Transmission Loss Computed of Star Topology Sensor Network Base on DT, RED and SFQ Buffer Mechanism for Overseeing High Rise Building Structural Health

M. E. Haque, M. F. M. Zain, M. A. Hannan, M. Jamil, and Mohd Huzairi Johari

***Abstract*—Wireless sensor network is the new invention applying for detects the damage of the civil infra-structural health. Recently, Wireless sensor network are widely used because it's low cost, portable, easy to run, install, reconfigured, easy maintenance. The coverage area becoming a crucial issue for multi-hop sensor network locally or remotely historical or high-rise structural health overseeing. The objective of this article is to design star topology sensor network and loss investigation of the sensor node transmit signal at the base station. The loss of the received signal are computed at base station based on DT (Drop Tail), RED (Random Early Discard), SFQ (Stochastic Fair Queuing) buffer mechanism.**

***Index Terms*—Structural health monitoring, sensor network, buffer mechanism, MEMS.**

I. Introduction

Recently, damage of the various large civil structural such as large building, bridge, dam's etc. health has been of prodigious disquiet. The patient of the structural injure monitor and exposure take in approach for detecting the beginning and dissemination of dent or humiliation in high-rise structural, as well as mechanism for system performance scratch. These measures are based on the different type of sensors and those connected as different kinds of sensor topology manner. These sensors are located at diverse location to cover the entire service location in the civil structural health monitoring. The whole systems consist of three main elements those are sensing system, sensor data collection system and sensor data analysing system founded on the base station microcontroller system. Still there are many challenging issue that are the main dispute for developing the optimum system among those real time measurement, optimum architecture, timely maintenance and so on [1]. The recent advancement of the smart sensor technologies has provided huge opportunities to measure civil structural health damage. Wireless sensor network provided more advantages but still have some drawback comparing with wire built data collection sensing system remarkably low data transmission rate, short rang communication, low power profile. In spite of those limitation many researcher shown that it can be employed to offer responsible and precious structural health monitoring system. Advancement development of the MEMS technology has capabilities to measure different types of damages of the civil structural (e.g. temperature, tilt, humidity, acceleration, corrosion, deterioration etc.) [2]. Most important inadequacy of the wireless sensor network is the parameter measuring under heavily load, those load must be created artificially because lack of the real-time traffic, extreme vibration and wind.

Ambient monitoring technique one of the simplest for measuring energetic distinctiveness of the civil structural health. In the ambient system, an absence of exciter output of the system reaction is stored using sensing device. MEMS technology develops the concurrent issue of the sensing device able to determine ambient measurement of the structural damage [3]. To protest the principle structural dent against certain natural event like earthquake, stream wind, dynamic measurement of the structural system response parameter by measuring kinetic energy of the structure [4]. From last several years, high-rise building structural health monitoring system based on vibration become a fourth-coming issue for environmental safety purpose [5], [6]. Due to new technology materialize in the field of the structural health monitoring, measurement technique become easily accessible to assess sensing information of the structural health condition with meaningful information and analysis those information to find out the how much damage occur. An increasing amount of organized sensor depend on this the amount of information collecting data going to large and become a wholly unmanageable system that issue one of the important issue for the engineering or researcher or system developer to take out the optimization of the employed system [7].

Various mechanism already developed among those wave guided based technique achieved recognition because it's suitable for long distance application and more sensitive to another approaches. In this technique, to generate guided wave and sensing purpose different kinds of sensor used amongst electromagnetic acoustic sensor, wedge sensor, and

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air-/fluid-coupled transducers [8]. Another challenging issue is the large scale structural health monitoring system design with large amount of sensor to cover the whole patient region to address real time development, the whole system become overburden and increase computation complexity [9]. In addition, a cyclic gathering of sensor field data of the structural health monitoring system can be utilized to progress plan and manufacture methods [10]. As vary to the substance and/or statistical assets of a structure can strictly impinge on its recital [11]. An recent review about civil structural health monitoring using wireless sensor network are found in [12].

II. Methodology

Firstly, we define sensor node, gateway node and base station. Every sensor node connects the base station through gateway node as shown below Fig. 1. Transmission link between two sensor nodes are duplex types. After locate sensor node, create CBR traffic and attach them to the source node SN-0, SN-1, SN-2, and SN-3 respectively by UDP agent. At base station, create four types of sink which followed the respective source node. The traffic generator at the source is exponential traffic. At BS node, received signal bandwidth is calculated and writes to the respective sink file. The simulation is continuing with in define star and finish time. At the receiver received signal are given below for different queuing method. The whole system analyse using NS-2 (Network Simulator-2) software.

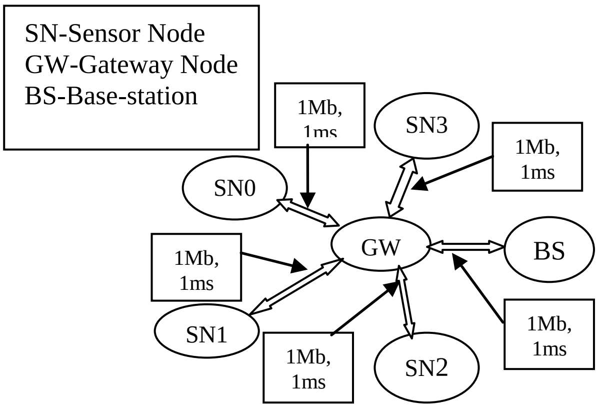

Fig. 1. Transmission loss monitoring of sensor network.

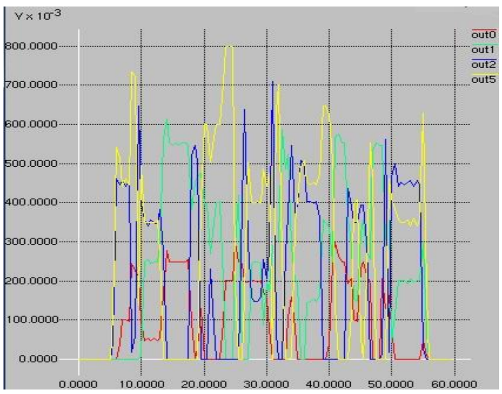

Fig. 2. Received BW at base-station using DT buffer.

From Fig. 2, we can say that received signal rate at the receiver are 297kbps, 614kbps, 710kbps, 801kbps respectively with link rate 1Mbps and transmission delay 1ms. The traffic signal packet sizes, burst time, ideal time for burst are 300kb, 3s, and 2s respectively.

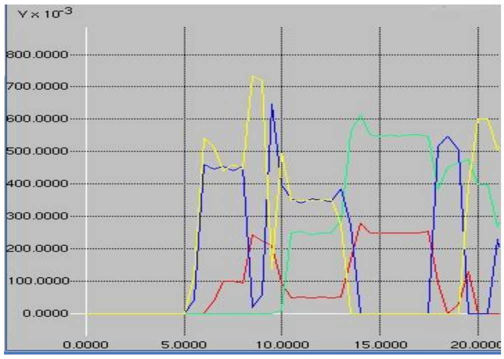

Fig. 3. One-third BW at base-station using DT buffer.

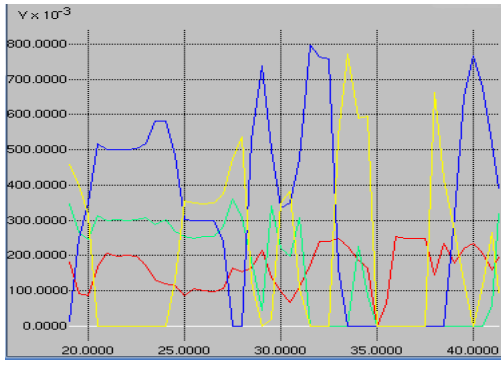

Fig. 4. Two-third BW at base-station using DT buffer.

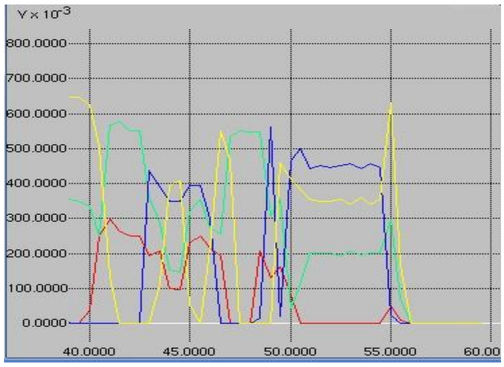

Fig. 5. Three-third BW at base-station using DT buffer.

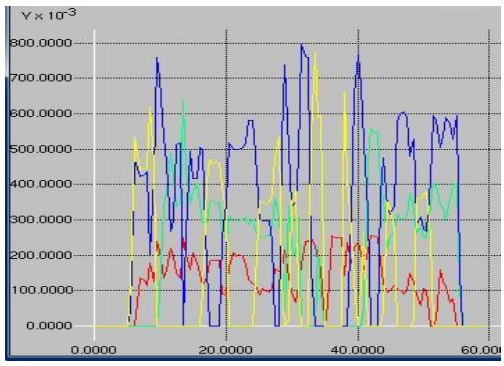

Fig. 6. Transmission loss based on RED method.

Fig. 3-Fig. 5 represent one-third, two-third and three-third of the main signal for DT (Drop Tail) queuing Method. Sensor node transmitter transmits the 250kbps, 550kbps, 800kbps and 850kbps signal. Fig. 3 depicts the peak flow of the received signal and in the case of SN3 and SN1 provided better received signal but more signal loss happen for SN0 and SN2.

We can say from Fig. 6. RED buffer based received signal rate at the receiver are 254kbps, 633kbps, 796kbps, 772kbps respectively with same link rate and transmission delay as previous. The traffic signal packet size, burst time, ideal time for burst is same as previous buffer mechanism

Fig. 7-Fig. 9 represent one-third, two-third and three-third of the main signal of the RED buffer mechanism.

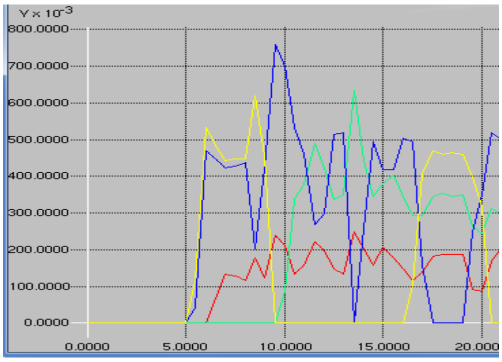

Fig. 7. One–third of received signal at BS base on RED.

At one-third of the RED transmission window, SN2 sensor node provide highest peak 758kbps signal in Fig. 7 and other sensor node SN0, SN1,SN3 transmits the signal 249kbps, 633kbps, 619kbps.

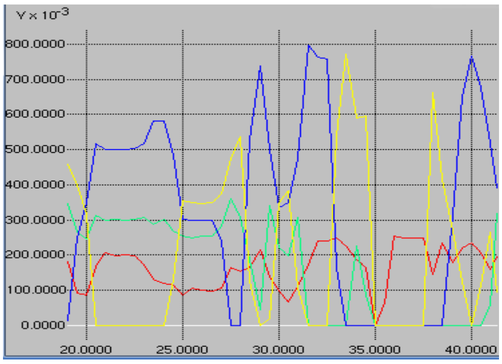

Fig. 8. Two–third of received signal at BS based on RED.

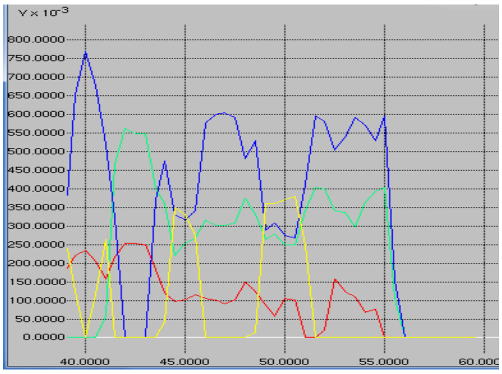

Fig. 9. Three–third of received signal at BS based on RED.

In Fig. 8 peak flow of the received signal in the case of SN2, SN3 sensor node are 796kbps, 772kbps provided better received signal but in the case of SN0 and SN1 received signal strength 254kbps and 360 kbps. The SN2 average received signal rate exceeds the SN3 received signal rate shown in Fig. 8. As increasing transmission time, from 40s to 60s a regime of SN2 sensor transmission TCP attained in Fig. 9 and received signal BW going to decreases more for SN3 greater than SN. The average transmission BW for SN0 is almost same for all transmission time.

For the SFQ based buffer mechanism the received signal rate at the base station are shown in the below figure. Since, every receiver in the system expects to receive as original transmitted signal as generated by the traffic generator in the sensor because loss probability of the received signal going to decreases.

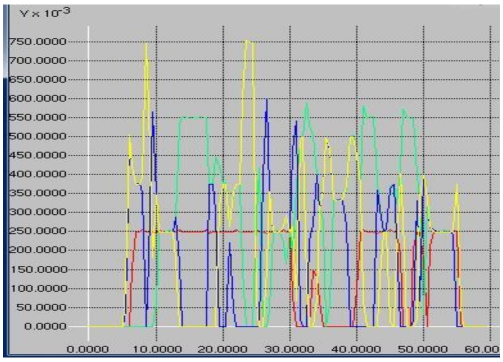

Fig. 10. SFQ buffer base transmission loss at BS.

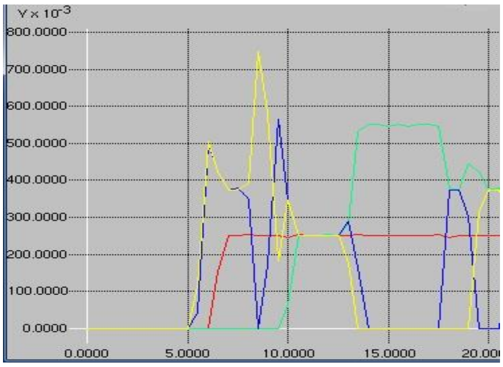

Fig. 11. One-third SFQ buffer based transmission loss.

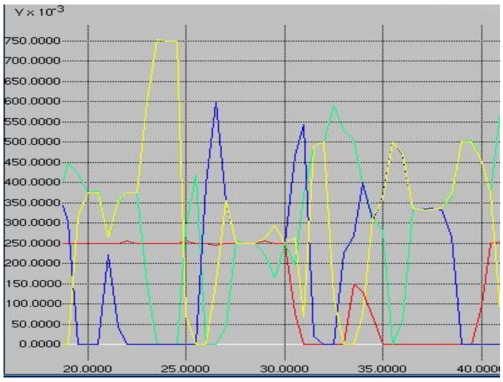

Fig. 12. Two-third SFQ buffer base transmission loss at BS.

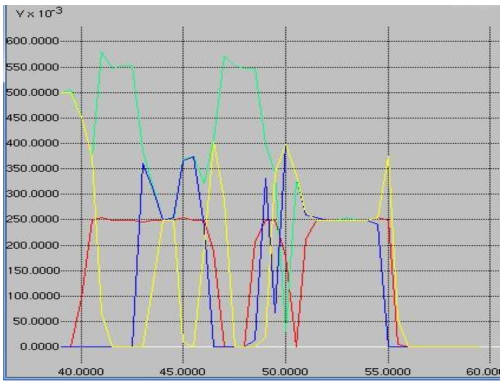

Fig. 13. Three-third SFQ buffer base transmission loss.

SFQ traffic generator system of SN0, SN1, SN2 and SN3 sensor node generate 250kbps, 300kbps, 800kbps, 850kbps rated transmitted signal and the respective receiver experience maximum 254kbps, 590kbps, 600kbps, 753kbps received signal rate with same parameter definition as RED buffer mechanism in the main window in Fig. 10.

At initial position of the sensor transmitted signal in Fig. 11 SN1 node provide better signal than other sensor node. Two-third and three-third of the main signal are shown in Fig. 12 and Fig. 13 correspondingly. At transmission time between 40s and 60s from Fig. 13, SN1 sensor node perform better quality signal than other sensor node SN0, SN1,SN3 transmits signal.

III. Conclusion

In this article, we investigated star topology sensor network transmission loss at DT, RED and SFQ queuing based mechanism at the base station. From above investigation we can told that, the receiver received higher data rate than SN0 and SN1 transmitter data rate but lower data rate in the case of SN2 and SN3 DT based queuing method. Alternatively, the peak flow of the received burst RED buffer based offer better signal performance for SN1 transmit node larger than DT based. With compare to the transmit signal data rate, the maximum received signal offered by SN1 node pedestal on SFQ mechanism. Finally, we conclude that, for single node consideration, RED performance better than other two but with considering whole node DT queuing method provide better with comparing receiver data rate.

Acknowledgment

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