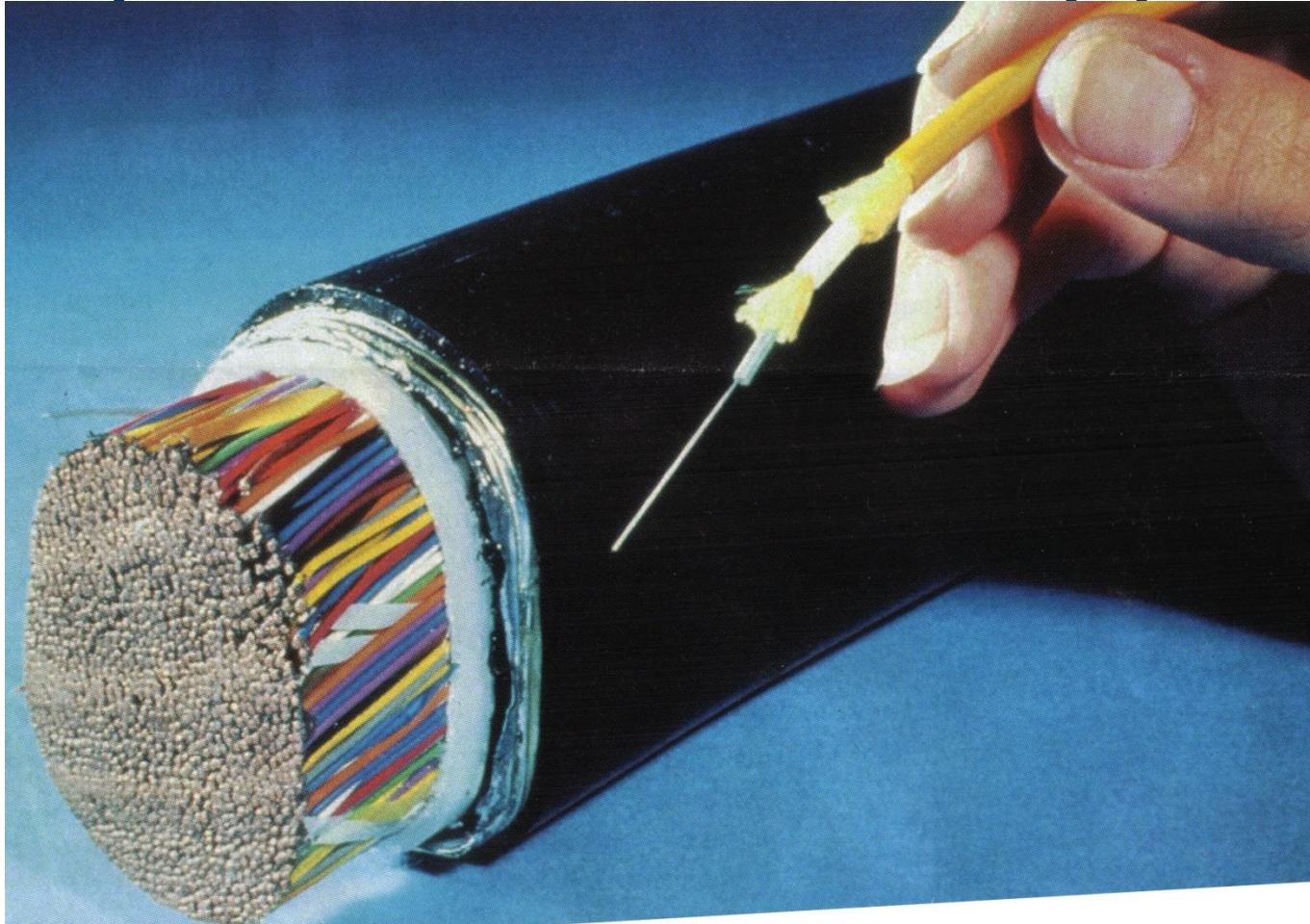


Introduction to Fiber Optics



Optical fiber vs Copper



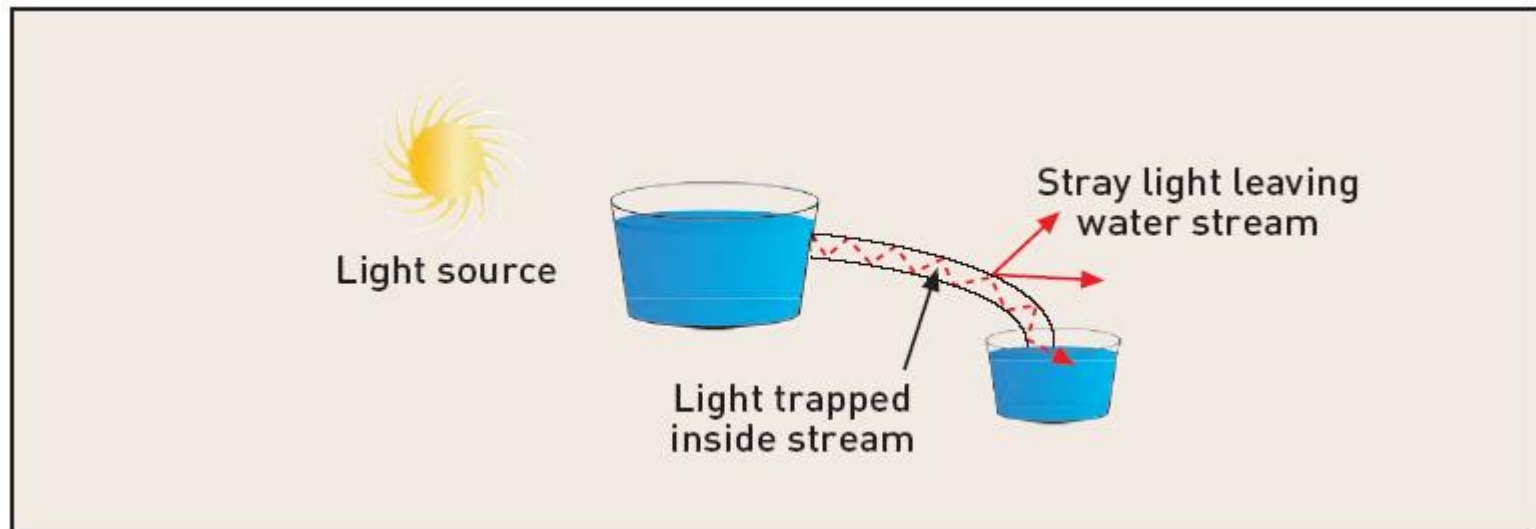
What are optical fibers

- Thin strands of pure glass
- Carry data over long distances
- At very high speeds
- Fiber can be bent or twisted

Background on Optical Communications

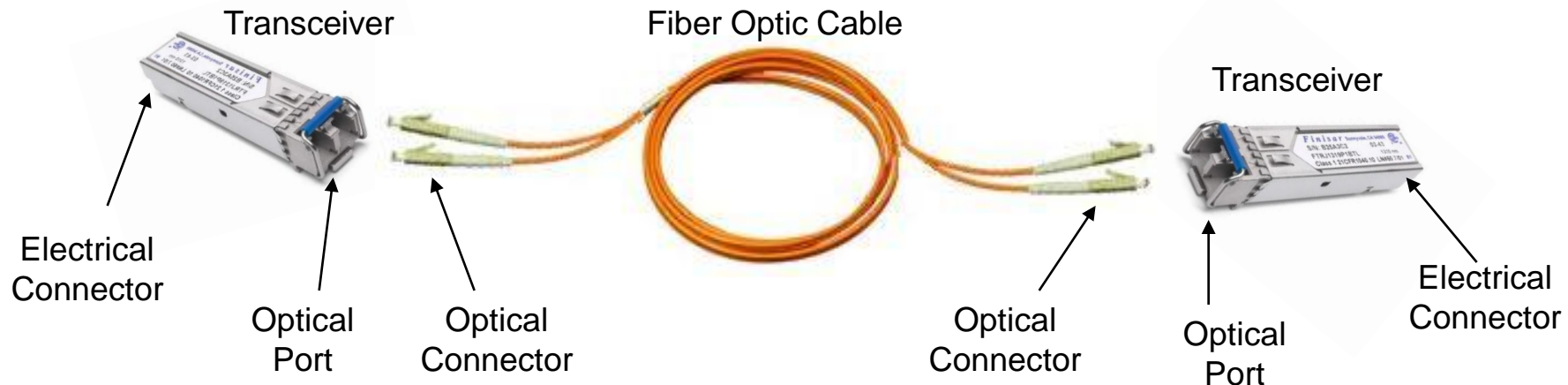
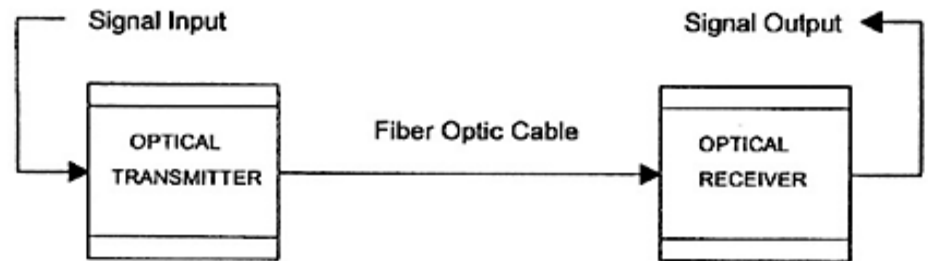
- Fiber-optic communication
 - Trapping light inside an optical fiber
 - Can carry any form of information
 - Fiber is an optical medium, which means it is capable of transmitting light
 - Based on total internal reflection (TIR)

Tyndall's Experiment



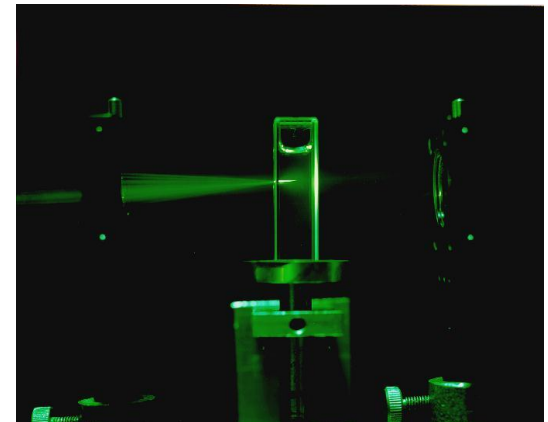
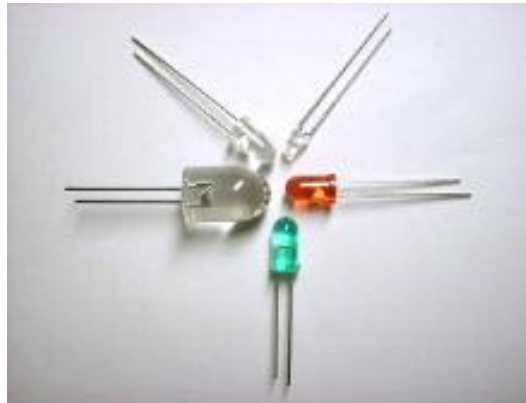
Fiber optic technology

- Sources
- Transmission medium
- Detectors



Sources of light

- Light emitting diodes
- Lasers

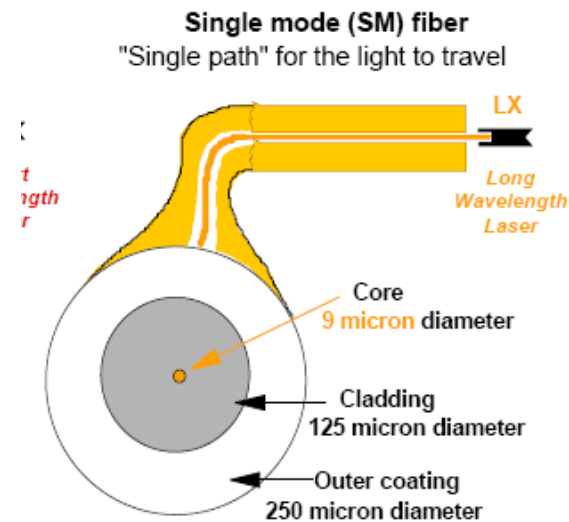
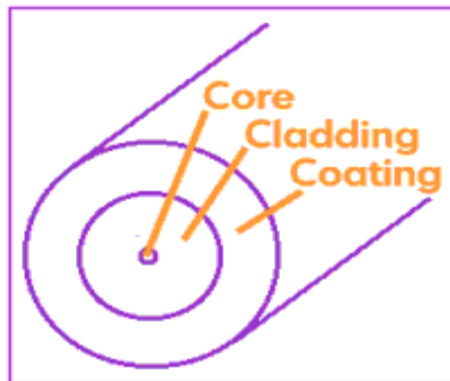


Sources

- Modulate electrical signals into optical signals
- Mostly modulate at 850nm, 1300nm and 1550 nm
- Lasers give high intensity, high frequency light
- LEDs are economical

Transmission medium

- Optical fiber is replacing copper
- Light is used as the carrier of information
- Much higher data rate



Structure of Fiber-Optic Cables – Cladding

- Cylindrical material made of glass or specialized plastic
- Central portion of the fiber
- Light signal carrying the information travels through the core
- The diameter of the core can range from a couple of micrometers (μm -one millionth of a meter) to a couple of millimeters (mm -one thousandth of a meter)

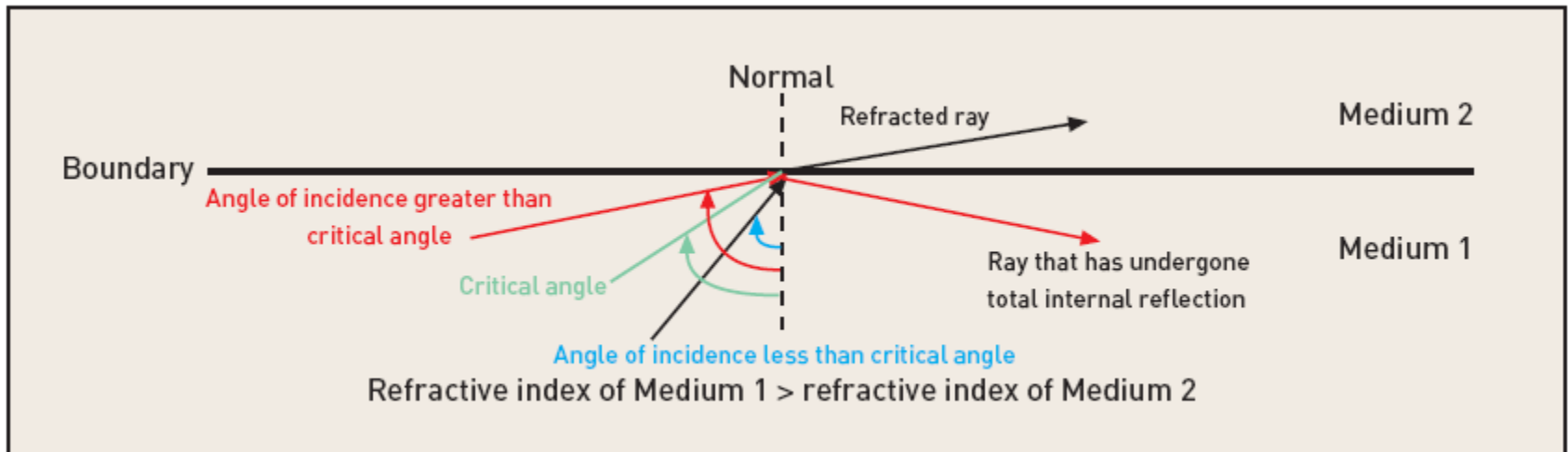
Structure of Fiber-Optic Cables – Jacket

- Surrounds the cladding
- Insulates and protects the fiber from physical damage and environmental effects, such as moisture, that might interfere with the inner workings of the cable
- Usually made of opaque plastic or another type of material

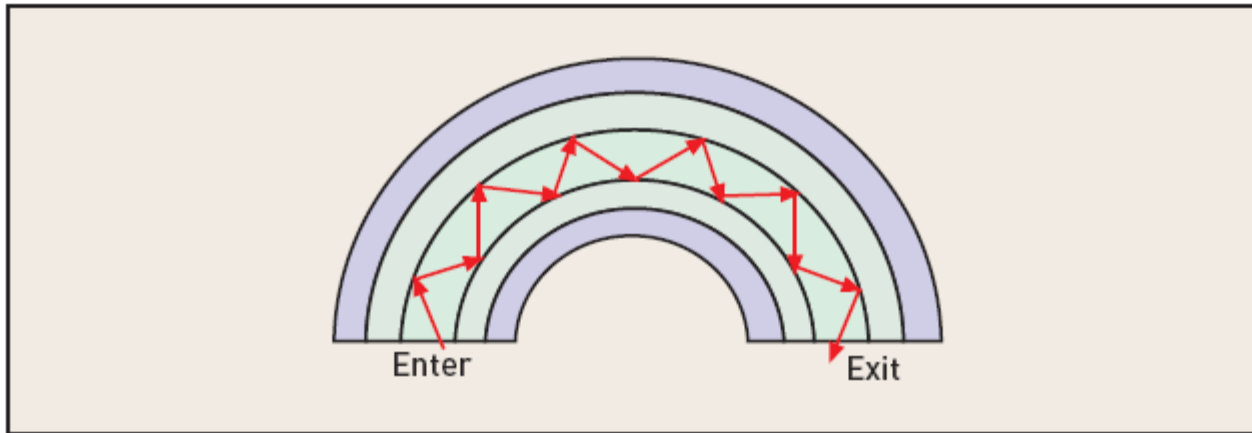
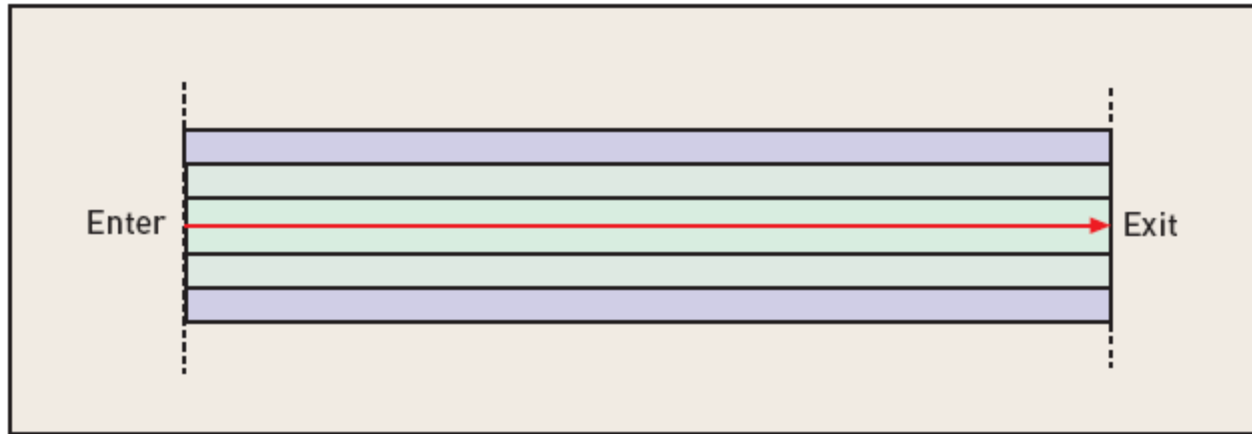
How Light Travels Through Fiber

- TIR is the basis of fiber-optic communication
- TIR may be considered to be an extreme case of refraction
- When a light ray strikes a boundary of two materials with different RIs, it bends, or in other terms, refracts to an extent that depends on the ratio of the RIs of the two materials

Total Internal Reflection

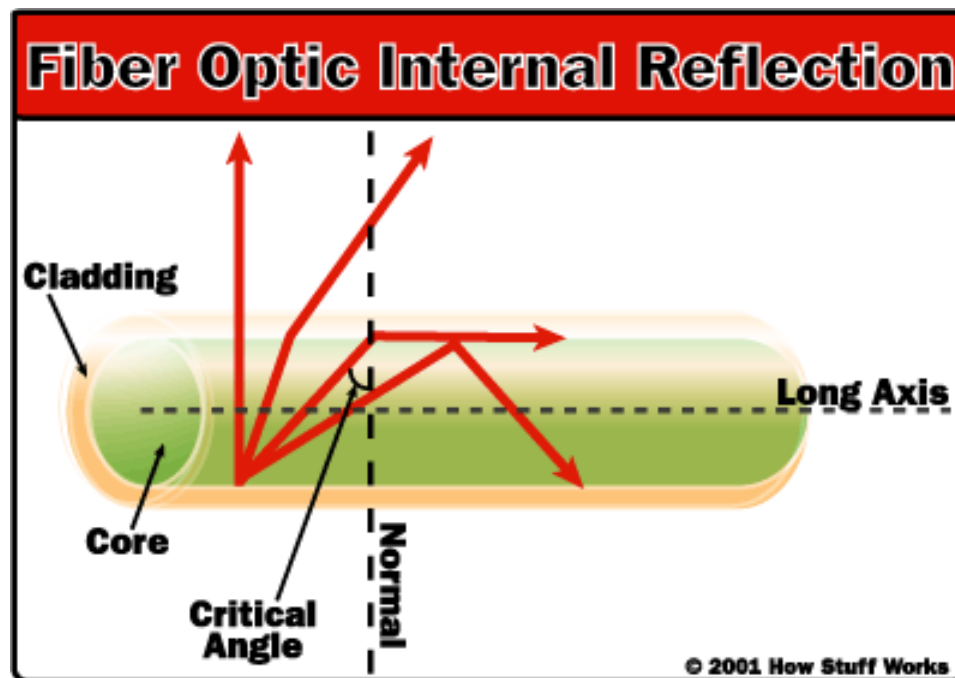


Total Internal Reflection (continued)



Total internal reflection

- Trapping light in the fiber



Fibers can be bent!!

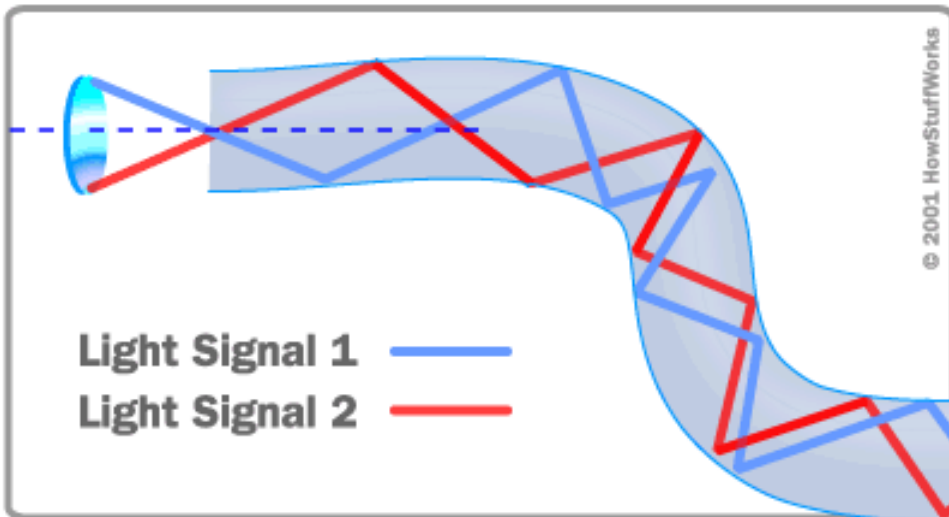


Fig: Illustration of total internal reflection

Types of optical fibers

- Single mode

- only one signal can be transmitted
- use of single frequency

- Multi mode

- Several signals can be transmitted
- Several frequencies used to modulate the signal

Losses in optical fibers

- Attenuation loss
- Dispersion loss
- Waveguide loss

Advantages of optical fibers

- Can carry much more information
- Much higher data rates
- Much longer distances than co-axial cables
- Immune to electromagnetic noise
- Light in weight
- Unaffected by atmospheric agents