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Comparison with HTTP and MQTT In Internet of Things (IoT)

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Abstract - Internet of Things (IoT) can be defined as a physical object which are connected over internet or an embedded system which consists of electronics, software, sensors, and connectivity module like modem or Wi-Fi which enable the device to connect over internet so that data can be exchanged and will be able to control the embedded device from anywhere over internet. IoT devices helps to connect all sensors which help to monitor and control electronic or mechanical systems. IoT system are very useful in industries where humans are unable to enter like a radiation room etc. Now a days IoT systems are used in government sectors for security and in-home security and home automation [4]. But still it's not common as the cost of IoT devices is high and the modularity is less. To make the device modular we need to find a best way of communication protocol so that the latency of the communication will be less. This paper presents the comparison of best to protocol and which is the best protocol which we need to use to reduce the latency and make the device modular and able to control remotely.

Keywords - Internet of Things (IoT), MQTT, SSL (Secure Socket layer), TLS (Transport Layer Security)

I. INTRODUCTION

A. IOT

Internet of things are the devices which help to connect to the internet and able to control all electronic and mechanical devices. IoT devices help to connect devices remotely to the internet using WIFI or GSM modules (Modem). To setup an IoT system we should develop a proper infrastructure so that all nodes are connected to the master node device (it can be a local Master Device or a Remote Server).[13]

In IoT Infrastructure always there should be an internal master node and a remote server and both should be synced. To connect the internal IoT system over the internet we should build a client server architecture so that the local and remotes system will be connected. This both devices should be connected via best protocol like ZigBee[7], MQTT, Rest(Http), etc and this is also based on various applications.

B. MQTT

IBM invented lightweight messaging protocol known as MQTT (Message Queue Telemetry Transport) which is suitable for IoT. In the OSI model based TCP/IP, it is an application layer protocol having very lightweight overhead as it has fixed header size of 2 bytes. It is an OASIS based standard. MQTT [5] follows asymmetric architecture. Since it is a lightweight protocol so apart from IoT it is also suitable for M2M (machine to machine) & WSN (Wireless Sensor Networks).[6] It works on the principle of Publish /Subscribe. Following diagram emphasises public/subscribes methodology.

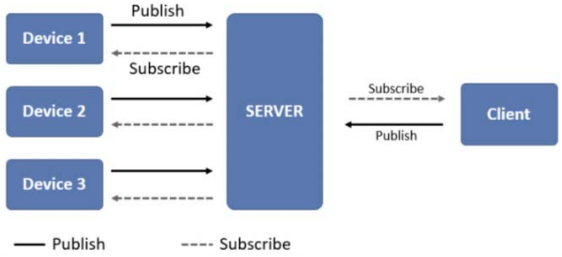

Fig 1 Client Server Flow Diagram For MQTT

Publisher and subscriber can be considered as MQTT client, whereas Broker is MQTT server. Server i.e. Broker is storage of Topics which is published by the publisher and subscriber subscribes to these topics which have been published by the broker. Mostly temporary Session exists between client server which identifies the attachment client and server. But in the case of subscription, it gets logically attached to the topic of its interest. When the client subscribes to a topic of its interest it can exchange messages with this topic. It becomes beneficial to use this protocol in the scenario where we want to exchange small messages which require less bandwidth. MQTT can be a good choice in wireless networks scenarios where latency is experienced due to bandwidth

issues. MQTT session is established after successful completion of four stage: connection, authentication, communication & termination. The client first connects to the broker via TCP/IP connection using standard port or custom port. SSL/TLS is used for security concerns. Client validates the server using the certificate provided by the server. The client also provides its certificate to the broker so that it can be used to authenticate. A bidirectional functionality of MQTT is making it popular and preferable in the industrial sector. The main purpose of an introduction is to collect data from various devices & then transporting those data since it has small code footprint and bandwidth is limited due to which is preferred for IOT.

C. HTTP

"Internet of Things" the word itself emphasises, many things connected to each other by a network. So, for this interrelated communication the protocol used is HTTP (Hyper Text Transfer Protocol). For client server communication, it uses request/response architecture. Http can transfer a large number of data in tiny packets which can possibly cause large overhead. So, due to this overhead communication for IOT via this protocol can cause serious bandwidth issues.

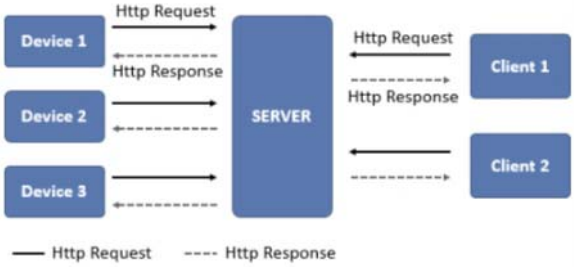

Fig 2 Client Server Flow Diagram For HTTP

It is always best practice to include the only client in your IoT device and not server to avoid security issues. The Http request uses complex header format of TCP with 9 packets which are not required in most cases of IoT it is an unnecessary waste of resources. Http protocol is used commonly where the data is triggered by the client for example weather reporting, pollution status, etc. on time basis.

II. RELATED WORKS

1. Ravi Kishore Kodali and Kopulwar Shishir Mahesh In this paper was trying to show that communication between the low power ESP8266 [1] WiFi as client with the clients on smartphones and laptop using an MQTT protocol becomes easier and more reliable. The WiFi enabled ESP8266 board interfaces with DHT11 sensor and LDR sensor to monitor the ambient condition and according to the light intensity level the brightness level of 8*8 Neopixel matrix is controlled. They were using Adafruit as a MQTT Broker to connect the device cloud.

2. Tetsuya Yokotani & Yuya Sasakiwa in this paper was trying to compare the performance between HTTP and MQTT, a type of named based transfer protocol. Additionally, this paper proposes enhancements to MQTT for better performance.

3. According to this article the author done a test with Android mobile and Mqtt and http clients and done a comparison between both. He used Android mobile to test the devices. He done various tests like Establishing & Maintaining a Connection, Receiving Data, Sending. In receiving data, he done different tests such as Sporadically and as fast as Possible

III. ARCHITECTURE

IoT is being used in all sectors like government and private. Nowadays IoT helps to get the Realtime data of climate, nature, agriculture, etc. which help in government sectors. And IoT helps in private sectors in various ways like Logistics, Transportation, Industrial and Home Automation etc. [11] To manage this type of devices we need to have a proper IoT architecture. [14]

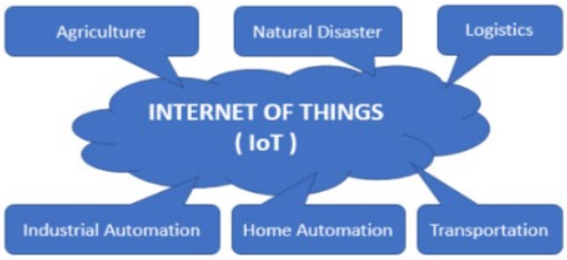

Fig 3 Applications Of IOT

In any IoT architecture, there should be a server and IoT devices which will be connected all time so that all the complex process can be handled by server and IoT devices only sends and receive data from server [7].

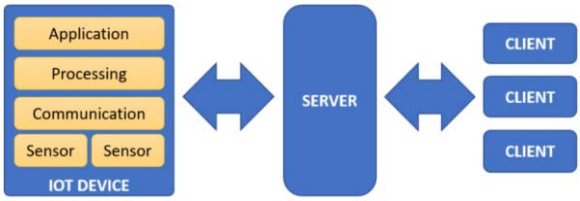

Fig 4 Architecture on IoT

For IoT communication functions of IP/TCP/UDP should be minimised. For doing this there should be a lightweight protocol for IoT over TCP/UDP [7]. But HTTP is one of the promising protocols for Internet to communicate. [15]

IV. IOT COMMUNICATION PROTOCOLS

A. IoT using Http Protocol

Http protocol sends many small packets to the server to get connected. This may lead to usage of high traffic which may cause high network resource utilisation and may lead to network delay. Http works on TCP/IP which provides a reliable communication.

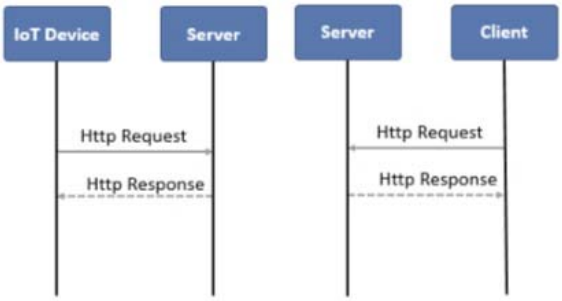

Fig 5 Working flow of HTTP

Normally all HTTP calls are stateless which lead to doing authentication every time it connected as it is connected to IP or URL to do Rest API calls so the session is not saved. So, after getting the response the device closes the connection. Therefore, IoT causes serious overhead in network communication.

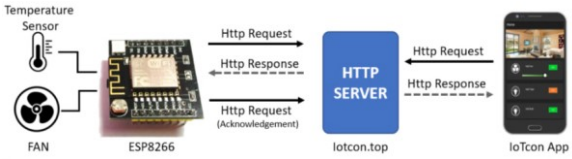

Fig 6 Live Working Example for HTTP

According to above image HTTP implementation, the user using client app send HTTP request to the server and send the message to get current temperature the server will request for the temperature to ESP8266(Node) on the response when the Node request to server and Node give response by sending Acknowledgment Request to the server. When the client app again requests for status server respond the current temperature.

B. IoT using MQTT Protocol

MQTT protocol is designed to send a message to one or more device with less latency the amount of message can be 0-256 Mb but it's not recemented to send a large amount of data. In IoT applications, the amount of data is too low so that we can use this protocol for messaging over fragile networks. MQTT consists of two message sets on a connection, "Publish" and "Subscribe"[8]. The Message is send using publish and the message can be received by subscribing it. The message is identified by the topic registered by Subscribe message, in advance.

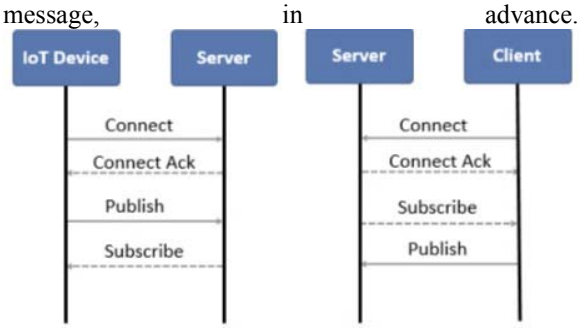

Fig 7 Working Flow Of HTTP

If Device 1 Subscribed for a topic and Device 2 publish for the same topic the Device 1 receives it. [9]

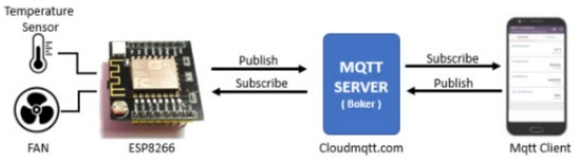

Fig 8 Live Workig Example for MQTT

According to above image MQTT implementation the user using MQTT [10] client app subscribe the temperature topic and the ESP8266(Node) publish the current temperature by getting data from the sensor and the devices which all are subscribed the same topic will get the current temperature using MQTT Broker. [10]

V. COMPARISON

A. Speed and Delivery

There are 4 types of quality service provided by MQTT:

- 100% Assured delivery.
- The message will deliver at least once.
- It Guarantees that each message is received only once by the receiver.
- Last will & testament

The above service can be achieved theoretically, but by default, there is none in HTTP approach. [13]

According to measurements in 3G networks, the throughput of MQTT is 90 times faster than HTTP.

B. Complexity and Message Size

MQTT is having a very small specification. There are only CONNECT, PUBLISH, SUBSCRIBE, UNSUBSCRIBE and DISCONNECT types that are significant for developers. But in HTTP specifications are very large. [2]

MQTT has a very small message header and packet message size is also very small of 2 bytes. In HTTP protocol, we can compose lengthy headers and messages. Which help to human readability. [12]

C. Power Used

	3G		Wifi	
Keep Alive (Seconds)	HTTP	MQTT	HTTP	MQTT
60	1.11553	0.72465	0.15839	0.01055
120	0.48697	0.32041	0.08774	0.00478
240	0.33277	0.16027	0.02897	0.00230
480	0.08263	0.07991	0.00824	0.00112

Table 1 Battery used for maintaining connection

According to the above table, we can see that MQTT is using low power consumption and when the connection time is higher it uses less power compared to less [3].

	3G		Wifi	
	HTTP	MQTT	HTTP	MQTT
% Battery / Hour	18.43%	16.13%	3.45%	4.23%
Messages / Hour	1708	160278	3628	263314
% Battery / Message	0.01709	0.00010	0.00095	0.00002
Messages Received	240 / 1024	1024 / 1024	524 / 1024	1024 / 1024

Table 2 Testing speed with sending 1024 Messages

From the above table, we can see that the message send by MQTT is having 100% delivery rate and the power consumption is less [3].

VI. CONCLUSIONS

According to above comparison, we can see that MQTT power consumption was lower than that of HTTP. As the result was MQTT uses less power to maintain an open connection, to receive messages and to send them. The only place where MQTT take time is in establishing the initial connection.

So according to us, MQTT wins in the Comparison so it will be the best techniques to use in IoT Communication as per our result.

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