

# AI-01814 Zigbee vs Matter

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**Tell me about Zigbee vs Matter. How the technology started, evolved and applied to modern human living. Assess which technology will play out longer and which one will disappear like the cd or a dvd player.**

## **Zigbee vs. Matter: A Smart Home Showdown**

The smart home landscape is a complex web of technologies, and for years, Zigbee has been one of the foundational standards. However, a new player, Matter, has entered the arena with the ambitious goal of unifying the smart home ecosystem. Here's a breakdown of how these technologies came to be, their applications, and an assessment of their future.

## **The History and Evolution**

### **Zigbee**

Conceived in the late 1990s, Zigbee was standardized in 2003 by the Zigbee Alliance (now the Connectivity Standards Alliance or CSA). The goal was to create a low-power, low-cost wireless communication standard specifically for short-range, low-data-rate applications. Its name is a nod to the "waggle dance" honey bees perform to communicate, reflecting the protocol's mesh networking capability.

The key feature of Zigbee is its mesh network. This allows devices to communicate with each other and extend the network's range without a central

hub, as long as each device is within range of another. This makes it ideal for a home full of battery-powered sensors and controls.

## **Matter**

Matter is the new kid on the block, but its origins are rooted in a collaboration of tech giants. It began in 2019 as Project Connected Home over IP (CHIP), founded by Amazon, Apple, Google, and the Zigbee Alliance. The project's goal was to simplify the smart home experience by creating a single, IP-based protocol that would work across different manufacturers' ecosystems. The first version of the specification, Matter 1.0, was published in 2022.

Unlike Zigbee, which is a transport layer (like Bluetooth or Wi-Fi), Matter is an application layer protocol. It doesn't replace existing networking standards; instead, it works on top of them. This means Matter-compatible devices can communicate over Wi-Fi, Ethernet, and Thread (a mesh networking protocol similar to Zigbee), with Bluetooth Low Energy used for initial setup.

## **Applications in Modern Living**

### **Zigbee**

For years, Zigbee has been the workhorse of the smart home, particularly for devices that need to be power-efficient. Its applications are widespread and include:

- **Smart Home Hubs and Devices:** Companies like Philips Hue, IKEA, and Amazon (with some Echo models) use Zigbee to connect and control smart lights, plugs, sensors, and more.
- **Energy Management:** Zigbee's low power consumption makes it a great choice for smart meters and other devices in "green tech" applications like solar and EV charging networks.
- **Industrial and Medical Automation:** Beyond the home, Zigbee is used in industrial control systems, building automation (for HVAC and security), and

even in healthcare for patient monitoring.

## **Matter**

Matter's primary application is to solve the smart home's biggest pain point: fragmentation. It's designed to make devices from different brands "just work" together. Its applications are growing as more manufacturers adopt the standard:

- **Interoperability:** The core promise of Matter is a seamless experience. A Matter-certified light bulb from one company can be controlled by a smart hub or app from another, regardless of the brand.
- **Simplified Setup:** Matter uses standardized onboarding, often with a QR code, to make adding new devices to a smart home network easier.
- **Local Control:** Matter devices can be controlled locally, reducing reliance on the cloud and improving responsiveness and reliability.
- **Future-Proofing:** Because it's an open standard backed by the biggest names in tech, Matter-enabled devices are intended to have a longer shelf life and be compatible with future smart home developments.

### **Assessment: Which Technology Will Play Out Longer?**

This isn't a simple case of one technology disappearing. Think of it less as a "CD vs. DVD" scenario and more like a "USB 2.0 vs. USB-C" evolution.

- Zigbee will not disappear entirely, but its role will change. It's a proven, reliable, and power-efficient transport layer. Matter, in fact, can run on a Zigbee-like network via Thread. For existing Zigbee devices, bridges or gateways will be essential to integrate them into a Matter ecosystem. These hubs act as a translator, allowing Zigbee devices to "speak" the Matter language.
  - Matter is positioned to become the dominant standard. Its strength lies in its unifying nature. By operating at the application layer and building on top of existing, robust transport layers (like Wi-Fi and Thread), Matter solves the interoperability problem that has plagued the smart home market. The broad support from major tech companies and the promise of a truly seamless user experience will drive its adoption.
- In conclusion, Matter is the future. It's the unifying standard that will bring true

interoperability to the smart home. Zigbee will likely continue to exist, especially in niche industrial applications and for legacy smart home systems, but it will increasingly be seen as an underlying network protocol rather than the consumer-facing standard. The "Matter" logo on a device will become a trusted symbol, much like "Bluetooth" or "Wi-Fi," and will be the deciding factor for consumers looking to build or expand their smart home. The days of needing a separate app for every brand of smart device are numbered, and Matter is the technology ushering in that change.

## **OSI Model**

In computer networking, the concept of network layers is used to break down the complex process of communication into smaller, more manageable parts. There are two primary models used to describe these layers: the OSI (Open Systems Interconnection) Model and the TCP/IP Model.

### **The OSI Model**

The OSI model is a conceptual framework that divides network communication into seven distinct layers. While it's more of a theoretical model, it's widely used for understanding and teaching networking principles. The layers are:

- **Layer 7: Application Layer** - This is the layer that users directly interact with. It provides network services to applications. Examples of protocols at this layer include HTTP (for web Browse), SMTP (for email), and FTP (for file transfer).
- **Layer 6: Presentation Layer** - This layer is responsible for data translation, encryption, and compression. It ensures that data is in a format that the receiving application can understand.
- **Layer 5: Session Layer** - This layer establishes, manages, and terminates connections between applications. It synchronizes communication and handles the dialog between two devices.
- **Layer 4: Transport Layer** - This layer provides end-to-end communication services. It breaks down data into smaller segments and ensures reliable delivery from the source to the destination. TCP (Transmission Control Protocol) and UDP (User Datagram Protocol) are key protocols here.

- Layer 3: Network Layer - This layer is responsible for logical addressing (like IP addresses) and routing. It determines the best path for data packets to travel across different networks. The Internet Protocol (IP) operates at this layer.
- Layer 2: Data Link Layer - This layer handles node-to-node data transfer on the same network segment. It uses physical addressing (like MAC addresses) and manages error checking.
- Layer 1: Physical Layer - This is the lowest layer, dealing with the physical transmission of data. It defines the hardware, cables, and other physical aspects of the network, converting data into electrical signals, light pulses, or radio waves.

#### The TCP/IP Model

The TCP/IP model is a more practical and widely-used model that closely maps to the actual protocols used on the internet. It condenses the seven layers of the OSI model into a four-layer stack.

- Application Layer - This layer combines the functions of the OSI's Application, Presentation, and Session layers. It handles the details of the specific application being used.
- Transport Layer - This layer is the same as the OSI's Transport Layer, responsible for end-to-end communication and data segmentation.
- Internet Layer - This layer is equivalent to the OSI's Network Layer, handling logical addressing and routing.
- Network Access Layer - This layer combines the functions of the OSI's Data Link and Physical layers. It deals with the physical transmission of data over a local network, including hardware and drivers.

### **List a comprehensive zigbee and matters applications in healthcare, industrial automation, home, automotive**

Here is a comprehensive list of Zigbee and Matter applications across various sectors.

#### Zigbee Applications

Zigbee has been a foundational technology for IoT, particularly for its low power consumption, mesh networking capabilities, and low data rate. Its applications are

well-established and have been in use for years.

## Healthcare

- **Remote Patient Monitoring:** Zigbee-enabled sensors can monitor a patient's vital signs, such as heart rate, blood pressure, and glucose levels, and transmit the data wirelessly to a central monitoring station for healthcare providers to review in real-time.
- **Medication Adherence Systems:** Smart pillboxes or medication dispensers can use Zigbee to send reminders to patients to take their medication and to alert caregivers or healthcare providers if a dose is missed.
- **Asset Tracking:** Hospitals can use Zigbee tags on medical equipment, wheelchairs, and other critical assets to track their location, improving operational efficiency and ensuring resources are always available.
- **Patient and Elderly Care:** Zigbee-based wearable devices can track the location of patients within a facility and send alerts in case of a fall or other emergency, promoting independent living for the elderly.

## Industrial Automation

- **Wireless Sensor Networks (WSNs):** Zigbee's mesh network is ideal for creating scalable WSNs in industrial settings. Sensors can monitor environmental conditions (temperature, pressure, humidity), machinery performance, and other critical parameters for real-time analysis and predictive maintenance.
- **Remote Monitoring and Control:** Industrial operators can remotely monitor and control equipment and processes via Zigbee networks. This is especially valuable in hazardous or hard-to-reach areas, reducing the need for on-site personnel.
- **Asset Tracking:** Similar to healthcare, Zigbee is used in factories and warehouses to track tools, equipment, and inventory, helping to optimize workflows and prevent loss.
- **Smart Energy Management:** Zigbee is a key component of smart grid systems, where it's used for smart meters, load control, and remote monitoring of energy usage.

## Home

- **Smart Lighting:** Philips Hue is a classic example of a Zigbee-based smart lighting system. Its mesh network allows light bulbs to act as signal repeaters, extending the network's range throughout a home.
- **Security and Surveillance:** Zigbee is widely used for wireless security sensors, such as door/window sensors, motion detectors, and smoke alarms, because of its reliability and long battery life.
- **HVAC Control:** Smart thermostats and climate control systems often use Zigbee to communicate with remote sensors and air vents to create an efficient, whole-home climate control solution.
- **General Home Automation:** From smart plugs to motorized blinds, Zigbee serves as the underlying technology for a vast array of smart home devices from brands like IKEA, Samsung SmartThings, and more.

#### Automotive

- **In-Vehicle Networking:** Zigbee can be used for low-power, short-range communication between different components within a vehicle, such as in-car entertainment systems or diagnostic sensors.
- **Wireless Key and Immobilizer Systems:** Its secure, low-power nature makes it suitable for applications like smart key fobs and vehicle immobilizer systems.
- **Tire Pressure Monitoring Systems (TPMS):** Some TPMS sensors use low-power wireless protocols similar to Zigbee to communicate tire pressure data to the vehicle's central computer.

#### Matter Applications

As an application layer protocol, Matter is not a replacement for Zigbee; instead, it's a unifying layer that sits on top of existing network technologies like Wi-Fi, Ethernet, and Thread (which is based on the same radio standard as Zigbee). This means Matter's applications are about interoperability and simplification.

#### Healthcare

- **Interoperable Patient Monitoring:** Matter will allow a patient's smart sensors (e.g., blood pressure cuff, pulse oximeter) from different manufacturers to communicate seamlessly with a single health monitoring app or a central patient record system.

- **Automated Environmental Control:** Matter-enabled sensors for air quality, temperature, and lighting can be installed in patient rooms and integrated with a central control system, regardless of the brand, to maintain a comfortable and safe environment.
- **Simplified Device Integration:** When a new piece of medical equipment or a smart sensor is needed, Matter will simplify the setup process, reducing the burden on IT staff and allowing for faster deployment.
- **Ambient Assisted Living (AAL):** In assisted living facilities, Matter can create a unified ecosystem of sensors, lights, and emergency call buttons that work together to ensure the safety and well-being of residents.

#### Industrial Automation

- **Unified Industrial IoT:** Matter has the potential to simplify the complex industrial IoT landscape. It would allow devices from different suppliers—like temperature sensors from one company and conveyor belt controllers from another—to communicate with a single automation platform.
- **Smart Building and Facility Management:** Matter can be used for building automation systems (BAS) within factories or offices, enabling a single platform to manage lighting, HVAC, and security devices from a variety of vendors.
- **Simplified Control Systems:** For industrial users, Matter offers the promise of a "plug-and-play" experience for new devices, reducing the time and effort required for system integration.

#### Home

- **True Smart Home Interoperability:** This is Matter's primary use case. It allows a user to control a smart bulb from Company A, a smart lock from Company B, and a smart thermostat from Company C, all from a single app or voice assistant (like Google Assistant or Apple HomeKit).
- **Simplified Onboarding:** Matter's standardized setup process, often using a QR code, makes adding new devices to a home network incredibly simple, removing the frustration of incompatible apps and complex pairing procedures.



- **Reliable Local Control:** By operating over IP, Matter allows devices to communicate locally, meaning you can control your lights or appliances even if your internet connection goes down.
- **Future-Proofing:** Consumers can buy Matter-certified products with confidence, knowing they will be compatible with future generations of smart home hubs and platforms.

#### Automotive

- **In-Car Smart Device Integration:** While still emerging, Matter has potential applications for integrating a vehicle's infotainment system with a user's smart home devices. For example, a driver could use their car's screen to check if their home's smart lock is engaged or turn on the lights before they arrive.
- **Vehicle-to-Home Communication:** Matter could enable a car to communicate with a Matter-enabled garage door opener or a home's security system, automating actions like unlocking the door or disarming the alarm as the car approaches.

### **The Mars Rover, zigbee or Matter standard? Or something else?**

The Mars rovers do not use Zigbee or Matter as their primary communication standards for a very simple reason: the immense distances involved. Zigbee and Matter are designed for short-range communication, typically within a building or a few hundred meters. The Mars rovers need to communicate across millions of kilometers.

Their communication systems are highly specialized and are part of a larger, complex network. Here's a breakdown of what they actually use:

#### Primary Communication Protocols

The communication system of a Mars rover is designed for two main purposes:

- **Sending data back to Earth:** This includes scientific data, images, and engineering telemetry.
- **Receiving commands from Earth:** This tells the rover what to do next. This is primarily accomplished using specialized radio-frequency (RF) communication links.
- **X-band (7-8 GHz):** This is a high-frequency radio band used for direct-to-Earth communication. The rovers use a high-gain antenna (HGA) to send a

focused, high-bandwidth signal directly to Earth. This requires precise aiming, but it provides the fastest data rate. A low-gain antenna (LGA) is also used for a weaker, omnidirectional signal for emergency communications.

- UHF-band (around 400 MHz): This is the band used for relaying data through orbiting spacecraft. Most of the data from the rover is sent to one of the Mars orbiters (like the Mars Reconnaissance Orbiter or Mars Odyssey). The orbiter then stores the data and relays it to Earth when it has a clear line of sight with one of the large ground antennas on Earth. This is the most common and efficient method of communication because the orbiters are closer and can transmit data at a higher rate.

#### The Network Infrastructure

The Mars rovers are not part of a simple home network. They are part of a massive, interplanetary network managed by NASA's Deep Space Network (DSN). The DSN is a worldwide network of large radio antennas located in California, Spain, and Australia. These stations are strategically placed to ensure continuous communication with spacecraft as the Earth rotates.

#### What about Zigbee and Matter?

While the main communication is with Earth, there is one very interesting use case where a short-range protocol is used. The Ingenuity helicopter, which flew on Mars, used a Zigbee-based radio link to communicate with the Perseverance rover.

- Ingenuity and Perseverance: The helicopter communicated with the rover, which acted as its "base station." The helicopter would send its flight telemetry and images to the rover via this Zigbee-based link. The rover would then store this data and later transmit it back to Earth using its own, more powerful radio antennas and the DSN.

This is a perfect example of a limited-range, low-power protocol like Zigbee being used for a very specific, local application (rover-to-helicopter communication), while the larger-scale, long-distance communication is handled by an entirely different, highly specialized system.

Matter has no application here. It's a protocol designed to solve a consumer problem of device interoperability within an IP-based network. It has no relevance in the context of deep space communication, which requires a completely different set of technologies to overcome the challenges of massive distance, signal delay, and power constraints.

## **In the hardware layer, are zigbee and matter similar? What board are each technology employed?**

This is an excellent and very important question because it gets to the heart of the fundamental difference between Zigbee and Matter. The short answer is: Zigbee and Matter are similar at the hardware layer, but they are not the same.

The Crucial Distinction: Where They Operate

The key to understanding their hardware lies in which network layers they occupy.

- Zigbee is a full-stack protocol. It operates across multiple layers, from the physical layer (Layer 1) up to the application layer (Layer 7). It defines its own physical and data link layers, which are based on the IEEE 802.15.4 standard. This means a single Zigbee-certified chip handles the entire communication stack, from the radio signals to the application-level commands.
- Matter is an application-layer protocol. It operates at a higher level, specifically Layer 3 (Network Layer), Layer 4 (Transport Layer), and Layer 7 (Application Layer). Matter does not define its own physical or data link layers. Instead, it is designed to run on top of existing, IP-based network technologies like Wi-Fi (IEEE 802.11), Ethernet (IEEE 802.3), and Thread (IEEE 802.15.4).

Hardware Similarities and Differences

Given this distinction, let's look at the hardware.

The Similarities

This is where it gets interesting. Matter's hardware similarity to Zigbee comes from its support for Thread.

- Both Zigbee and Thread are based on the IEEE 802.15.4 radio standard. This is a global standard for low-power, low-data-rate wireless personal area networks (WPANs). This means that at the very bottom, in the radio chip itself, the physical radio hardware for a Zigbee device and a Matter-over-Thread device are often very similar, or even identical.
- A single chip from a manufacturer like Silicon Labs, NXP, or Nordic Semiconductor might be able to run either a Zigbee firmware or a Thread firmware. The physical radio capabilities are there; it's the software stack loaded onto the chip that determines which protocol it will use.

The Differences

The differences are in the chip's other capabilities and the overall system design.

- Zigbee-only boards typically have a microcontroller and a radio transceiver integrated into a single chip. This chip is purpose-built to run the full Zigbee protocol stack. Because Zigbee is not IP-based, these chips are often simpler and require less memory and processing power than a Matter-compatible device.
- Matter-compatible boards are designed to run an IP stack, which requires more processing power and memory. This is especially true for Matter-over-Wi-Fi devices, which require much more robust hardware.
- Matter-over-Thread devices still use the same 802.15.4 radio as Zigbee, but the firmware running on the chip implements the Thread protocol, which is IP-based. These devices are part of a larger network that includes a Thread Border Router—a device (often a smart hub, Wi-Fi router, or smart speaker) that connects the Thread network to the Wi-Fi or Ethernet network and the broader internet. A Zigbee network, on the other hand, requires a dedicated Zigbee hub or a multi-protocol hub to translate between Zigbee and Wi-Fi.

#### Boards and Chipsets

Here are some examples of the types of boards and chipsets employed for each technology:

#### Zigbee

These boards are designed to run the full Zigbee protocol stack. They are often low-cost, low-power, and come with a simple microcontroller.

- Texas Instruments CC2530/CC2531: These were some of the early and very popular Zigbee System-on-Chips (SoCs).
- Silicon Labs EFR32MG Series (e.g., EFR32MG21, MG24): These are multi-protocol chips that can be configured to run either Zigbee, Thread, or even both simultaneously. Many modern Zigbee devices use these chips.
- NXP JN516x and JN517x series: Another common family of chips used for Zigbee products.
- Modules: Manufacturers often use these chips to create pre-certified modules (like the Telegesis ETRX series or the popular CC2531 USB stick) to make it easier for product developers to integrate Zigbee into their designs.

#### Matter

Matter is employed on boards that can support an IP network stack. The

choice of board depends on the transport layer being used (Wi-Fi, Ethernet, or Thread).

- For Matter-over-Thread: These devices use the same type of hardware as modern Zigbee. You will find chips from manufacturers like Silicon Labs (EFR32MG series), Nordic Semiconductor (nRF52 and nRF53 series), and Espressif (ESP32-H2). The key is that the firmware loaded onto the chip implements the Thread protocol, not the Zigbee protocol.
- For Matter-over-Wi-Fi: These devices require more robust hardware to handle the higher data rates and power requirements of Wi-Fi. This includes chips like the Espressif ESP32 series, the Silicon Labs WF200 series, and other Wi-Fi modules.
- For Matter Controllers/Hubs: These are the most powerful devices. They typically have a more powerful processor (like a Raspberry Pi or a similar single-board computer) that can run the Matter controller software and often a secondary radio chip (like a Silicon Labs EFR32) to act as a Thread Border Router.

In summary, while the physical radio chip for Zigbee and Matter-over-Thread devices may be based on the same IEEE 802.15.4 standard, the software stack and the overall system design (particularly the need for IP compatibility) make the technologies fundamentally different at the hardware layer.

### **Can I build my own zigbee or matter end device (DIY)? Esp32 board?**

Yes, you can absolutely build your own Zigbee or Matter end devices as a DIY project, and ESP32 boards are an excellent platform for this. However, it's crucial to understand a few key details about the specific ESP32 chip you're using.

The ESP32 and Radio Connectivity

The popular ESP32 boards you might already have for Wi-Fi projects (e.g., an ESP32-WROOM) do not have the necessary radio hardware for Zigbee or Thread. These traditional ESP32 boards only support Wi-Fi and Bluetooth.

To get into the world of Zigbee and Matter-over-Thread, you need a newer generation of ESP32 chips that include an IEEE 802.15.4 radio.

The key players are:

- ESP32-C6: This is a versatile chip that supports Wi-Fi 6, Bluetooth LE, and the IEEE 802.15.4 protocol. This makes it a great choice for a Matter device

because you can choose to have it communicate over Wi-Fi or Thread. It's often the go-to for DIY projects.

- ESP32-H2: This chip is a more specialized, low-power option that only supports Bluetooth LE and IEEE 802.15.4. It's an ideal choice if you only need Zigbee or Matter-over-Thread and want to optimize for power consumption. So, when you're looking for a DIY board, make sure it has either an ESP32-C6 or an ESP32-H2 chip. Boards from companies like Seeed Studio (XIAO series) and Espressif themselves offer development kits based on these chips.

#### Building Your DIY Device

The process for building your own Zigbee or Matter device will typically involve these steps:

##### 1. Hardware Selection

- Choose a development board with the correct chip (ESP32-C6 or ESP32-H2).
- Add your sensors or actuators. This is the fun part! You can connect anything from a simple temperature sensor (DHT22) to a motion sensor, a relay for a smart switch, or an LED strip.

##### 1. Software Framework

This is where you choose your development environment.

- For Zigbee: Espressif provides a dedicated ESP Zigbee SDK built on their ESP-IDF framework. There are also examples and libraries for the Arduino IDE, which can be easier for beginners.
- For Matter: Espressif also has a robust ESP Matter SDK. This is the recommended route as it provides all the necessary components to implement a Matter-compliant device, including security and commissioning features.
- ESPHome: This is a fantastic option for DIYers, especially those who use Home Assistant. ESPHome is a framework that allows you to configure your device's behavior using simple YAML code, and it handles all the complex underlying code for you. It has excellent support for creating Matter-over-Wi-Fi and Matter-over-Thread devices on supported ESP32 boards. This is often the simplest path for a beginner.

##### 1. Flashing the Firmware

Once you have your code, you'll flash it onto the ESP32 board using a USB

cable. This process can be done from your computer using tools like the ESP-IDF CLI or a web flasher.

#### A Note on Certification

When you build a DIY device, it will not be "officially certified." Certified devices have passed rigorous testing to ensure interoperability and security. Your DIY device will likely use a "development vendor ID," which might trigger warnings in some smart home ecosystems. However, for a hobbyist in their own home, this is generally not a concern and your device will function just fine.

In short, yes, it's not only possible but also a very popular and rewarding DIY project to build your own Zigbee or Matter end device using modern ESP32 boards. Just be sure to select a board with the right wireless capabilities.

### **Does ISS uses Zigbee technology, devicenet, CAN?**

The International Space Station (ISS) uses a complex and highly specialized network, and the short answer is no, it does not use Zigbee, DeviceNet, or CAN for its primary communication.

These three technologies are industrial and consumer-grade protocols designed for specific applications on Earth. The ISS, on the other hand, operates in an extremely harsh and unique environment that requires a different set of standards. Here's a breakdown of the networking technologies the ISS uses and why the others are not suitable:

#### ISS's Internal and External Networks

The ISS has multiple networks, each serving a specific purpose:

- **Ethernet:** The ISS has a robust local area network (LAN) that uses Ethernet for data transfer between different modules, computers, and scientific payloads. This network has been upgraded over the years, starting with 10 Mbps and moving to 100 Mbps, with plans for gigabit Ethernet. This allows astronauts to use laptops, transfer files, and manage experiments.
- **MIL-STD-1553B:** This is a legacy military standard used for command and control of the station's systems. It's a highly reliable, fault-tolerant bus used for critical tasks like controlling valves, heaters, and other vital equipment.
- **Space Communications Protocols:** For communication with Earth, the ISS uses highly specialized protocols developed by the Consultative Committee for Space Data Systems (CCSDS). These protocols are designed to handle the

massive delays, disruptions, and potential data loss that occur during space communication.

- Delay-Tolerant Networking (DTN): The ISS has been a testbed for DTN, a suite of protocols specifically designed to handle long delays and frequent disconnections. This "store and forward" technology is the foundation for an "interplanetary internet" and is essential for reliable communication with deep-space missions.

Why Zigbee, DeviceNet, and CAN are not used

- Zigbee: As we've discussed, Zigbee is a low-power, short-range wireless standard designed for home and industrial sensor networks. Its range is far too limited for the physical size of the ISS modules, let alone for communicating between the station and ground control. While a Zigbee-based link was used for a very specific, local application between the Mars Perseverance rover and the Ingenuity helicopter, the ISS itself relies on hardwired and high-power radio links.
- DeviceNet: This is a network protocol used in industrial automation, primarily for connecting control devices on a factory floor. While it's based on the CAN bus, it's not designed for the extreme conditions of space, such as vacuum, radiation, and extreme temperature swings. The complex power and safety requirements of the ISS make a proprietary industrial protocol unsuitable.
- CAN (Controller Area Network): CAN is a very reliable and robust bus standard widely used in automotive and industrial applications. It's designed for real-time control within a single system, like a car's engine or braking system. While the ISS does have a complex control system, it uses its own set of standards (like MIL-STD-1553B and Ethernet) that are tailored to the specific, high-stakes requirements of a space environment. Space-grade components and protocols undergo much more rigorous testing and have different design philosophies to account for radiation and long-term reliability in a non-serviceable environment.