

Network Media

COMP476

Goals

- Be able to calculate how long it will take to transfer data across a network.
- Be able to select an appropriate network media for a given situation.

Calculating Hints

- Watch your bits and bytes
 - Make sure all units are compatible
 - There are 8 bits per byte or octet
- If your units do not work, the answer is wrong
- Be mindful of significant digits

Moving Energy

- Communications requires moving energy (usually light or electricity)
- The speed of light is the maximum speed data can travel.
 - 3×10^8 m/sec in a vacuum (299,792,458 m/s)
 - 2×10^8 m/sec in glass
 - 2×10^8 m/sec electrical propagation in a copper wire

Time to Send Information

- There are two components that determine how long it takes to send X bytes.
- **Transmission time** – the time required to send the bits out the transmitter. Different systems can send bits at different rates.
- **Propagation delay** – the time required for the signal to flow down the wire or through the air.

Total Transmission Time

- Time to transmit X bytes D meters through wire or fiber with a transmission rate of B.

$$\text{Time} = \frac{X\text{bytes} * 8\text{bits/byte}}{B\text{bits/sec}} + \frac{D\text{m}}{2.0 * 10^8 \text{m/s}}$$

Example

- How long does it take to send 30K bytes at 10M bits/sec across a 4,000 km ocean cable?

$$\text{Time} = \frac{30\text{Kbytes} * 8\text{bits/byte}}{10\text{Mbits/sec}} + \frac{4 * 10^6 \text{m}}{2.0 * 10^8 \text{m/s}}$$

$$\text{Time} = 0.024\text{sec} + 0.02\text{sec}$$

$$\text{Time} = 0.044 \text{ seconds}$$

How long does it take to send?

4K bytes at 2M bits/sec
across 300 km

1. 0.0035 sec
2. 0.0160 sec
3. 0.0175 sec
4. 16.01 sec

Example

- How long does it take to send a 30 KB file over a 10 Mbit/sec line to a server located 20 meters down the hall?

$$\text{Time} = \frac{30\text{Kbytes} * 8\text{bits/byte}}{10\text{Mbits/sec}} + \frac{20\text{m}}{2.0 * 10^8 \text{ m/s}}$$

$$\text{Time} = 0.024\text{sec} + 1.0 * 10^{-7} \text{ sec}$$

$$\text{Time} = 0.0240001 \text{ seconds}$$

Nearby

- Often the time necessary for the data to propagate to the destination is trivial compared to the transmission time
- If the distance is not stated in a problem, you can ignore the propagation time

Considerations for media

- cost
- ease of installation and repair
- attenuation
- interference
- security
- ability to cross public land
- mobility

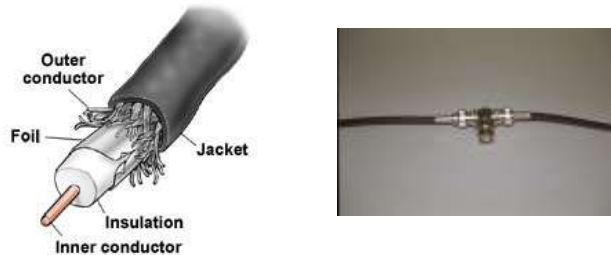
Twisted Pair

- Pairs of copper wires twisted together.
- Used for telephones and Ethernet



Coax Cable

- Used for cable TV and older Ethernet



Fiber Optics

- Data is transmitted as light through thin fibers of glass.
- There are two types of fiber: multimode and single mode.



Infrared

- Used by TV remote controls



Radio

- Long wave (low frequency) will bend around objects
- Short wave (high frequency) is more line of sight.



Satellites

- Radio transmission to a geosynchronous satellite 36,000 km above the earth
- Round trip is 72,000 km or 72 Mm
- Radio propagates at 3×10^8 m/s



How long does it take to send

a 125 KB file to another computer over a 1.0 GB/sec satellite link

1. 0.00124 sec
2. 0.241 sec
3. 0.34 sec
4. 2.41 sec

How long does it take to send

a 125 KB file to another computer over a 10.0 GB/sec satellite link

1. 0.05 sec
2. 0.1205 sec
3. 0.2405 sec
4. 2.41 sec

Comparison of Media

	twisted pair	coax	fiber	Infrared	long radio	short radio	satellite
cost	5	4	4	5	3	2	1
ease of installation/repair	5	4	3/1	5	3	2	1
attenuation	3	4	5	2	3	4	5
interference	3	4	5	3	1	2	2
security	3	4	5	2	1	2	1
ability to cross public land	1	1	1	2	5	5	5
mobility	1	1	1	4	5	3	5