

N.D. Mehta, Assistant Professor, VGEC Chandkheda

Introduction:

For gigabits and beyond gigabits transmission of data, the Fiber Optic Communication (FOC) is the ideal choice. This type of communication is used to transmit voice, video, telemetry and data over long distances and local area networks or computer networks. A FOC System uses light wave technology to transmit the data over a fiber by changing electronic signals into light.

Some exceptional characteristic features of this type of communication system like large bandwidth, smaller diameter, light weight, long distance signal transmission, low attenuation, transmission security, and so on make this communication a major building block in any telecommunication infrastructure. The subsequent information on FOC system highlights its characteristic features, basic elements and other details.

Working of FOC:

Unlike copper wire based transmission where the transmission entirely depends on electrical signals passing through the cable, the fiber optics transmission involves transmission of signals in the form of light from one point to the other. Furthermore, a FOC network consists of transmitting and receiving circuitry, a light source and detector devices like the ones shown in the figure 1.

When the input data, in the form of electrical signals, is given to the transmitter circuitry, it converts them into light signal with the help of a light source. This source is of LED whose amplitude, frequency and phases must remain stable and free from fluctuation in order to have efficient transmission. The light beam from the source is carried by a fiber optic cable to the destination circuitry wherein the information is transmitted back to the electrical signal by a receiver circuit.

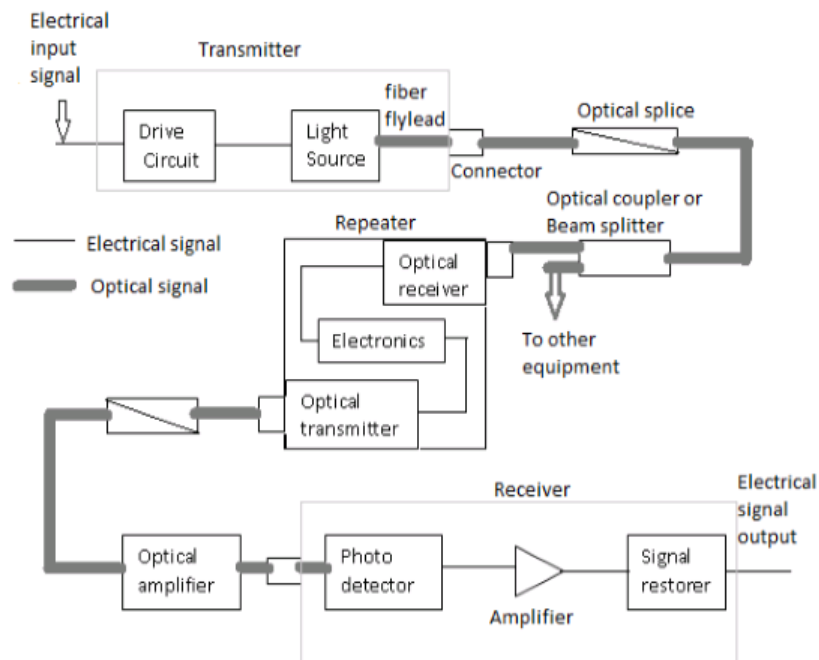


Fig. 1 Block Diagram of Fiber Optic Communication

N.D. Mehta, Assistant Professor, VGEC Chandkheda

The Receiver circuit consists of a photo detector along with an appropriate electronic circuit, which is capable of measuring magnitude, frequency and phase of the optic field. This type of communication uses the wave lengths near to the infrared band that are just above the visible range. Both LED and Laser can be used as light sources based on the application.

Basic Elements of a Fiber Optic Communication System

There are three main basic elements of FOC system. They are

- 1 Transmitter : Compact Light Source
- 2 Transmission channel : Low loss Optical Fiber
- 3 Receiver : Photo Detector

Transmitter: An electric signal is applied to the optical transmitter. The optical transmitter consists of driver circuit, light source and fiber flylead.

- Driver circuit drives the light source.
- Light source converts electrical signal to optical signal.
- Fiber flylead is used to connect optical signal to optical fiber.

Transmission channel: It consists of a cable that provides mechanical and environmental protection to the optical fibers contained inside. Each optical fiber acts as an individual channel.

- Optical splice is used to permanently join two individual optical fibers.
- Optical connector is for temporary non-fixed joints between two individual optical fibers.
- Optical coupler or splitter provides signal to other devices.
- Repeater converts the optical signal into electrical signal using optical receiver and passes it to electronic circuit where it is reshaped and amplified as it gets attenuated and distorted with increasing distance because of scattering, absorption and dispersion in waveguides, and this signal is then again converted into optical signal by the optical transmitter.

Receiver: Optical signal is applied to the optical receiver. It consists of photo detector, amplifier and signal restorer.

- Photo detector converts the optical signal to electrical signal.
- Signal restorers and amplifiers are used to improve signal to noise ratio of the signal as there are chances of noise to be introduced in the signal due to the use of photo detectors.

For short distance communication only main elements are required.

1. Source- LED
2. Fiber- Multimode step index fiber
3. Detector- PIN detector

For long distance communication along with the main elements there is need for couplers, beam splitters, repeaters, optical amplifiers.

1. Source- LASER diode
2. Fiber- single mode fiber
3. Detector- Avalanche Photo Diode (APD)

Advantages of Fiber Optic Communication:

- Optical fibers have largely replaced copper wire communications in core networks in the developed world, because of its advantages over electrical transmission. Here are the main advantages of fiber optic transmission.

N.D. Mehta, Assistant Professor, VGEC Chandkheda

- **Extremely High Bandwidth:** No other cable-based data transmission medium offers the bandwidth that fiber does. The volume of data that fiber optic cables transmit per unit time is far greater than copper cables.
- **Longer Distance:** in fiber optic transmission, optical cables are capable of providing low power loss, which enables signals can be transmitted to a longer distance than copper cables
- **Resistance to Electromagnetic Interference:** in practical cable deployment, it's inevitable to meet environments like power substations, heating, ventilating and other industrial sources of interference. However, fiber has a very low rate of bit error (10^{-13}), as a result of fiber being so resistant to electromagnetic interference. Fiber optic transmission is virtually noise free.
- **Low Security Risk:** the growth of the fiber optic communication market is mainly driven by increasing awareness about data security concerns and use of the alternative raw material. Data or signals are transmitted via light in fiber optic transmission. Therefore there is no way to detect the data being transmitted by "listening in" to the electromagnetic energy "leaking" through the cable, which ensures the absolute security of information.
- **Small Size:** fiber optic cable has a very small diameter. For instance, the cable diameter of a single OM3 multimode fiber is about 2mm, which is smaller than that of coaxial copper cable. Small size saves more space in fiber optic transmission.

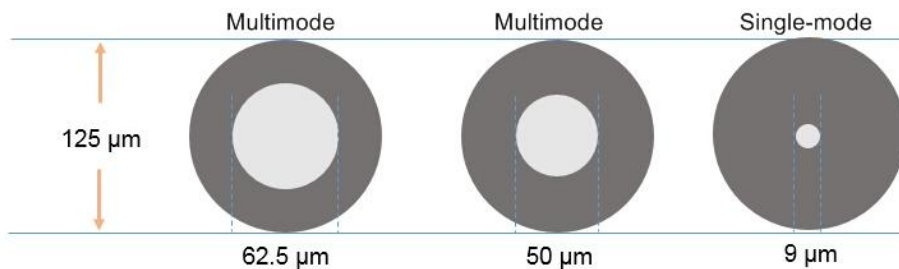


Figure 2: core diameter of fiber optic cable

- **Light Weight:** fiber optic cables are made of glass or plastic, and they are thinner than copper cables. These make them lighter and easy to install.
- **Easy to Accommodate Increasing Bandwidth:** with the use of fiber optic cable, new equipment can be added to existing cable infrastructure. Because optical cable can provide vastly expanded capacity over the originally laid cable. And WDM (wavelength division multiplexing) technology, including CWDM and DWDM, enables fiber cables the ability to accommodate more bandwidth.

Disadvantages of Fiber Optic Communication:

- Though fiber optic transmission brings lots of convenience, its disadvantages also cannot be ignored.

N.D. Mehta, Assistant Professor, VGEC Chandkheda

- **Fragility:** usually optical fiber cables are made of glass, which lends to they are more fragile than electrical wires. In addition, glass can be affected by various chemicals including hydrogen gas (a problem in underwater cables), making them need more cares when deployed under ground.
- **Difficult to Install:** it's not easy to splice fiber optic cable. And if you bend them too much, they will break. And fiber cable is highly susceptible to becoming cut or damaged during installation or construction activities. All these make it difficult to install.
- **Attenuation & Dispersion:** as transmission distance getting longer, light will be attenuated and dispersed, which requires extra optical components like EDFA to be added.
- **Cost is higher than Copper Cable:** despite the fact that fiber optic installation costs are dropping by as much as 60% a year, installing fiber optic cabling is still relatively higher than copper cables. Because copper cable installation does not need extra care like fiber cables. However, optical fiber is still moving into the local loop, and through technologies such as FTTx (fiber to the home, premises, etc.) and PONs (Passive Optical Networks), enabling subscriber and end user broadband access.