

Development and Prospect of Twisted Pair Cables

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Abstract. As the most common interconnect cable, twisted pair has been widely used in various aspects of society. This article systematically introduces the classification of twisted pair cables and its advantages and disadvantages. At the same time, it specifically analyzes how to better identify and select twisted pair cables. With the increase in its use, many realistic challenges it faces are becoming more and more prominent. This article provides great help for understanding and using of twisted pair cables.

1. Introduction

With the rapid development of the global communications network business, broadband transmission and high-speed transmission have become the best way of information networking. But at the same time it also brings serious electromagnetic interference problems. Signals are transmitted between the two systems and require the use of transmission media. It is a physical line that connects the sending end and the receiving end in data communication and is an important part of the computer communication network. [1, 2] Although common wireless transmission media such as satellites and cellular networks have become more sophisticated and more widely used, common wired transmission media include twisted pair, coaxial cable, and optical fiber interconnection cables are the main media for near field communication. In the transmission of information, it still has an irreplaceable status. As the most common interconnect cable, twisted pair has been widely used in various aspects of society. [3]

2. Overview of the twisted pair

Twisted pair has a long history. It was born in the 1970s. It appeared with the invention of the telephone and it plays an important role in the history of human wired communication. Twisted Pair (TP), also known as twisted pair, is the most traditional and common transmission cable. Twisted pair is a kind of universal wiring made by winding two copper wires with insulating layers spirally twisted at a certain density (usually wound in counterclockwise) and putting one or more pairs of twisted pairs. Twisted pair cables are formed in one insulating sleeve. [4] Twisted pair used to transmit analog signals in the past and is now also suitable for the transmission of digital signals.

3. Twisted Pair Classification and Characteristics

Generally, a twisted pair cable contains multiple pairs of twisted pairs. The number varies depending on the application. Generally, it is between 2 and 1800 pairs. Everyday more common twisted pair cables connecting computer terminals include 2 pairs or 4 pair pairs. Stranded wire. There are many kinds of twisted-pair cable classification methods. In the project, we can see that some twisted-pair



wires have a layer of metal shielding. Some twisted-pair wires do not have a metal shielding layer. According to the presence or absence of the shielding layer, but mainly divided into shield twisted pair Line and unshielded twisted pair two categories. [5]

3.1. Classification of Twisted Pairs

The unshielded twisted pair cable is composed of pairs of twisted pairs and a layer of plastic. According to the thickness of the wire and the transmission quality, the International Electrical Industry Association (EIA) defines five types of unshielded twisted pair (UTP) cables. Different quality categories. Category 1 lines are mainly used for voice transmission; Category 2 lines are used for voice transmission or data transmission with a maximum transmission rate of 4 Mbps; Category 3 lines are cables currently specified in the ANSI and EIA/TIA 568 standards. These cable transmission characteristics are specified up to 16 MHz for voice and data up to 10 Mbps. Examples of these systems are the UTP cable 4 Mbps Token Ring at IEEE 802.5 and 10 Mbps Ethernet at IEEE 802.3, which have gradually faded out. Market. The transmission characteristics of Category 4 are specified up to 20 MHz and are used for voice and data with a maximum transmission rate of 16 Mbps. The example of these systems is the 16 Mbps Token Ring network used by the UTP standard in IEEE 802.5. Such lines are not widely used. . The transmission characteristics of Category 5 cable are specified up to 100MHz for voice and data up to 155Mbps. Examples of these systems are UTP standards for IEEE802.3z 100BASE-T Fast Ethernet and ANSI X3T9.5 100 Mbps CDDI systems. The most commonly used Ethernet cable. There are also Super Category 5 cables that are mainly used for Gigabit Ethernet (1000 Mbps); Type 6 cables can provide twice the bandwidth of Ultra-5, and their cabling transmission performance is much higher than the Ultra-Five standard. Meet the latest Gigabit Ethernet high-speed applications for applications with transfer rates higher than 1 Gbps. There are not many applications of Category 7 cables, and Category 7 cables can only be used for shielded cables. Their high cost, difficulty in construction, and transmission performance differences have discouraged ordinary users and placed them in an awkward market position. [6]

The inside of the shielded twisted pair (STP) cable is twisted pair copper wire like the unshielded twisted pair cable. The outer layer is covered with aluminum foil. The shielded twisted pair cable is relatively expensive, but it is still rougher than the same uranium. Cables and optical cables are cheaper. It is more difficult to install than an unshielded twisted pair cable, similar to a coaxial cable. It must be equipped with a special connector that supports shielding and the corresponding mounting technology. It has a high transmission rate of up to 155 Mbps within 100m, but it is usually used at a transmission rate of 16 Mbps, which does not exceed 100 Mbps. The maximum use distance of shielded twisted pair cables is also limited to a few hundred meters.

3.2. Twisted Pair Characteristics

Twisted-pair uses a wide range, we can see it in industrial control systems, long-distance video transmission, telephone transmission and other things. The reason why twisted-pair cables are so widely used is because they have strong anti-jamming capability and at the same time have relatively long transmission distances, which can meet most of the production needs. Moreover, twisted-pair cables have convenient wiring, low price, and good compatibility. And many other advantages.

1) High transmission quality and long transmission distance. Due to the adoption of advanced processing technology in twisted pair transceivers, video signals transmitted using twisted pairs are excellently compensated for the attenuation of the amplitude of the video signal and the difference in attenuation between different frequencies. The real-time nature and brightness of the original signal, when the transmission distance reaches 300m or more, the image signal is basically no distortion. If relay mode is used, the transmission distance will be further away.

2) Easy wiring and high cable utilization. An unshielded twisted pair can transmit high-definition image signals and can also transmit high-fidelity stereo audio signals. A pair of ordinary telephone lines can be used to transmit video signals. In Category 5 and Category 6 twisted pairs, four pairs of cables can transmit network signals, video signals, control signals, audio signals, power supply or

other signals at the same time, which can maximize the use of cables and avoid the separate wiring of various signals. Come in trouble and reduce engineering costs. [7, 8]

3) Strong anti-interference ability. The twisted pair is twisted together by two metal insulated conductors in accordance with certain rules. The two conductors of the twisted pairs have the same electrical properties and maintain a balance, which can cancel the radiation between each other and reduce the interference. Therefore, twisted pairs can transmit high-quality image signals even under strong interference environments. In addition, several pairs of twisted pairs in a cable are used to transmit different signals and no interference occurs between them. [9]

4) Easy to use, high reliability. Use twisted pair transmission network signal, telephone signal, just do the crystal head according to the requirement and then connect the corresponding equipment to use. To transmit video signals using twisted pair, you only need to connect dedicated signal transmitters and receivers at both ends of the twisted pair. It can be said that twisted-pair transmission equipment is easy to operate, and once it is installed, it can work stably for a long time without manual intervention.

5) The cost is low and the materials are convenient. At present, five types of unshielded twisted-pair cables are widely used in the project. The cost is relatively low, and there are many suppliers. It is easy to purchase and brings great convenience to the project. [10, 11]

4. How to identify the advantages and disadvantages of twisted pair

1) Test the speed of twisted pair

Testing the transmission speed of the twisted pair is the most effective means to identify the authenticity of the twisted pair, and reduces the influence of external factors on the transmission speed of the twisted pair to a minimum degree. Try to use a good quality branded network card. At the same time, it is also necessary to ensure that the computer system is clean, tidy, and fast. In addition, when connecting twisted-pair cables, try to use good-quality crystal plugs, and make sure that the cable ends are standardized.

2) Check twisted pair flexibility

Good quality twisted pairs are designed with ease of wiring in mind and are as flexible as possible. No matter how they are bent, they are easy to use and they are not easily broken. Of course, if the twisted pair is found to be too soft, it should be noted that it may be counterfeit.

3) Test flammability of twisted pair

In general, the materials that make up the twisted pair must have anti-combustibility. Therefore, when choosing the twisted pair, you must check the flammability of the twisted pair jacket to identify the authenticity. With the lighter burning against the skin, the genuine twisted-pair wire will be gradually melted and deformed under the barbecue of the fireworks, but the skin will not burn by itself. If the twisted-pair wire cannot be restrained from the test of fire, it will burn. When it gets up, the transmission speed of the twisted pair should be given up again. After all, such a twisted pair is very insecure in the wiring project. Using it will leave a great security risk.

4) Test the temperature resistance of twisted pair

In the wiring project, there is a very high requirement for the twisted pair to resist the change of the outside temperature. To ensure that the performance of the twisted pair is not affected in the high temperature environment, the sheath material used in the genuine twisted pair can withstand high temperatures of up to about 50 degrees. No similar phenomenon occurs when the twisted pair is softened or deformed. In the case of poor quality twisted pairs, rubber will soften at temperatures above 40 degrees, and high quality twisted pairs will not. If the skin is found to be softer than the normal skin, the quality of the twisted pair is definitely not too hard.

5) Identify the logo on the twisted pair jacket

Identify the authenticity of the twisted pair by observing the marking on the twisted pair jacket. The twisted pair jacket of the regular brand has the category identification of the twisted pair and the manufacturer's trademark. For example, the CAT5 logo indicates that the twisted pair is a Category 5 cable, and the CAT6 logo indicates that the twisted pair is a Category 6 cable; if the twisted pair if there is no logo on the skin of the line, everyone should be vigilant.

6) Test the twist of the twisted pair

The so-called twisted pair winding is actually the length of the twisted section of the twisted pair. Usually, people use the winding distance to indicate the tightness of each pair twisted, and in order to crosstalk between each pair of pairs. To minimize the degree, the pairs are often wound tightly counterclockwise, and the windings used for each pair of pairs should not be the same. The crosstalk between pairs is greatly increased, which seriously affects the performance of the twisted pair.

7) Test the extensibility of the skin

Considering that twisted wires often need to be bent during wiring, making the twisted pairs gives a certain degree of extensibility to the sheath to ensure that the twisted pair is not damaged when it is bent. If the external force of the twisted pair cable is severed or the external skin is cracked, the quality of the twisted pair is problematic. [12]

5. Conclusion

Twisted pair is used as a bridge connecting network physical equipment. Twisted pair has great potential in the field of transmission in the short-to-medium distance in the future. It can meet the necessary conditions for high-efficiency, energy-saving, environmental protection and many other current social development trends, providing users with Cost-effective transmission mechanism. With the ever-increasing demand for communications, twisted-pair wire, the most common communication medium, is bound to continue to exploit its communication potential. Twisted pair products will have a higher degree of integration, higher transmission rate, more distant transmission distance, more stable transmission performance, and the installation of products will also become simple and intelligent.

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References

- [1] Zhao Qian, Qian Jianping, Guo Enquan, Du Hao. Research on Electromagnetic Interference Protection of Twisted Pairs [J]. Journal of Electronic Measurement and Instrument, 2010 (03).
- [2] Ma Jinping, Mao Naihong, Ding Jun, Chen Guorui. Field-to-Twisted Pair Electromagnetic Coupling Study [J]. Chinese Journal of Radio Science, 1998 (01).
- [3] Xu Xin, Wen Min. Twisted pair research and discussion [J]. Science and Technology Innovation Forum, 2013 (04).
- [4] Zhao Dahao. Research on anti-interference technology of multi-core interconnection cable [D]. Xi'an: University of Electronic Science and Technology, 2003
- [5] Wei Shoulong. Shielding performance testing of symmetrical and multi-core cables [D]. Nanjing: Southeast University, 2009
- [6] Fu Hongfang. The characteristics and classification of twisted pair cable [J]. Computer Knowledge and Technology, 2012 (09)
- [7] Paul C R, McKnight J. W. Prediction of cross talk involving twisted pairs of wires, Part 1, A transmission line model for twisted wire pairs [J]. IEEE Trans. on Electromagnetic Compatibility, 1979, EMC-21 (2): 922-105.
- [8] Paul CR, McKnight JW. Prediction of crosstalk involving twisted pairs of wires, Part 2, A simplified low frequency model [J]. IEEE Trans. on Electromagnetic Compatibility, 1979, EMC-21 (2): 105-114.

- [9] Qiu Chang. Multi-core cable anti-jamming technology and test research [D]. Xi'an: University of Electronic Science and Technology, 2002
- [10] Alksne A.Y, Magnetic Fields Near Twist Wires [J]. IEEE Trans. On space Electronics and Telemetry, 1964 (4): 154-158.
- [11] Agrawal A K, LEEKM, Scott L D, et al. Experiment characterization of multi conductor transmission lines in the frequency domain [J]. IEEE Trans. on electromagnetic compatibility, 1979, EMC21 (1): 20-27.
- [12] Liu Jianpei. Deep analysis of twisted pair [J]. Computer Knowledge and Technology, 2006 (20).