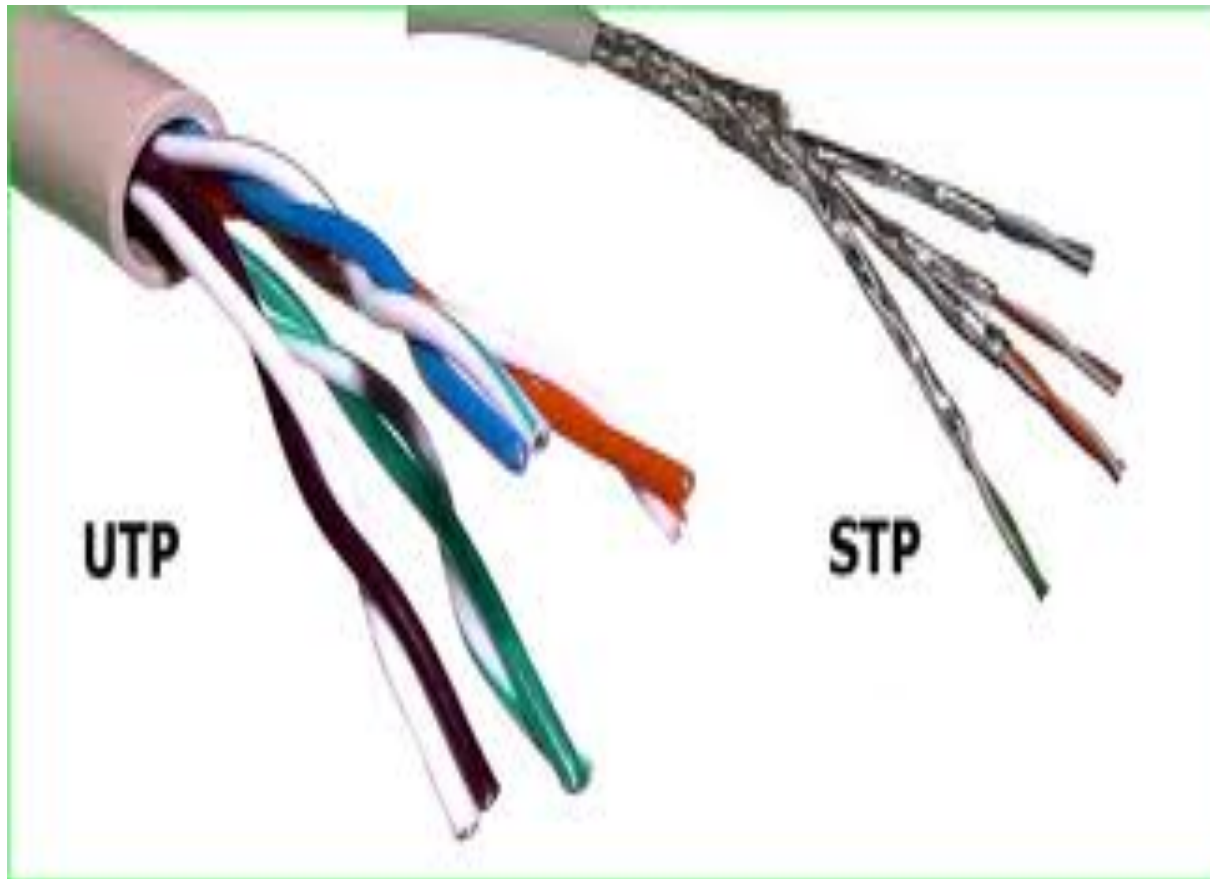


Physical Layer

Twisted pair cable

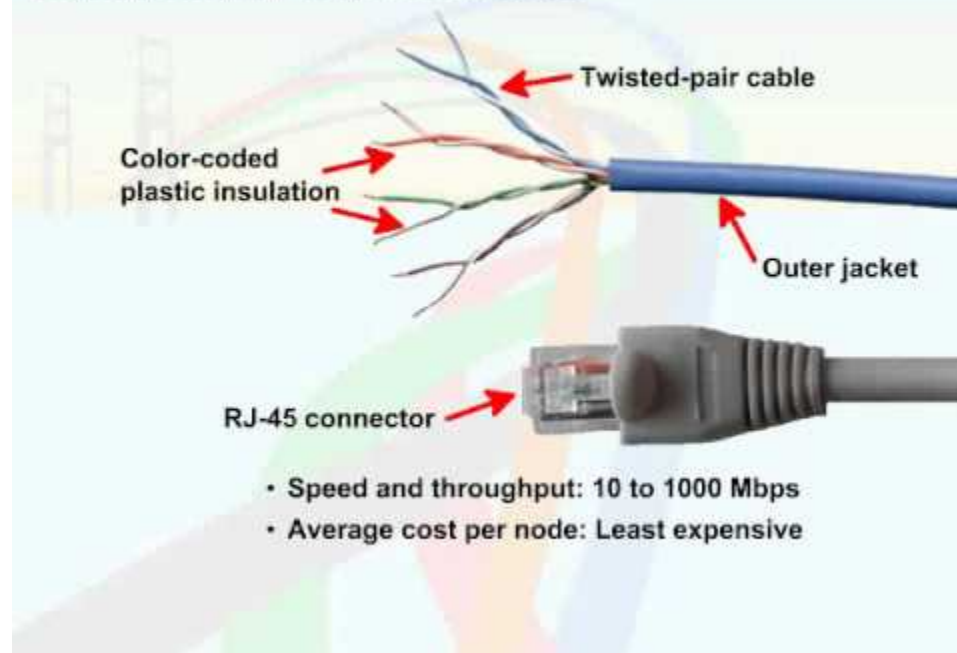


Twisted Pair cable

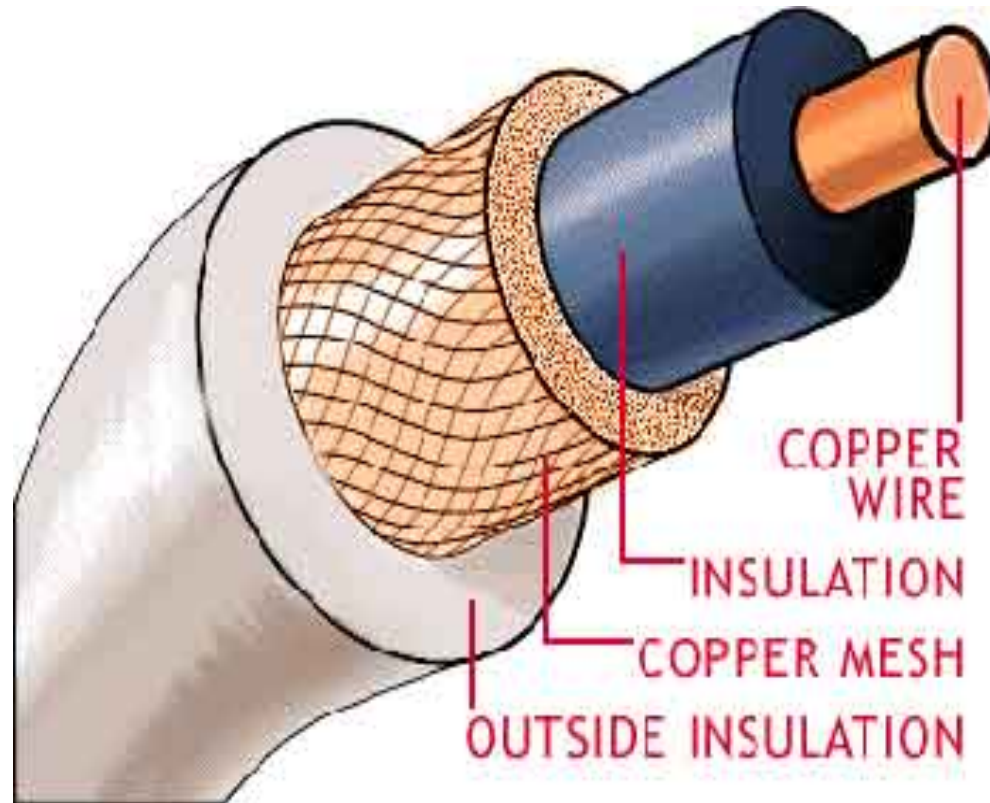
- Used in telephone system
- Frequency range: 100HZ to 5MHZ
- Type: 1) UTP(Unshielded Twisted Pair)
2) STP (Shielded Twisted Pair)
- UTP is affected by EMI

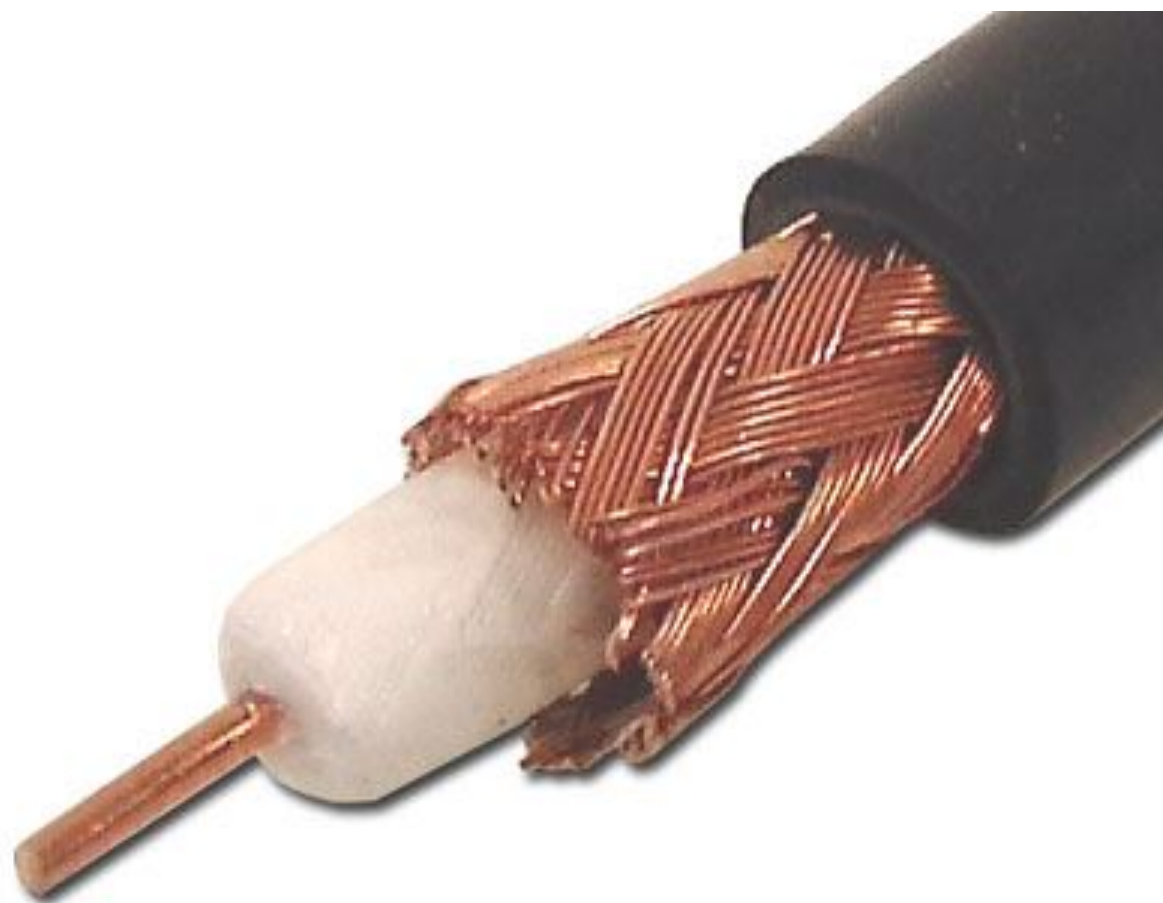
Connector: RJ-45

Unshielded Twisted Pair



Co-axial cable



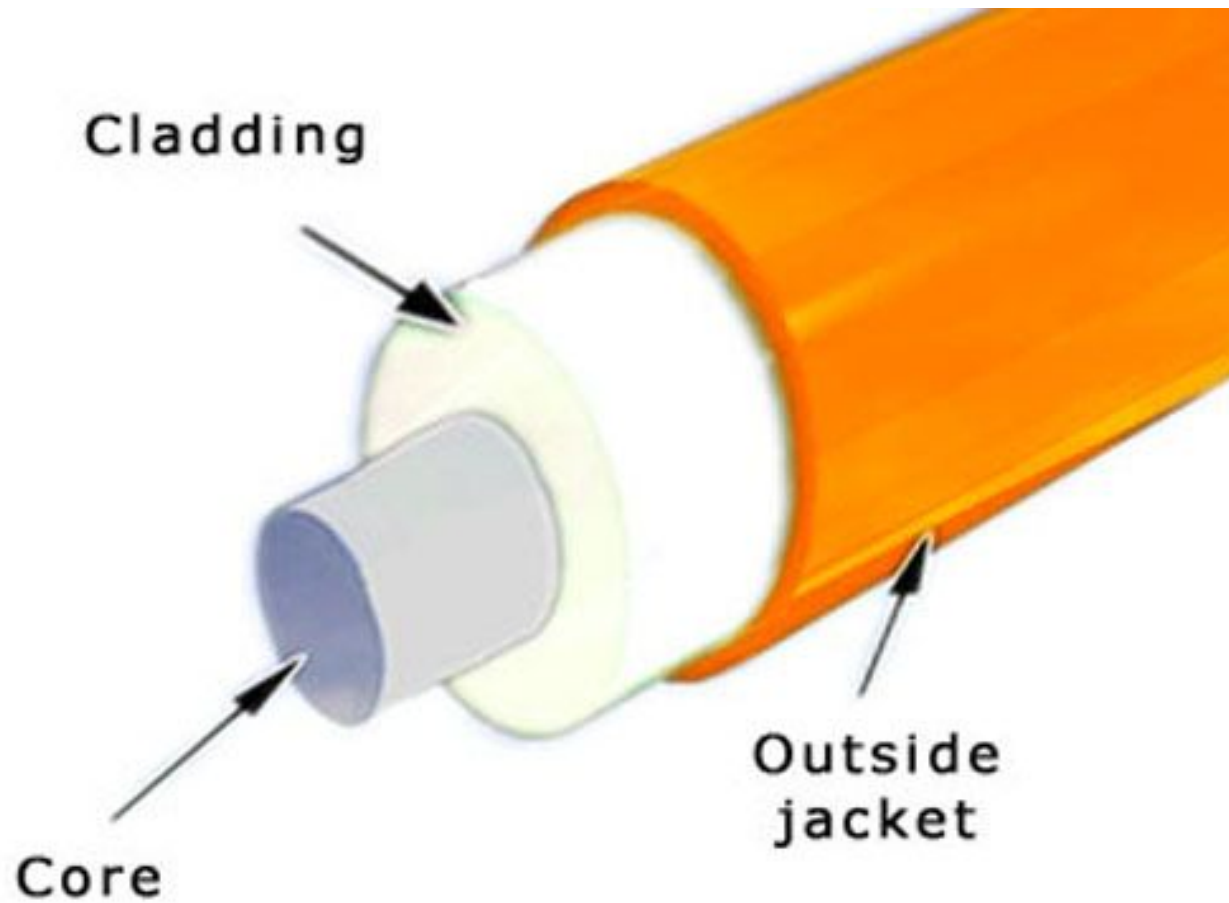


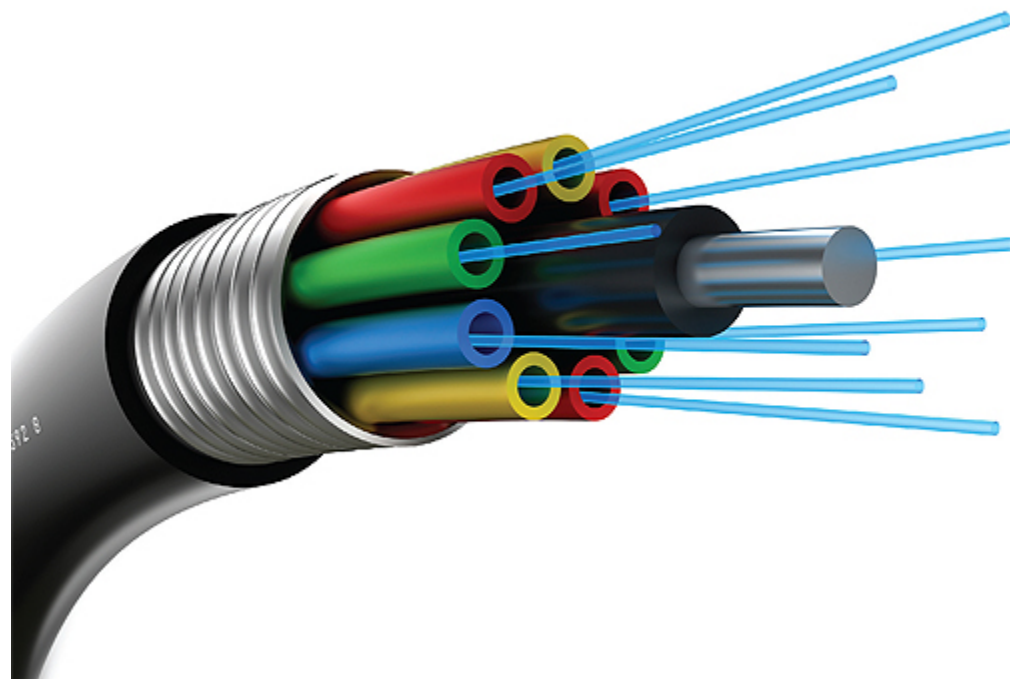
Co-axial

- Better protection than twisted pair
- Frequency range: 100KHZ to 500MHZ
- Used in n/w cable
- Flexible
- Easy to install
- Two type: Thinnet (IEEE 10 base 5)
Thicknet (IEEE 10 base 2)



Fiber-optic cable





Fiber Optic cable

- Signal is send in form of Light
- Advantage:

1)Lighter

2)Noise Resistance

3)Less Signal attenuation

4)Higher bandwidth

5)Excellent security

Fiber Optic cable

- Disadvantage:

- 1) Cost
- 2) Installation/maintenance
- 3) Fragility
- 4) unidirectional



Radio wave

- Frequency range: 3khz to 1ghz
- Can travel long distance
- Penetrate building
- Used for communication: indoor, outdoor
- Omni direction
- sky propagation

Radio wave

- Disadvantage:
- 1) Omni direction
- 2) low data rate

Application

- 1) FM Radio
- 2) Television broadcast
- 3) Police radio
- 4) GPS receiver

Micro wave

- Frequency range: 1GHZ to 300GHZ
- Unidirectional
- Line of Sight Propagation

Micro wave

Advantage:

- Higher data rate
- Relatively inexpensive
- Easy to install

Disadvantage:

- Line of Sight
- Cant penetrate wall

Infrared

- Frequency range: 300ghz to 400thz
- Short range communication
- more secure against tapping
- Wireless keyboard and mouse

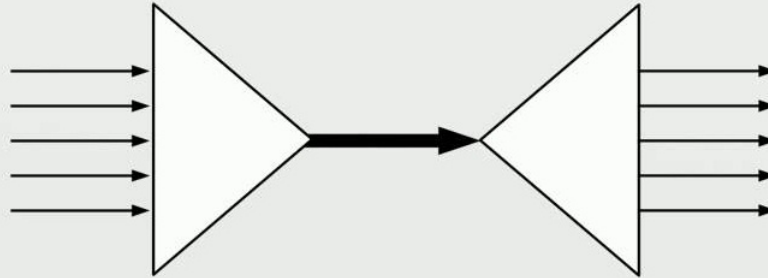
Infrared

Disadvantage:

- Long range communication
- Don't pass through solid object
- Cant used outside building

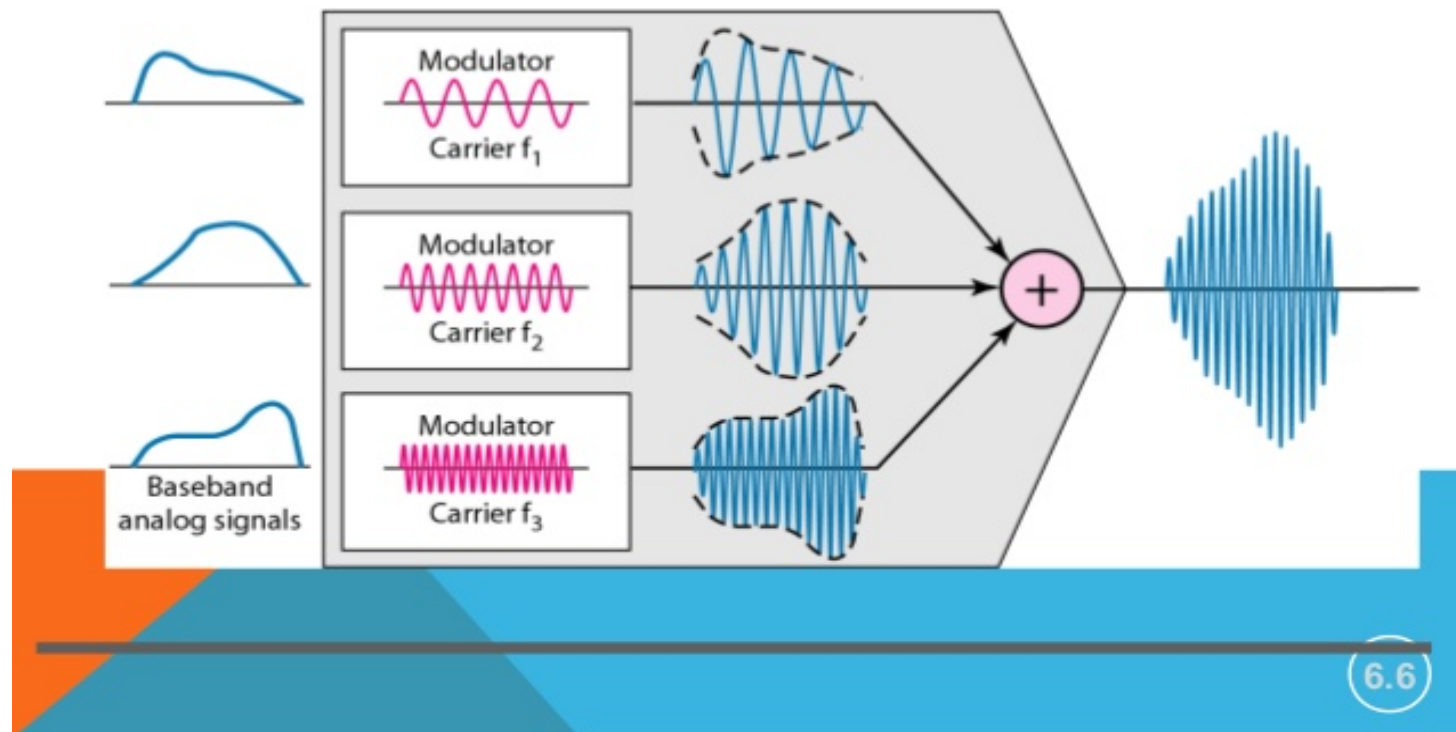
FDM

Frequency-division multiplexing

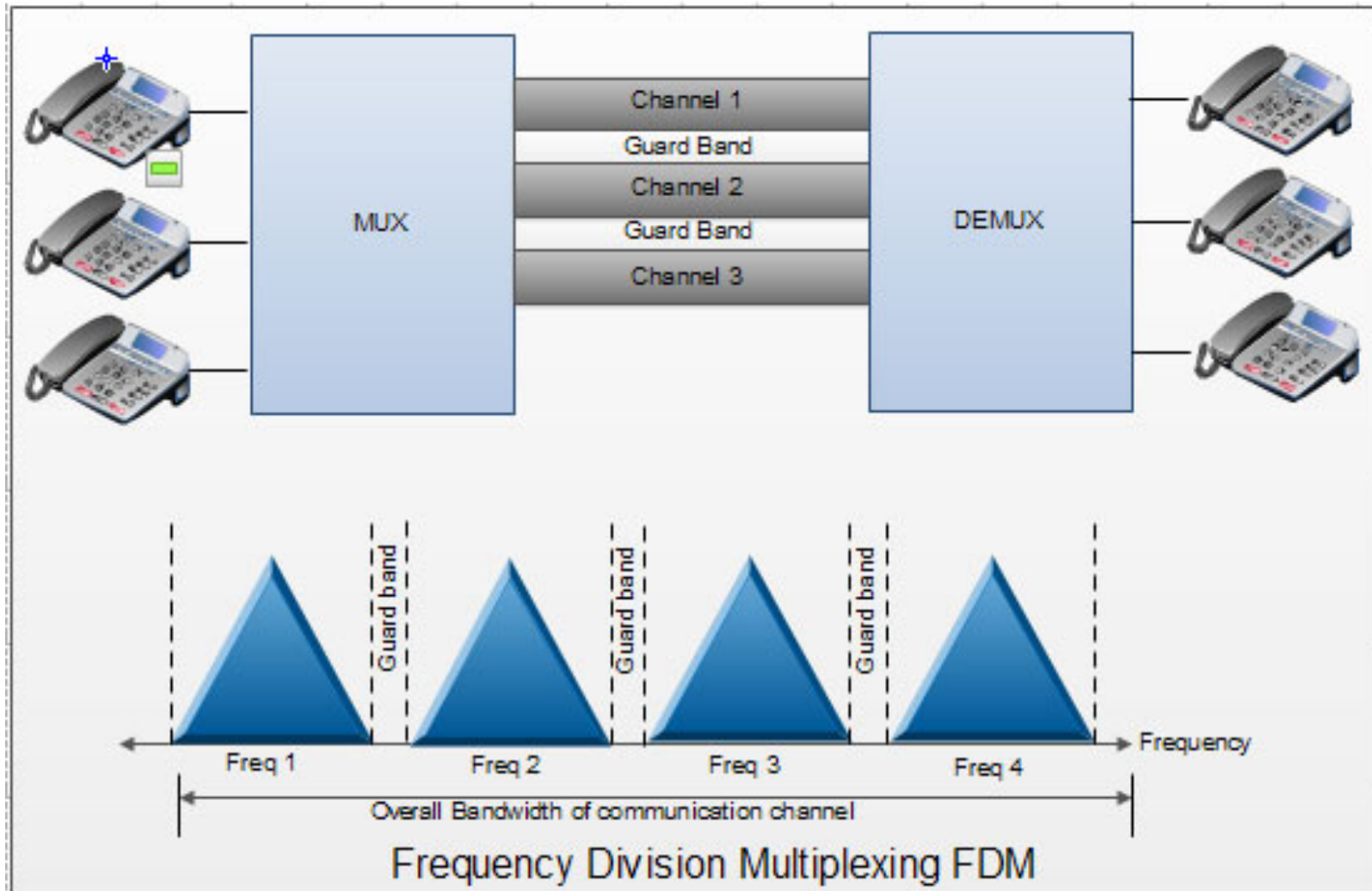


FDM

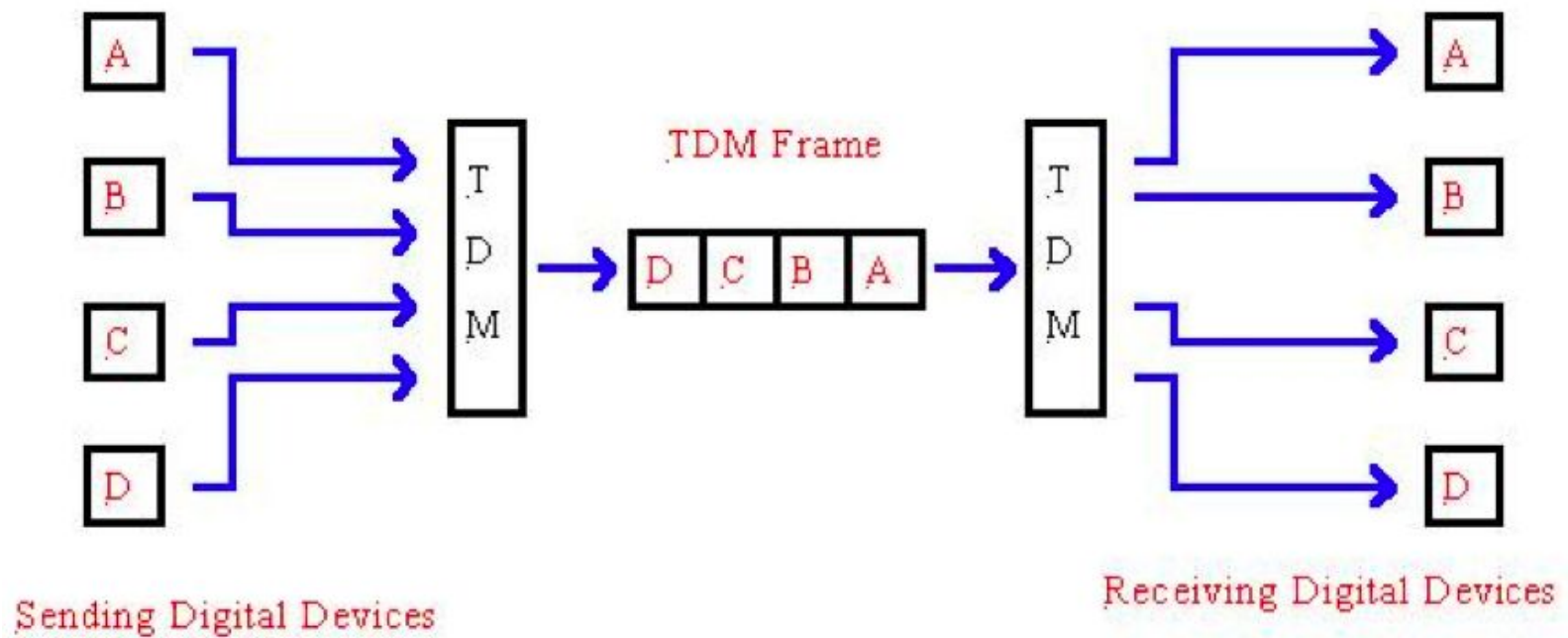
Figure 6.4 *FDM process*



FDM



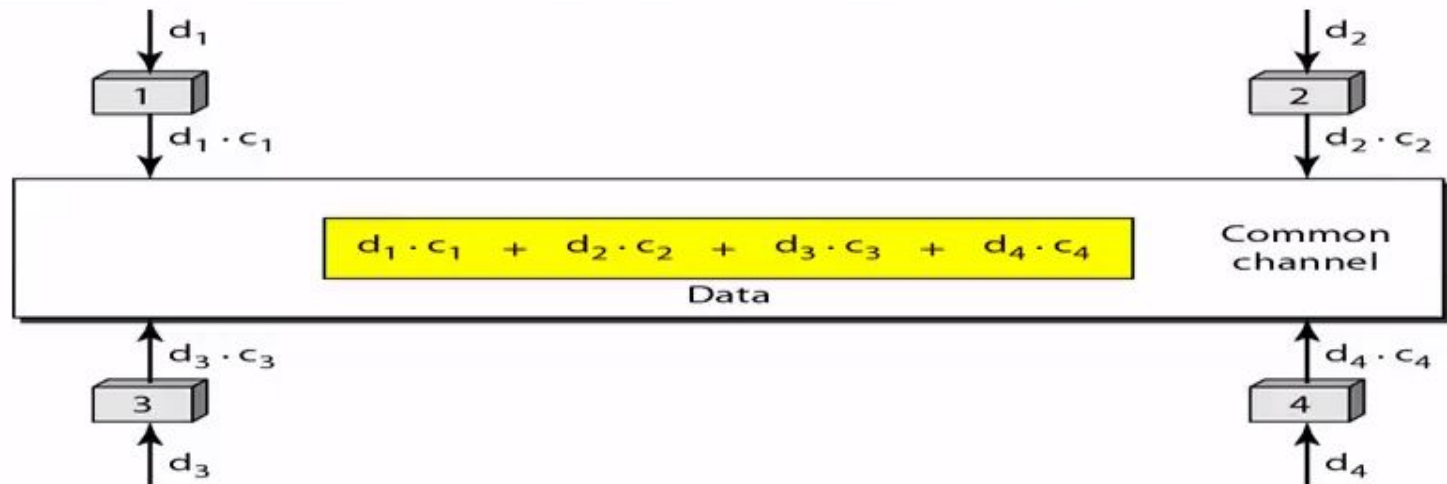
TDM



CDM

Each station will be given a unique code. The codes assigned to the stations satisfy the following rules:-

- 1) If we multiply each code by another ($c_1 * c_2$), we get **0**.
- 2) If we multiply each code by itself ($c_1 * c_1$), we get **4** (the number of stations).



Station 2 wants to hear what station 1 is saying. It multiplies the data on the channel by c_1 the code of station 1.

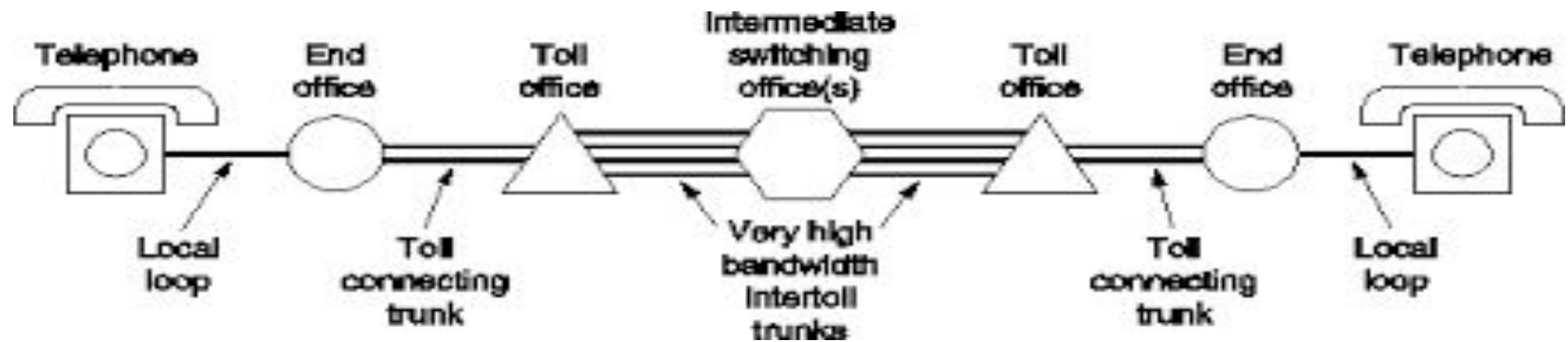
$$\begin{aligned} \text{Data} &= (d_1 \cdot c_1 + d_2 \cdot c_2 + d_3 \cdot c_3 + d_4 \cdot c_4) \cdot c_1 \\ &= d_1 \cdot c_1 \cdot c_1 + d_2 \cdot c_2 \cdot c_1 + d_3 \cdot c_3 \cdot c_1 + d_4 \cdot c_4 \cdot c_1 \\ &= 4d_1 \quad \boxed{4d_1 / 4 = d_1} \end{aligned}$$

$d_1, d_2, d_3, d_4 \rightarrow$ Data Frames
 $c_1, c_2, c_3, c_4 \rightarrow$ Codes of 4 Stations

Transmission impairment

- 1) Attenuation
- 2) Signal to noise ratio
- 3) Noise
- 4) distortion

Structure of telephone system



Communication satellite

- Artificial satellite that relay and amplify radio signals.
- Used for television ,radio ,internet ,military application.
- Over 2000 satellite in earth orbit
- Use electromagnetic wave to carry signal
- Require line of sight propagation
- To avoid signal interference band are allocated to different private and government organization

Satellite VS fiber

1. fiber optic is quicker but Satellite is slow in communication.
2. Optical Fiber higher bandwidth but Satellite Lower Bandwidth.
3. In case of any fault we can easily repair Fiber Optics but Satellite can not be repair.
4. Fiber Optics initial Cost is low but Satellite is very High.
5. Many People want to communication during jogging, driving, flying these all possible in Satellite Communication But Fiber Optics not use for them.
6. Satellite cost low for long range communication, while optical fiber is very costly for long range communication.
7. Minimum three or four satellite can cover the whole world, Fiber optics can also do that but cost considerations are to be worked out.
8. Satellite provide global mobile communication, for example, GPS. For optical fiber, there is no possibility of mobile terminals since cable is to be laid physically.
9. Satellite suffers from propagation delay. For optical fiber, less such delays.