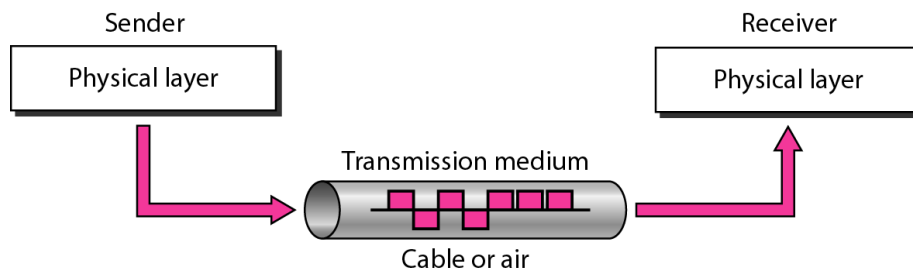


Chapter 7

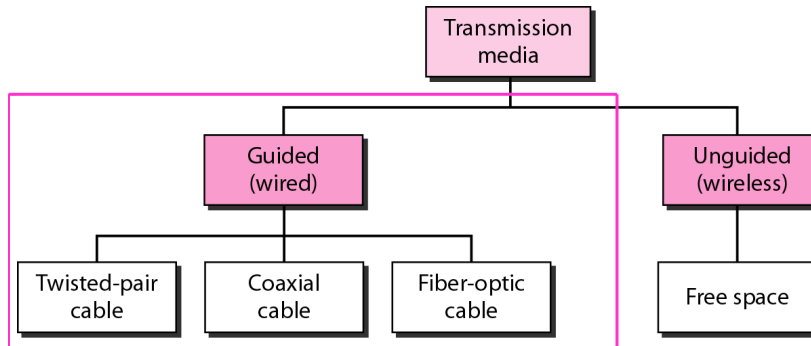
Transmission Media

Transmission medium (layer zero)

- A transmission media defined as anything that carry information between a source to a destination
- Located below the physical layer and are directly controlled by the physical layer



Classes of transmission media



GUIDED MEDIA

Guided media, which are those that provide a conduit from one device to another, include twisted-pair cable, coaxial cable, and fiber-optic cable.

Twisted –pair cables and coaxial cable: use metallic (copper) conductors that transport signals in the form of **electric current**

Optical fiber : transport signals in the form of **the light**

Twisted-pair cable

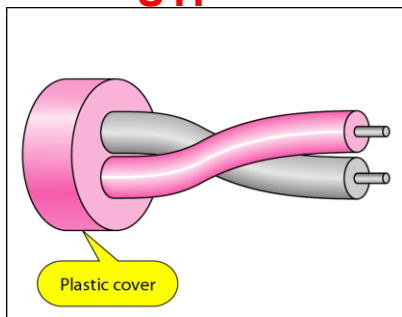


- One of the wire used to carry signal and the other as a ground. The receiver uses the **difference** between the two
- If the two wires are parallel, the effect of interference noise and crosstalk is big
- Twisting the pair of wire balance the effect of unwanted signal and reduce it.

The number of twists per unit of length effects on the quality of the cable

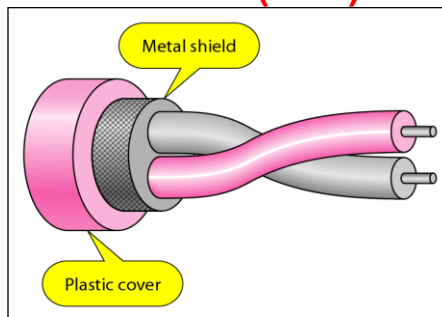
Unshielded versus Shielded Twisted-pair cable

UTP



a. UTP

STP (IBM)



b. STP

Metal shield in STP

- Improve the quality of cable by preventing the **penetration of noise or crosstalk**
- It is **bulkier and more expensive**

Categories of unshielded twisted-pair cables (EIA standards)

Category	Specification	Data Rate (Mbps)	Use
1	Unshielded twisted-pair used in telephone	< 0.1	Telephone
2	Unshielded twisted-pair originally used in T-lines	2	T-1 lines
3	Improved CAT 2 used in LANs	10	LANs
4	Improved CAT 3 used in Token Ring networks	20	LANs
5	Cable wire is normally 24 AWG with a jacket and outside sheath	100	LANs
5E	An extension to category 5 that includes extra features to minimize the crosstalk and electromagnetic interference	125	LANs
6	A new category with matched components coming from the same manufacturer. The cable must be tested at a 200-Mbps data rate.	200	LANs
7	Sometimes called SSTP (shielded screen twisted-pair). Each pair is individually wrapped in a helical metallic foil followed by a metallic foil shield in addition to the outside sheath. The shield decreases the effect of crosstalk and increases the data rate.	600	LANs

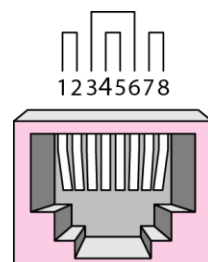
LOWEST TO HIGHEST

Dr. Gihan NAGUIB

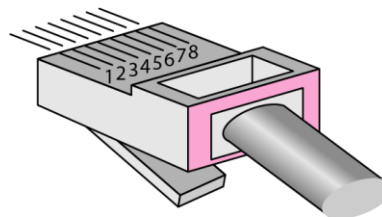
Behrouz A. Forouzan "Data communication and Networking" 4th edition

7

UTP connector(Registered Jack:RJ45)



RJ-45 Female



RJ-45 Male

RJ45 is a **keyed connector** , meaning the connector can be inserted in only **one way**

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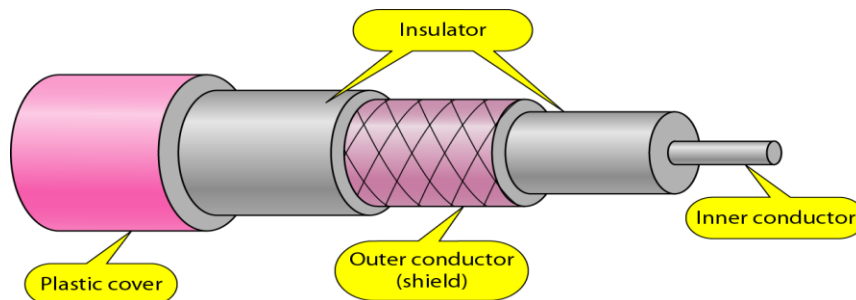
8

Applications of Twisted pair

Used in

1. telephone lines to provide voice and data channels (local loop)
2. The DSL lines that are used by the telephone companies to provide high-data-rate connections
3. Local area networks, such as **10-base-T** and **100base-T**

Coaxial (Coax) cable



- Coax cable carries signals of **higher frequency ranges than those in Twisted pair cable** because the two media are constructed quite differently
- The outer conductor serves both as **a shield against noise** and as **second conductor**, which complete the circuit

Categories of coaxial cables

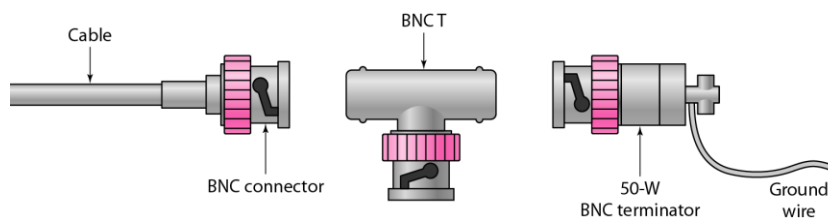
Category	Impedance	Use
RG-59	75 Ω	Cable TV
RG-58	50 Ω	Thin Ethernet
RG-11	50 Ω	Thick Ethernet

Coax cables are categorized by radio government rating (RG) Each RG number denotes a unique set of physical specifications.

Note

Attenuation is much higher than in Twisted pair cable. Although Coaxial cable has a much higher BW, The signal weakens rapidly and requires the frequent use of repeater

BNC connectors



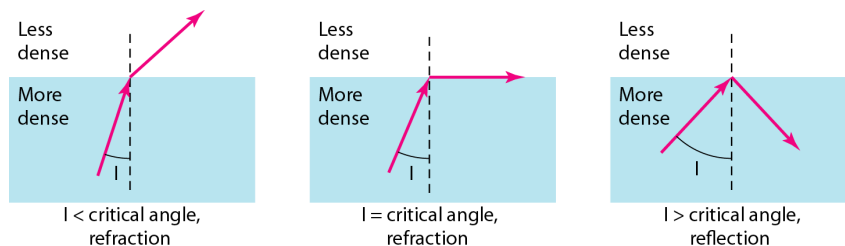
- 1. BNC connector:** Used in TV
- 2. BNCT:** Ethernet network
- 3. BNC terminator:** End of the cable to prevent the reflection of the signal

Applications of coaxial cable

- 1. Analog telephone network** where a single cable could carry 10,000 voice signals. Later it was used in **Digital telephone networks** where cable can carry 600Mbps
- 2. Cable TV network:** hybrid network use coaxial cable only at the network boundaries , near the consumer. Cable TV use RG-59
- 3. Traditional Ethernet LANs.**
 - 10-base-2** or “Thin Ethernet”, uses RG-58 coax cable to transmit data at **10 Mbps** with a range of **185m**.
 - 10-base-5**, or “Thick Ethernet”, uses RG-11 to transmit **10 Mbps** with rang of **500 m**

Fiber-Optic Cable

- Is made of glass or plastic and transmit signals in the form of light
- Light travels in a straight line as long as it is moving through a single uniform substance. If a ray of light traveling through one substance enters another substance of different density , the ray change direction as shown:

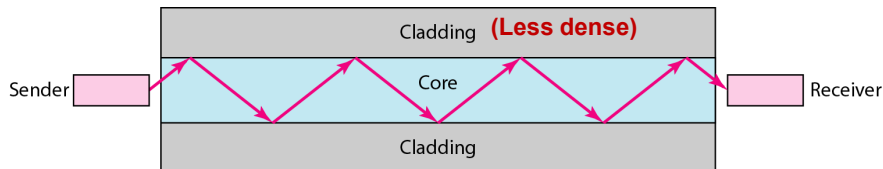


I: angle of incidence: the angle the ray makes with line perpendicular to the interface between the two substances

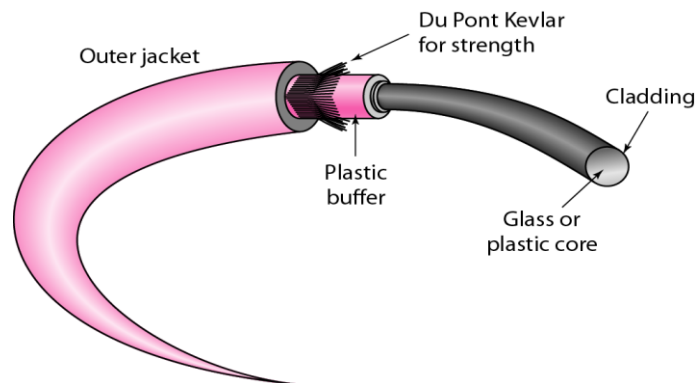
Critical angle: property of substance, its value differs from one substance to another

Fiber Optical

Fiber Optical : uses reflection to guide light through a channel. A glass or plastic core is surrounded by a **cladding of less dense** glass or plastic

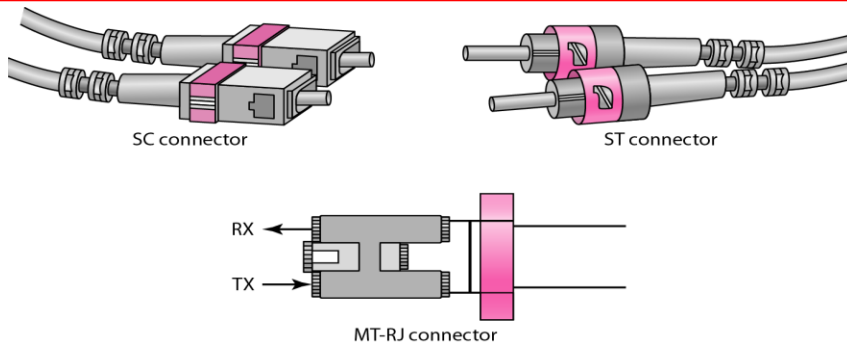


Fiber construction



Performance : Attenuation is flatter than in the case of UTP and coax cable. We need fewer (actually **10 times less**) repeaters when we use fiber optic cable

Fiber-optic cable connectors



1. **SC** (subscriber channel): used for TV cable
2. **ST** (Straight Tip): used for connect cable with networking devices
3. **MT-RJ**: Network

Applications of Fiber-optic cable

Used in

1. **Cable TV network**: hybrid network use a combination of optical fiber and coax cable. Optical provides the backbone while coaxial cable provide the connation to the user.
2. **Local area networks such as 100base-FX**(fast Ethernet) and **1000base-X LANs**.
3. **Backbone networks** because its wide bandwidth

Advantages of fiber-optical

- 1. Higher Bandwidth**
- 2. Less signal attenuation**
- 3. Immunity to electromagnetic interference (noise)**
- 4. Resistance to corrosive materials. Glass is more resistance to corrosive material**
- 5. Light weight. Fiber cables are much lighter than copper cables**
- 6. Greater immunity to tapping: copper cables create antenna effects that can easily tapped**

Disadvantages of fiber-optical

- 1. Installation and maintenance.** It's a new technology. Its installation and maintenance require expertise that is not yet available every where
- 2. Unidirectional light propagation.** If we need bidirectional , two fibers are needed.
- 3. Cost.** The cable and the interfaces are more expensive than those of other guided media. If the demand of BW is not high , often use of optical fiber can not be justified