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Application-Aware End-to-End Delay and Message Loss Estimation in Internet of Things (IoT) - MQTT-SN Protocols

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Abstract— Wireless Sensor Network (WSN) is suffering from ailments like a small lifetime of participating nodes, packet loss during delivery, an end-to-end delay etc. Static allocation of sensor nodes and gateways are suitable for the predefined, pre-planned WSN. The more we comprise sensor nodes, the more we need gateways to accomplish the whole IoT (Internet of Things) based scenario. These communication imprecisions have led the trendy IoT network to be self-motivated in nature. This article proposed a gateway to gateway load balancing solution for smart talk static defined WS cluster network to overcome these issues. We have explored the unusual behavior of WSN gateways with suitable theoretical expressions and applied dynamic gateway selection formula to reduce end-to-end delay as well as to increase packet delivery rate. The experimental scenario has been developed using sensor devices, Arduino Uno, Raspberry Pi 3, Amazon web services, MQTT broker and private cloud platform in our Mobile Cloud computing laboratory. Theoretical analysis shows that the occurrence of delay due to increasing number of packets and message payload has reduced compared to the existing approaches. Experimental results confirm the correctness of the proposed model.

Keyword- MQTT-SN, Publish/subscribe system, Pub-to-Sub delay, Eclipse-Paho, Mosquitto, Android MQTT application.

I. INTRODUCTION

We consider a general model of wireless sensor network (WSN) [31] [38] [39] which can be used for various type of applications domain such as crop field monitoring, flood controlling, industrial plant controlling and monitoring, smart home monitoring [40], cultural heritage site monitoring [36] system etc. Data-centric communication approach provides a wrapper of publish/subscribe (pub/sub) messaging system onto these kinds of WSNs and implements IoT (Internet of Things), MQTT-SN protocol to achieve the message flow and exchange content between the sensor node and Broker/Server or user (Application PI) and Broker/Server. This is an approach, where the information is conveyed to the purchasers based on a function of their contents and interests, instead of their network addresses. Message Queuing Telemetry Transport (MQTT) protocol designed specifically for machine-to-machine is one out of various data-centric protocol of Internet of Things (IoT) is based on publish/subscribe messaging systems [4] [26]. MQTT protocol is optimized for communications over networks [33] where the network connection could be broken very frequently or where bandwidth is at a premium. However MQTT provides an ordered lossless connection capability in a network such as TCP/IP which is too complex for wireless SA devices that have a small footprint, battery-operated devices with limited processing and storage resources. Lightweight publish/subscribe MQTT-SN protocol is the best suited and exclusively design for WSN environment, offers the real-time data transmissions with minimum publish to subscribe delay. From the gateway to the cloud platform [38] or from the system analysis to system response both totally depends upon available bandwidth service, security prohibitions of the whole system architecture and subscribed packages of the rent cloud platform like real-time factors. A network address is changed with the breaking of wireless links between the SA nodes. To keep the service alive once the SA node fails is replaced by another new node rather than being repaired. In such condition, apply a prediction approach [32] by using network address as announcement mode between the application and the SA node [35] [39] may become tough because of the temporal and dynamic nature of the network. SA devices

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