TRANSMISSION MEDIA

**Twisted Pair** - A twisted pair consists of two insulated copper wires arranged in a regular spiral pattern. A wire pair acts as a single communications link. Typically a number of these pairs are bundled together into a cable by wrapping them in a protective sheath.

Over longer distances, cables may have hundreds of pairs. The twisting of pairs minimizes the magnetic interference between them.
HOW IS TWISTED PAIR USED?

By far, the most common transmission medium for digital and analog transmission is twisted pair. It is the backbone of the telephone system as well as the workhorse for intrabuilding communications.

*Local Loops:* Individual sets are connected to the local telephone exchange by twisted pair wire called Local Loops.

*PBX:* This is an on-premise telephone exchange (private branch exchange). It provides for intrabuilding calls via extension numbers and outside calls by a trunk connecting to a local office. Within the building the telephones are connected via twisted pair.
TRANSMISSION CHARACTERISTICS OF TWISTED PAIR

Wire pairs can carry both digital and analog signals. For analog signals, amplifiers are required every 5-6 KM. For digital signals, repeaters are used every 2-3KM.
PROBLEMS WITH TWISTED PAIR

– It is limited in distance, bandwidth, and data rate.

– The medium is quite susceptible to interference and noise because of its easy coupling with electromagnetic fields. ** Shielding the wire with metallic braid or sheathing reduces the interference normally found.
TRANSMISSION MEDIA (Continued)

2. **Coaxial Cable** - like twisted pair, consists of two conductors, but is constructed differently to permit it to operate over a wider range of frequencies.
WHAT DOES COAXIAL CABLE LOOK LIKE?

It consists of a hollow outer cylindrical conductor, which surrounds a single inner wire conductor (Cable TV).
WHAT IS A COAXIAL CABLE USED FOR?

- Long distance telephone and TV transmission.
- Local area networks.
- Short run system links
- CATV: Community Antenna Television

Using Frequency Division Multiplexing (FDM), a coaxial cable can carry over 10,000 voice channels simultaneously.
TRANSMISSION CHARACTERISTICS OF COAXIAL CABLE

Coaxial cable is used to transmit both analog and digital signals. CATV is analog and Local Area Networks are digital.

Coaxial cable has superior frequency characteristics to twisted pair and can be used at higher frequencies and data rates.

It is susceptible to much less interference and crosstalk than twisted pair due to its shielded concentric design.
3. **Optical Fiber** - An optical fiber is a very thin line capable of conducting an optical ray.

**Uses:** One of the most significant technological breakthroughs in data transmission has been the development of fiber optics.
ADVANTAGES OF OPTIC FIBER OVER TWISTED PAIR

- Greater bandwidth
- Smaller size and lighter weight
- Lower attenuation
- Electromagnetic isolation: with fiber optics we have no interference, impulse noise or crosstalk
- Greater repeater spacing: means lower cost and fewer sources of error
WHAT TYPES OF LIGHT SOURCES ARE USED IN FIBER OPTICS?

– **LED:** (Light Emitting Diode) This is a solid state device that emits light when current is applied.

– **ILD:** (Injection Laser Diode) Laser beam.

Benefits of **LED**:
- Less costly
- Operates over a greater temperature range
- Longer operational life

Benefits of **ILD**:
- More efficient
- Faster data rates
TRANSMISSION MEDIA

4. *Terrestrial Microwave*

Characteristics:
- Microwave dish is about 10 feet in diameter.
- The antenna is fixed and focuses a narrow beam to achieve Line-of-Sight transmission to the receiving antenna.
- Supports high data rates.
- Requires far fewer repeaters and amplifiers than coaxial.
- Used for Point-to-Point communications for short hauls between buildings.
- Long haul telecommunication service. Television and voice.
MICROWAVE ATTENUATION AND INTERFERENCE

- Varies with distance
- Attenuation increases with rainfall
- Interference due to transmission area overlap
  Because of this problem, microwave frequency bands are strictly regulated by the FCC
TRANSMISSION MEDIA

5. **Satellite Microwave:** A communications satellite is a microwave relay station used to link two or more ground-based microwave transmitters/receivers known as earth stations.
HOW DOES THE SATELLITE WORK?

The satellite receives the transmission on one frequency band (Uplink) and amplifies or repeats the signal and transmits it on another frequency (Downlink).

**Transponder:** A single orbiting satellite will operate on a number of frequency bands called transponders.

For continuous operation without interference, a satellite cannot transmit and receive on the same frequency. Two frequencies are used.
6. **Radio:**

**Difference Between Microwave and Radio**

The principle difference between radio and microwave is that radio is omnidirectional and microwave is focused. The term "Radio" covers the FM radio and UHF and VHF television.

**Packet Radio:** Uses a ground based antenna to link multiple sites in a data transmission network.

**Teletext Service:** This service inserts character data in the vertical blanking interval in a conventional TV signal. Televisions equipped with a decoder can receive and display the signal (Closed Caption).

**Cellular Radio:** A given frequency may be used by a number of transmitters in the same area.
POSSIBLE DATA TRANSMISSION PATH

Data transmitted via common carriers

VDT and computer in the same building downtown Seattle

VDT and computer in the same building downtown Orlando

Copper Wire  Microwave  Satellite  Optical Fiber

Coaxial Cable
SATELLITE vs. TERRESTRIAL CONNECTION

22,000 Miles to 26,000 Miles

22,300 Miles

30 Miles

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Prior to the use of satellites, the transmission paths were terrestrial. These transmission paths consisted of:
2- and 4-wire voice grade lines
High-speed coaxial lines
Microwave
Fiber optics (recently introduced)
In comparing a long-haul connection over satellite to our traditional microwave link, there are several obvious differences. In the microwave link, there are many repeater sections; whereas with the satellite link, there is a single repeater - the satellite.

The most notable characteristic of a satellite is its altitude above the earth. The satellite is launched in a geosynchronous orbit; that is, it rotates at the same velocity as the earth does and it appears to be stationary.
In order to achieve this stationary orbit, the satellite must be launched at an altitude of approximately 22,300 miles.

From a transmission standpoint, a satellite connection is better. In particular, because its beams tend to traverse the earth's atmosphere in a vertical direction, it is not as affected by the phenomena of layering of the earth's atmosphere, which results in microwave fading for radio links.
From A to B and back is called one circuit. From A to B only is a single channel. Between A or B and the satellite is a half-circuit.