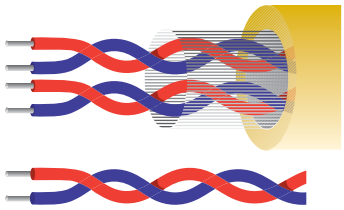
Types of copper cables

The physical cable is often the weak link in data communication. It is the cable that handles the interference sensitive analogue signal. It is the cable, through its design, installation and length together with the surrounding electrical effects, which determines the rate and quality of communications.

Twisted pair wire

Twisted pair wire is the simplest, cheapest and most common cable. Usually as a twisted pair 4-wire cable. It is a standard copper wire in a protective plastic sheath, with or without a protective metal screen. There are different brands and types of cable offering different performance, which should be considered depending on the installation requirement. And there are different isolation layers that suit different installation environments. There are three important concepts that affect the transmission quality: resistance, capacitance and attenuation.



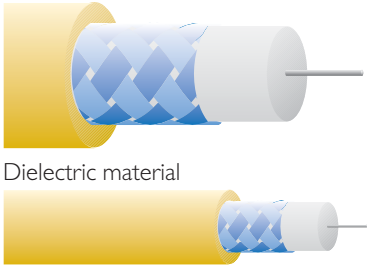
Resistance states the cable's electrical resistance. It is measured in ohm/km and varies with the wire's material and cross section. The resistance of the cable is evident from the data sheet for each cable. Cable with a solid conductor should not have a diameter of less than 0.26 mm^2 and for multicore conductors 0.2 mm^2. At low transmission rates it is the resistance that sets the limitations.

Capacitance as the conductors in the cable are isolated from each other they will generate a capacitive effect between each other. The twisted pair, conductor material and any screen will also have an effect. The capacitance attenuates the signals differently at different frequencies and the value is usually stated at 800 Hz. Capacitance is measured in pF/m and a guideline value for a good data cable is approximately 50–70 pF/m.
At high transmission rates it is the capacitance that sets the limitations.

Attenuation states the cable's overall attenuation of the signal from the transmitter to the receiver. Cable attenuation is stated in dB/km and increases with ascending frequency. An increase in attenuation of 3 dB represents a halving of the output.

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



Coaxial cable

Coaxial cable consists of a single copper conductor surrounded by a screen. In order to maintain the distance constant the gap is filled with an insulating plastic dielectric layer. The screen is used as protection and for the return signals. Coaxial cable has good electrical properties and is suitable for communication at high transmission rates. Initially Ethernet only used coaxial cable and was available in two variants, the heavier (10Base5) and the lighter (10Base2). Today, Ethernet increasingly uses a special twisted pair cable (10BaseT). Coaxial cable offers the advantage of being broadband, i.e. you can send several channels simultaneously (like cable-TV).

Distance and design

It is not always easy to construct bridges for data communications. Not only must different points be connected by a communications medium, the medium must also be designed to handle current and future traffic loads. It must also be able to effectively handle certain transmission speeds, it should not require maintenance and it must be able to withstand environmental impact.

Since this is a question of determining the right design for the specific conditions of the particular application, it is impossible to formulate a general design which can be applied to all areas. The best approach is to discuss different alternatives with one or several experts in order to arrive at an optimum solution.

Transmission range with different types of cable media and data rates

The diagram below shows the transmission distance that you can attain with different types of cable media and data rates. The lines with the colours black, blue and green are a twisted pair cable with the specifications 0.3 mm^2 and 42 pF/m. As quality and dimensions differ between different telecom cables, we have used a common cable used in the Swedish telephone network that has a cross section of 0.2 mm^2 and attenuation of approximately 1.1 dB/km.