



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 6, June 2023

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

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6381 907 438

ijirset@gmail.com

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Comparative Study of MQTT and HTTP

Sanaya Kadam, Prof. Swati Ghule

Department of MCA, P.E. S. Modern College of Engineering, Pune, India

ABSTRACT: MQTT is a reliable and lightweight transport protocol that allows IOT devices to communicate with other devices. MQTT is a specific protocol for low-powered and lightweight communication, so that there is a minimum load on devices and gadgets. The best thing is that MQTT uses really few bytes to describe the content of the messages, so it can be very useful to adopt in a context where we need to exchange small messages and we have limited bandwidth. HTTP is the commonly used protocol for the Internet and can be used for IOT devices that need to publish a lot of data, particularly if used with JSON in a RESTful architecture to save bytes for the markup. Finally, you can use MQTT to send data in the cloud, and you can use HTTP to communicate in a close area, but you can be perfect if you use the protocol that fits the needs of the contest. In this paper, we compare MQTT and HTTP protocols. Our comparison shows that MQTT is widely used in IOT instead of HTTP.

I. INTRODUCTION

In our interconnected and global society, security plays a crucial role in our daily lives. Whether we are conducting online banking transactions, making purchases, or accessing personal documents, security is always a consideration. The growing interest in IOT is a significant concern worldwide. IOT involves the transfer of numerous small data blocks from various components and sensors across networks. Internet Protocol (IP) is commonly used for communication, and currently, application protocols relying on TCP/IP or UDP/IP require internet access.

Hyper Text Transfer Protocol (HTTP) :

HTTP is a widely used "client-server" protocol designed for transferring information between computers over the World Wide Web (WWW). It allows for the transfer of various types of data, such as documents, files, images, and videos over the internet. HTTP operates at the application layer and relies on an underlying network-layer protocol like TCP.

When a URL is entered into a web browser, it initiates an HTTP request to a web server. The server then responds using the HTTP format. In the case of HTTPS, the "S" denotes a secure connection where the packets are encrypted. The HTTP request and response are encapsulated within separate IP packets, or multiple packets if the response data is large. Protocol overhead can sometimes cause issues, leading to increased utilization of system resources and delays. However, HTTP ensures reliable communication as it functions over TCP/IP. However, in IOT communication, problems can arise due to protocol overhead.

Despite these challenges, HTTP remains a reliable means of communication, and it is widely adopted due to its compatibility with TCP/IP.

Message Queuing Telemetry Transport:-

The MQTT protocol was created by Andy Standford-Clark and Arlen Nipper and was released by IBM in 1999. Its primary purpose was to enable accurate data transfer in situations with long network delays and low bandwidth. MQTT consists of two message sets: publish and subscribe. These messages are associated with specific topics that are predetermined for transmitting and receiving information. To communicate with the server, MQTT utilizes commands such as CONNECT, PUBLISH, SUBSCRIBE, DISCONNECT, and more. Compared to HTTP, MQTT reduces protocol overhead and minimizes the impact on network resources and delays. This simple model also supports Quality of Service (QoS), ensuring reliable message delivery. As a result of its capabilities, MQTT has become ubiquitous in countless IOT devices.



II. NEED OF STUDY

Nowadays, billions of smart devices or things are present in the Internet of Things (IoT). MQTT is used for machine-to-machine communication. It sends data with low bandwidth, reducing the load on the CPU and RAM. Using MQTT, we can achieve successful implementation of remote sensing and control. MQTT efficiently distributes the data. The MQTT protocol connects millions of devices. The need for the MQTT protocol is fast, efficient message delivery, which motivated us to perform this study. MQTT requires efficient computing resources, so it is suitable for battery-powered applications.

III. PROBLEM STATEMENT

Nowadays, there are multiple protocols available in IOT for communication. HTTP and MQTT are both used to transfer data from machine to machine. But now MQTT is widely used in IOT instead of HTTP because HTTP servers only respond to requests one at a time.

IV. HYPOTHESIS

A survey was conducted on the comparative study of HTTP and MQTT. They both run over TCP connections and are both client-server in architectures. A survey was conducted to understand the limitations of HTTP as a communication protocol for IOT applications. The purpose of this survey is to conclude that HTTP is made up of a set of requests and responses over the internet. When HTTP comes to the Internet of Things (IOT), it tends to perform poorly, mainly because it was designed to be a reliable but heavy-weight protocol for the world wide-web. And HTTP does not fulfill the need for one-to-many communication between sensors and the server.

V. RESEARCH METHODOLOGY

MQTT was designed for the Internet of Things (although it wasn't called that at the time), whereas HTTP was created to make documents available across the internet. They both run over TCP connections and are both client-server in architecture, but MQTT allows messages to pass in both directions between clients and servers, whereas HTTP servers only respond to requests from clients. Once an MQTT connection is established, any number of messages can be sent through it in both directions: data from the sensor to the back-end and commands the other way. HTTP deals with requests one at a time, with overhead such as authentication carried out each time. HTTP does have some ability to pool TCP connections, but the overhead for each message remains. MQTT message payloads are binary, whereas HTTP message payloads are textual, so binary data needs to be base64 encoded.

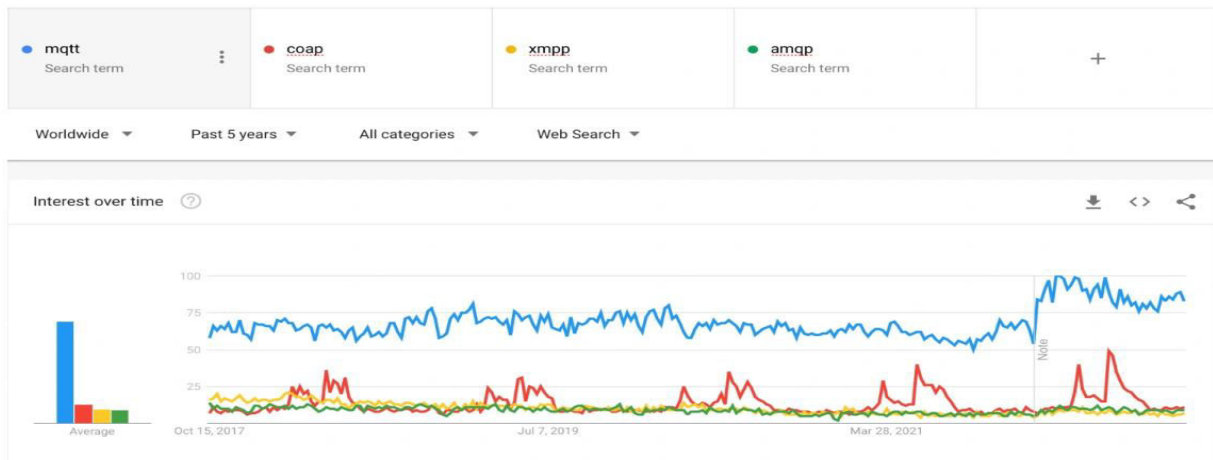
Parameter	MQTT	HTTP
Abbreviation	Message Queuing Telemetry Transport	Hyper Text Transfer Protocol
Architecture	It works on publish/subscribe model.	It works on request/response model.
Complexity	It has less complexity.	It is more complex.
Runs over	It runs over Transmission Control Protocol.	It runs over Transmission Control Protocol (TCP) and can also adapted to User



Parameter	MQTT	HTTP
		Datagram Protocol.
Protocol Design	This protocol’s design is Data centric.	This protocol’s design is Document centric.
Message Size	The message size generated is less as it uses binary format.	The message size generated is more as it uses ASCII format.
Header Size	It is of 2 bytes.	It is of 8 bytes.
Port Number	It works on 1883 port.	It works on 80 or 8080 port.
Data Security	It provides data security with SSL/TLS.	It does not provide security but Https is built for that.

VI. RESULT

MQTT protocol was developed specifically to tackle these challenges and has evolved over the years to become the preferred choice for the IoT industry. It offers a range of benefits, including lightweight design, efficient messaging, reliable communication, extensive support for connecting devices, secure bidirectional communication, and more.





Therefore, during a 5-year period from 2004 to 2019, research studies focusing on MQTT demonstrated a consistent and significant annual exponential growth rate percentage (as represented by Equation 1).

$$\ln \left(\frac{\frac{\text{Present}}{\text{Past}}}{\text{No. of years}} \right) * 100$$

TABLE 4 MQTT Application Areas Related Literature Search Data, 7th Nov 19

	Keywords	No. of related documents	Dimensions:	Keywords	No. of related documents	Scopus:	Keywords	No. of related documents
Google Scholar: 2000-2019 (20 years' data)	MQTT in healthcare	3,870	2000-2019 (20 years' data)	MQTT in healthcare	2,050	2000-2019 (20 years' data)	MQTT in healthcare	38
	MQTT in agriculture	1,850		MQTT in agriculture	1,264		MQTT in agriculture	26
	MQTT in logistics	1,560		MQTT in logistics	1,474		MQTT in logistics	19
	MQTT in disaster management	1,180		MQTT in disaster management	1,000		MQTT in disaster management	1
	MQTT protocol in smart city services	5,110		MQTT protocol in smart city services	3,161		MQTT protocol in smart city services	70

VII. FINDING

One major advantage of using HTTP in IoT is its familiarity among developers who have experience implementing web solutions. This familiarity leads to the wide availability of client libraries and servers that support HTTP. However, MQTT is catching up in popularity, and a simple search for MQTT software will yield numerous options, including open source solutions like HiveMQ. It's important to note that MQTT offers several features specifically designed for IOT that HTTP lacks. These features include queuing, Quality of Service (QOS) support, retained messages, and message push. These capabilities enhance the functionality and efficiency of MQTT in IOT applications.

VIII. CONCLUSION

MQTT and HTTP are two different protocols with distinct purposes. They cannot be compared directly, as MQTT is designed for real-time updates among multiple devices using a publish-subscribe approach, while HTTP serves a different purpose altogether. However, it's important to note that MQTT and HTTP both use the underlying TCP protocol. Although they cannot replace each other, they can complement each other in certain situations. MQTT is often chosen for real-time data transmission and communication over the internet, especially in scenarios involving resource-constrained networks with limited bandwidth, such as IoT devices like smart sensors and wearables. MQTT offers lightweight messaging services for machine-to-machine communication, enabling efficient data transmission with minimal code. In contrast, HTTP, which relies on TCP, requires more computing resources and may not be suitable for battery-powered applications. Additionally, HTTP has certain limitations when it comes to IoT applications. Thus, MQTT is utilized to overcome these limitations and provide real-time, reliable messaging services for network-connected devices.

IX. FUTURE SCOPE FOR FURTHER RESEARCH

As part of our future work, we continue to work on the broker of MQTT, which will be able to provide functionalities such as priority of messages, ordering, and security based on key policy-attribute-based encryption using lightweight elliptic curve cryptography. Overall, the future of MQTT looks promising, with continued adoption and advancements in various domains driven by the need for efficient, scalable, and reliable communication protocols in a connected world.



X. THE ADVANTAGES AND DISADVANTAGES OF HTTP IN IOT

The principal advantage of HTTP for use in IOT is its familiarity to developers, many of whom have implemented web solutions of one kind or another. A consequence of this is the availability of client libraries and servers. However, MQTT is not far behind these days; a search for MQTT software will show up lots of options, including HiveMQ's open source software. HTTP has no equivalent of many MQTT features that are useful for IOT, such as queuing, QOS, retained messages, and message push. One slight disadvantage of MQTT compared to HTTP is the overhead involved in establishing connections. If only one message is sent in each TCP session, the connection setup cost can be higher than with HTTP. However, in typical IOT scenarios where multiple messages are exchanged within the same TCP session, MQTT's advantage becomes more apparent. One of the notable benefits of MQTT is its flexibility in creating solutions. The publish-subscribe model allows multiple clients to easily share information with each other and back-end systems. MQTT brokers can be connected together, and MQTT gateways can be linked to cloud services by mapping message flows using topics. Devices can receive firmware and configuration updates efficiently over the air. Additionally, MQTT brokers have built-in queuing capabilities, which help handle connection interruptions and buffer data for resource-limited devices that may not have their own buffering capabilities.

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Impact Factor: 8.423



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