



## Fibre Optic Cables

**For Prelims:** Fibre Optic Cables, [Optical Fibres](#), Charles Kao, Total Internal Reflection, National Mission on Quantum Technologies and Applications.

**For Mains:** Fibre Optic Cables, Evolution of Internet, Challenges in Fibreisation, Government's Initiative.

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### Why in News?

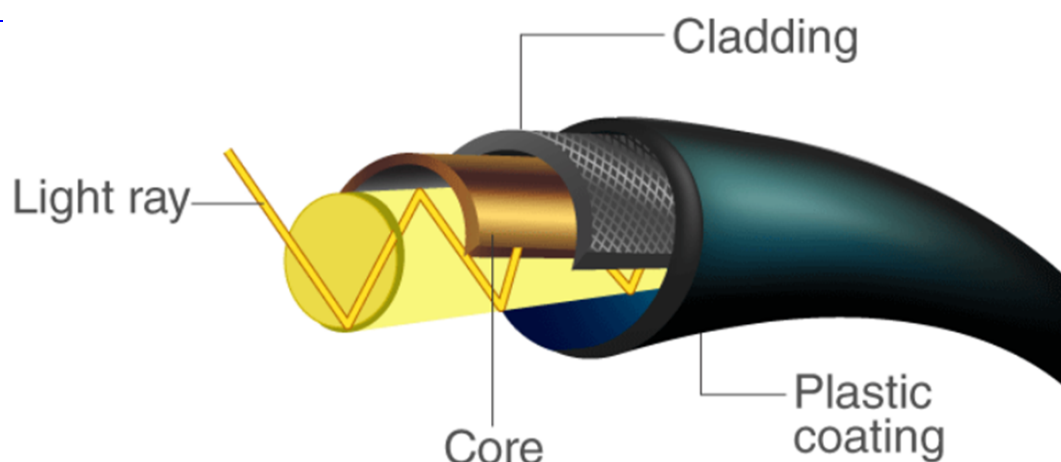
With the increasing demand for high-speed internet connections [Optical Fibres](#) have been materialized into the present-day reality of high-speed data transmission.

### What is an Optical Fibre?

#### ▪ About:

- Optical Fibres are thin, cylindrical strands composed of glass, with a diameter typically comparable to that of a human hair.
- These fibres possess the **remarkable ability to transmit various forms of information**, including text, images, audio, video, phone calls, and any data that can be digitized, across vast distances at **speeds approaching that of light**.
- They are **strong, lightweight, and remarkably flexible**, making them suitable for burial underground, submersion underwater, or coiling around a spool.
- Almost 60 years ago, physicist **Charles Kao proposed the concept of using glass Fibres** as a superior medium for telecommunications, superseding the prevalent copper wires.
  - His groundbreaking contributions to Fibre optic communication earned him a share of the 2009 Nobel Prize in Physics.

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### ▪ Working:

- **Principle of Total Internal Reflection:** The phenomenon of Total Internal Reflection (TIR) **forms the basis for guiding light within optical Fibres.**
  - If light travels from a higher refractive index medium (like glass) to a lower one (such as air) at a specific angle, it may not exit the medium **but be entirely reflected back within it.** This phenomenon is called TIR.
- **Signal Encoding:** Information is encoded into optical signals as **rapidly blinking light pulses**, typically representing binary digits (zeros and ones).
  - These optical signals are fed into one end of an optical Fibre, where they travel by reflecting and bouncing between the glass walls due to total internal reflection.
- **Signal Transport:** The optical Fibre carries the encoded signals across several kilometers without significant loss of signal integrity.
  - At the destination, a receiver reproduces the encoded information from the transmitted optical signal.

### ▪ Benefits:

- **High Speed:** Fibre provides more bandwidth and has standardized performance up to 10 Gbps and beyond, something that it is impossible to achieve when using copper.
  - More bandwidth means that Fibre can carry more information with far greater efficiency than copper wire.
- **Range of Transmission:** Since data travels in the form of light in Fibre-optic cables, very little signal loss occurs during transmission and data can move at higher speeds and greater distances.
- **Not susceptible to interference:** Fibre-optic cable is also much less susceptible to noise and electromagnetic interference than copper wire.
  - It is so efficient, in fact, that roughly 99.7% of the signal reaches the router in most cases.
- **Durability:** Fibre-optic cable is completely immune to many environmental factors that affect copper cable.
  - The core is made of glass, which is an insulator, so no electric current can flow through.

## What is the Current Scenario of Fibre Optics in India?

- Fibre optics technology has since been widely used in **telecommunication, medical science, laser technology, and sensing.**
- With a goal to securing communication and promoting quantum science, the Government of India announced a national mission in the Union Budget of 2020. The proposed budget for this **'National Mission on Quantum Technologies and Applications'** is Rs 8,000 crore over a period of five years.
- The possibilities of fibre optic networks are growing at an accelerated rate, reaching all the way into our homes. Along with **quantum optics, fibre optic communication** stands on the cusp of a new era.