iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 12 **Issue:** IV **Month of publication:** April 2024

DOI: https://doi.org/10.22214/ijraset.2024.61338

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 12 Issue IV Apr 2024- Available at www.ijraset.com

Communication Protocols for IoT Applications

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Abstract: ***The Internet of Things (IoT) can be defined as an ecosystem of interconnected devices such as sensors, microcontrollers, actuators that enable them to communicate and share information between them through internet for making the system intelligent and smart.***

As there is growth in IoT, communication protocols play a pivotal role in facilitating efficient, reliable, and secure data exchange between these components. Through this analysis, guidance is provided to users to choose particular protocol according to the application. Communication protocols in IoT offers a varied set of options which are designed for specific use cases.

By understanding their characteristics, features, strengths and shortcomings one key build in expertise in effective designing of IoT systems.

Keywords: IoT, ecosystem, sensors, microcontrollers, actuators, protocols

I. INTRODUCTION

Communication protocols are the set of rules established between nodes to exchange information in a reliable and safe manner. They can also be also explained as description of digital message formats and norms required to exchange messages in or between computing system. Communication protocols are important in each and every system as they offer consistency, universality, authentication, error detection and correction. They are implemented in both hardware and software.

Some of the factors considered while selecting a particular protocol are:

1) *Speed or Data Rate:* The number of bits transmitted from one device to another one or a network per second is known as data rate.
2) *Range of the Devices to be Interconnected:* Any instrument having the capability to work between the maximum and minimum value is called as range.
3) *Power Consumption:* Amount of energy dissipated per unit time by the device in terms of current in active state.
4) *Interoperability:* Real-time data exchange between different systems that communicate between different systems in same or different protocols and interpreting incoming data and presenting it as it was received while preserving its original content.
5) *Cost*
6) *Topology:* Topology refers to the way the hardware are connected ex. Ring, mesh, bus topology
7) *Scalability:* The ability to increase the number of connected devices in any given network.

II. WEB COMMUNICATION PROTOCOLS FOR CONNECTED DEVICES

Web communication protocols are the set of rules and conventions that are required to control communication between different devices over the World Wide Web. Below are the web communications protocols for connected devices.

1) *CoAP:* Constrained Application Protocol, works on the principle of synchronous request/response type. It works on low power devices which has communication and computation abilities. It does not provide feature of security. Stop and wait mechanism is used for retransmission of packets. It has four modes namely confirmable, non-confirmable, piggyback and separate.
2) *LWM2M:* Lightweight machine to machine protocol is application layer protocol specified by Open Mobile Allaince for transfer of service data/messages. It enables functionalities for device management in cellular or sensor networks. LWM2M provides a standardized way to manage these devices and send telemetry data drawn in by the sensors quickly and cost effectively to the cloud. LWM2M has been designed to reduce power and data usage for low-power devices, which are limited in processing power and bandwidth. The protocol is ideal when devices are a long way from power and need to use battery-powered local devices, have a SIM card and no power cord.

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III. MESSAGE COMMUNICATION PROTOCOLS FOR CONNECTED DEVICES

A device or node or end point client/server sends and receives messages. A communication module includes a protocol handler, message queue and message cache. The protocol handler functions during transmission and reception of messages according to the communication protocols for these actions. Various protocols are

1) *MQTT:* Message Queue Telemetry Transport protocol is used for connecting middle ware and application layer. It is suitable for M2M communication. It works on publish/subscribe principle. There is one broker system in between the publisher and subscriber. The information is sent and received through this broker system. It is generally used in low power devices.
2) *XMPP:* Extensible Messaging and Presence Protocol was designed for messaging and chatting purpose. It works on both publish/subscribe and request/response principle, it is not suitable for M2M communication.
3) *SMQTT:* It is secure MQTT. It works in four modes: setup, publish, encryption and decryption.
4) *AQMP:* Advanced Message Queuing Protocol is designed for industrial purpose. It uses asynchronous publish/subscribe communication.
5) *DDS:* Data Distributed Service has two sub layers namely data-centric publish-subscribe and data-local reconstruction. Sensor data distribution is carried out by publisher layer.
6) *SOAP:* Simple Object Access Protocol is a W3C approved open-source protocol. It is the protocol for exchange of objects between applications and for access to web service. SOAP specifies the formats and ways of communicating messages. Its usage is independent of the application language and platforms.

IV. DATA LINK AND PHYSICAL LAYER PROTOCOL

In networking of connected devices, the two layers which are part of OSI (Open Systems Interconnect) handle different aspects of communication. Data link layer is responsible for the reliable transfer of data frames between nodes over a physical network segment. While physical layer protocols handles the transmission and reception of raw data bits over a physical connections like switches, hubs. It defines characteristics such as voltage levels, timing of signals, and data transmission rates.

1) *Wireless HART:* Wireless addressable remote transfer protocol is a data link layer protocol which operates at the physical layer.
2) *Z wave:* it is a MAC layer protocol. It is generally used in wearable devices and home automation. It uses CSMA/CA technology for collision detection and ACK messages. It works on the principle of master and slave where master controls slave by sending commands.
3) *Bluetooth:* It is short range MAC layer protocol. It works in physical layer also. It works in master slave architecture of two types of frames namely advertising and data frames.
4) *Zigbee:* It is used in smart home, healthcare systems and remote controls.
5) *DASH7:* It works on active RFID that uses Industrial Scientific Medical Band
6) Near field communication: Typically set of short range wireless technologies requiring 4 cm or less to initiate a connection.
7) *WLAN 802.11:* The IEEE 802.11 standard, commonly known as Wi-Fi. Wi-Fi uses high-frequency radio waves instead of cables for connecting the devices in LAN.
8) *Light Fidelity (Li-Fi):* In Li-Fi light is used as a medium to transfer or receive data. It does not require any special equipment that would make it expensive to achieve the target. The data is transferred by modulation of light through the light source and send and the photodetector is used to demodulate the data. It provides data rate of 224 Gbps.
9) *NFC:* It stands for Near Field Communication, It is a short range wireless communication technology that allows two devise to transfer data when they are in the vicinity of each other.

Comparison table of different protocols are given below

First is the comparison table between message communication protocols for connected devices. Difference between MQTT and CoAP is given in the table below

Parameter	MQTT	CoAP
Underlying protocol	TCP connection oriented	UDP connectionless
Communication	Many to many	One to one
Power	Higher than CoAP	Lowest
Model	Publisher-subscriber	Request-response

Second is the comparison between data link and physical layer protocols. Difference between NFC, Bluetooth, Zigbee and WLAN protocols are given in the table given below.

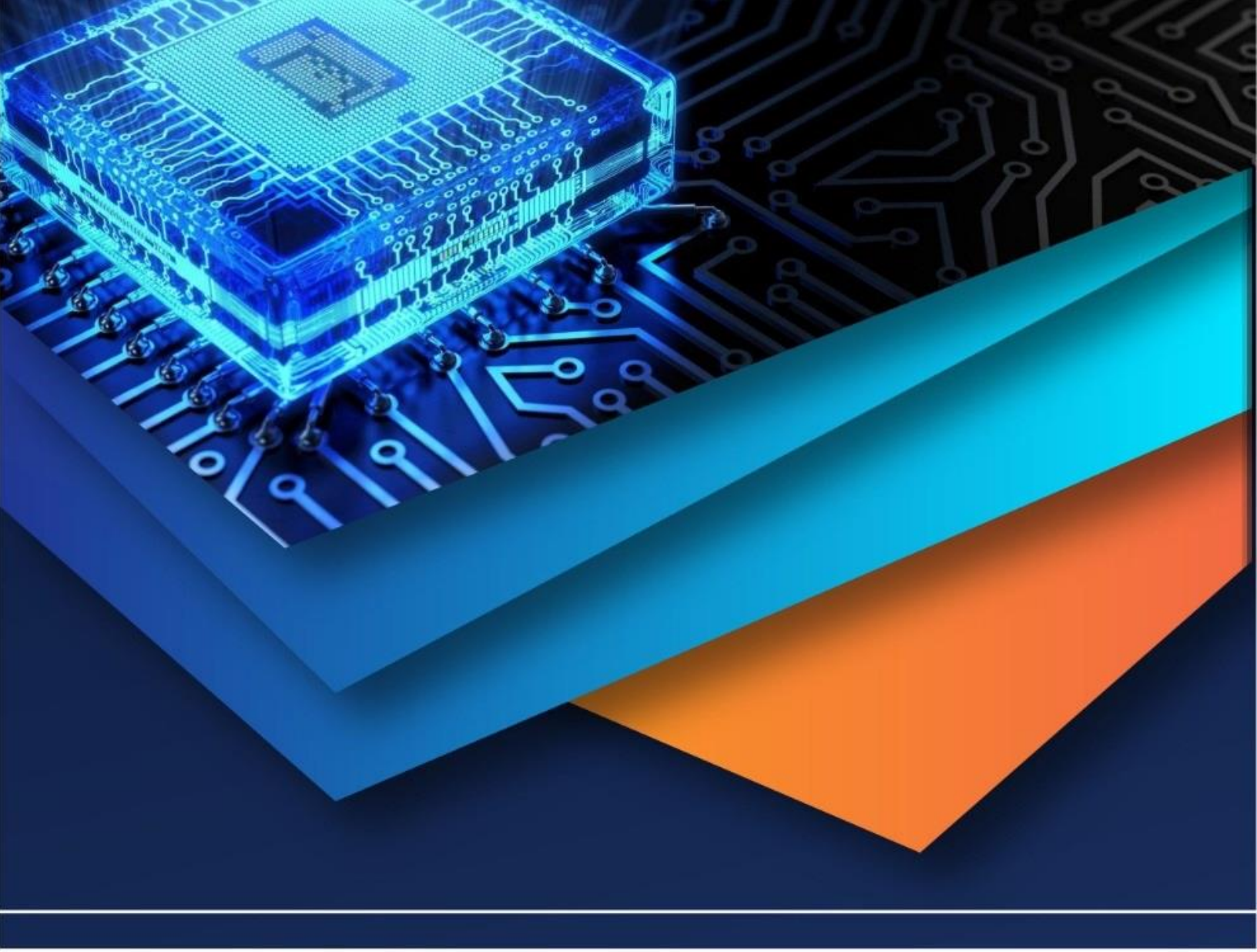
Parameter	Near field communication	Bluetooth	Zigbee	WLAN 802.11
IEEE Protocol		802.15.1	802.15.4	802.11z
Data transfer rate	106 kbps	1 Mbps	250 kbps	54 Mbps
Form factor and range	10-20 cm	Small	10 m to 20 m	Bigger
Power dissipation	Very low	Lower than Zigbee and WiFi	2 mW for router and 0.1 mW for end device	Much higher
Setup connection time	0.1 second	3 second	20 ms	
Broadcast/multicast/unicast	Unicast	Unicast	Multicast	Unicast
Applications	Payment wallet short distance communication	IoT devices, widely present in mobiles	Wider presence in sensors, actuator, controllers in IoT devices	WLAN and WWAN network tablet, desktop, mobiles, home networking

V. CONCLUSION

As the horizon of IoT is growing rapidly, more and more research and innovation in communication protocols are essential to address emerging challenges and requirements. Important factors such as scalability, security, and interoperability were dwelled into. Future research work may include enhancements to existing protocols to improve the performance, efficiency, integration with more devices to increase the scalability. Thus by understanding the characteristics of different protocols, users can make a wise decision of selecting particular protocol while designing, deploying and managing IoT applications.

REFERENCES

[1] Çorak, Burak H., et al. "Comparative analysis of IoT communication protocols." 2018 International symposium on networks, computers and communications (ISNCC). IEEE, 2018.
[2] Elhadi, Sakina, et al. "Comparative study of IoT protocols." Smart Application and Data Analysis for Smart Cities (SADASC'18) (2018).
[3] Jaloudi, Samer. "Communication protocols of an industrial internet of things environment: A comparative study." Future Internet 11.3 (2019): 66.
[4] Shilpa, B., R. Radha, and Pavani Movva. "Comparative analysis of wireless communication technologies for IoT applications." Artificial Intelligence and Technologies: Select Proceedings of ICRTAC-AIT 2020. Singapore: Springer Singapore, 2021. 383-394.
[5] Al Enany, Marwa O., Hany M. Harb, and Gamal Attiya. "A Comparative analysis of MQTT and IoT application protocols." 2021 International Conference on Electronic Engineering (ICEEM). IEEE, 2021.



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