A Recent Survey on Internet of Things (IoT) Communication Protocols

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***Abstract*: Internet of Things (IoT) consists of sensors embed with physical objects that are connected to the Internet and able to establish the communication between them without human intervene applications are industry, transportation, healthcare, robotics, smart agriculture, etc. The communication technology plays a crucial role in IoT to transfer the data from one place to another place through Internet. This paper presents various communication protocols, namely Zigbee, Bluetooth, Near Field Communication (NFC), LoRA, etc. Later, it provides the difference between different communication protocols. Finally, the overall discussion about the communication protocols in IoT.**

***Keywords*: Internet of Things, Communication Protocols, Wireless Technology, Applications.**

1. Introduction

The term IoT was coined by Kevin Ashton in year 1999. IoT is an emerging technology, which is used to transfer the information from human to human, machine to machine and human to machine. Nowadays the smart devices are connected to the Internet that able to sense the data, transfer the data and take the decision by themselves without consulting the human in the environment. The IoT is connected to the Internet that transfer the data at anytime, anydevice and anywhere the world [1-3].

The IoT environment consists of an enormous number of smart devices, but with many constraints. Processing capability storage volume, short in power life and radio range are among of these constraints. Therefore, the IoT implementation requires a communication protocols that can efficiently manage these conditions [4,5].

This paper provides the survey on recent IoT communication protocols. Section 2 provides the information about importance of the communication protocols and what are all the communication protocols are available in the network layer. Section 3 provides the differences between the communication protocols in IoT. Finally, section 4 provides the overview of various communication protocols.

2. IoT Communication Protocols

2.1. ZigBee

Zigbee protocol is developed by zigbee Alliance. It is based on low power wireless network that follows the standard as IEEE 802.15.2. It consists of Zigbee coordinator (ZC), Zigbee Router (ZR) and Zigbee End Device (ZED). Generally, the ZC acts as root node of the Zigbee wireless network structure. It supports various network topologies, namely star, mesh and tree. The ZC decides the network structure. The ZR collects the data from the ZED and forwards the data to the ZC. The ZED's are simple sense the data from the environment and forwards it to the ZR [6,7,8].

2.2. *RFID*

RFID stands for radio frequency identification, which is developed by Harry Stockman. RFID consists of reader and tag. The RFID reader is a electronic device, which is attached with antenna. The antenna propagates the radio waves to the certain ranges in the environment. The RFID tag is categorized into two types, namely active tag and passive tag. The active tag is required the external power sources. But the passive tag is not required the external power sources. Each tag contains the electronic product code. The reader reads the tag information and the reader checks the database with existing product details. The application of RFID is used to track the product, vehicle, object, etc [9,10] .

2.3. BLE

Bluetooth Long Evolution (BLE) is a important protocol in IoT, which is used to establish the short range communication between the IoT devices. It transfers the data slowly, due to low bandwidth and low latency. It supports the star topology with unlimited nodes [11].

2.4. 6LoWPAN

6LowPAN stands for IPv6 low power personal area network, which is the first IP based IoT communication protocol. 6LowPAN based IoT devices are directly connected to the network without gateway. 6LowPAN was standardized by Internet Engineering Task Force (IETF). IPv6 supports 2^{128} devices, so the numbers of addresses are more than sufficient. IT supports different topologies, namely star and mesh [16,80].

2.5. NFC

NFC stands for near field communication. It supports very short range communication. It follows the RFID technology but it covers less area than RFID. It is not only identify the objects and also establishes the two way communication between the devices. There are three main operating modes for NFC: card emulation mode (passive mode), reader/writer mode (active mode) and peer-to- peer mode). NFC technology is extensively used in mobile phones, industrial applications and contactless payment systems. Similarly, NFC makes it easier to connect, commission, and control IoT devices in different environments like home, factory and the work [12].

2.6. LoRa

LoRa stands for long range wireless communication, which is developed by LoRa Alliance. Currently, it is used about 100 countries. It provides bidirectional and long range communication. Also, it supports star topology. LoRA can be used various technology applications, namely Internet of things, machine to machine (M2M), building automation, smart city and smart metering, etc. The architecture of LoRA consists of Application server, Network server, Gateways and LoRa end-devices. The LoRa end-devices are battery powered. The Gateway and servers are directly connected by main power [13-15].

3. Comparison between IoT communication Protocols

Characteristics	Zigbee	RFID	BLE	6LowPAN	NFC	LoRa
Standard	IEEE802.15. 4	RFID	IEEE 802.15. 1	IEEE 802.15.4	ISO/IEC 14443 A&B,JIS X-6319- 4	LoRa
Frequency Bands	2.4 GHz	125 kHz, 13.56 MHz, 902-928 MHz	2.4 Ghz	868Mhz(EU) 915Mhz(USA) 2.4Ghz(Global)	125KHz, 13.56Mhz 860Mhz	915 MHz (Australia,America) and 923 MHz (Asia)
Network	WPAN	Proximity	WPAN	WPAN	P2P Network	LoRAWAN
Topology	Star ,Mesh Cluster Network	P2P Network	Star –Bus Network	Star Mesh Network	P2P Network	Star
Power	30 mA Low power	Ultra-low power	30 mA Low Power	Low power consumption	50 mA low power Very Low	Low power consumption
Range	Short Range 10-100 m	Short Range Up to 200 m	Short Range ~15-30 m	Short Range 10-100 m	Short Range 0-10cm 0-1m 10cm-1m	5km
Data Rate	250 kbps	4 Mbps	1Mbps	250 kbps	212 or 424 kbps	27 kbps
Security	AES	RC4	AES-128	AES	RSA, AES	AES
Common Applications	Home industry monitoring and controlling	Tracking, Inventory,	Wireless headsets, Audio Applications	Monitor and Control via internet	Payment, Access	Smart city

4. Conclusion

Internet of Things (IoT) is an emerging technologies, which provides various exciting solutions in various domains. The communication technology plays a crucial role in IoT to transfer the data from one place to another place through Internet. This

paper presents various communication protocols, namely Zigbee, Bluetooth, Near Field Communication (NFC), LoRA, etc. Later, it provided the difference between different communication protocols. Finally, the overall discussion about the communication protocols in IoT.

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