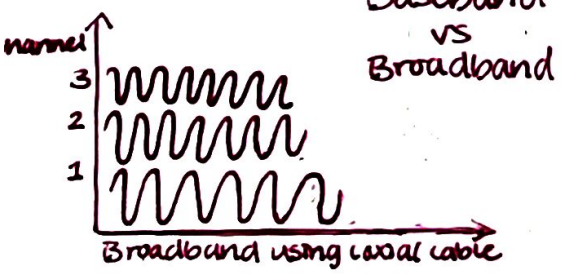
Module 2: Supporting Cabling and Physical Installations

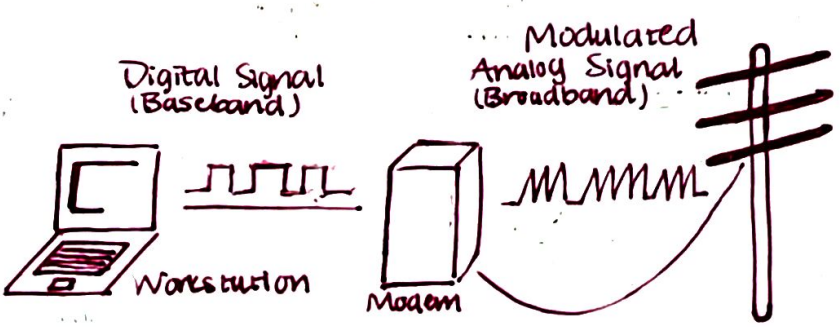
Network Data Transmission

* electromagnetic carrier wave with a range of frequencies (bandwidth)

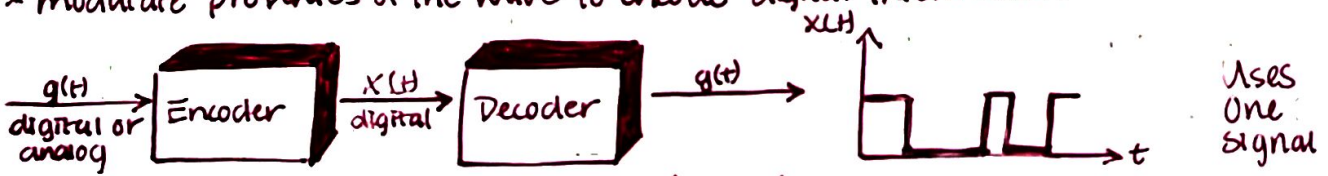
Baseband may use UTP, coaxial or fiber

Baseband vs Broadband





* modulate properties of the wave to encode digital information



Uses One signal

(a) encoding onto a digital signal

Uses Multiple Signals

(b) modulation onto an analog signal

Network Data Transmission

Cable Characters

- Copper cable
  - * carries electric signals
  - * types
    1. twisted pair
    2. coaxial
  - * attenuation (signal weakens quickly over distance)
  - * twisted pair defined by cat cable standards/specifications
- Fiber optic cable
  - * carries infrared light signals
  - * single mode (SMF) and multimode (MMF) types
  - * optic mode (OM) category destinations

Ethernet standards

- Ethernet Architecture
  - * Institute of Electrical and Electronics Engineers (IEEE) 802.3 defines Ethernet standards
  - * Characteristics
    - x Base - y
      where:
      x = bitrate
      BASE = Baseband signal mode
      y = media type

EXAMPLE: 10BASE-T
- ✓ 10 Mbps
- ✓ twisted-pair copper cable

Ethernet Standards

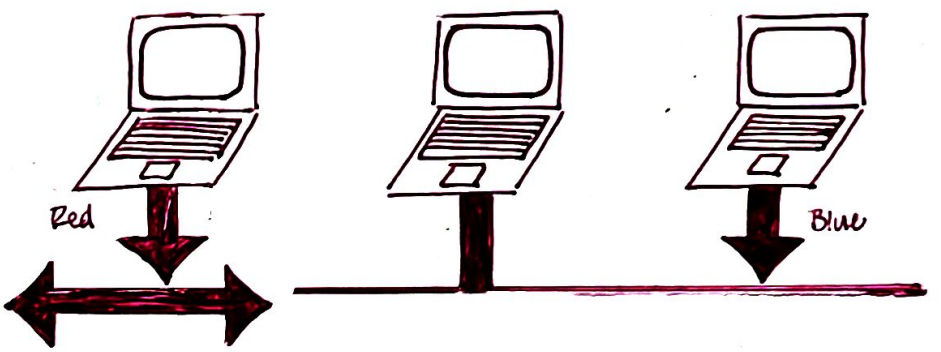
Standard	Speed	Segment Length	Cable
10BASE5	10 Mbps	500m/1640ft	2G-8 or RG-11 coaxial
10BASE2	10 Mbps	185 m/606 ft	2G-58A/U or RG58 C/U coaxial
10BASE-T	10 Mbps	100 m/328ft	Category 3 or better UTP
100BASE-T	100 Mbps	100 m/328ft	Cat 5 UTP or STP
100BASE-TX	100 Mbps	100m/328ft	Cat 5 UTP or STP
100BASE-FX	100 Mbps	2 KM	2 par 850 nm multimode, optic fiber
1000BASE-T	1 Gbps	100m/328ft	4 pair, CAT5 or CAT5e
1000BASE-SX	1 Gbps	550m (multimode)	2 pair fiber optic

CSMA/CD
- detect collision by signal prescense on Tx and Rx simultaneously
- half-duplex transmission
- 10 BASE-T hubs form a single collision damage

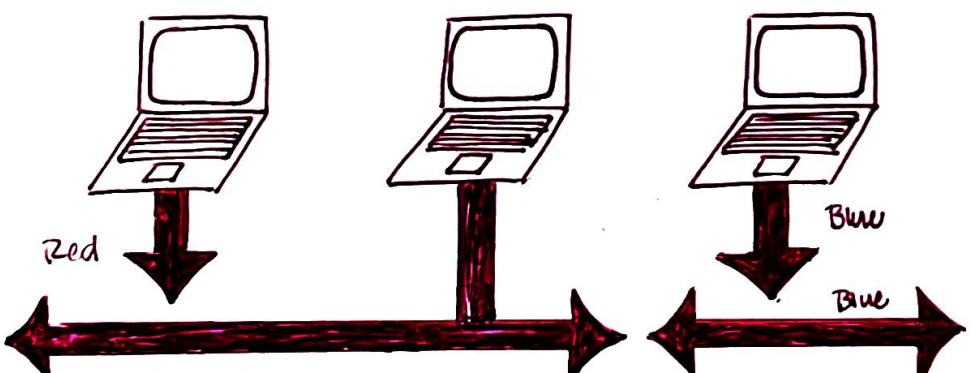
Media Access Control and Collision Domains

Multiple
- contention-based media access control
- collision require nodes to re-transmit
- more nodes within collision domain reduces performance
- Ethernet uses contention-based media access defined by IEEE 802.3 Standard

CARRIER SENSE



MULTIPLE ACCESS



COLLISION DETECTION

Carrier Sense Multiple Access w/ Collision Detection (CSMA/CD)
- All devices have equal access to media
- Device listens to media BEFORE transmission (carrier sense)
  - * if not free, device waits random amount time and listens
  - * if free, device transmits
- collision – sending devices detects a collision in messages
  - * devices send jam signal to notify all other devices of collision
  - * sending devices wait random length time before resending

backoff

1000BASE-TX Fast Ethernet Standard

CSMA/CD
- detect collision by signal presence on TX and RX simultaneously
- half-duplex transmission
- 10BASE-T hubs form a single collision domain

CSMA/CD over twisted pair but at 100 Mbps
- Cat 5 or better cable
- Maximum link length of 100 meters (328 feet)

Ethernet switches
- replaces hubs
- isolates collision domain to single switch port
- allows full-duplex transmission

Autonegotiation Protocol
- host device chooses highest speed / duplex
- fast link pulse

HALF DUPLEX

FULL DUPLEX

Mode	Description	Bandwidth
Half Duplex	* collision detection is turned on * device send/receives in only 1 dir at time * devices connected to hub must use half-duplex	UP to the rated band Ex: 10 Mbps for 10Base 100 Mbps for 100Base-T
Full Duplex	* collision detection is turned off * device can send and received at the same time * this mode requires full-duplex capable in the NIC * this mode requires switches with dedicated switch ports (single device)	Double the rated bandwidth Ex: 200 Mbps for 100BASE T 2000 Mbps for 1000 BASE T

Carrier Sense Multiple Access/ Collision Detection
- devices with collision detection turned on operate in HALF-DUPLEX mode
- devices with collision detection turned off operate in FULL-DUPLEX mode