

Bit Rate is the number of bits transmitted during one second. Baud rate is the number of signal units per second that are required to represent those bits. Baud rate determines the Bandwidth reqd to send the signal.

$$\text{Bit Rate} = \text{Baud Rate} \times \text{No of bits per signal element}$$

TRANSMISSION MEDIA TWO TYPES

↳ Guided ↳ Unguided

Guided media can have following categories: -

- a. Twisted pair cable b. Coaxial cable c. Fibre optic cable.

Twisted pair & co-axial cable use metallic conductors (copper) that accept & transport signals in the form of electrical current. Optical fibre is a glass or plastic cable that accepts & transports signals in the form of light.

Twisted pair cable Two types (i) Unshielded (ii) Shielded

Unshielded Twisted Pair (UTP) cable most common type of telecommunication medium in use today. UTP's frequency range is suitable for transmitting both data & voice. Twisted pair consists of 2 conductors (usually copper) each with its own colored plastic insulation. Insulation is color-banded for identification. Colors are used both to identify the specific conductors in a cable & to indicate which wires belong in pairs & how they relate to other pairs in a large bundle.

Frequency range for twisted pair cable is 100 KHz - 5 MHz (12)
Previously parallel wires, but nowadays twisted pair cable. 53

Advantages of UTP

1. Cost
2. Ease of use

Higher grades of UTP are used in many LAN technologies like Ethernet & Token Ring.

Categories of UTP

Category 1 Basic twisted pair cabling used in telephone systems. Fine for voice but inadequate for all but low speed data communication.

Category 2 Suitable for voice & for data transmission up to 4 Mbps.

Category 3 Reqd to have at least 3 twists per foot suitable for data transmission up to 10 Mbps. It is now standard cable for most telephone systems.

Category 4 3 twists per foot & data transmission up to 16 Mbps.

Category 5 used for data transmission up to 100 Mbps.
Cat 5E = 100 Mbps, Cat 6 = 200 Mbps, Cat 7 = 600 Mbps

UTP Connectors most frequently used ones are RJ45 connectors with 8 conductors, one for each wire of 4 twisted pairs.

Shielded Twisted Pair (STP) Cable

STP has a metal foil or braided mesh covering that encases each pair of insulated conductors. Metal casing prevents penetration of electromagnetic noise. It can also eliminate a phenomenon called crosstalk.

which is the undesired effect of one channel on another channel. E.g. of crosstalk is the experience during tele telephone conversations when one can hear other conversations in the background. Shielding each pair of a twisted pair cable can eliminate most crosstalk.

STP has same quality considerations as UTP. Also STP uses same connectors as UTP. Shield of STP must be grounded. Materials & manufacturing requirements make STP more expensive than UTP but less susceptible to noise.

COAXIAL CABLE carries signals of higher frequency than twisted pair cable. Freq range of coaxial cable is 100 KHz to 500 MHz. Coaxial cable has a central core conductor of solid or stranded wire (usually copper) enclosed in insulating sheath which in turn is encased in an outer conductor of metal foil, braid or combination of the two (also usually copper). Outer ~~is~~ metallic wrapping serves both as a shield against noise & as a second conductor which completes the circuit. Outer conductor is also enclosed in an insulating sheath, & the whole cable is protected by a plastic cover.

Coaxial Cables are categorized by Radio Gort (RG) ratings.

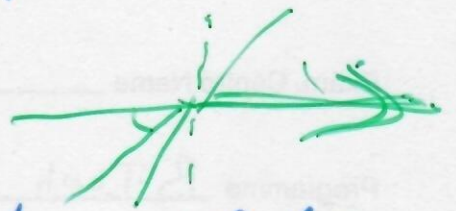
RG-8	Used in thick Ethernet	RG-59	Used in TV
RG-9	" " " "		
RG-11	" " " "		
RG-58	" " thin "		

Common connectors (14) (55)
is bayonet network connector (BNC).

Two other commonly used types of connectors are T-connectors & Terminators. T connector allows a secondary cable to branch off from a main line. Termination are reqd for bus topologies.

OPTICAL FIBER made of glass or plastic & transmits signals in the form of light.

Refraction



Critical angle That angle of incidence where angle of refraction is 90° .

Reflection when \angle of incidence $>$ critical angle, the reflection occurs, where light no longer passes into less dense medium at all.

Optic fibre uses reflection. A glass or plastic core is surrounded by cladding of less or dense glass or plastic. Info is encoded onto a beam of light as a series of on-off flashes that represent 1 & 0 bits.

Propagation Mode (a) Multimode (b) Single Mode
(a) Multiple beams from a light source move thru core in different paths.
(b) uses highly focussed source of light that limits beam to small range of \angle s all close to horizontal.

Advantages of optic Fibre

- Noise resistance
- Less signal attenuation
- Higher bandwidth

Disadvantages

- Cost
- Installation / Maintenance
- Fragility

Unguided media transport EM waves w/o using physical conductor.

- Radio waves
- Satellite Communication
- Cellular Telephony.

Factors for Media Comparison

- Cost — materials + installation
- Speed
- Attenuation
- EM Interference
- Security — How secure is link. Optic fibre more secure.

Signals are normally broadcast through free space & thus are available to anyone who has a device capable of receiving them.

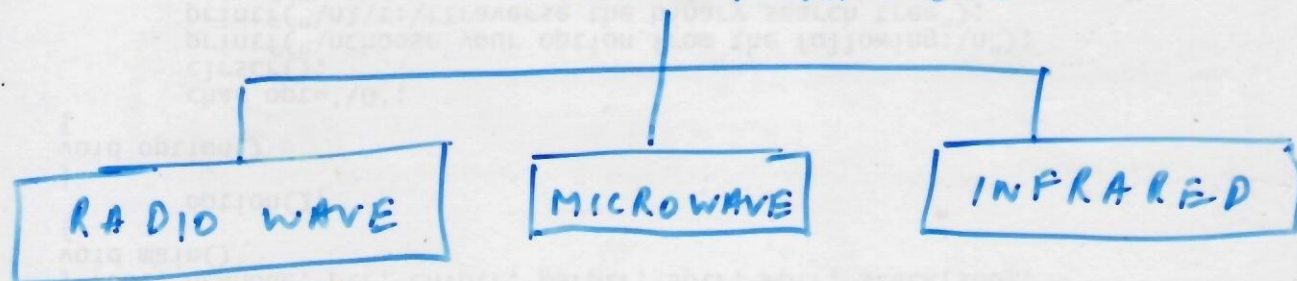
Electromagnetic spectrum for wireless communication

RADIO WAVE & MICROWAVE	INFRARED	LIGHT WAVE
3 KHz	300 GHz	400 THz
		900 THz

Unguided signals can travel in several ways

- Ground propagation
- Sky propagation
- Line-of-sight propagation

Wireless Transmission



No clear cut demarcation b/w radio wave & microwave
 but 3 KHz to 1 GHz = Radio waves
 1 GHz to 300 GHz = Microwave

Radio wave for most part are omnidirectional.
 Radio waves are a good candidate for long distance broadcasting such as AM radio.

Radio waves, particularly of low & medium frequency can penetrate walls (Both advantage & disadvantage).

Applications AM & FM Radio, TV, maritime radio, (58)
cordless phones.

- MICROWAVES These are unidirectional & can be focussed narrowly. This means that sending & receiving antennas need to be aligned. Some characteristics are :-
- (a) Microwave propagation is line-of-sight. Since towers with mounted antennas need to be in direct sight of each other, towers that are far apart need to be very tall. Repeaters are often needed for long distance communication.
 - (b) Very high frequency microwaves can't penetrate walls. This is disadvantage if receivers are inside buildings.
 - (c) High data rate is possible as microwave band of almost 299 GHz is relatively wide.
 - (d) Use of certain portions of band require permission from authorities.

APPLICATIONS cellular phones, satellite N/Ws, wireless LANs.

INFRARED WAVES used for short range communication. These waves can't penetrate walls. Short range communication makes infrared signals useless for long-range communication. Can't use houses outside a building because sun's rays contain infrared waves that can interfere with communication.

Applications wide bandwidth can be used to transmit digital data with a very high data rate.