# Data transmission - Cabling

## Cabling types

Several physical data-transmission media are available to connect together the various devices on a network. One possibility is to use cables. There are many types of cables, but the most common are:

- Coaxial cable
- Double twisted pair
- Optical fibre

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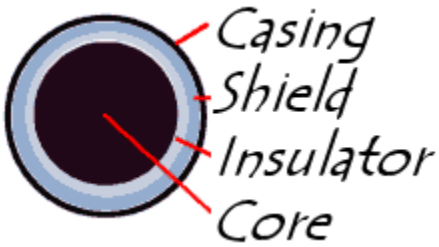
## Coaxial cable

Coaxial cable has long been the preferred form of cabling, for the simple reason that it is inexpensive and easily handled (weight, flexibility, ...).

A coaxial cable is made of up a central copper wire (called a *core*) surrounded by an insulator, and then a braided metal shield.




- **The jacket** protects the cable from the external environment. It is usually made of rubber (or sometimes Polyvinyl Chloride (PVC) or Teflon).
- **The shield** (metal envelope) surrounding the cables protects the data transmitted on the medium from interference (also called *noise*) that could corrupt the data.
- **The insulator** surrounding the central core is made of a dielectric material that prevents any contact with the shield that could cause electrical interactions (short circuit).
- **The core**, which actually transports the data, generally consists of a single copper strand or of several braided strands.

Thanks to its shield, coaxial cable can be used over long distances at high speed (unlike twisted pair cable), however it is usually used for basic installations.

Note that there are also coaxial cables that have a double shield (one insulating layer, one shield layer) and coaxial cables with four shields (two insulating layers, two shield layers).

Normally, two types of coaxial cable are used:

- **10Base2 - thin coaxial cable** (called *Thinnet* or *CheaperNet*) is a thin cable (6 mm in diameter), that is white (or grayish) by convention. It is very flexible and can be used in most networks by connecting it directly to the network card. It is able to transport a signal up to around 185 metres without line loss.

It is part of the RG-58 family whose impedance (resistance) is 50 ohms. The different types of thin coaxial cables are differentiated by the central part of the cable (core).

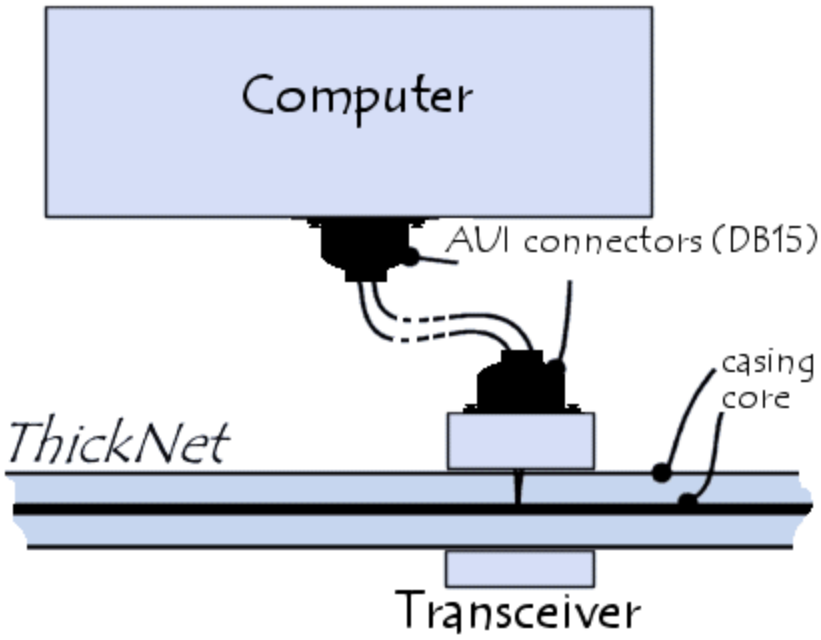
| Cable | Description |
|---|---|
| RG-58 / U | Central core consisting of a single copper strand |
| RG-58 A/U | Braided |
| RG-58 C/U | Military version of RG-58 A/U |
| RG-59 | Wide band transmission (cable television) |
| RG-6 | Thicker diameter, recommended for higher frequencies than RG-59 |
| RG-62 | Arcnet Network |

- **10Base5 - thick coaxial cable** (*Thicknet* or *Thick Ethernet* and also called *Yellow Cable*, because of its yellow color - by convention) is a shielded cable with a thicker diameter (12 mm) and 50 ohm impedance. It was used for a long time in Ethernet networks, which is why it is also known as "Standard Ethernet Cable". Given that it

has a larger-diameter core, it is able to carry signals over long distances: up to 500 meters without line loss (and without signal reamplification). It has a bandwidth of 10 Mbps and is very often used as a backbone to connect networks whose computers are connected with Thinnet. However, because of its diameter, it is less flexible than Thinnet.

## Transceiver: the connection between Thinnet and Thicknet

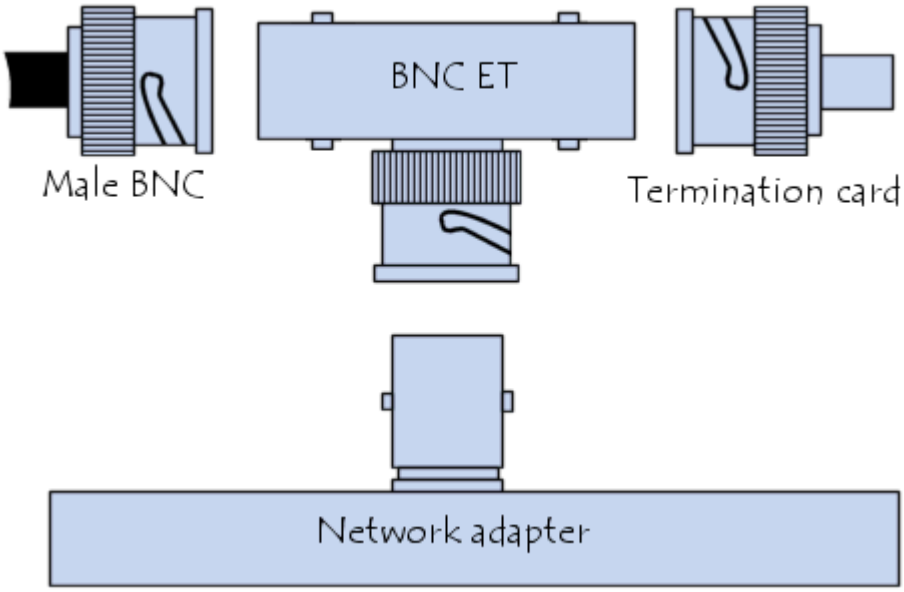
Thinnet and Thicknet are connected using a **transceiver**. It is equipped with a so-called "*vampire*" plug that makes the real physical connection to the central part of the Thinnet by piercing the insulating envelope. The transceiver cable (*drop cable*) connects to an **AUI** (*Attachment Unit Interface*) connector, also called a**DIX** (Digital Intel Xerox) connector or a **DB 15** (*SUB-D 15*) connector.




## Coaxial cable connectors

Thinnet and Thicknet both use **BNC** (*Bayonet-Neill-Concelman* or *British Naval Connector*) connectors to hook up the cables to computers. The following connectors are in the BNC family:

- **BNC cable connector**: this is soldered or crimped to the end of the cable.
- **BNC T-connector**: this connects the computer's network card to the network cable.
- **BNC Extender**: this joins two coaxial cable segments to form a longer one.
- **BNC terminator**: this is placed at each end of a cable in a Bus network to absorb interference signals. It is connected to earth. A bus network cannot function without them. It would stop working.




Twisted pair cabling

In its simplest form, twisted-pair cable consists of two copper strands woven into a braid and covered with insulation.

Two types of twisted pair cable are generally recognized:

- Shielded Twisted Pair (**STP**);
- Unshielded Twisted-Pair (**UTP** ).

A cable is often made of several twisted pairs grouped together inside a protective

jacket. The twisting eliminates noise (electrical interference) due to adjacent pairs or other sources (motors, relays, transformers).
Twisted pair is therefore suitable for a local network with few nodes, a limited budget and simple connectivity. However, over long distances at high data rates it does not guarantee data integrity (i.e. loss-less data transmission).

## Unshielded Twisted Pair (UTP)

UTP cable complies with the 10BaseT specification. This is the most commonly used twisted pair type and the most widely used on local networks. Here are some of its characteristics:

- Maximum segment length: 100 metres
- Composition: 2 copper wires covered with insulation
- UTP Standards: determine the number of twists per foot (33 cm) of cable depending on the intended use
- UTP: collected in the EIA/TIA (Electronic Industries Association / Telecommunication Industries Association) Commercial Building Wiring Standard 568. The EIA/TIA 568 standard used UTP to create standards applicable to all sorts of spaces and cabling situations, thereby guaranteeing the public homogeneous products. These standards include five categories of UTP cables:
- **Category 1**: Traditional telephone cable (voice but no data transmission)
- **Category 2**: Data transmission up to a maximum of 4 Mbit/s (RNIS). This type of cable contains 4 twisted pairs
- **Category 3**: 10 Mbit/s maximum. This type of cable contains 4 twisted pairs and 3 twists per foot
- **Category 4**: 16 Mbit/s maximum. This type of cable contains 4 copper twisted pairs
- **Category 5**: 100 Mbit/s maximum. This type of cable contains 4 copper twisted pairs
- **Category 5e**: 1000 Mbit/s maximum. This type of cable contains 4 copper twisted pairs

Most telephone installations use UTP cable. Many buildings are pre-wired for this type of installation (often in sufficient number to satisfy future requirements). If the pre-installed twisted pair is of good quality, it can be used to transfer data in a computer network. Attention must be paid, however, to the number of twists and other electrical characteristics required for quality data transmission.

UTP's major problem is that it is particularly susceptible to interference (signals from one line mixing with those of another line). The only solution to this is shielding.

## Shielded Twisted Pair (STP)

**STP** (*Shielded Twisted Pair*) cable uses a copper jacket that is of better quality and more protective that the jacket used for UTP cable. It contains a protective envelope between the pairs and around the pairs. In an STP cable, the copper wires of one pair are themselves twisted, which provides STP cable with excellent shielding, (in other words, better protection against interference). It also allows faster transmission over a longer distance.

## Twisted pair connectors

Twisted pair cable is connected using an RJ-45 connector. This connector is similar to the RJ-11 used in telephony, but differs on a few points: RJ-45 is slightly larger and cannot be inserted into an RJ-11 jack. In addition, the RJ-45 has eight pins while the RJ-11 has no more than six, usually only four.

## Fibre optics

Optical fibre is a cable with numerous advantages:

- Light-weight
- Immune to noise
- Low attenuation
- Tolerates data rates on the order of 100 Mbps
- Bandwidth from tens of megahertz to several gigahertz (monomode fibre)

Fibre optic cabling is particularly suited to links between distributors (central link between several buildings, known as **backbone**) as it allows connections over long distances (from several kilometres to 60 km in the case of single-mode fibre) without requiring earthing. Furthermore, this type of cable is very secure as it is extremely difficult to tap in to such a cable.

However, despite its mechanical flexibility, this cable type is not suitable for local network connections as it is difficult to install and is very expensive. For this reason, twisted pair or coaxial cable are preferred for short links.

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