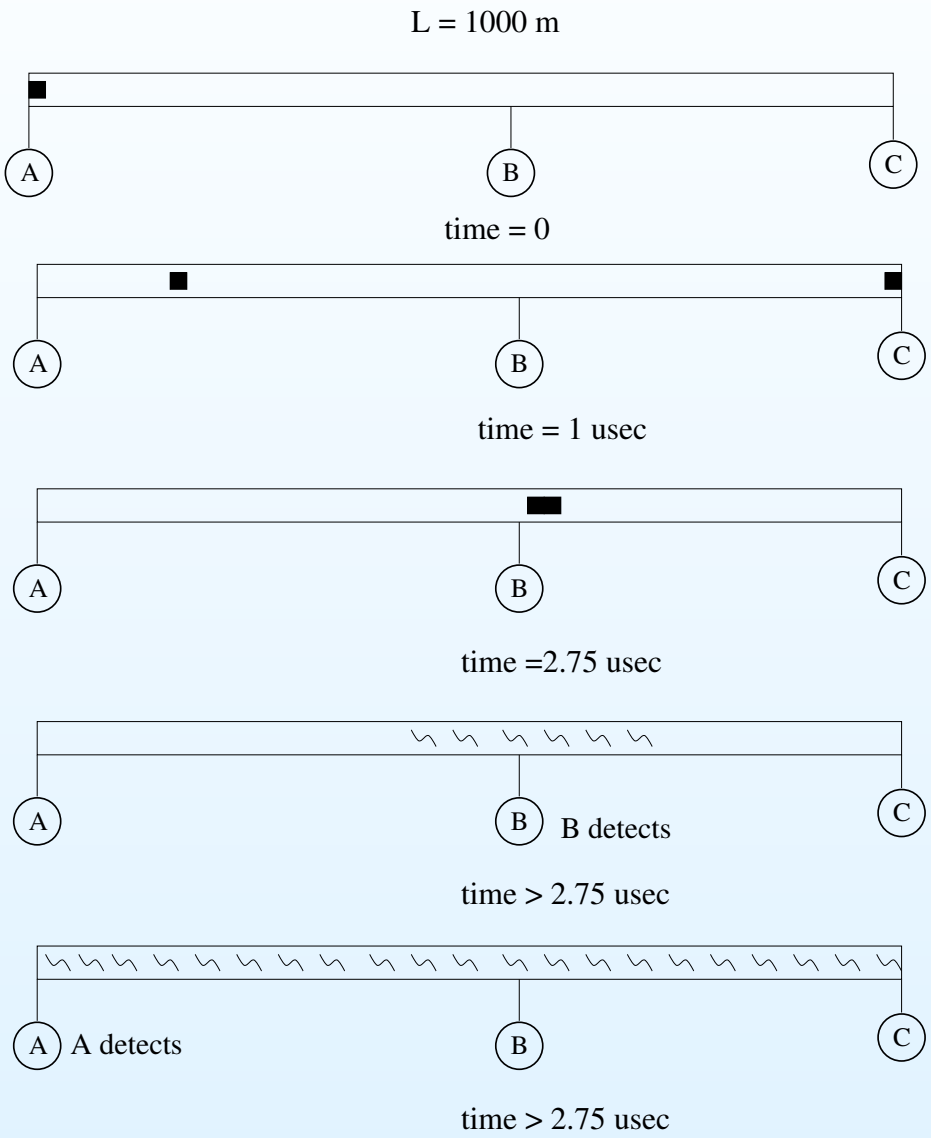



Signal 2



Collided
Signal 1 and 2

# Collision Detection



## Minimum Frame Length

- $\tau \leq D/V = 2500m/2 \times 10^8 m/s = 12.50\mu s$, so $2\tau = 25\mu s$.
- This is the worst case time needed to detect a collision.
- This also becomes the required length of time that a message should be required to take.
- Figuring in a safety factor and raising to an even power of 2, the minimum frame length is 512 bits or 64 bytes.
- The slot time is $51.2\mu s$.

## Error Control

- CRC-32 is used in each frame.
- One bit time is allowed at the end of each frame for an acknowledgement bit. This is typically ignored.

# Frame Format

| Preamble | Destination Address | Source Address | Type | Data | Pad | CRC |
|---|---|---|---|---|---|---|
| 8 Bytes | 6 | 6 | 2 | 0–1500 | 0–46 | 4 |

Ethernet Frame Format

- The preamble is 8 bytes of alternating zeros and ones.
- Addresses are standard 48-bit Ethernet MAC addresses which are unique to each device manufactured.
- Type is the protocol which needs to receive the message on the receiving node.
- The pad insures that the message is at least 512 bits long.

## Fast Ethernet

- IEEE 802.3u.
- Cascading star topology.
- Switches buffer and forward to destination, hubs forward to all connections.
- Delays in hubs limit the number of segments on a line.
- 100 Mbps, 100 m length.
- Media is Category 5 UTP (100Base-TX). 100Base-X allows duplex.

## Gigabit Ethernet

- IEEE 802.3z.
- Media is Category 6 UTP (1000Base-CX) copper for 25 m.
- Media is Category 6 UTP (1000Base-SX) for 260 m/550m using 62.5/50 micron fiber.
- Media is Category 6 UTP (1000Base-LX) for 440m/550m and 3 km for single-mode fiber.
- Now pursuing 10 Gigabit Ethernet standard.