Wireless Sensor Network: Quality of Services Parameters and Analysis

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Abstract

WSN term can be generally sensed as devices range from laptops, PDAs or mobile phones to very tiny sensing devices. At present, most available wireless sensor devices are significantly controlled in terms of computational power, memory, efficiency and communication capabilities due to economic and technology reasons. That's why most of the research in WSN has concerted on the design of energy and computationally efficient algorithms and protocols, and application domain has been confined to simple data –oriented monitoring and reporting applications. In this paper we mainly focus on the performance analysis on QoS parameter and their analysis on the basis of their Delay, Throughput and Data transfer rate etc.

Keyword: WSN, Opnet IT Guru, Sensor Node Architecture, Throughput, Delay, Load etc

1. Introduction

Wireless sensor network is a type of wireless connection network spatially as autonomous bodies to work in harmony to perform a specific function or task. In this fast telecommunication era where shows positive aspects there it brings many negative effects as well. As administration is very important to run an organization successfully. For proper administration different tools have been devised to track, monitor and control the working bodies in a network. Wireless sensor network is one such device. Wireless networking is quite a handy and advance tool to connect different computers remotely at one place. There are broadly speaking two types of wireless sensor networking; physical and environmental. They are used to track and monitor heat, pressure, temperature, vibratory movements, movement or pollution level, sound detection, and many more.

2.Working and usage of wireless sensor networks

Wireless Sensor Network mechanism is quite easy, simple and applicable to a variety of fields. It is based on smaller nodes, controller, radio transceiver, and battery. The key to stimulate the sensor networking is the algorithm sponsor multi-router phenomenon. The system is totally dependent on the nodes and the harmony established between them through proper frequency. These nodes are of different sizes according to the function they perform. To activate the monitoring or tracking function of these nodes a radio transmitter is attached to forward the information signals in the form of waves. They are controlled by the microcontroller according to the function and device in which they are used. All the system remains in working condition with the help of energy supply which is in the form of battery. The Wireless Sensor Networks perform function concurrently where nodes are autonomous bodies incorporated in the field spatially for the accurate results. The information transmits through proper channel taking the information collecting it in the form of data and send to the base.

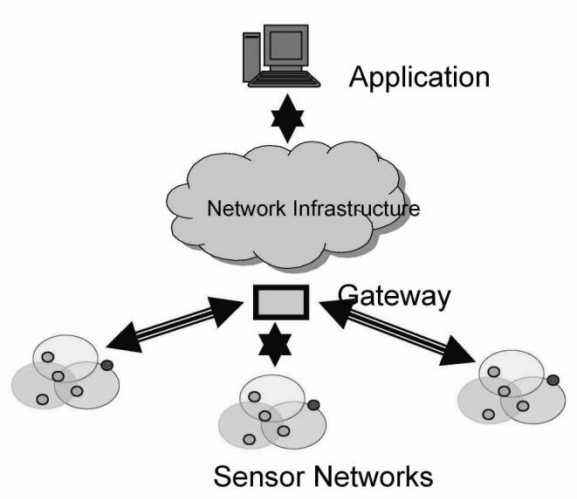

Fig. 1 Wireless Sensor Networks

According to their types they are used by different organizations and fields to monitor a specific task. Wireless Sensor Networks are incorporated at different point to monitor a specific area a common known example is that of military communication either land or water. Major issues which are becoming a possible threat to life are environmental and industrial issues. Wireless Sensor Networks are doing great job in the relevant fields to sense to temperature for greenhouse gasses and similarly earthquake detectors are implanted to detect the land sliding phenomenon for precautionary measurements etc.

Pollution is the major problem of today so is the waste of natural resources. There is great danger of finishing the natural reservoirs. Wireless Sensor Networks are successfully devised to monitor the water and electricity use. They are used to monitor the waste water in the landfill for cleaning process through landfills and water level detection in the domestic and industrial tanks. Similarly they are used to sense the light and help to consume the daylight properly till the evening and detecting the dim light it automatically switches on the light. This is permissible at homes, offices and factories. Machinery health is an important issue to keep the machines in running conditions for a long time. It helps to reduce the need of huge labor and cost.

3.Related work

An important issue related to the network performance is congestion which may occur in a network when the number of packets sent to the network is greater than the number of packets that the network can handle. The intermediate devices like routers and switches in a network have buffers where the packets wait in a queue before and after processing. Depending on the packet arrival rate and the packet departure rate which may be higher or lesser than the packet processing rate, the size of input or the output queue may increase or decrease. This increase in queue size may lead to congestion. A key issue in designing any good network is to use congestion control mechanism. The congestion control involves two factors that measure the performance of a network: delay and throughput. Efforts have been made to analyze the effect of various parameters on the performance of both wired and wireless networks. Wired local area networks includes several technologies like Ethernet, token ring, token bus, Fiber distributed data interface and asynchronous transfer mode local area networks. The Ethernet is a contention media access method. In its purest form, contention means that the computers are contending for use of the transmission medium. Any computer in the network can transmit at any time (first come, first serve). IEEE 802.3 standard specifies CSMA/CD as the access method for first-generation 10-Mbps Ethernet, a protocol that help devices share the bandwidth evenly without having the two devices transmit at the same time on the network medium. When the two devices transmit at the same time the collision can occur. This collision generates a jam signal that causes all nodes on the segment to stop sending data, which informs all the devices that a collision has occurred. The collision also invokes a random back off algorithm. Each device on the Ethernet segment stops transmitting for a short time until the timers expires. Thus the collisions are overcome. This CSMA/CD protocol was created to overcome the problem of collisions that occur when the packets are transmitted simultaneously from different nodes over the same medium. The CSMA/CD network sustaining heavy collisions causes following effects:

Delay: Back off introduces the transmission delay which is enforced when a collision occurs. The retransmissions are resumed on the expiry of this delay time.

Low throughput: Throughput in a network is defined as the number of packets passing through the network

in a unit of time. The throughput is reduced as a result of collisions.

Congestion: Congestion occurs when load on the network i.e. the number of packets to be sent to the network) is greater than the capacity of the network i.e. the number of packets that a network can handle. The collisions in the network cause the routers and switches to have queues that buffers that hold packets before and after processing. If either packet arrival rate or packet departure rate is higher than the packet processing rate the input/output queue becomes longer, thus leading to congestion. So collisions introduce congestion.

4.Modelling and Simulation

A model is a logical, physical, mathematical representation of an entity, process, a system or phenomenon. These models are analyzed by the network designers to predict how these networks would perform in real-time. This adoption of low cost simulation techniques helps to overcome expenses and design an accurate network model. Models can be static or dynamic. While static models are not effective for changing environments, the dynamic models are much effective over there. This dynamic modeling is called simulation. Simulation can be used to model the ideas, evaluate the pros and cons of the network designs, make alternatives and finally choose a better configuration just by sitting at one place i.e. the designers can predict and estimate the performance of the system. It is the replica of a dynamic process within a model to achieve knowledge, which one can carry over to reality. Network simulations allow alternatives to be compared under a wider variety of workloads and environments. Among the various simulators available, Optimized Network Engineering Tools (OPNET) IT Guru Academic Edition is a simulator which is comprehensive and technology neutral in its capabilities. IT Guru enables the network designers to create a virtual network consisting of relevant hardware, protocols, and application software. This virtual network is a pure software entity that can run on an individual workstation. The network devices like routers, switches etc. can be modeled in IT Guru virtual network. This network can be scaled from a small LAN to wide area network. Once a virtual network has been created it can be manipulated according to the need of the application. The network devices can be changed, removed or inserted into the virtual network as desired to find out the most appropriate configuration and also implement the given application. The effects of various manipulations can be quantifiably examined and analyzed. The OPNET IT Guru provides a GUI to create the virtual network conveniently. OPNET simulator is built on top of discrete event system (DES) and it simulates the system behavior by modeling each event in the system and processing it through user defined processes. OPNET is very powerful software to simulate heterogeneous network with various protocols. It has several distinct methods of creating topologies. Modeler supports almost all network types and technologies. OPNET runs on top of a C compiler and provides a GUI. Models are built in hierarchical fashion. OPNET Modeler is based on a series of hierarchical editors that directly parallel the structure of real networks, equipment, and protocols. These editors are Project editor, node editor and process editors.

5.Scenario: general node functions

The wireless station node model represents an IEEE802.11 wireless LAN station. The node model consists of following processes:

1. The MAC layer which has a wireless LAN MAC process model with following attributes:

MAC address - station address

Fragmentation Threshold - based on this threshold station decides whether or not to send data packets in fragments.

Rts threshold - based on this threshold station decides whether Rts/Cts exchange is needed for every data transmission.

The wireless LAN MAC layer has an interface with higher layer which receives packet from higher layer and generates random address for them.

2. Wireless LAN interface

This process model is an interface between MAC layer and higher layer. The function of this process is to accept packets from higher layer and generate random destination address for them. This information is then sent to the MAC layer.

3. Wireless LAN receiver

This is wireless receivers which accepts any incoming packets from the physical layer and pass it to the wireless MAC process.

4. Wireless LAN transmitter

This is a wireless transmitter which receives packet from MAC layer and transmits it to the physical medium.

The given table showing the Mobile Node Configuration simulation parameters for the Network Simulator. The QoS parameters on which the network is being analysed are Data traffic received, Data traffic sent, Delay, load and Throughput basis under Global and Office statistics. The application definition and profile definition had taken with their default configuration and values.

Mobile_Node_Configuration	
Model	Wlan_station_adv
Trajectory	NONE
Destination Address	Random
Traffic Generation Parameters	
Start time (seconds)	Uniform(0.1,1.0)
ON start time (seconds)	Constant(100000)
OFF start time (seconds)	Constant(10)
Packet Generation Argument	
Inter-arrival time (seconds)	Exponential(0.008)
Packet size(bytes)	Exponential(1024)
Segmentation size(bytes)	1500
Stop time (seconds)	Never
Wireless LAN MAC Address	Auto assigned
Wireless LAN Parameters	
Data rate	1Mbps
Physical characteristics	Direct sequence
Packet reception	
Power Threshold	7.33E-14
Short Retry Limit	7
Long Retry Limit	4
Buffer size	256000
Max Receiver lifetime (seconds)	0.5

Table 1.Simulation parameters

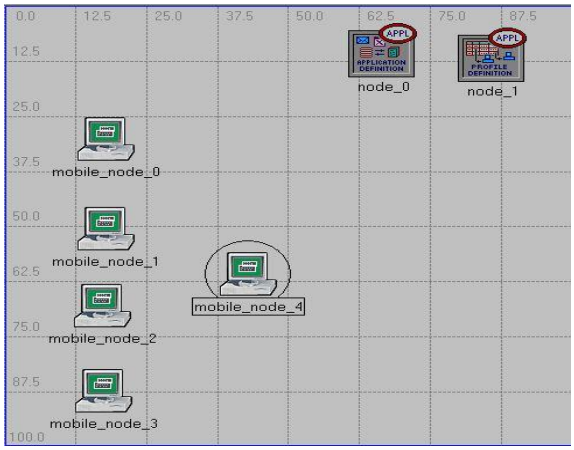

Fig. 2 Network to be simulated

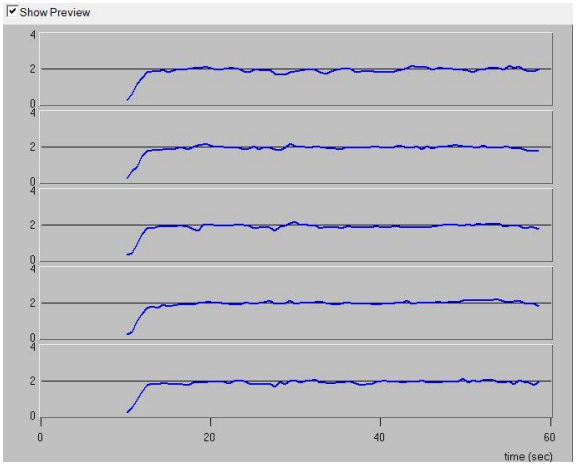

Fig. 3 Data Traffic Received (bps)

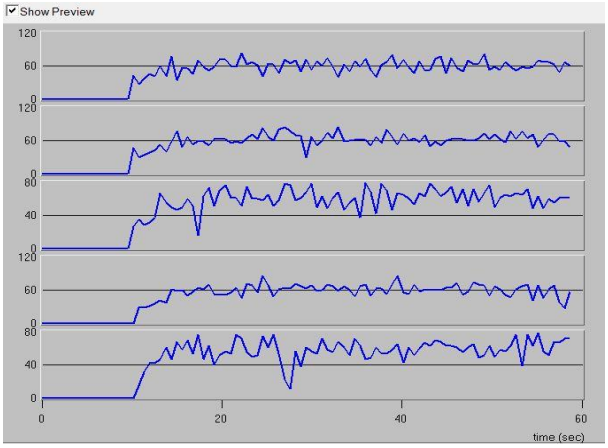

Fig. 4 Data Traffic Received (packets/sec)

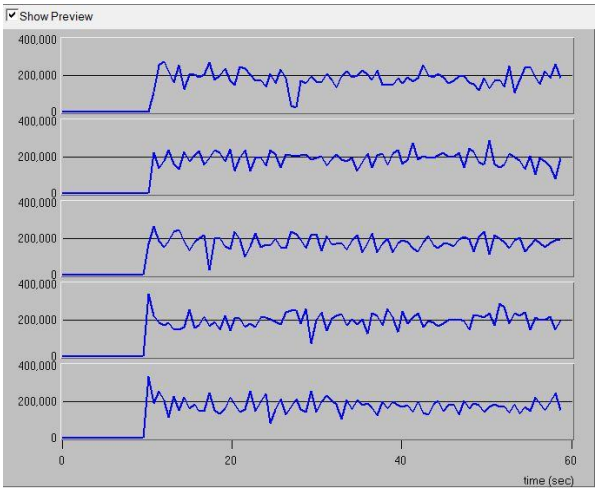

Fig. 5 Data Traffic Sent (bps)

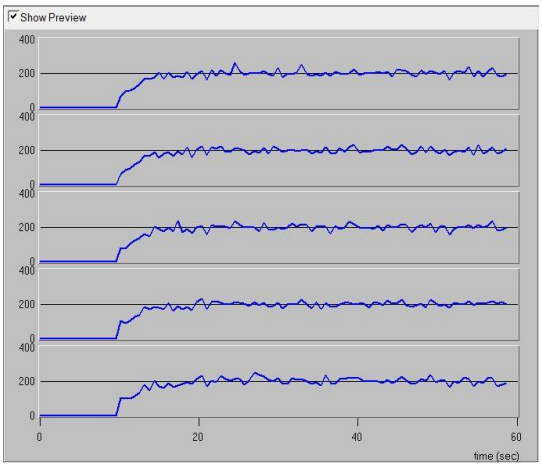

Fig. 6 Data Traffic Sent (packets/sec)

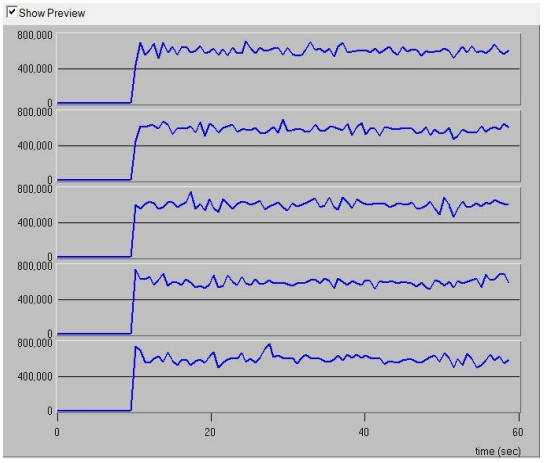

Fig. 7 Delay

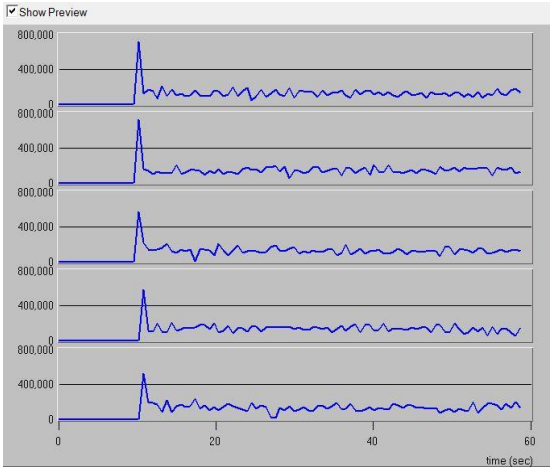

Fig. 8 Load (Packet/sec)

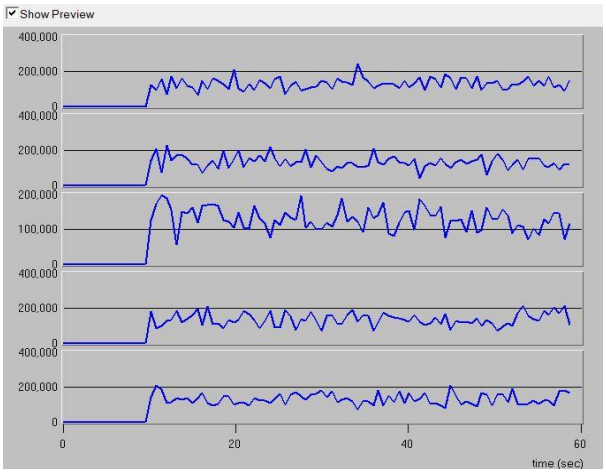

Fig. 9 Throughput

6. Conclusion

In this paper we mainly focused on the working and usage especially the Quality of Service parameters in for the Wireless Sensor Networks and providing the various outcome of the QoS parameters like Data transfer rate, data packet transmission rate, Delay, Load parameters and Throughput as well. We also discussed some challenging directions that need some attention. Focus should be placed on designing protocols that are scalable, flexible, fault tolerant and adaptable to dynamic changes done through the network simulator.

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