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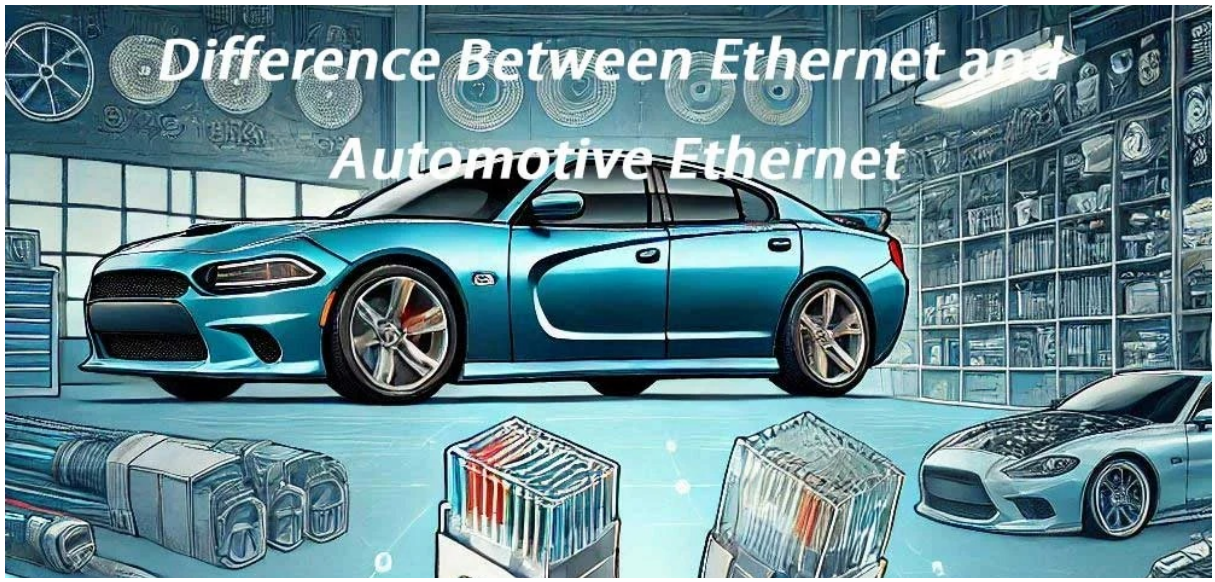

Difference Between Ethernet and Automotive Ethernet

• By IoTCloudPlatForm • December 19, 2024 • No Comments

There are many significant **differences between Ethernet and automotive Ethernet** . These differences are mainly reflected in multiple dimensions such as physical media, bandwidth speed, protocol stack and communication model, reliability and durability, power consumption, and cost.

The following is introduced to you by the **IoT cloud platform** . The following is a detailed comparative analysis of the two:

Table of Contents

Physical media

Ethernet

- Ethernet usually uses multiple pairs of shielded twisted pair (STP) or unshielded twisted pair (UTP), such as Cat5e, Cat6, etc. These cables are widely used in business and home network environments to meet general data transmission needs.

Automotive Ethernet

- Automotive Ethernet uses a single pair of unshielded twisted pair (UTP). This design not only reduces the overall weight of the car and reduces production costs, but also improves fuel efficiency.
- The electromagnetic environment of automobiles is complex and there are various sources of electromagnetic interference, such as engines, electronic equipment, etc. Therefore, the single-pair UTP cable **design of Automotive Ethernet** can better resist electromagnetic interference and improve the stability of data transmission.

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Bandwidth speed

Ethernet

- The bandwidth speed of Ethernet has developed rapidly, from the initial 10Mbps to now supporting transmission rates of 10Gbps or even higher. This high-speed transmission capability enables Ethernet to efficiently transport large amounts of data in enterprise and home network environments.

Automotive Ethernet

- Although Automotive Ethernet currently supports a speed of 1Gbps at its fastest, this is enough to meet the data transmission needs of automotive electronic systems. In an automotive environment, excessive speeds are not necessary because automotive electronic systems typically do not need to process such large amounts of data.
- Automotive Ethernet focuses more on optimizing transmission delay and real-time performance to ensure timely transmission of key data. For example, in self-driving cars, data from sensors such as cameras, lidars, and millimeter-wave radars need to be transmitted in real time.

The transmission of these data requires high-bandwidth and low-latency network support. Automotive Ethernet meets these needs by using BroadR-Reach technology and the 1000BASE-T1 standard to achieve transmission rates up to 1Gbps on a single pair of wires.

Protocol stack and communication model

Ethernet

- Traditional Ethernet follows the IEEE 802.3 standard and is usually used to build a local area network. Its communication model is relatively complex and involves multiple levels of network protocols, including the physical layer, data link layer, network layer, transport layer and application layer. Each layer has specific functions and protocols that work together to achieve data transmission and communication.
- In traditional Ethernet, the communication model is based on shared media, with multiple devices connected together through hubs or switches, sharing the same physical media. Devices need to compete for access to the physical medium to send data, and conflicts and delays may occur.

Automotive Ethernet

- Although Automotive Ethernet is also based on the IEEE 802.3 standard, it is simplified and optimized for automotive applications. Its protocol stack is simplified compared to traditional Ethernet, reducing some unnecessary layers and protocols. For example, automotive Ethernet may omit some functions of the network layer and transport layer and communicate directly between the data link layer and application layer.
- In the automotive environment, the real-time and deterministic requirements of communication are high. Therefore, Automotive

Ethernet ensures real-time and deterministic data transmission by simplifying the protocol stack and adopting time-sensitive network (TSN) technology. TSN technology ensures timely transmission of critical data and avoids delays and jitters by scheduling and priority management of network traffic.

Reliability and Durability

Ethernet

- Traditional Ethernet is mainly used in enterprise and home network environments. It is relatively stable, with less temperature changes, less vibration and other harsh conditions. Therefore, traditional Ethernet equipment has relatively low reliability and durability requirements and usually follows commercial-grade or industrial-grade design standards.
- In traditional Ethernet, if a certain device fails, it may affect local network communication, but it will not have a serious impact on the entire system. And the fault recovery time is relatively long, and it may take several minutes or even longer to restore normal communication.

Automotive Ethernet

- Temperature changes, vibration and other harsh conditions in automotive environments require greater reliability and durability. Therefore, automotive Ethernet components must be specially designed and tested to meet the automotive industry’s stringent standards, such as AEC-Q100.
- In terms of special design, automotive Ethernet components require special materials and designs to resist harsh conditions such as temperature changes, vibration, and electromagnetic interference. For example, automotive Ethernet connectors need to be designed to be waterproof, dustproof, and shockproof to ensure that they will not

become loose or have poor contact while the car is driving. Some automotive Ethernet connectors also use special sealing structures to prevent moisture and dust from entering, while being able to withstand high-intensity vibration and shock.

- In terms of rigorous testing, automotive Ethernet components must undergo rigorous testing in multiple aspects such as high temperature, low temperature, vibration, impact, and electromagnetic compatibility. Only components that pass the test can be used in cars. This rigorous testing and certification process ensures the reliability and durability of Automotive Ethernet components in the automotive environment.
- In addition, the fault recovery time of automotive Ethernet must be very short, usually requiring normal communication to be restored within a few milliseconds or even less. This ensures that critical data can be transmitted in a timely manner, improving system reliability and security.

Power consumption

Ethernet

- Traditional Ethernet equipment is usually powered by an external power supply and consumes relatively high power. In enterprise and home networks, power consumption is usually not a major consideration. Although some devices adopt energy-saving measures, such as automatic sleep and power management, the effect is limited.
- Traditional Ethernet equipment includes switches, routers, network cards, etc., and their power consumption usually ranges from a few watts to tens of watts. For example, the power consumption of an ordinary Ethernet switch may be around 10 watts, and the power consumption of a high-performance router may be tens of watts or even higher.

Automotive Ethernet

- The power resources inside the car are limited, so the on-board Ethernet equipment needs to be designed to be more energy-efficient to minimize power consumption. This is different from traditional Ethernet equipment.
- In terms of power limitations, the internal power supply of the car mainly comes from the car battery, which has limited capacity. Therefore, in-vehicle Ethernet equipment needs to reduce power consumption as much as possible to extend the service life of the car battery. If the power consumption of each device is high, it may cause the car battery to be over-discharged, affecting the normal starting and driving of the vehicle.
- In terms of energy-saving design, automotive Ethernet equipment adopts a variety of energy-saving designs, such as low-power chips, dynamic power management, sleep mode, etc. Some automotive Ethernet chips adopt low-power designs and can automatically enter sleep mode when idle to reduce power consumption. In-vehicle Ethernet equipment can also use dynamic power management technology to adjust power consumption according to network load and data transmission needs to achieve optimal energy utilization efficiency.

Cost

Ethernet

- The cost of traditional Ethernet equipment is relatively low, especially in large-scale production and application. As technology continues to develop, the price of traditional Ethernet equipment continues to drop.
- The price of traditional Ethernet equipment usually ranges from tens to hundreds of yuan, and the specific price depends on the performance and functions of the equipment. For example, the price of an ordinary Ethernet network card may be around tens of yuan, and the price of a high-performance switch may be several hundred yuan or even higher.

- In terms of deployment costs, the deployment costs of traditional Ethernet are relatively low. Because of its mature technology, the equipment is easy to install and manage. In business and home networks, it's often easy to build a LAN by just purchasing some Ethernet equipment and cables.

Automotive Ethernet

- Cost is an important factor when it comes to widespread use in automobiles. The design of automotive Ethernet takes this into consideration and strives to reduce hardware costs while ensuring performance.
- However, the hardware cost of automotive Ethernet is relatively high because it requires special materials and designs to meet the requirements of the automotive environment. For example, automotive Ethernet connectors, cables, chips, etc. all need to undergo strict testing and certification, and the cost is high.
- In addition, the number of in-vehicle Ethernet devices is relatively small, making mass production difficult, which will also lead to increased costs. However, as the technology matures and automobile manufacturers and suppliers actively explore, the cost of automotive Ethernet is gradually declining.

Application scenarios and importance

Ethernet

- Ethernet, as an important part of computer network technology, provides an efficient way to transmit information between devices. It is widely used in enterprise and home network environments, supports

high-speed data transmission, has strong compatibility, and is easy to connect with other types of network devices.

- Ethernet dominates local area network (LAN) technology and is used in almost all office and home networks.

Automotive Ethernet

- Ethernet is increasingly used in the automotive field, mainly to help achieve communication and connectivity within the vehicle. It has become an integral part of modern automotive electronic systems.
- Automotive Ethernet plays an important role in vehicle multimedia systems, vehicle diagnosis and maintenance, safety and driver assistance systems, vehicle internal communications and remote vehicle control. As automotive technology continues to develop, Ethernet will play an increasingly important role in achieving smarter, safer and more convenient vehicle transportation.
- For example, in self-driving cars, Ethernet supports driver assistance functions such as adaptive cruise control and automatic braking systems by transmitting data from sensors such as cameras, lidar, and millimeter-wave radar. In addition, Ethernet can connect communications between vehicles and transportation infrastructure, providing real-time traffic conditions and navigation information.

Development trends and challenges

Development Trend

- With the continuous advancement of automotive technology and the improvement of intelligence level, the application of automotive Ethernet will become more widespread. In the future, automotive Ethernet will not only be limited to communication and connections within the vehicle, but will also extend to communication between the vehicle and the external

environment (such as transportation infrastructure, other vehicles, etc.).

- At the same time, with the continuous development of technology, the bandwidth speed, reliability and durability of automotive Ethernet will be further improved to meet the higher requirements for data transmission of automotive electronic systems.

Challenge

- Although the application of automotive Ethernet has made great progress, it still faces some challenges. For example, automobiles have high real-time requirements for data transmission, so they require high-speed and low-latency transmission capabilities. In addition, electromagnetic interference and temperature changes inside the vehicle can also affect Ethernet performance.
- In response to these problems, engineers are constantly improving and optimizing Ethernet technology to meet the needs of the automotive industry. For example, by using more advanced materials and designs to improve the anti-interference ability and durability of cables and connectors; by optimizing the protocol stack and adopting more efficient communication algorithms to improve the real-time and deterministic nature of data transmission.

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Summarize

To sum up, there are significant differences between Ethernet and Automotive Ethernet in many aspects such as physical media, bandwidth speed, protocol stack and communication model, reliability and durability, power consumption, and cost.

These differences make Ethernet and Automotive Ethernet suitable for different application scenarios and needs. With the continuous advancement

of technology and the improvement of intelligence level, Ethernet and automotive Ethernet will play an increasingly important role in their respective fields.

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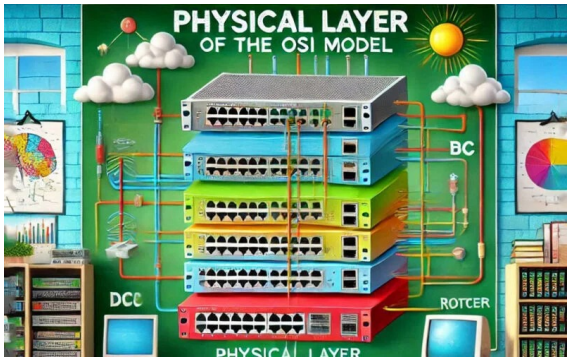

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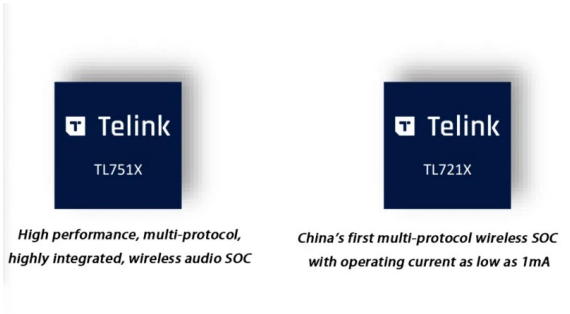

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