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Traffic Prioritization in Message Queue Telemetry Transport Protocol

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Abstract-

The Internet of Things (IoT) is one of the utmost favorable technologies meant for the future. Wireless sensor networks can make a world of difference when they are embedded with IoT. Since various sensors are installed in the field of sensor, they entirely transmit data generated by them with an IoT gateway to an application in the cloud that aidslink the innerlink of sensors with the World Wide Web. Dissimilar sensor types relay various kinds of information to the gateway. There are, for example, temperature sensors that send temperature data, detectors which transmit information to the physician about the heartbeat of a patient, etc. Our goal is the prioritization of the traffic / information gathered using sensors in a gateway for the Message Queue Telemetry Transport for Sensor Networks (MQTT-SN) to alleviate the latency of the packets of data required for moment-critical applications.

Keywords- - Internet of Things, Message Queue Telemetry Transport Protocol for Sensor Networks (MQTT-SN), Gateways, Traffic Prioritization.

1. INTRODUCTION

The Internet of Things is a novelpluscontinuouslygrowingidea that comprises of omnipresent smart objects and gimos with implanted sensors. The IoT provides knowledge in the sensor systems for communication, share information to make smart choices independently [1]. Internet of things applications require access to sensor-generated data in real-time according to their requirements.The gateways are among the most important elements needed to realize the IoT. Entryways are intended to make connection with the domain of the the gadget to the application area. Entryways dynamically collate its information of the ongoing sensor and afterwards communicate this information with applications who want it on the Internet. A portable medical /

health care portal, for illustration, collects data from various sensors forblood sugar, blood pressure, ECG, and so on. Those data are then consolidated, processed, processed, and so on. and then sent to the applications that require them. [2]

As a large number of detectors and sensors are installed, the gadgets must be remotely linked or else a huge expense of linking them with the help of wires will be incurred. Wireless sensor networks are prettyactive, the wireless links mightbreakdown at time which mayconduce node replacement. A major issue facing WSN is the tending to plans of the systems included.This issue can be resolved by making usecommunication protocol which is data centric.In this protocol, the beneficiaries get data on the basis of data content. In this paper,we proposed a methodfor prioritization of data in a MQTT gatewayto alleviate the delay in data packets required for time-critical applications using MQTT-SN.

2. LITERATURE REVIEW

Khan, et al.[1] The advancement of the Web in to the current Internet of Things and the transformation of human-human correspondence into human-human, human-gadget and gadget interaction has been explored.There have been some key obstacles faced by the Iot. Some of them of them as listed below:

1. Standardization and Interoperability- There are several distributors providing non-accessible software and services to others. Standardization is therefore a must in the Iot for the interoperability for all devices.

2. Information Privacy-Iot uses various enabling technology such as RFID, 2D, and since all types of objects in everyday use bear identification tags that contain data about a particular object, confidentiality must be guaranteed.

Karagiannis, et al. [10] discusses the different protocols and compared them on the basis of various factors which includes energy consumption, reliability etc, to recognize how well suited they are for of Internet of things. There were different factors which helps in the choice of procedures at the application layer and it was found that the most significant of them are: batteryfeeding, computational speed and capability to connect with other devices.

Lesjak, Christian, et al.[12], says that A safe end-to-end link is essential for the secure data acquisition process for intelligent maintenance services between the conveyed gadgets and the remote support specialist organization.

Wilcox etal.[14] validates that intelligently chosen transport protocols May improve the efficiency of network resource use under different network conditions. VNET, an unique, visualisation-based, decentralized network simulation test bed, was introduced and tested using the regression testing Message Queue Telemetry Transport (MQTT) before the QoS multi-protocol transport layer concept was validated.

Bandyopadhyay etal[2] says that Lightweight Internet protocols are now widely used in omnipresent environments to optimize the use of restricted device resources such as a smart mobile entryway. This paper presents a study on the various such protocols to maximize network resources, the use of power, as well as the expense of computing a restricted gateway system.

3. OBJECTIVES OF THE STUDY

Iot is a modern and ever-evolving idea where various gismos are connected and can communicate to each other without human interference. IoT applications needadmittance to sensor-generated data in real-time according to their demands. Gateways are intended to link the domain of the device / device to the application domain. A WSNcomprises sensors that generate vastrush and advancing it to their particular applications in the cloud via a gateway. The blocking delay (or queuing delay) experienced by packets of some MQTT-SN nodes can be high as the number of sensor nodes increases. Furthermore, this latency is unacceptable for time-critical applications. So, MQTT-SN nodes need to be prioritized in such a way that top priority nodes are blocked for a minimum of time. In an MQTT gateway, we create a priority packet scheduler to reduce this delay.The objectives of this study are as follows:

1. Study of packet delay/latency in an un-prioritized MQTT IoT gateway using Matlab.
2. Addition of priorities to MQTT packets streams using Matlab.
3. Establishment and study of various priority scheduling algorithms (FIFO, RR) on MQTT packets, in an MQTT gateway using Matlab.
4. Analysis and comparison of delay/latency on packets in an MQTT gateway (with and without priorities) using Matlab and implementation.

4. RESEARCH METHODOLOGY

Step 1:Information is collected about message queue telemetry protocol gateway.

Step 2: Then find the average traffic delay from the generated traffic of MQTT-SN nodes
Step 3: Create a prioritized gateway model with different algorithms

Step 4: Generate packet-delay graph of prioritized

Step 5: Comparative analysis of the graphs to find which the best suited algorithm is.

Step 6: Draw the conclusion about the best suited scheduling algorithms.

ASSUMPTIONS

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Size of each packet is equal to a TCP packet.

The queue lengths are same.

Traffic arrivals are Poisson Distributed.

5. SIMULATION PARAMETERS

Parameters Used	1. Entities Departed from Server 2. Server Utilization 3. Average Waiting Time of Packets
Simulation Time	50s

Table.1. Simulation Parameters

6. COMPARISON OF RESULTS

The results are shown on the basis of three parameters. These are Packets Departed from the Server, Server Utilization Time and Average Waiting Time. The simulation is done using Matlab R2013a.

<u>Packets departed from server</u>

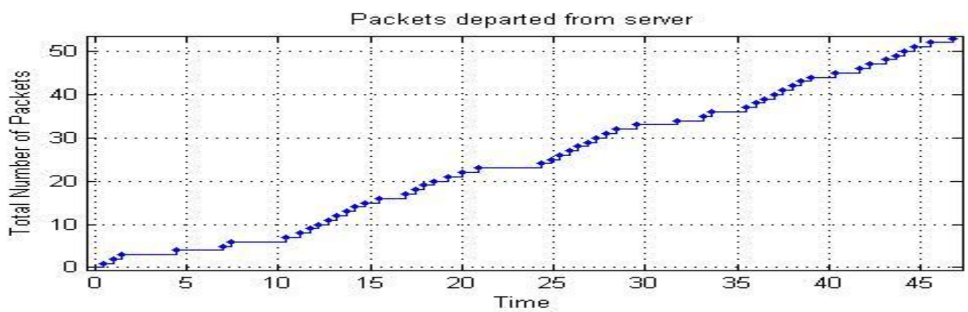

Fig.1. Packets Departed from Server in Priority Scheduling Algorithm

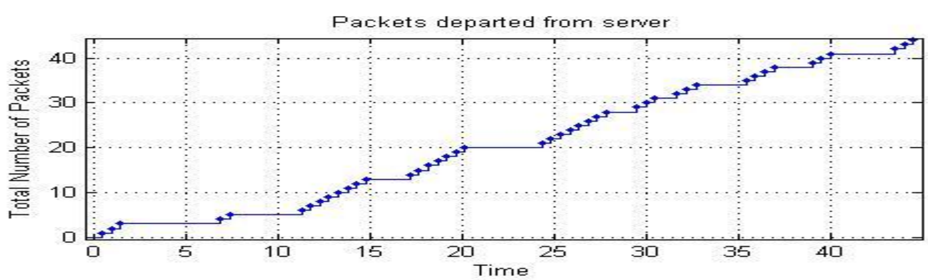

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Fig.2. Packets Departed from Server in Round Robin Algorithm.

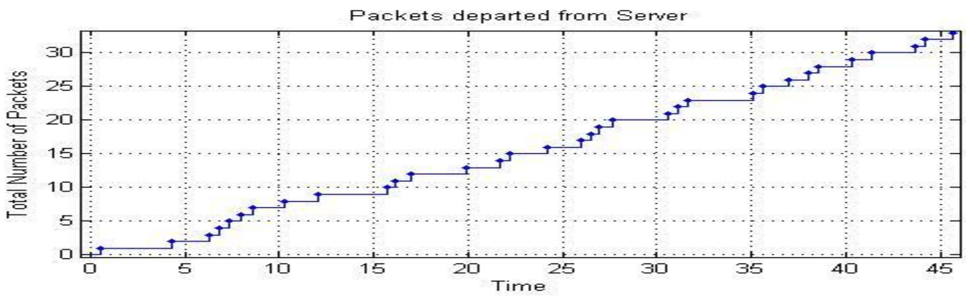

Fig.3.

Packets Departed from Server in Unprioritized MQTT-SN Gateway

A comparison between the above given three plots shows that:

1. Maximum number of packets are departed from the server when Priority Scheduling Algorithm is used. Here time T= 25, 25 packets are departed.
2. In case of Round Robin Algorithm, at time T=25 about 22 packets are departed by the server after processing them.
3. In the graph where no scheduling algorithm is used, at time T= 25 almost 16 packets are departed from the server.

Hence in terms of packets departed from the server, best results are obtained using Priority Scheduling Algorithm.

<u>Server Utilization</u>

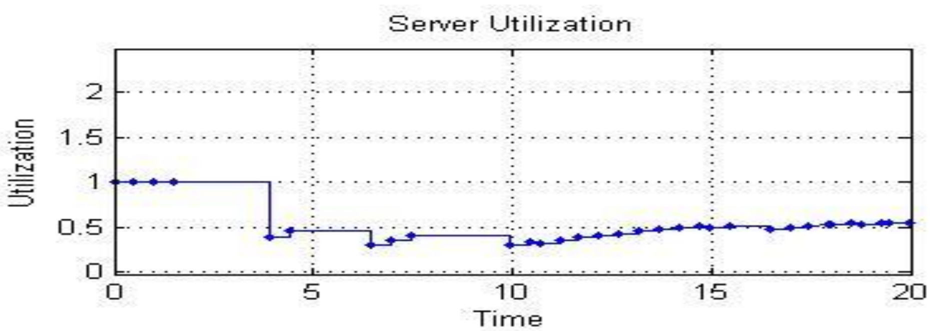

Fig.4. Server Utilization Time in Priority Scheduling Algorithm

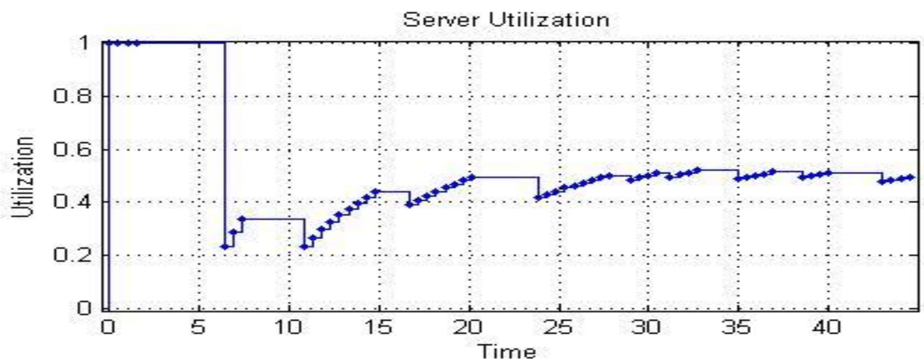

Fig.5. Server Utilization Time in Round Robin Algorithm

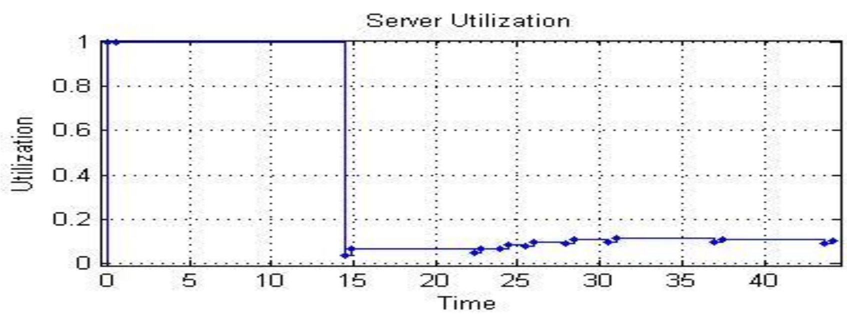

Fig.6. Server Utilization Time in Unprioritized MQTT-SN Gateway

From the above given three graphs, it is clear that:

1. In case of Priority Scheduling Algorithm the server is continuously busy (value being 1) till time T=3.9. After that it becomes somewhat free and its utilization decreases to about 0.383. Thereafter the utilization fluctuates between 0.24 and 0.48. It means that it is then available for processing more packets. From time T=10 s, the utilisation of the server is getting steady around 0.5 i.e. there is a monotonic trend.
2. In case of Round Robin Algorithm, the server is completely busy for about T=6.5 seconds. Then the utilization decreases and from time, T= 10 onwards there is a rising and falling trend in utilization. This ringing effect in server utilisation in Round Robin Algorithm is because of the fact that Round Robin is switching between different queues providing a chance for a packet to be processed from each queue.
3. In case of unprioritized MQTT-SN Gateway, the server is fully busy for about T=14.5 seconds. Here the server is completely busy in the beginning and that too for a long time. Then its utilization decreases to about 0.13. After that the utilization continues to be in between 0.17 and 0.36.

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Hence in terms of server utilization, Priority Scheduling Algorithm gives the best results as in that case server is not 100% busy for a long time and therefore can process other waiting packets.

Average Waiting Time of Packets

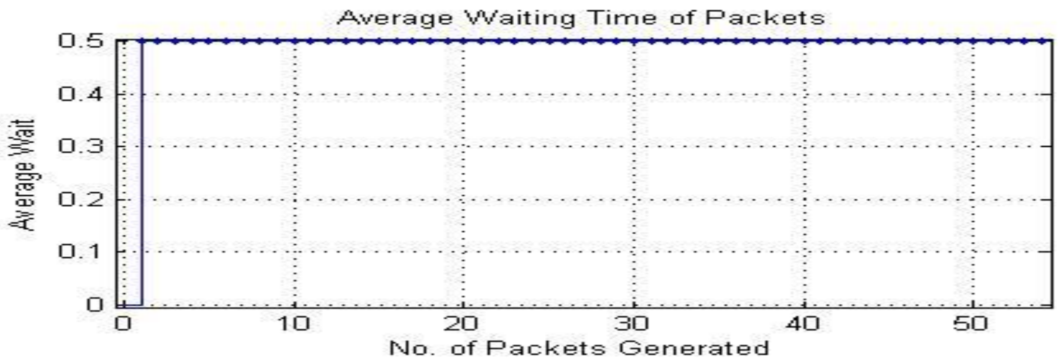

Fig.7. Average Waiting Time in Priority Scheduling Algorithm

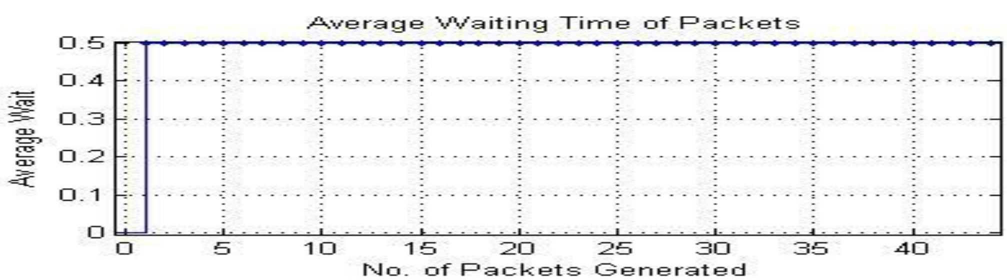

Fig.8.Average Waiting Time in Round Robin Algorithm

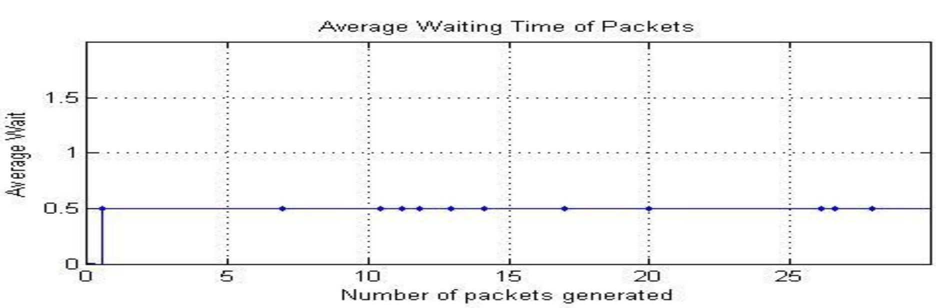

Fig.9. Average Waiting Time in Unprioritized MQTT-SN Gateway

From the above given plots it is clear that in all the three cases the average waiting time in the server does not change after the first departure from the server because the service time (here being 0.5) is fixed for all departed packets.

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7. CONCLUSION

From the above given comparisons, it can be concluded that for traffic that is random and sensitive in time constraints as well as for low power devices, Priority Scheduling Algorithm is better suited. It however does not mean that Round Robin is not suitable. If the traffic arrives at a uniform rate and starvation is not desirable, then Round Robin Algorithm is better suited. Hence both of these scheduling algorithms have their own benefits and can be used in conditions to which they are better suited.

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