Types of communication and IoT Protocols

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What is IOT?

The Internet of Things (IoT) is a technology that simplifies our today's work. Now it rapidly increased more number of internet enabled devices. IoT enables these smart devices to communicate with other web-enabled gadgets. It depicts the network of physical devices. These devices are embedded with sensors, software, and other technologies which allow devices to connect and exchange data over the internet in order to perform different tasks.

For example in *Smart agriculture***,** farmer use IoT sensor to collect environmental data, state of soil, monitor the state of crops etc., and based on that the farmer make decision to improve the farming skill. IoT plays a vital role in social innovations fields such as medicines, transportation and industry.

Various Types of Communication in IoT

IoT uses different types of communication based on its purpose and applications. The following are the various types of communication in IoT :

- ✓ Device-to-Device Communication
- ✓ Device-to-Cloud Communication
- ✓ Cloud-to-Device Communication
- ✓ Peer-to-Peer Communication
- ✓ Machine-to-Machine Communication

Device-to-Device Communication

The most common type of communication in IoT is device-to-device communication .It connects two or more IoT devices directly and communicate between one another. These devices communicate over many type of network including IP networks or the internet, but most often use

protocols like Bluetooth, Z-Wave, and ZigBee. This type of model mostly used in home automation system like smart washing machine, smart refrigerator, smart bulbs, health and urine analysis etc., Modern wearable technology fall under this type of communication, which includes smart watches, fitness trackers and Bluetooth headsets.

Cloud-to-Device Communication

This type of communication is used to send one-way notification or commands from the cloud platform to IoT devices. It uses two protocols for device connection and communication MQTT and HTTP. When a message is sent to IoT devices, the device can then retrieve message from the queue and take appropriate action. In a Smart Parking system, for example, sensor is embedded in the ground notify the driver of available parking spaces via smartphone application when a vehicle has departed from a parking space. This type of communication is important in IoT because it allows the user to make changes in response to changing events or conditions.

Peer-to-Peer Communication

This type of communication enables direct communication channels between IoT devices without a central server to route and manage interactions. This decentralized approach enhances IoT systems security, scalability, flexibility and responsiveness. For example, if parent and child both are having smart phones then the parent can track his child location using his smart phone. This is basically communication between sensor devices.

Machine-to-Machine Communication

This type of communication involves machine to machine exchanging of information without human interface or intervention. An IoT M2M for example, while a patient's vital signs and symptoms drop beneath ordinary, an M2M-linked life help tool ought to robotically administer oxygen and further care until a healthcare expert arrives at the scene. IoT M2M additionally allows patients to monitor their own homes instead of in hospitals or care facilities. This type of communication is useful in situations when automated work is needed.

What is IoT Communication Protocols?

A sender can transform information to recipient using language or gesture or some other medium .This process of transforming information is called communication. IoT communication Protocols (IoT protocols) having some set of rules for interconnecting IoT devices and allow to exchange data between each other over wireless networks. To communicate with different devices IoT system uses different types of communications protocols. The following factors to be consider when choosing IoT protocols based on the specific requirements and constraints of a given system:

- ✓ Geographic locations
- ✓ Power consumption needs
- ✓ Physical barriers
- ✓ Cost

IoT Protocols

IoT protocols that enable the exchange and transmission of data between the Internet and devices at the edge. Each IoT protocol enables either device-to-device, device-to-gateway or device-to-cloud/data center communication -- or combinations of those communications. Factors such as geographic and special location, power consumption needs, battery-operated options, the presence of physical barriers and cost determine which protocol is optimal in an IoT deployment.

IoT protocols can be divided into two categories: *IoT network protocols and IoT data protocols*. Data protocols mainly focus on information exchange, while network protocols provide methods of connecting IoT edge devices with other edge devices or the Internet. Each category contains a number of protocols that each have their own unique features. Some of the common IoT protocols are discussed below:

IoT network Protocols

- Wi-Fi

  WiFi connectivity is one of the most popular IoT communication protocol for Wireless Local Area (WLAN).Many of the development boards allow people to build IoT applications using Wi-Fi. The most popular board is Raspberry which allow people to build IoT prototypes and can also be used for small real-time applications. The chip has application like wearables, wireless audio & smart home.

- Bluetooth

  Bluetooth is a technology used for exchanging data wirelessly over short distances and preferred over various **IOT network protocols**. It uses short-wavelength UHF radio waves of frequency ranging from 2.4 to 2.485 GHz in the ISM band. This low-power, low-range connectivity option is a go-to for both personal area networks and IoT deployments. A new version optimized for IoT connections is Bluetooth Low Energy, known as either Bluetooth LE or BLE. Due to its less power consume, it can be used in health and fitness trackers and smart home devices on the consumer side and for in-store navigation on the commercial side.

- LTE CAT 1

  The Long Term Evolution (LTE) cellular technology standard designed for IoT applications that require medium data speeds with broad global coverage cellular standards like 2G and 3G, 4G.it is designed for a vast number of feature-rich IoT applications requiring medium data speeds, lower power consumption, full mobility, and voice support, LTE Cat 1 is the lowest cost, globally available LTE category that still delivers the speeds necessary to support video streaming with up to 10 Mbit/s downlink and 5 Mbit/s uplink. LTE Cat 1 uses standard LTE channelization and benefits from network communication handover. Handover is the capability to transfer an ongoing call (voice or data) from one cell node to another seamlessly and transparently to the user, avoiding a connectivity drop when the device is mobile.

- NB-IoT

  Narrowband IoT or NB-IoT is a type of Low Power Wide Area (LPWA) radio technology that connects devices (which need small amounts of data, low bandwidth, and long battery life) to the Internet of Things(IoT). This makes it suitable for a variety of IoT applications with a wide range of new IoT devices and services . It provides excellent coverage, running on a licensed spectrum, offers deep coverage, low-cost hardware and long battery life. Vodafone was the first to complete a successful trial on a live commercial network for Narrowband-IoT.

- ZigBee

ZigBee is a ***IoT wireless protocols*** , which is similar to Bluetooth technology. Some of the advantages of ZigBee are low-power consumption, robustness, high security, and high scalability. Zigbee offers a range of about 10 – 100 meters maximum and data rate to transfer data between communicated devices is around 250 Kbps. It has a large number of applications in technologies like M2M & IOT.

- LoRaWAN

Now a day's LoRaWAN (Long Range Wide Area Network) is the most popular protocols used in **IOT network protocol** which is used for long distances applications and is designed to **provide low-power for communication in IoT, M2M applications**. It has a capacity of connecting millions of devices with data rates ranging from 0.3 kbps to 50 kbps. The distance for LoRaWAN application ranges from 2 - 5km for the urban environment & maximum 15km for the suburban environment.

IoT Data Protocols

- AMQP

AMQP (Advanced Message Queuing Protocol) is lightweight open messaging protocols used for specifically banking system. This means that the subscriber and publisher of the system communicate by sending and requesting messages from a 'message queue'. This standard satisfies the need for IoT applications on asynchronous communication, ensuring that the system is flexible enough to enable communication across numerous things. Due to its reliable, secure, interoperable, open, and standard properties, along with its low overhead characteristics, AMQP has become a good solution for IoT applications.

- MQTT

The MQTT protocol was aimed to operate on data transmissions with a small bandwidth and minimum resources. It supports messaging between devices to the cloud and the cloud to the device. This protocol has some features during data transmissions are lightweight and efficient, scalable, reliable, secure etc.

- CoAP

Constrained Application Protocol (CoAP) is a specialized web transfer protocol for use with constrained nodes and constrained networks in the Internet of Things. CoAP is incredibly lightweight. It has been developed to RFC 7252 standards. This means it can be run on devices with very limited resources. As low as 10k of memory and 100k of application space is all that a device needs to run CoAP. It is generally used for machine-to-machine (M2M) applications such as smart energy and building automation.

- DDS

DDS is another lightweight communication IoT protocol. DDS is highly scalable, offers high-quality IoT communications, and uses the publisher-subscriber messaging model. This protocol is popular because it can be used in a variety of different settings, from small IoT devices to the cloud. Its operation claims to provide a secure and real-time data distribution. Like MQTT, DDS works in a Publisher/Subscriber architecture. However, the protocol doesn't implement the use of Brokers together with its Clients,

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