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Investigation of Performance Analysis of QoS in the Internet of Things (IoT)

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ABSTRACT

With the coming out of the new era, Internet of Things (IoT) is essential to describe best models, which can sort out IoT applications and establish the Quality of Service (QoS) factors needed to fulfil the needs of those services. Quality of Service in IoT is one of the decisive features which desires investigate and stabilization for QoS execution, administration and optimizations. On the different approach, as Wireless Sensor Networks (WSN) comprises a major factor of the IoT, they be converted into a key issue regarding QoS condition. In addition, regarding QoS needs, we also classify best models for the IoT and representation their achievability through a classification of IoT applications. The review is done to afford a summary of different QoS ideas and for various qualities of service parameters of IoT.
Keywords: Internet of Things, Quality of Service, Service Oriented Architecture, Wireless Sensor Networks, Protocol

I. INTRODUCTION

Internet of Things (IoT) intends to allow the interconnection of a huge quantity of smart devices using a grouping of networks and computing technologies. But an entry of interconnected devices constructs a larger requires on the fundamental communication networks and concerns the quality of service (QoS). Devices such as security alarms, cameras, etc, produce delay sensitive information that must be converse in a real time. Such devices have diverse features with partial buffer capacity, storage and processing power. Therefore the commonly used model cannot be a good-looking mechanism to pleasure delay sensitive traffic. Based on the systematic model different simulation results are cause in instruct to scrutinize the backlog length and the blocking probability of high and low priority traffic for system with various capacities[2].

Now-a-days the different communication technologies are used for the transfer of information, more number of issues in security and privacy sectors. IoT finds its application in the all the fields, since new mode of communication between the different systems and devices. Internet of Things (IoT) also called the internet of everything or industrial network is a wide technology which is been viewed as a global network of machines and devices capable of interacting with each other [4]. The IoT allows things to be controlled remotely across existing network infrastructure, provide opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention [5].

II. REVIEW OF LITERATURE

An extensive range of research results have been reputable for QoS support in traditional networks, but, only a small number of research efforts are found with IoT it provides an stimulating and capable idea for effortlessly connecting the fundamental world of information to the real world. Dores et al. have discussed the circumstances of the art technologies such as Next Generation Networks (NGN), Internet of Things (IoT), Wireless Sensor Networks (WSN), Body Sensor Networks (BSN) and Cloud Computing and have suggest the necessitate for the incorporation of the technologies in making the future internet a reality [11]. The authors have also execute a QoS test in conditions of delay and jitter and have recommended that more explore work is required to enhance QoS with varied characteristic which will assure certain quality of services to users and the providers.

Mohamed et al. have illustrated the requirement of put together IoT paradigms and the different issues involved in this context [12]. They have presented ever growing connected devices allocate a lot of data which cannot be locally or temporarily accumulate on the devices and the required foreseen is hire storage space and the well-organized consumption of the data and the resources. The authors have said that the active prioritization of the demand is necessary along with the QoS requirements such as bandwidth, delay, jitter and packet loss.

Ren et al have projected a QoS architecture for IoT as the consequence of their thorough analysis of the active QoS mechanism with view to the description of IoT in a layered basis, such as application layer, network layer and perception layer which insisted the require for the trustworthy QoS design.[13]. The authors, illumination the functions of each layer of their planned work they did suggest that the research work is further essential to comfort an end to end quality in availing and providing services in smart environment as IoT is integrated with heterogeneous networks. The existing research on IoT and Quality of Service is the necessity for dynamic prioritization of the demand along with the QoS requirements which are capable of delivering real time services and applications with guaranteed quality. Hence, in this discussion a novel Quality of Service design for the Internet of Things is proposed [14].

III. KEY ELEMENTS INVOLVED IN IOT

A. Sensing

The first step in IoT workflow is gathering information at a “point of activity.” The information collected may be information collected by the appliance or any devices. The sensing can be biometric, biological, environmental, visual or audible.

B. Communication

IoT devices need a channel for sending collected information at the device level to the Cloud-based service for further processing. This expects either Wi-Fi (wireless LAN based communications) or WAN communications.

C. Cloud Based Capture & Consolidation

Collected data is sent to the cloud based service where the data is combined with other data to produce useful information to the user. Collected information may be forming any sources [1]. Data processing is always required for analysing.

D. Delivery of Information

Delivery of Information is the last step where the useful information is sent to the user. That may be a consumer, a commercial or an industrial user. The aim is to provide information in a simple and transparent manner.

IV. PROTOCOLS AND NETWORK TECHNOLOGIES

IoT mainly uses the standard protocols and networking technologies. The most important technologies and protocols of IoT are RFID [9], NFC, low-energy Bluetooth, low-energy wireless, low-energy radio protocols, LTE-A, and Wi-Fi Direct. These technologies hold the explicit networking functionality desirable in an IoT arrangement in dissimilarity to a typical standardized network of general systems.

A. NFC and RFID

RFID (radio-frequency identification) and NFC (near-field communication) offers simple, less energy, and flexible options for characteristics and contact tokens, connection bootstrapping, and payments [3].

B. Low-Energy

Bluetooth affords the low-power, long-use require of IoT purpose while uses a normal technology with local support across systems [16].

C. Low-Energy Wireless

These technologies return the mass power starving attribute of an IoT structure. Even though sensors and additional elements can ability following over extended periods, communication links (i.e., wireless) must remain in listening mode. Low-energy wireless diminish consumption [8] thus extends the existence of the device. The following list shows the protocols involved in internet of things devices and applications as shown in Figure 1.

D. CoAP

CoAP is designed to enable low-power sensors to use RESTful services while meeting their power constrains.

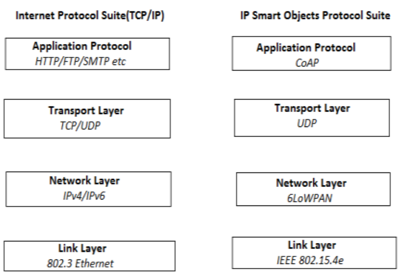

Figure 1. Comparison of Internet Protocol Suite with IP Smart object protocol suite

It is built over UDP, instead of TCP commonly used in HTTP [21] and has a light mechanism to provide reliability. CoAP architecture is divided into two main sub layers: messaging and request/response. The messaging sub layer is responsible for reliability and duplication of messages while the request/response sub layer is responsible for communication.

E. 6LoWPAN

IPv6 over Low power Wireless Personal Area Network (6LoWPAN) is the first and most commonly used standard in this category [15]. It efficiently encapsulates IPv6 long headers in IEEE802.15.4 small packets, which cannot exceed 128 bytes.

F. MQTT

It is designed to provide embedded connectivity between applications and middleware's on one side and networks and communications on the other side[14].

G. Radio Protocols

ZigBee, Z-Wave, and Thread are radio protocols used for establishing low-rate private area networks technologies not only use low-power but also offer high throughput. This increases the power of small local device networks without the typical costs.

H. LTE-A

LTE-A, or LTE Advanced, provides an important boost to LTE technology by increasing not only its coverage, but also reducing its latency and raising its throughput. It gives IoT an enormous power by increasing its range, with its most noteworthy applications being vehicle, UAV.

I. Wi-Fi Direct

Wi-Fi Direct removes the need of an access point [10]. It allows P2P (peer-to-peer) connections retaining the speed of Wi-Fi, but with lower latency. Wi-Fi Direct removes an element of a network that often marsh it down and it does not compromise on speed or throughput.

V. QOS ARCHITECTURE VISUALIZATION OUTLINE

There are numerous concepts and implementation factors incorporated in defining and designing IoT architectures [7] such as:

(i) Essential the architecture basing the facility components for providing the services in IoT using applicable protocols and access networks for execute the IoT systems - service oriented architectures.

(ii) Maintenance of the framework or situations of the application systems as the base for designing the architecture - context aware architectures.

(iii) The plan of architectures build approximately the middleware (software components) as the base to employ the IoT systems [6].

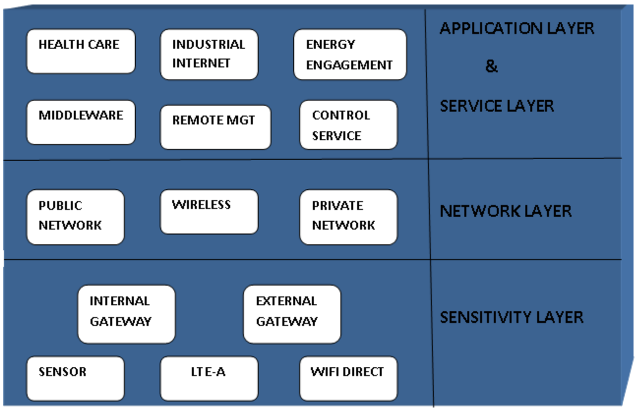

Figure 2. Three Layer Conceptual architecture embedding the QoS architecture and cross layer QoS components.

The works of three-layer architecture for our conceptual IoT systems are

A. Application Layer and Service Layer

This layer consists of helpful modules for application systems and users which utilise the actual world data for analysis, computation, and for a real world action.

End Users / Applications: The application layer has systems or users or machines or an environment for consuming / using the data sensed by the real world object or situation. The application functional modules will be particular to application domains which consume data received from lower layers indicating the real situation for needed functions [17].

IoT data specific modules: It incorporates the functions like optimization [6] of duplicate and redundant data from field devices, functions of storing/retrieval of data for future references, and retrieval of data for adaptive and dynamic decisions etc. Some of these components are distributed between application and perception layers for achieving effective QoS.

B. Network Layer

The network layer is involved in routing [20] the data from lower layer to upp1er layer and vice versa. The essential components and modules of this layer would include:

i. Diverse class of access networks, protocols

ii. Communication devices vital for connectivity and communication.

iii. Routing functionality/modules

C. Perception Layer

The sensing layer functional modules will comprise of the essential data sensing / data gathering from real world objects which would consist of all the real world objects, machines and people [19]. Also the functions may contain controlling of field devices/actions based on data sensed and control commands received by upper layers and application systems/users of the domain.

Edge Nodes: These are smart embedded devices which has the minimum computing, storage and communication capabilities. (System on Chip - SoCs, Microcontrollers etc.)

D. Field Devices

These are the devices where the real world data is sensed with or without intelligence and are capable of sensing data/information for a specific purpose. Example sensors, RFID, ECP, actuator and other objects accessible directly or indirectly and providing the field data in the IoT environment by enabling IoT application for actions with real world data/situation (can include devices, machines and objects with computing capabilities and participating in IoT data [20].

VI. CONCLUSION

The QoS parameters directly map to IoT layers, some of the QoS parameters are applicable across the layers and parameters are defined and schemes are implemented to achieve various organisations by different researches. The QoS parameters of application layer are service time, services availability, service delay, service accuracy, service load, service priority, information accuracy, cost of network deployment, and cost of service usage and maximum of resources available per unit price & penalties for service degradation and fault tolerance.

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