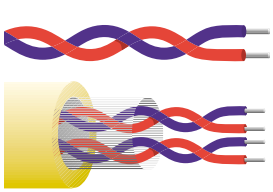
Selecting the right cable

The physical cable is often the weak link in data communications. The cable is the medium which handles the analogue signal which is highly vulnerable to interference. Through its design, installation and length, it is the cable and the electrical environment in its vicinity which determine the speed and quality of the transmissions.

Twisted pair cable

Twisted pair cable is the simplest, least expensive and most commonly used type of cable and is most often found in the form of a 4-wire twisted pair cable. It consists of an ordinary copper wire in a protective plastic covering, with or without a protective metal shielding. Such cables are manufactured by different manufacturers and different types exist with different levels of performance. This should be taken into account when considering the requirements of the particular installation. Different layers of insulation exist which are suitable for different environments. Three important parameters affect the quality of data transmission: resistance, capacitance and attenuation.



Resistance The electrical resistance of the cable. Resistance is measured in Ω/km and varies between the material of the wire and the surface area. The resistance is provided in the technical data for the particular cable. The diameter of cables with solid conductors should not be less than Ø 0.5 mm and, for multi-conductor cables, the recommended area is 0.2 mm^2. At low transmission speeds the resistance is the limiting factor.

Capacitance Since the conductors in the cable are isolated from each other, they will generate a capacitive connection between each other. Similarly, the twisted pair, the material of the conductors and any shielding will also have an effect. The capacitance causes the signals to be attenuated differently at different frequencies and the value of 800 Hz is often given. The capacitance is measured in pF/m and a good rule of thumb when selecting an adequate computer cable is about 50–70 pF/m. At high transmission speeds the capacitance is the limiting factor.

Attentuation (examples)

150 kHz	*8 dB/km*
1 MHz	*20 dB/km*
4 MHz	*40 dB/km*
10 MHz	*65 dB/km*
16 MHz	*82 dB/km*
25 MHz	*105 dB/km*

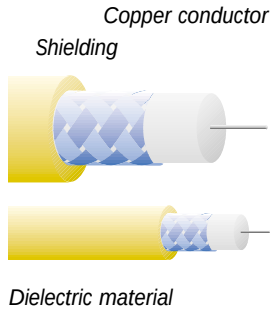
Attenuation The cable's total attenuation of the signal from the transmitter to the receiver. The attenuation is given in dB/km and increases, the higher the frequency. An decrease by 3 dB means that the power is reduced by half.

Coaxial cables

A coaxial cable consists of a single copper conductor surrounded by a grounded shielding. In order to keep the gap between the two constant, it is filled with an insulating plastic layer of dielectric material. The shielding is used for protection and for return signals. The coaxial cable has high electrical properties and is suitable for high-speed communication.

From the start, only coaxial cables were used for Ethernet. There are two types of coaxial cable: a thick cable (10Base5) and a thin cable (10Base2). Nowadays, a special 4-wire cable (10BaseT) is increasingly being used for Ethernet.

The advantage of the coaxial cable over the 4-wire cable is that it can be used for broadband transmission, i.e. several channels can be transmitted simultaneously (as with cable TV).



Fibre optic cables

Instead of conducting electric signals, as in the case of the copper cable, the fibre optic cable conducts light signals. A fibre optic cable can have a light-conducting core of *glass* or *plastic*. The core is surrounded by a thicker layer, called the *cladding*, which renders the surface area of the core totally refractive, and around this, there is a protective layer which acts as a buffer for the sensitive core. A distinction is made between *single mode* and *multi mode* fibres. Single mode fibre has a very thin core which is used together with a laser for long range high speed communication. The multi mode fibre is somewhat coarser which allows for more refraction which leads to lower data rates and a shorter range. Multi mode glass fibre is most commonly used in local data communications applications.

The greatest advantage of the fibre optic cable is that it is immune to electrical and magnetic interference. Consequently, it is highly suitable for harsh industrial environments. It guarantees secure transmission and has a very high transmission capacity. Fibre optic cables can be used in certain vulnerable network segments and can be combined, via a modem, with a 4-wire cable in a network.

A modem for fibre optical transmission transforms the electrical current into light signals which are transmitted over the cable with the help of LEDs. The signals are received by a photodiode which re-creates the electrical signals.

The signals can be modulated for different carriers (frequencies) which create transmission channels in both directions. Fibre optic cables can also be used for *broadband transmission*, where several channels (bands of frequency) are handled in parallel and where it is also possible to mix data transmission channels with channels for telephone, graphics, TV and sound.

Fibre optic cable and cable installation are still a bit more expensive than copper but have some major advantages, and the market is growing.