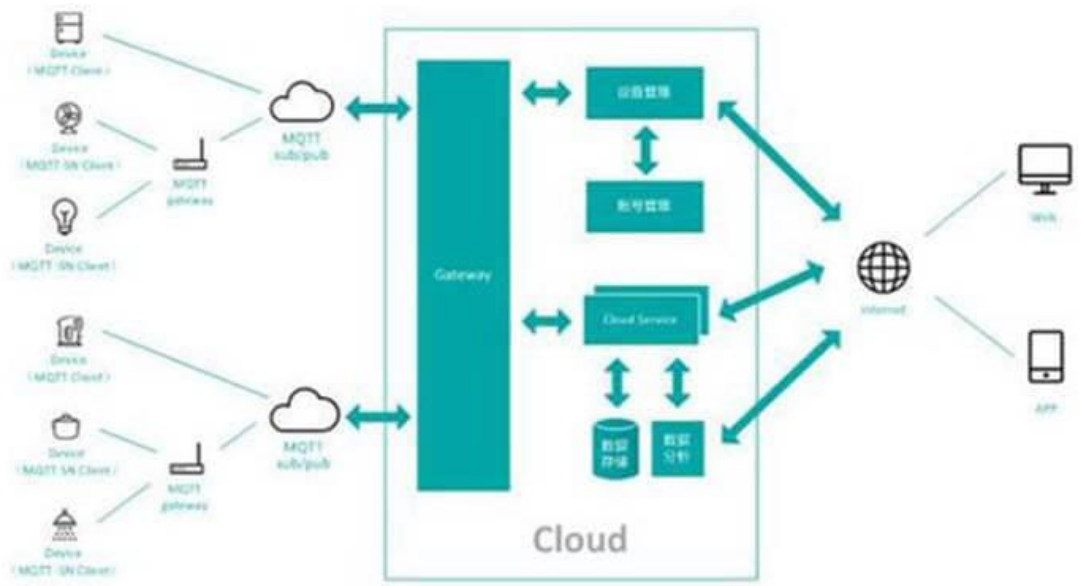
16 Wired and Wireless Communication Technologies in the IoT



The common wired and wireless communication technologies in IoT include RS-232, RS-485, USB, Z-Wave, IPv6, Wi-Fi, Bluetooth, Lora, NB-IoT, NFC, RF, GSM, 3G 4G, etc.

With the progress and development of the times, society gradually enters the Internet +, various sensors collect data more and more abundantly, big data applications follow, and people consider incorporating various devices directly into the Internet to facilitate data collection, management as well as analysis and calculation.

IoT intelligence is no longer limited to small devices and small network stages but has entered the complete field of intelligent industrialization. Intelligent IoTisation steps into maturity on big data, cloud computing, and virtual reality, and is incorporated into the whole big ecological environment of the Internet+.

Early IoT connection is the data transmission between two or more devices in close proximity to solve the problem of connecting things, mostly using wired methods, after considering the convenience of the location of the device can be moved at will, the later more use of wireless methods.

However, with the progress and development of technology, society has gradually entered the Internet+, all kinds of sensors to collect data more and more abundant, the traditional IoT connection method may not be suitable or meet the diversity of IoT connection at this stage.

According to the different types of terminals, there are other kinds of methods that can be connected, the following are several common wired and wireless communication technology.

Wired and wireless communication technology

Wired and wireless communication connectivity can be divided into wired and wireless, the purpose of the connection is to communicate, and therefore wired and wireless communication technologies are used respectively.

Wired communication is a technology that uses a tangible medium such as optical fibers and metal wires to transmit information. Currently, wired communication is very popular, such as telephone lines, internet cables, TV lines, etc.

Wireless communication is a communication technology that uses electromagnetic wave signals that travel through space to exchange information (no physical medium is required to connect the two ends of the communication).

Common wireless communication technologies include cellular wireless connections, wifi connections, Bluetooth connections, and some more mysterious methods such as visible light communication and quantum communication.

Generally speaking, wired connections are more reliable and stable, but the disadvantage is that the connection is limited by the transmission medium. Wireless connections are free and flexible, the terminals can move without spatial restrictions, but they are susceptible to other electromagnetic waves in the transmission space and other obstacles that affect them, and are therefore less reliable than wired connections.

Short-range and long-range wired and wireless communication technologies

We usually refer to communication over a distance of 100m or less as short-range wired and wireless communication, and communication over 1000m as long-range wired and wireless communication.

There are many different wired and wireless communication technologies available to meet different communication needs, but there is no single wired and wireless communication technology that can meet all wired and wireless communication needs.

When cost, power consumption, and efficiency are taken into account, transmitting data over longer distances and transmitting more data means higher energy consumption and higher costs. Thus, short-range and long-range wired and wireless communications are different in terms of technology implementation, power consumption, and cost.

In the early days of the Internet of Things, two devices were simply connected together with a signal wire, later on, wireless was used and simple networking emerged.

In the Internet+ era, more and more sensors and devices are connected to the Internet, and the Internet is not only transmitted through wires but also introduced into the air network, satellite network, etc. The application fields are also becoming more and more extensive.

Common wired and wireless communication technologies in the IoT industry

C&T RF Antennas Inc summarises the common IoT wired and wireless communication methods into four main categories.

1. Wired transmission in wired and wireless communication technologies

The devices are directly connected with physical wires, which is not very convenient. There are

mainly wire carrier or carrier frequency, coaxial line, switch signal line, RS232 serial port, RS485, USB, here only for the common RS232 serial port, RS485, USB to do the introduction.

RS232 serial port in wired and wireless communication technologies

Serial communication interface, the full name of the data terminal equipment (DTE) and data communication equipment (DCE) between the serial binary data exchange interface technology standards, is a standard interface for computers and other devices to transmit information.

The standard specifies a 25-pin DB25 connector, specifies the signal content of each pin of the connector, and also specifies the levels of the various signals.

RS-232 is a single-ended signal transmission, there are problems such as common ground noise and inability to suppress common-mode interference, so it is generally used for communication within 20m, and the commonly used serial lines are generally only 1~2m.

RS-485 bus of wired and wireless communication technologies

When communication distances of tens to thousands of meters are required, when there is a need for multi-device networking, RS232 is unable to meet the demand, hence the birth of the RS-485 serial bus standard.

The RS-485 uses balanced transmission and differential reception, with the ability to suppress common-mode interference, and the high sensitivity of the bus transceiver, which can detect voltages as low as 200mV, allowing the transmission signal to be recovered over kilometers.

The RS-485 works in half-duplex mode and can be networked to form a distributed system, which is very convenient when used for multi-point interconnection, eliminating many signal lines and allowing up to 32 drivers and 32 receivers to be connected in parallel.

USB of wired and wireless communication technologies

Universal Serial Bus, an external bus standard that supports plug-and-play and hot-plugging of devices, has the advantages of fast transmission speed, ease of use, flexible connection, and independent power supply.

USB uses a 4-pin (9-pin for USB 3.0) plug as a standard plug and daisy-chains all peripherals, allowing up to 127 external devices to be connected without loss of bandwidth.

It can be connected to keyboards, mice, printers, scanners, cameras, chargers, flash drives, removable hard drives, external optical/floppy drives, USB network cards, ADSL Modems, Cable Modems, MP3 players, mobile phones, digital cameras, and almost all other external devices. It has successfully replaced serial and parallel ports and become one of the mandatory interfaces for personal computers and smart devices.

2. **Wireless transmission in close proximity of wired and wireless communication technologies**

Wireless signals are used to transmit information between devices. The main ones are wireless RF 433MHz/315MHz, Bluetooth, Zigbee, Z-ware, IPv6/6Lowpan.

RF433MHz/315MHz in wired and wireless communication technologies

Wireless transceiver module, using RF technology, working in the ISM band (433 MHz / 315MHz), generally contains a transmitter and receiver, high-frequency stability, good harmonic suppression, data transmission rate 1K ~ 128Kbps, using GFSK modulation has the superb anti-interference ability.

RF433MHz/315MHz Application range

(1) Wireless meter reading system
(2) Wireless street light control system
(3) Railway communication
(4) Wireless remote control of aircraft models
(5) Wireless security alarm
(6) Home appliance control
(7) Industrial wireless data acquisition
(8) Wireless data transmission.

Low power consumption RF 433 MHz can work in the voltage range of 2.1-3.6V, in 1SEC cycle polling wake-up power saving mode (Polling mode), the reception only consumes less than 20uA, a 3.6V/3.6A lithium sub-battery can work for more than 10 years.

Bluetooth of wired and wireless communication technologies

The Bluetooth wireless technology standard with a packet-based, master-slave architecture using UHF radio waves in the ISM band between 2.4 to 2.485 GHz, enabling short-range data exchange between fixed devices, mobile devices, and in-building personal networks.

Managed by the Bluetooth SIG, the IEEE listed Bluetooth technology as IEEE 802.15.1 but no longer maintains the standard today, Bluetooth technology has a proprietary network that can be issued to devices that comply with the standard.

Bluetooth uses frequency hopping technology to split the data transmitted into packets, which are transmitted separately over 79 designated Bluetooth channels. Each channel has a frequency bandwidth of 1 MHz.

Bluetooth 4.0 uses a 2 MHz pitch and can accommodate up to 40 channels. The battery is a good quality wireless Bluetooth headset that will last typically 2-3 years, usually a few weeks.

Bluetooth is a technology for wireless communication between devices and the latest version of the Bluetooth standard, Bluetooth 5, was launched in June 2016 and officially released on 8 December of the same year. Bluetooth uses short-wave UHF (Ultra High Frequency) radio waves to communicate via the ISM band from 2.4 to 2.485 GHz, over distances ranging from a few meters to several hundred meters.

Benefits of BlueTooth

Since the launch of Bluetooth 4.0 in 2010, Bluetooth has introduced a number of excellent features to accommodate the development of the Internet of Things.

(1)The three modes of low power Bluetooth, conventional Bluetooth and high-speed Bluetooth have been proposed;

(2) The Low Power Bluetooth mode achieves low power consumption and enhanced coverage, with a maximum range of over 100 meters;

(3) Support for complex networks: optimized for one-to-one connections and support for one-to-many connections in a star topology, etc;

(4) Intelligent connectivity: increased support for setting the connection frequency between devices;

(5) Improved security: packet encryption and authentication using AES-128 CCM encryption algorithm, etc.

These features make Bluetooth more responsive to the Internet of Things era.

Disadvantages of BlueTooth

The main disadvantage of Bluetooth is its poor networking capability

ZigBee of wired and wireless communication technologies

ZigBee is a low-power, close-range wireless communication technology with a digital transmission module similar to a mobile network base station. In practice, it has been found that despite the many advantages of Bluetooth technology, there are still limitations to its application.

The introduction of the ZigBee protocol has made up for these shortcomings.

Zigbee is based on the IEEE802.15.4 standard of low-speed, short-range, low-power, two-way wireless communication technology of the local area network communication protocol, also known as the purple bee protocol.

It is characterized by proximity, low complexity, self-organization (self-configuration, self-healing, self-management), low power consumption, and low data rates.

ZigBee protocol from bottom to top are physical layer (PHY), media access control layer (MAC), transport layer (TL), network layer (NWK), application layer (APL), etc., where the physical layer and media access control layer follow the provisions of the IEEE 802.15.4 standard and are mainly used for sensor and control applications (Sensor and Control).

It can operate in three frequency bands, 2.4 GHz (popular worldwide), 868 MHz (popular in Europe), and 915 MHz (popular in the USA), with transmission rates of up to 250 kbit/s, 20 kbit/s, and 40 kbit/s respectively, and a single point of transmission in the range of 10-75 m.

ZigBee is a wireless data transmission network platform that can be composed of one to 65535 wireless data transmission modules, each ZigBee network data transmission module can communicate with each other throughout the network range, from the standard 75m distance for unlimited expansion.

ZigBee nodes are very power efficient, with a battery life of around 6 months to 2 years and up to 10 years in hibernation mode.

Z-Wave of wired and wireless communication technologies

Z-Wave is an RF-based, low-cost, low-power, highly reliable, network-friendly, short-range wireless communication technology led by the Danish company Zensys, Z-Wave operates at 908.42MHz (USA), 868.42MHz (Europe), Z-Wave uses FSK (BFSK/GFSK) modulation, with data rates of The effective coverage of Z-Wave signals is 30m indoors and over 100m outdoors, making it suitable for narrowband applications.

Z-Wave uses dynamic routing technology, each Z-Wave network has its own independent network address (HomeID); the address of each node within the network (NodeID) is assigned by the Controller.

Zensys provides a dynamic library (DLL) for Windows development and the API functions within the DLL are used by developers for PC software design.

The wireless network built with Z-Wave technology allows remote control of home appliances not only from the devices in the network but also from the Internet network to the devices in the Z-Wave network.

IPv6/6Lowpan of wired and wireless communication technologies

A low-speed wireless personal area network standard based on IPv6 is known as IPv6 over IEEE 802.15.4. The IEEE 802.15.4 standard is designed for the development of compact, low-power, inexpensive embedded devices (e.g. sensors) that can run on batteries for one to five years.

The standard uses radio transceivers operating in the 2.4GHz band to transmit information, using the same frequency band as Wi-Fi, but with approximately 1% of the RF transmit power of Wi-Fi. 6LoWPAN has emerged to enable all types of low-power wireless devices to join IP homes and to be networked with Wi-Fi, Ethernet, and other types of devices.

IETF 6LoWPAN technology has the characteristics of a wireless low-power, self-organizing network, and is an important technology for IoT sensing layer and wireless sensor network. SEP2.0, the new generation of ZigBee smart grid standard, has adopted 6LoWPAN technology, and with the deployment of smart grid in the US, 6LoWPAN will become the de facto standard and replace the ZigBee standard comprehensively.

Lora of wired and wireless communication technologies

Lora is one of the LPWAN communication technologies, was born in August 2013. Lora is an ultra-long-range wireless transmission solution based on spread spectrum technology adopted and promoted by Semtech in the US.

This solution changes the previous compromise between transmission distance and power consumption, providing users with a simple system that enables long-range, long battery life (3-5 years), high capacity, and thus extended sensing networks.

Easy to build and deploy, low-power wide-area IoT technology uses linear FM spread spectrum modulation, which maintains the same low-power characteristics as FSK (frequency shift keying) modulation, while significantly increasing the communication distance;

At the same time, network efficiency is improved and interference is eliminated, i.e. terminals with different spread spectrum sequences do not interfere with each other even if they transmit at the same time using the same frequency so that the Concentrator/Gateway developed on this basis can receive and process data from multiple nodes in parallel, greatly expanding the system capacity.

The LoRa network consists of four main components: terminals (with built-in LoRa module and Lora antennas), gateways (or base stations), servers, and clouds, and application data can be transmitted in both directions over distances of 15 to 20 km.

3. Traditional Internet of wired and wireless communication technologies

The Internet has developed to the point where basically all software systems run on the basis of the Internet, people get all kinds of data from the Internet, communicate and work, basically, everyone knows the Internet, here is only a brief description.

WI-FI of wired and wireless communication technologies

Wireless LAN based on IEEE 802.11 standard, which can be regarded as a short-range wireless extension of wired LAN. All you need to set up a WIFI is a wireless AP or a wireless router, and the cost is low.

Wi-Fi commonly known as wireless broadband is a wireless LAN communication technology. Wi-Fi is an industry term published by an organization called the Wireless Ethernet Compatibility Alliance. It is a short-range wireless transmission technology that can support radio signals for

Internet access within a range of several hundred feet.

Benefits of Wi-Fi

The advantage of Wi-Fi is that LAN deployments do not require the use of cables, reducing the cost of deployment and expansion.

Disadvantages of Wi-Fi

The disadvantages of Wi-Fi are poor stability, high power consumption and its security has been criticized by many.

Ethernet of wired and wireless communication technologies

This includes standard Ethernet (10Mbit/s), Fast Ethernet (100Mbit/s), and 10G (10Gbit/s) Ethernet. They are all compliant with IEEE802.3, which specifies the connectivity, electrical signaling, and media access layer protocols including the physical layer.

Ethernet is the most common communication technology for local area networks (LANs) and specifies a protocol that includes the physical, electrical, and media access layers. Ethernet uses twisted-pair cable as the transmission medium and can cover a range of up to 200 meters without a relay, with the most popular data transmission rate being 100Mb/s.

4. **Mobile networks of wired and wireless communication technologies**

Mobile wireless communication technology has developed to the point where mobile terminals have direct access to the world of the Internet. As communication tariffs fall and the cost of 3G/4G wireless modules fall, more and more devices are using mobile network technology as 3G/4G can easily communicate directly with the Internet.

GPRS of wired and wireless communication technologies

GPRS (General Packet Radio Service) is the abbreviation for General Packet Radio Service, a mobile data service available to GSM mobile phone users, which is a second-generation mobile communication data transmission technology, between 2G and 3G, also known as 2.5G, and can be said to be a continuation of GSM. GPRS is transmitted in packet form and can increase the transmission rate to 56-114Kbps.

3G/4G of wired and wireless communication technologies

The third and fourth generation of mobile communications technology, 4G is a combination of 3G and WLAN, enabling fast and high-quality transmission of data, images, audio, video, and more.

4G can be deployed in areas not covered by wired networks and is capable of downloading at speeds of 100Mbps or more, meeting the requirements of almost all users for wireless services with unparalleled superiority. 4G mobile system network architecture can be divided into three layers, physical network layer, intermediate environment layer, and application network layer.

NB-IoT of wired and wireless communication technologies

NB-IoT (Narrow Band Internet of Things / NarrowBand-IoT) is built on cellular networks, consuming only about 180KHz of bandwidth, and can be deployed directly on GSM networks, UMTS networks, or LTE networks to support cellular data connectivity for low-power devices in wide area networks, also known as Low Power Wide Area Networks (LPWA).

NB-IoT supports efficient connectivity for devices with long standby times and high network connectivity requirements. It is said that the battery life of NB-IoT devices can be increased to at least 10 years, while still providing very comprehensive coverage of indoor cellular data

connections.

RadioFrequency of wired and wireless communication technologies

Current Radio Frequency is abbreviated as RF and it is a high-frequency AC variation of electromagnetic waves. RF system is composed of tag (Tag, i.e. RF card), antenna, and reader three parts, we usually commonly used access control card, canteen card, bus card, etc. belong to the RF communication system equipment.

NFC of wired and wireless communication technologies

NFC is an emerging technology, the use of NFC technology devices can be in close proximity to each other in the case of data exchange, is from the non-contact radio frequency identification (RFID) and interconnection and interoperability technology integration evolved, through the integration of inductive reader, inductive card and point-to-point communication functions on a single chip, the use of mobile terminals to achieve mobile payment, access control, identification, and other applications.

These are the 4 categories of the 16 common wired and wireless communication technologies, also there has other wired and wireless communication technology such as UWB, etc.

Besides the 16 Wired and Wireless Communication Technologies in IoT article, you may also be interested in the below articles.

About Wi-Fi, You Did Not Know

What is the difference between WIFI and WLAN?

Summary of 41 Basic Knowledge of LTE

What Spectrum Is Used In 5G?

What Is Wi-Fi 7?

How To Choose 2.4G And 5G?

What Are The Advantages And Characteristics Of NB-IoT And LoRa?

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