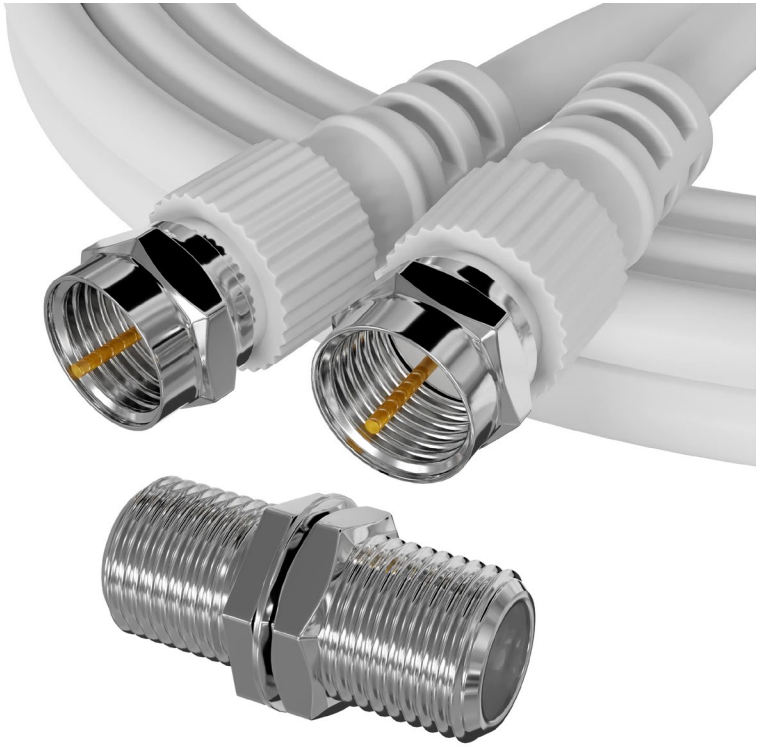
Transmission Media

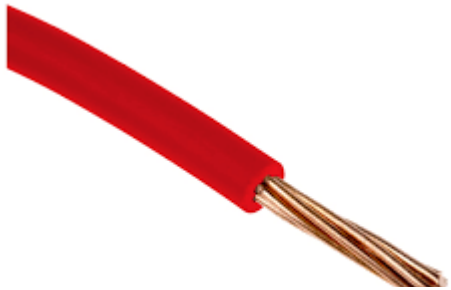
What is transmission media

- Transmission media is the physical cable we use to send signals from one device to another
- It allows electrical, optical, or electromagnetic signals to travel from a sender to a receiver.
- There are multiple different types of cables we use for media transmission.



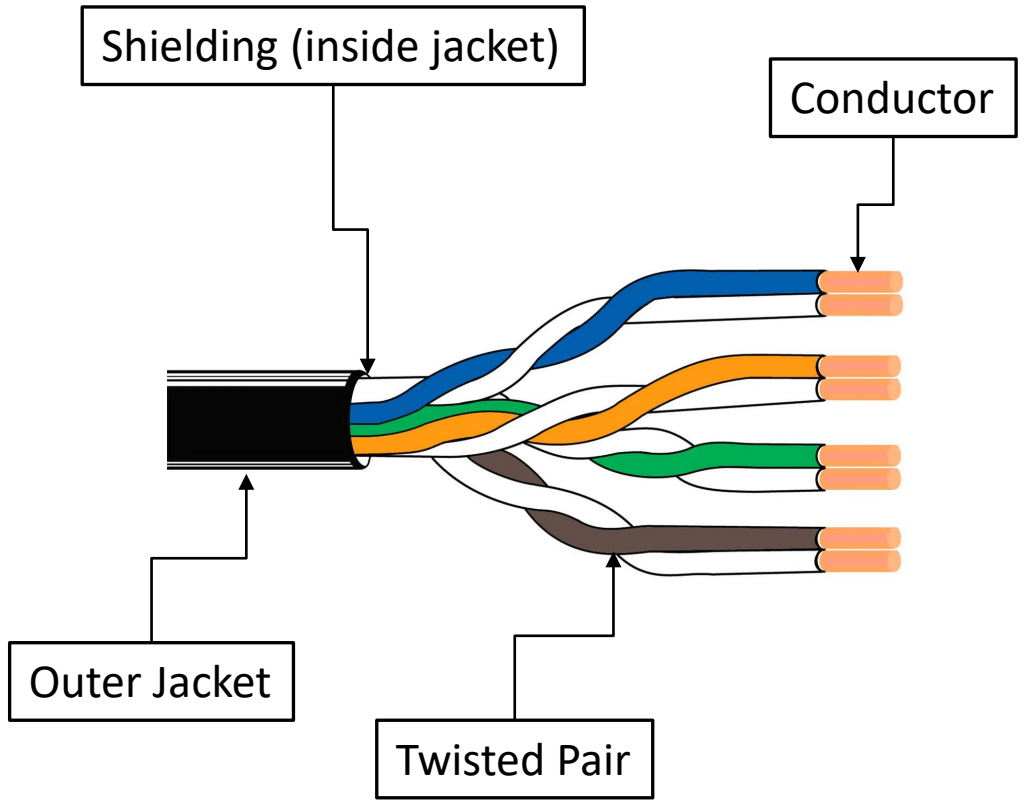
Guided vs Unguided transmission media

- There are two types of transmission media:
- Guided media transmits data by directing electrical or light signals through a physical path like cables (e.g., twisted pair, coaxial, fiber optic).
- Unguided media transmits data wirelessly through the air using electromagnetic waves like radio, microwave, or infrared signals.



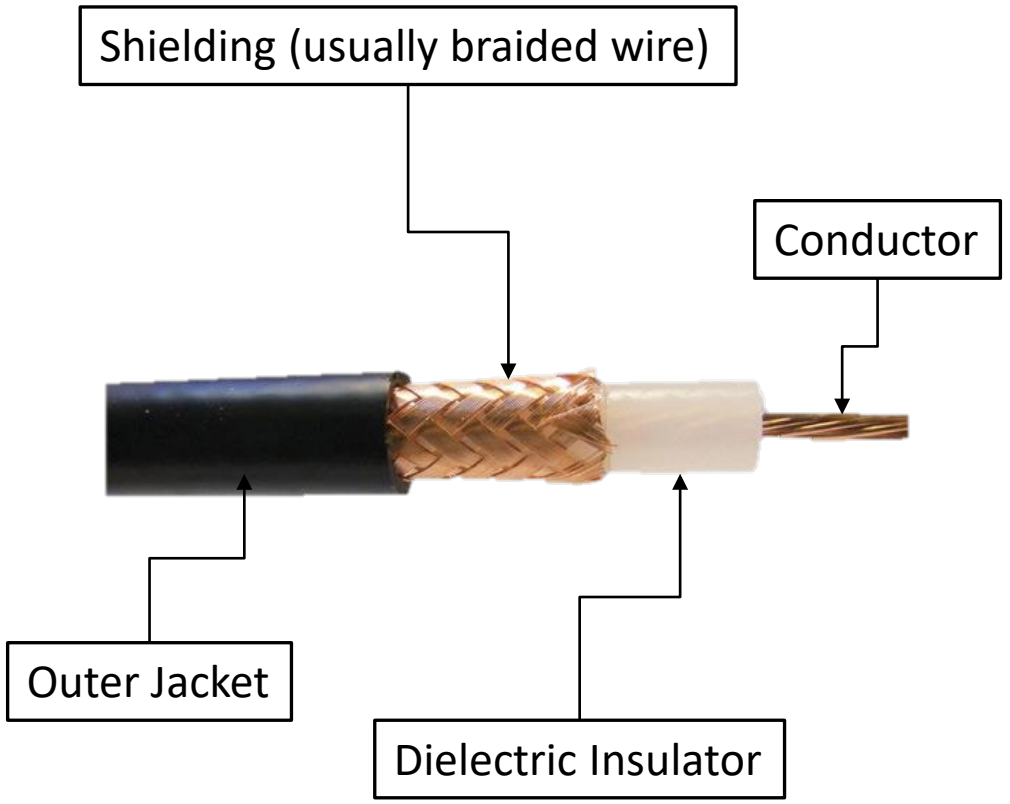
Twisted Pair wires

- Twisted pairs are an example of a guided transmission media
- Consist of pairs of insulated copper wires twisted together to reduce electromagnetic interference.
- Commonly used in Ethernet networks and telephone systems; available in shielded (STP) and unshielded (UTP) types for different noise protection levels.



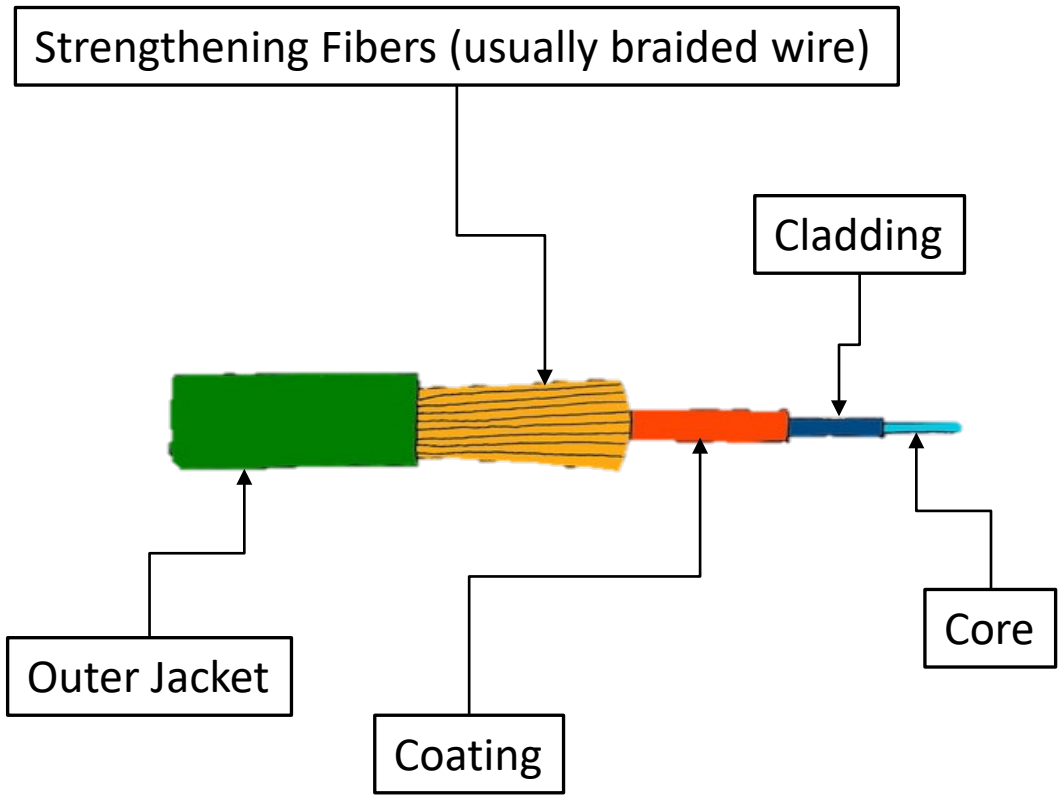
Coaxial wires

- Coaxial cables are an example of a guided transmission media
- Coaxial cables have a central conductor, insulating layer, metallic shield, and outer cover—designed to carry high-frequency signals with minimal interference.
- Commonly used for cable TV, broadband internet, and some CCTV systems due to their durability and shielding.



Fibre Optic wires

- Fibre optic cables are an example of a guided transmission media
- Fibre optic cables transmit data as pulses of light through thin strands of glass or plastic, offering extremely high speed and bandwidth.
- Ideal for long-distance and high-performance networks like internet backbones, due to their immunity to electromagnetic interference and low signal loss.

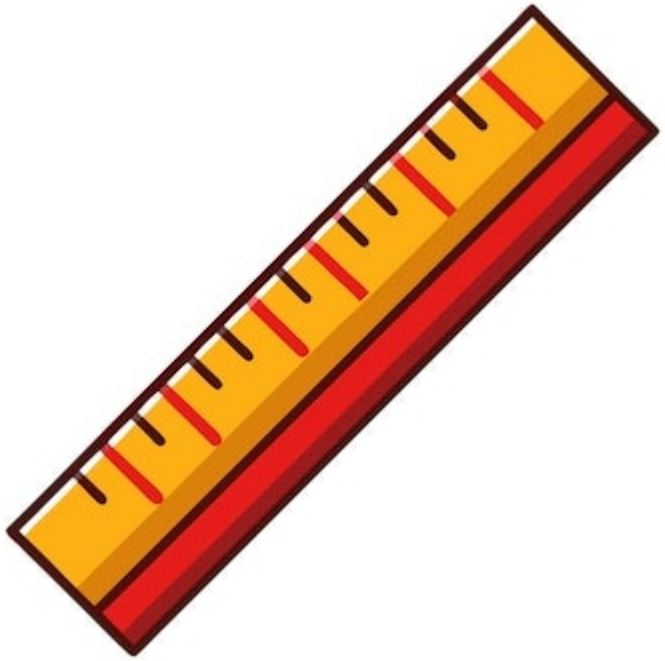


Typical Data Transfer Rates

- **Twisted Pair (UTP/STP)**
  - Standard Ethernet (Cat5e): Up to 1 Gbps
  - Higher grades (Cat6a/Cat7): Up to 10 Gbps over short distances
- **Coaxial Cable**
  - Typically, up to 1 Gbps (DOCSIS 3.0)
  - Some advanced systems (DOCSIS 3.1): Up to 10 Gbps downstream
- **Fibre Optic**
  - Single-mode: Up to 100 Gbps and beyond
  - Multi-mode: Typically 10–40 Gbps, depending on grade and equipment

Typical Range

- **Twisted Pair**
  - Up to 100 meters (standard Ethernet limit)
  - Susceptible to signal degradation and interference over long distances
- **Coaxial Cable**
  - Up to 500 meters without amplification
  - Can go further with repeaters or amplifiers
- **Fibre Optic**
  - Multi-mode: Up to 2 km
  - Single-mode: Up to 100 km or more, ideal for long-distance links

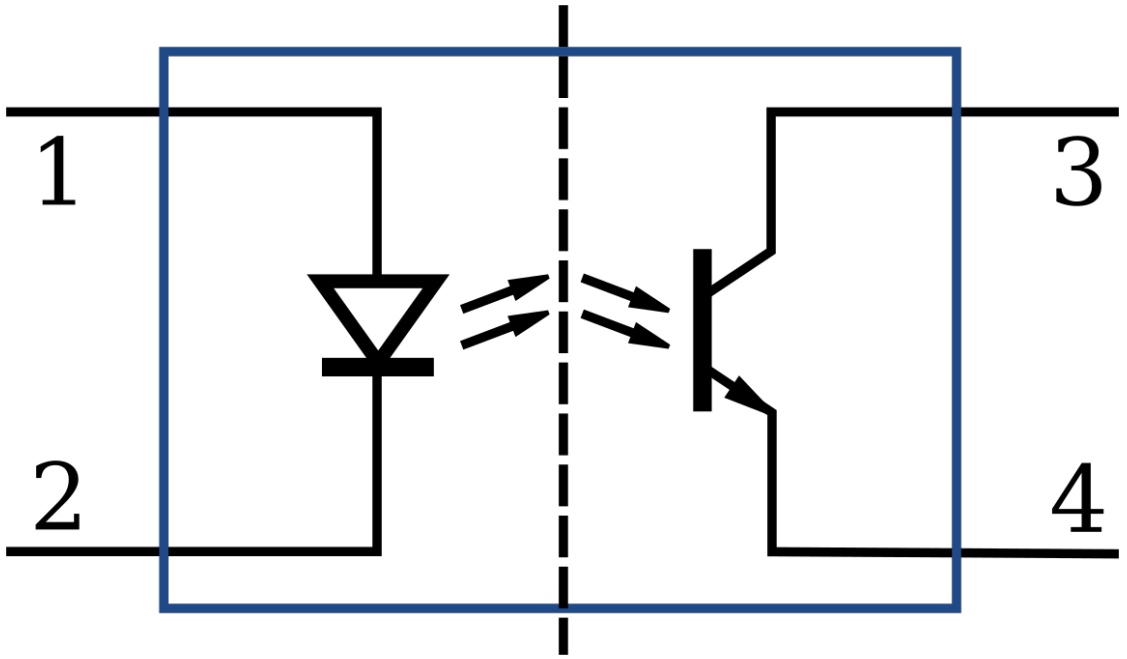


Typical Connectors

- **Twisted Pair**
  - RJ45 (8P8C) connector – standard for networking
  - Occasionally TERMINAL BLOCKS in industrial settings
- **Coaxial Cable**
  - BNC (Bayonet Neill–Concelman) – CCTV, RF equipment
  - F-type – cable TV and broadband
  - N-type – high-frequency applications
- **Fibre Optic**
  - LC (Lucent Connector) – small form factor, common in data centres
  - SC (Subscriber Connector) – larger, easy to use
  - ST (Straight Tip) – older style, still found in some setups

Opto-Isolator

- An opto-isolator (also called an optocoupler) is a device that transfers electrical signals between two isolated circuits using light.
- It protects sensitive components by electrically isolating high-voltage sections from low-voltage control systems.



Opto-Isolator

- Inside the device:
  - An LED emits infrared light when an input signal is applied.
  - A phototransistor or photodiode on the other side detects the light and switches the output circuit.
- There is no direct electrical connection between input and output—only light passes through.