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DATA CENTER
SOLUTIONS

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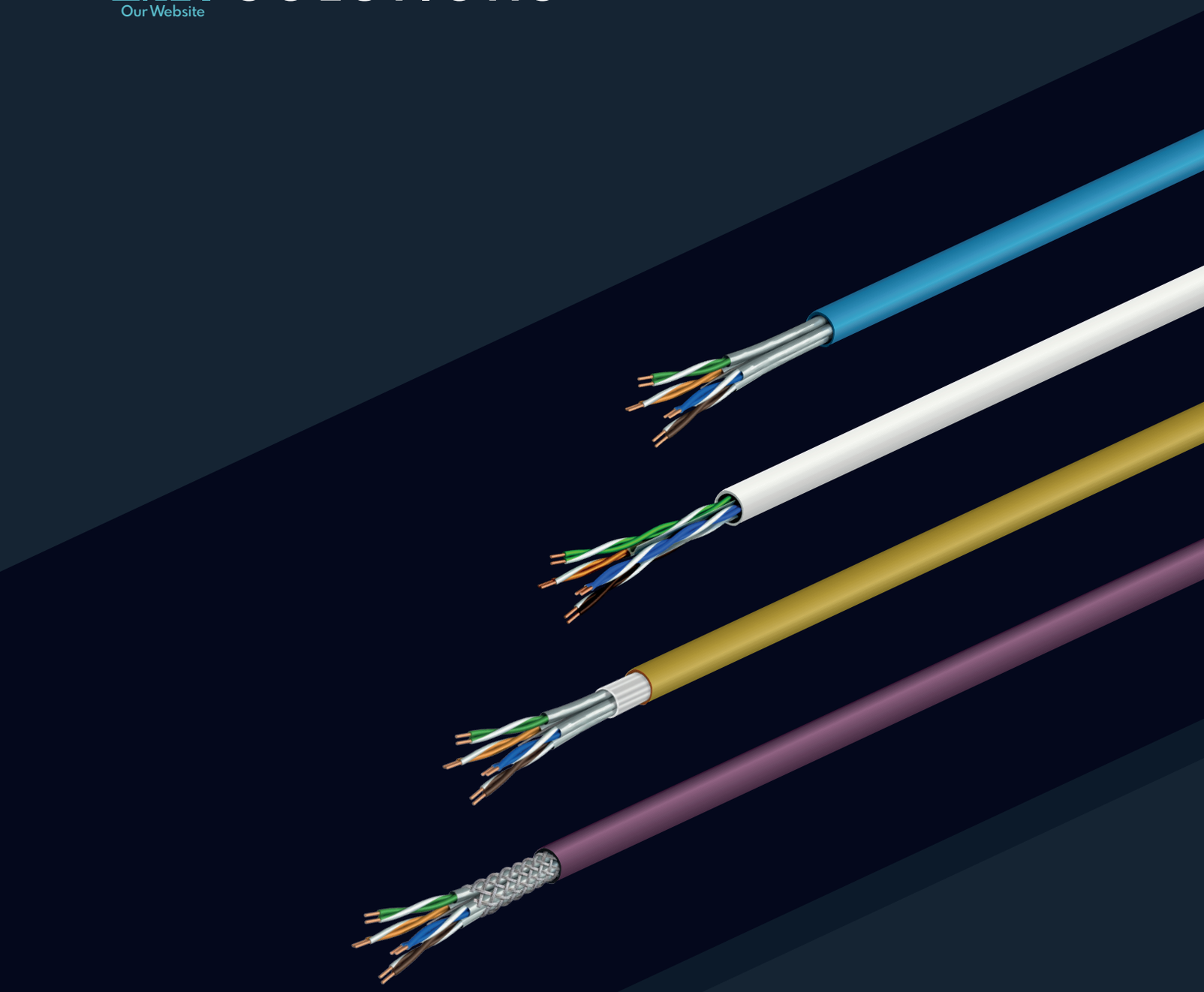

DATA CENTER COPPER CABLES

PRODUCT KNOWLEDGE
TECHNICAL GUIDELINES

DOC-G-002-V0-EN/08-25

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Founded in 2003, SAMM Technology offers cutting-edge products and services in the fields of telecommunication infrastructure and data center by producing in line with the expectations and needs of its customers.

With more than 20 years of experience, SAMM Technology has become one of the important suppliers of Europe in terms of capacity, technology and innovation by continuously investing in production, technology, R&D and people.

SAMM Teknoloji produces high performance fiber optic cables, fiber optic cable assemblies, data center infrastructure products and structured cabling solutions in its two factories located in the Gosb/Gebze industrial zone.

SAMM also has a ministry-approved research and development center since 2017.

20+ Years' Experience

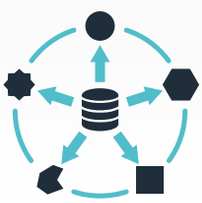
With more than 200 employees and 2 factories, we have achieved several significant projects in telecommunication fiber optic infrastructure.

World Class Production

With systematic and scientific methods, we always focus on reaching the highest quality in our fiber optic cable production and assembly lines.

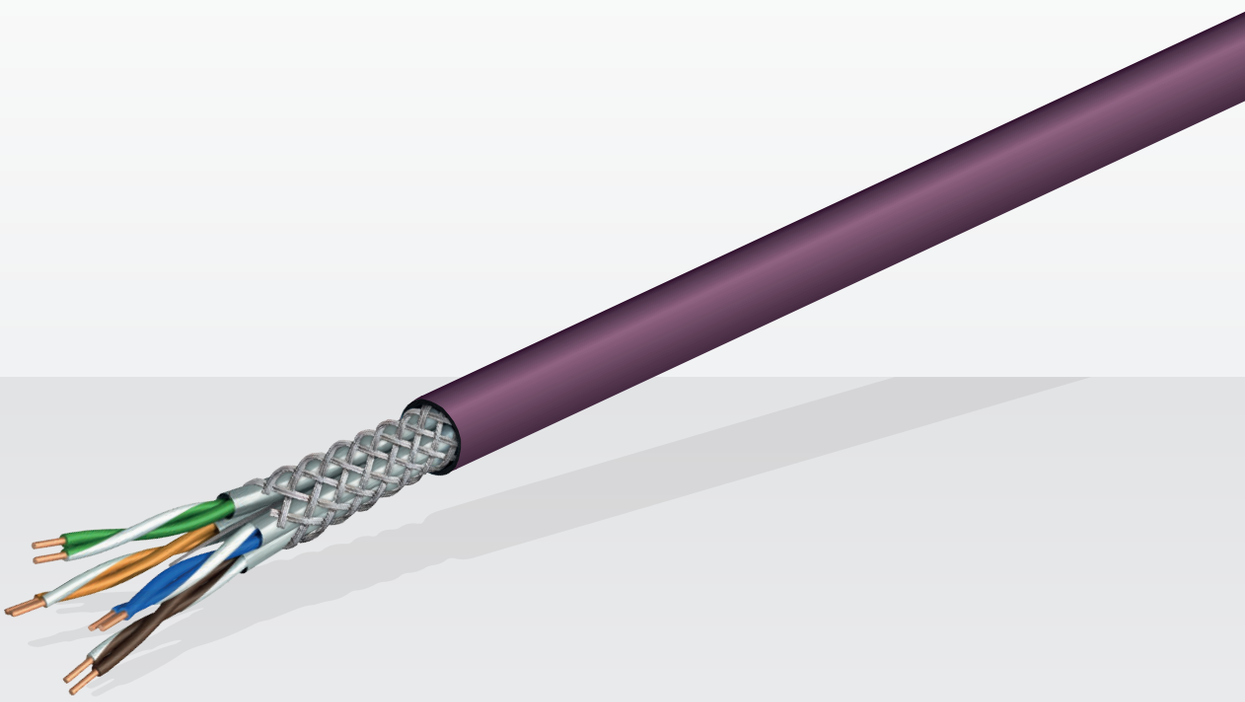
Connecting Continents

An advantageous shipping location, at the intersection of Asia, Europe and the Middle-East.



Innovative Solutions

We are passionate about responding to customer demand and keeping pace with the ever-evolving telecommunication and fiber optic technologies.



DATA CENTER COPPER CABLES

PRODUCT KNOWLEDGE
TECHNICAL GUIDELINES

1. CAT.5E

1.1 Basic Introduction

CAT.5E, short for Category 5 Enhanced, is an improvement of the CAT.5 standard. It consists of four twisted pairs of copper wires and is terminated by an RJ45 connector.

1.2 Performance Characteristics

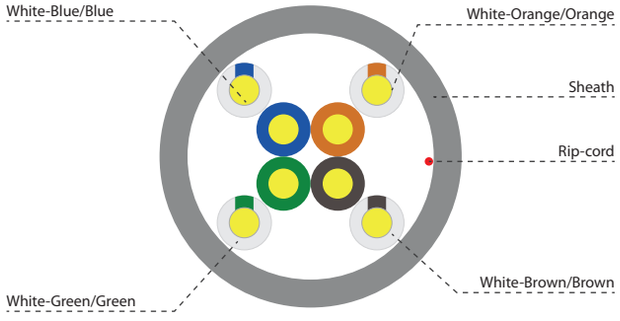
- **Frequency Range:** It supports a frequency range of up to 100 MHz.
- **Transmission Speed:** Designed for transmission speeds of up to 1 gigabit per second (Gigabit Ethernet), which means it can handle data transfer rates of 1000 Mbps. However, it should be noted that in some cases, especially when the cable length exceeds a certain distance (the maximum recommended length is 100 meters), the actual speed may be affected.
- **Attenuation and Crosstalk:** Compared to CAT.5, CAT.5E has lower noise and less potential for crosstalk. Crosstalk is the interference transmitted from adjacent wires. The enhanced design of CAT.5E helps to reduce this interference, providing a more stable data transmission environment.

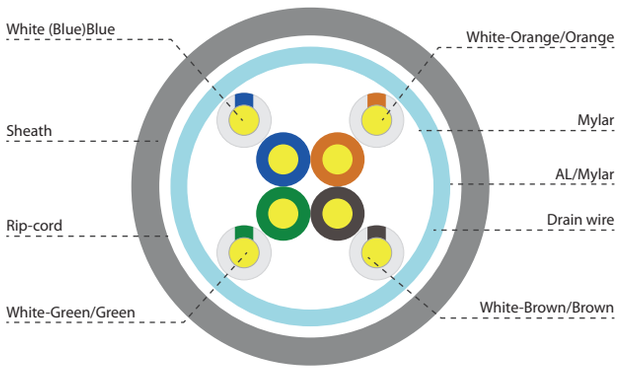
1.3 Applications

CAT.5E is very common in both residential and commercial network deployments. In residential areas, it can be used to connect devices such as desktop computers, smart TVs, and game consoles to the local network, meeting the daily network needs such as internet browsing, video streaming, and online gaming. In commercial spaces, it is often used for office network setups, connecting office computers, printers, and other network - connected devices.

1.4 Structure Diagram

Typically, a CAT.5E cable contains four pairs of twisted copper wires. The twisting of the wires helps to reduce electromagnetic interference. There is no central separator in a basic CAT.5E cable. The entire cable is then encased in an outer jacket, which provides protection against physical damage and some environmental factors.





Left diagram is for unshielded cable, right diagram is for shielded cable.

2. CAT.6

2.1 Basic Introduction

CAT.6, the sixth generation of Ethernet cabling, is designed to meet the increasing demands for higher - speed data transmission. It also has four twisted pairs of copper wires with an RJ45 connector.

2.2 Performance Characteristics

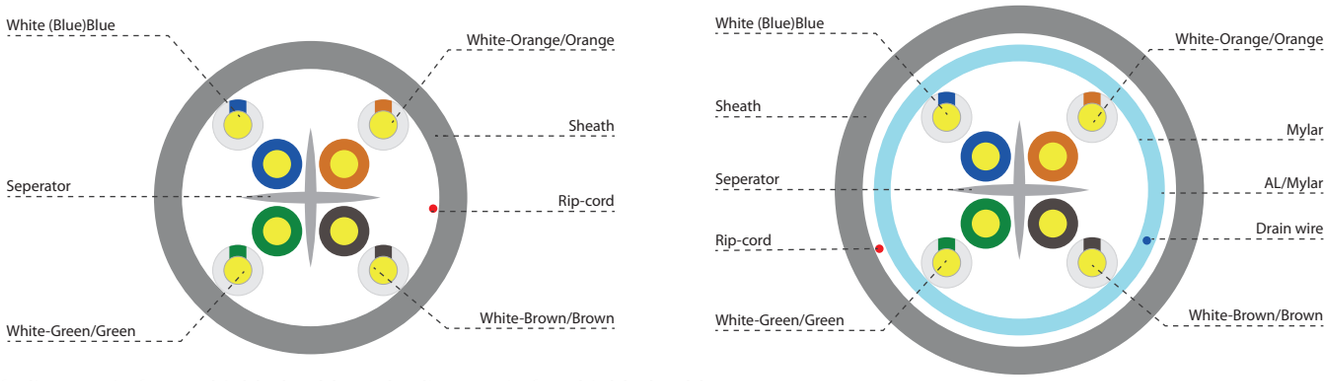
Frequency Range: CAT.6 supports a frequency range of up to 250 MHz, which is 2.5 times that of CAT.5E. Transmission Speed: It is designed for transmission speeds of up to 1 gigabit per second (Gigabit Ethernet) over a distance of 100 meters. For short - distance applications (up to 55 meters), it can support up to 10 gigabit per second (10Gigabit Ethernet) speeds. Structural Design: CAT.6 cables often have a more complex structure. They may have a central cross - shaped separator (also known as a cross - skeleton) that keeps the four pairs of wires separated, reducing crosstalk. Some CAT.6 cables also come with additional shielding to further improve performance.

2.3 Applications

CAT.6 is suitable for high - speed network applications. In enterprise networks, it can support large - scale data transfer, such as data backup, file sharing among multiple users, and running business - critical applications. In home networks, it is ideal for users who require high - speed and stable connections, such as those who frequently stream 4K videos, participate in online gaming with high - bandwidth requirements, or use cloud - based storage services extensively.

2.4 Structure Diagram

A CAT.6 cable has four pairs of twisted copper wires, similar to CAT.5E. But the key difference lies in the addition of a central cross - shaped separator. This separator physically divides the four pairs of wires, minimizing the interference between them. Some CAT.6 cables may also have an additional shielding layer, either in the form of foil shielding around each pair or an overall braided shield. The outer jacket is also present for protection.



Left diagram is for unshielded cable, right diagram is for shielded cable.

2.5 Differences between CAT.5E and CAT.6

- **Frequency Range:** CAT.6 has a much higher frequency range (250 MHz) compared to CAT.5E (100 MHz), allowing it to carry more data simultaneously.
- **Transmission Speed:** CAT.6 can support 10Gbps over short distances (up to 55 meters), while CAT.5E is limited to 1Gbps even over its maximum 100 - meter length.
- **Structural Design:** CAT.6 has a central cross - shaped separator which CAT.5E lacks, contributing to better crosstalk reduction in CAT.6. Also, CAT.6 may have more advanced shielding options.
- **Cost:** Generally, CAT.6 cables are more expensive than CAT.5E due to their higher performance capabilities and more complex manufacturing process.

3. CAT.6A

3.1 Basic Introduction

CAT.6A, or Category 6 Augmented, is an enhanced version of CAT.6. It is designed to meet the needs of even more demanding network applications.

3.2 Performance Characteristics

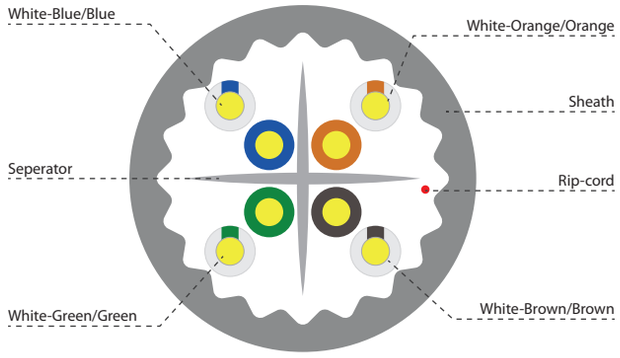
- **FFrequency Range:** CAT.6A offers a bandwidth of up to 500 MHz, which is double that of CAT.6.
- **Transmission Speed:** It is designed for transmission speeds of up to 10 gigabits per second (10Gigabit Ethernet) over a distance of 100 meters. This makes it suitable for high - density data - intensive applications.
- **Improved Crosstalk and Noise Resistance:** CAT.6A has further reduced crosstalk and better noise resistance compared to CAT.6. It often has more advanced shielding and construction techniques to ensure stable performance in complex electromagnetic environments.

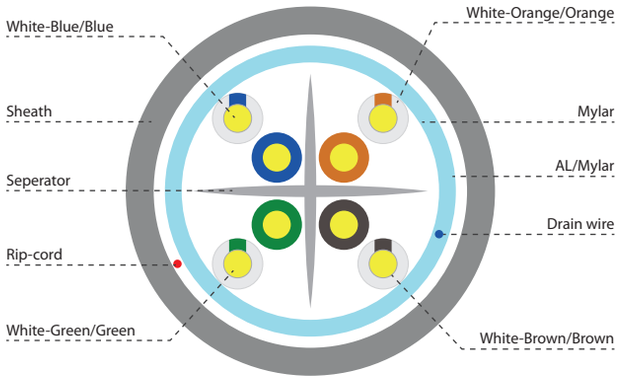
3.3 Applications

CAT.6A is mainly used in enterprise - level data centers, large - scale network infrastructure projects, and other scenarios where high - speed, long - distance, and reliable data transmission is required. For example, in data centers, servers need to transfer large amounts of data quickly and stably, and CAT.6A cables can meet these requirements.

3.4 Structure Diagram

CAT.6A cables have four twisted pairs of copper wires. They typically have a more robust central separator compared to CAT.6, which further reduces crosstalk. In terms of shielding, CAT.6A cables often have both foil shielding around each pair and an overall braided shield. This double - shielding design provides excellent protection against electromagnetic interference. The outer jacket is also made more durable to withstand the rigors of industrial and high - end applications.





Left diagram is for unshielded cable, right diagram is for shielded cable.

3.5 Differences between CAT.6 and CAT.6A

- **Frequency Range:** CAT.6A has a frequency range of 500 MHz, while CAT.6 has 250 MHz, enabling CAT.6A to handle more data - intensive applications.
- **Transmission Speed:** CAT.6A can support 10Gbps over 100 meters, while CAT.6 can only support 10Gbps over up to 55 meters.
- **Shielding and Crosstalk Reduction:** CAT.6A has more advanced shielding techniques and a more effective separator, resulting in significantly lower crosstalk compared to CAT.6.
- **Cost:** Due to its higher performance and more complex construction, CAT.6A is more expensive than CAT.6.

4. CAT.7

4.1 Basic Introduction

CAT.7 is a very high - performance data cable. It is different from previous categories in some aspects, especially in terms of shielding and connector types.

4.2 Performance Characteristics

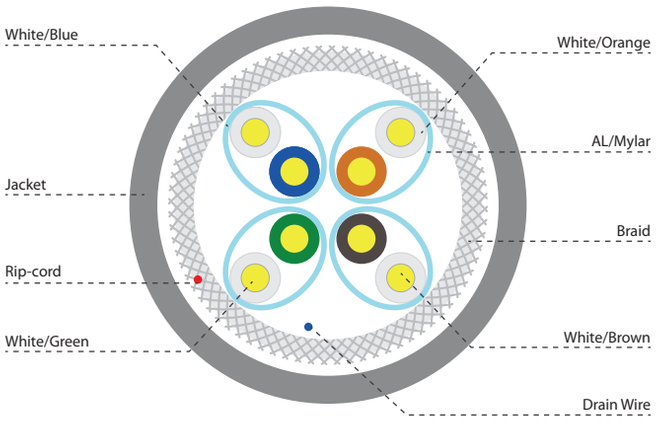
- **Frequency Range:** CAT.7 supports frequency ranges up to 600 MHz.
- **Transmission Speed:** It is designed for transmission speeds of up to 10 gigabits per second (10Gigabit Ethernet) over a 100 - meter distance.
- **Shielding:** CAT.7 cables have individual and overall screening. Each pair of wires is shielded separately, and there is also an overall shield around all the pairs. This shielding design helps to meet strict crosstalk requirements and provides excellent protection against electromagnetic interference.
- **Connector:** Unlike CAT.5E, CAT.6, and CAT.6A which mainly use RJ45 connectors, CAT.7 may use different types of connectors, such as GG45 (GigaGate45), which are designed to better match the high - performance requirements of CAT.7 cables.

4.3 Applications

CAT.7 is suitable for applications with extremely high - performance requirements, such as in high - end data centers, high - speed trading networks in the financial industry, and some professional audio - visual systems that require high - speed and interference - free data transmission.

4.4 Structure Diagram

CAT.7 cables feature four pairs of twisted copper wires, each pair individually shielded with foil. There is also an overall braided shield covering all the pairs. The individual shielding of each pair and the additional overall shield make it highly resistant to electromagnetic interference. The connectors used with CAT.7 cables, such as GG45, are designed to maintain the high - performance characteristics of the cable.

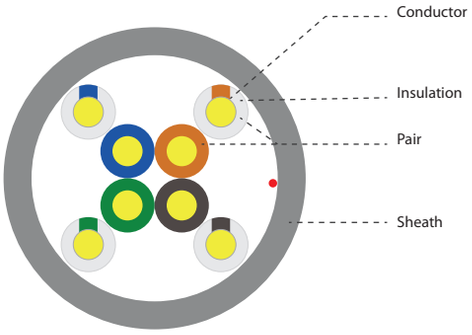


4.5 Differences between CAT.6A and CAT.7

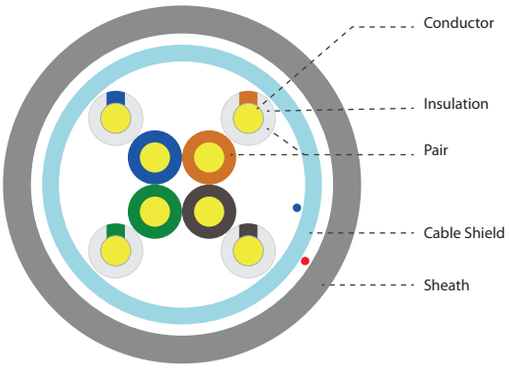
- **Frequency Range:** CAT.7 has a slightly higher frequency range (600 MHz) compared to CAT.6A (500 MHz).
- **Shielding:** CAT.7 has more comprehensive shielding with individual shielding for each pair in addition to the overall shield, while CAT.6A mainly relies on a central separator and some shielding measures.
- **Connector:** CAT.7 uses different types of connectors like GG45, while CAT.6A typically uses RJ45 connectors.
- **Cost and Application:** CAT.7 is generally more expensive and is used in applications where the highest level of performance and interference protection are required, such as in high - end financial trading systems, while CAT.6A is more commonly used in enterprise - level data centers and large - scale network infrastructure projects.

Supplementary information:

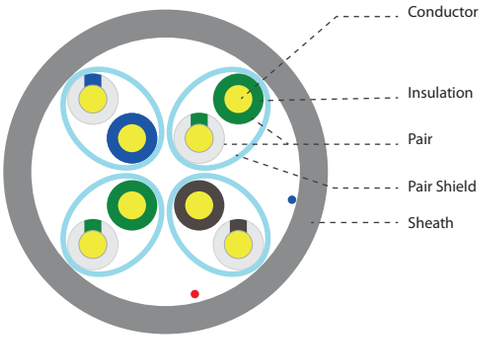
U/UTP



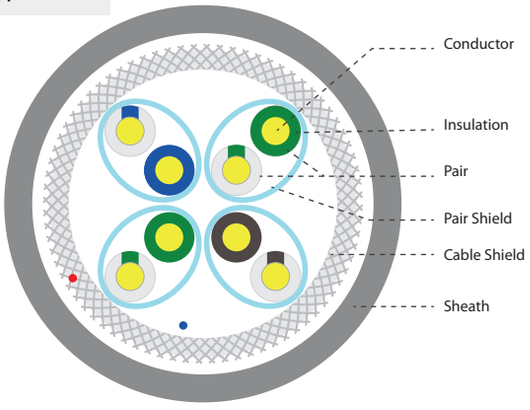
F/UTP



U/FTP



S/FTP



This picture illustrates four types of twisted - pair cable structures, which are common in network cabling:

1. U/UTP (Unshielded/Unshielded Twisted Pair)

- It has four pairs of twisted conductors. Each conductor is insulated. There is no additional shielding for the pairs or the entire cable, only the outer sheath for protection. The components are labeled as “conductor” (the copper wire for signal transmission), “insulation” (the material around each conductor to prevent short - circuits), “pair” (the twisted - together conductors), and “sheath” (the outer protective layer of the cable).

2. F/UTP (Foiled/Unshielded Twisted Pair)

- Similar to U/UTP in having four pairs of twisted conductors with individual insulation. But it has an additional “cable shield” (usually a foil layer) inside the sheath, surrounding all the pairs. This shield helps reduce electromagnetic interference from external sources. The components include “conductor”, “insulation”, “pair”, “cable shield”, and “sheath”.

3. U/FTP (Unshielded/Foiled Twisted Pair)

- Each pair of conductors has its own “pair shield” (usually a foil layer), while there is no overall cable - wide shield other than the outer sheath. The components are “conductor”, “insulation”, “pair”, “pair shield”, and “sheath”.

4. S/FTP (Shielded/Foiled Twisted Pair)

- It has both “pair shields” for each individual pair of conductors and an overall “cable shield” inside the outer sheath. This double - shielding provides a higher level of protection against electromagnetic interference. The components are “conductor”, “insulation”, “pair”, “pair shield”, “cable shield”, and “sheath”.

LAN Cable CAT.5E/CAT.6/CAT.6A /CAT.7 Knowledge Test

Part I: Multiple - Choice Questions (5 points each, total 50 points)

1. What is the maximum frequency range supported by CAT.5E?
   A. 50 MHz
   B. 100 MHz (Answer)
   C. 150 MHz
   D. 200 MHz
2. CAT.6 can support a transmission speed of 10Gbps over a distance of:
   A. 100 meters
   B. 80 meters
   C. 55 meters (Answer)
   D. 30 meters
3. Which of the following cables has a frequency range of 500 MHz?
   A. CAT.5E
   B. CAT.6
   C. CAT.6A (Answer)
   D. CAT.7
4. What is the main improvement of CAT.5E compared to CAT.5?
   A. Higher frequency range
   B. Lower crosstalk and noise (Answer)
   C. Support for 10Gbps speed
   D. Different connector type
5. CAT.7 cables are mainly characterized by:
   A. High - frequency support up to 600 MHz
   B. Individual and overall shielding
   C. Use of non - RJ45 connectors in some cases
   D. All of the above (Answer)
6. Which cable is most suitable for a home network that requires stable high - speed internet for 4K video streaming and online gaming?
   A. CAT.5E
   B. CAT.6 (Answer)
   C. CAT.6A
   D. CAT.7
7. In a data center where servers need to transfer large amounts of data at high speed over long distances, which cable is the best choice?
   A. CAT.5E
   B. CAT.6
   C. CAT.6A (Answer)
   D. CAT.7
8. The central cross - shaped separator in CAT.6 cables is mainly used to:
   A. Increase the cable's flexibility
   B. Reduce crosstalk (Answer)
   C. Improve the cable's appearance
   D. Support higher frequencies
9. Which of the following statements about CAT.6A is incorrect?
   A. It has a higher frequency range than CAT.6
   B. It can support 10Gbps speed over 100 meters
   C. It has less crosstalk than CAT.6
   D. It is thinner than CAT.6 (Answer)
10. What is the maximum transmission speed of CAT.5E?
    A. 100 Mbps
    B. 1 Gbps (Answer)
    C. 10 Gbps
    D. 100 Gbps

Part II: Short - Answer Questions (10 points each, total 30 points)

1.Briefly describe the main differences between CAT.6 and CAT.6A in terms of performance characteristics.

- **Frequency Range:** CAT.6 has a frequency range of up to 250 MHz, while CAT.6A offers a bandwidth of up to 500 MHz. This means CAT.6A can handle more data - intensive applications as it can carry a greater amount of data simultaneously.

- **Transmission Speed:** CAT.6 is designed for 1Gbps over 100 meters and 10Gbps over up to 55 meters. CAT.6A, on the other hand, can support 10Gbps over a full 100 - meter distance.

- **Crosstalk and Noise Resistance:** CAT.6A has more advanced shielding and construction techniques. It often has a more robust central separator and better shielding, which results in further reduced crosstalk and better noise resistance compared to CAT.6.

2. Explain why CAT.7 has better anti - interference performance compared to CAT.6.

- **Shielding Design:** CAT.7 cables have individual shielding for each of the four pairs of twisted copper wires, usually in the form of foil shielding. In addition, there is an overall braided shield around all the pairs. This double - layer shielding design in CAT.7 provides excellent protection against electromagnetic interference. In contrast, while some CAT.6 cables may have shielding, it is not as comprehensive as that of CAT.7. CAT.6 may have a central cross - shaped separator to reduce crosstalk and some may have additional shielding, but not the individual - pair - by - pair shielding like CAT.7.
- **Connector Design:** CAT.7 often uses different types of connectors, such as GG45, which are designed to better maintain the cable's high - performance characteristics and reduce interference during data transmission. CAT.6 mainly uses RJ45 connectors, which may not be as effective in minimizing interference in high - performance scenarios as the connectors used with CAT.7.

3. List two common applications for CAT.6A in a commercial environment.

In commercial environments, CAT.6A LAN cables are widely used due to their ability to support 10 Gbps data transmission over 100 meters, excellent resistance to alien crosstalk (AXT), and high bandwidth (500 MHz). Two common applications are:

- **High-Density Network Closets and Data Centers**

  Commercial buildings with large numbers of networked devices (e.g., offices with hundreds of workstations, or enterprise data centers hosting servers, storage systems, and switches) rely on CAT.6A cables. These environments demand fast, reliable connections to handle heavy data traffic (such as large file transfers, cloud-based applications, and real-time data processing). CAT.6A's 10 Gbps capacity ensures seamless communication between devices, while its shielding (often S/FTP design) minimizes interference in crowded cable runs—critical in spaces where multiple cables are bundled together.

- **Video Surveillance and IP Camera Systems**

  Modern commercial security systems increasingly use high-definition (HD) or 4K IP cameras, which require consistent high-bandwidth connections to transmit large video streams in real time. CAT.6A cables can support the bandwidth needs of multiple IP cameras simultaneously, even over long distances (up to 100 meters). Additionally, their robust shielding protects against electromagnetic interference (EMI) from nearby electrical equipment (e.g., power lines, HVAC systems), ensuring stable video transmission without signal degradation—essential for reliable security monitoring in offices, retail stores, or industrial facilities.

Part III: Essay Question (20 points)

Suppose you are responsible for setting up a network in a new office building. The office building has multiple floors and a large number of office rooms. The network needs to support high - speed data transfer for daily office work, such as file sharing, video conferencing, and cloud - based application access. Please explain which type of LAN cable (CAT.5E, CAT.6, CAT.6A, or CAT.7) you would choose and the reasons for your choice. Consider factors such as cost, performance requirements, and future expandability.

Answer: In this scenario, CAT.6A would be the most suitable choice.

- **Performance Requirements:**

  For daily office work involving file sharing, video conferencing, and cloud - based application access, high - speed and reliable data transfer is crucial. CAT.6A can support 10Gbps speeds over a 100 - meter distance, which is more than sufficient to handle the data - intensive tasks in a large office building. In contrast, CAT.5E is limited to 1Gbps, which may not be enough to support multiple users simultaneously engaging in high - bandwidth activities such as large file downloads, real - time video conferencing, and accessing complex cloud - based applications. CAT.6 can support 10Gbps only over up to 55 meters, which may not be practical for a multi - floor building where cable runs may be longer.

- **Cost:**

  While CAT.7 offers even higher performance in terms of frequency range and shielding, it is generally more expensive than CAT.6A. Given that CAT.6A can meet the performance requirements of the office network, choosing CAT.7 would be overkill in terms of cost. CAT.6A provides a good balance between performance and cost, offering high - speed data transfer capabilities at a more reasonable price compared to CAT.7. CAT.5E is the cheapest option, but its lower performance may lead to network bottlenecks and dissatisfaction among users in the long run.

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