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Evaluating Wireless Sensor Network on Quality of Services Using Mobile Sink Nodes

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Abstract- Node failures represent a fundamental problem in wireless sensor networks. Such failures may result in partitioned networks and lose of sensed information. A network recovery approach is thus necessary in order to ensure continuous network operations. In this paper, we propose CoMN2 a scalable and distributed approach for network recovery from node failures in wireless sensor networks. In this paper, various reactive, proactive and hybrid protocols are going to be evaluated under the applications generating congestion and node failure. Various matrices will be used to gather the information about the behavior of the protocols under these heavy applications and a conclusion will be carried out. Parameters for Quality of service would be throughput, failure of nodes, network load, response time and overhead. These parameters will distinguish the normal working of the network and QoS in network. This research, will present better solution for quality of service by improving quality in between wireless nodes. This research will reflect the node failure and the will provides solutions for it. The result is carried out on the OPNET Network simulator and presented in result discussion along their parameters.

Keywords-WSN, WSN TYPES, NODES,ISSUE , Network Protocol, QOS, fault tolerance, sensor failure;

1. INTRODUCTION-WIRELESS SENSOR NETWORKS [1]

Recent advances in micro-electro-mechanical systems (MEMS) technology, wireless communication digital electronics have enabled the development of low-cost, low-power, multifunctional sensor nodes that are small in size and communicate in short distance [1].

These tiny sensor nodes, which consist of sensing, data processing, and communicating components, leverage the idea of sensor networks based on collaborative effort of a large number of nodes. Sensor networks represent a significant improvement over traditional sensors, which are deployed in the following ways -

- Sensors can be positioned far from the actual phenomenon, i.e., something known by sense perception. In this approach, large sensors that use some complex techniques to distinguish the targets from environmental noise are required [2].
- Several sensors that perform only sensing can be deployed. The positions of the sensors and communications topology are carefully engineered. They transmit time series of the sensed phenomenon to the central nodes where computations are performed and data are fused. A sensor network is composed of a large number of sensor nodes, which are densely deployed either inside the phenomenon or very close to it. The position of sensor nodes need not be engineered or pre-determined. This allows random deployment in inaccessible terrains or disaster relief operations. On the other hand, this also means that sensor network protocols and algorithms must possess self-organizing capabilities [3].

Another unique feature of sensor networks is the cooperative effort of sensor nodes. Sensor nodes are fitted with an on-board processor. Instead of sending the raw data to the nodes responsible for the fusion, sensor nodes use their processing abilities to locally carry out simple computations and transmit only the required and partially processed data.

2. Node Failure Definition and types of Node Failure:[5]

Failed nodes may decrease the quality of service (Qos) of the entire WSN. It is important and necessary to study the fault detection methods for nodes in WSNs for the following reasons [5,6]:

(1) Massive low-cost sensor nodes are often deployed in uncontrollable and hostile environments. Therefore, failure in sensor nodes can occur more easily than in other systems;

(2) The applications of WSNs are being widened. WSNs are also deployed in some occasions such as monitoring of nuclear reactor where high security is required. Fault detection for sensor nodes in this specified application is of great importance;

(3) It is troublesome and not practical to manually examine whether the nodes are functioning normally;

(4) Correct information cannot be obtained by the control center because failed nodes would produce erroneous data. Moreover, it may result in collapse of the whole network in serious cases.

(5) Nodes are usually battery-powered and the energy is limited, so it is common for faults to occur due to battery depletion.

WSN node faults are usually due to the following causes: the failure of modules (such as communication and sensing module) due to fabrication process problems, environmental factors, enemy attacks and so on; battery power depletion; being out of the communication range of the entire network.

The node status in WSNs can be divided into two types [7,8]: normal and faulty. Faulty in turn can be “permanent” or “static”. The so-called “permanent” means failed nodes will remain faulty until they are replaced, and the so-called “static” means new faults will not generated during fault detection. In[7,9], node faults of WSNs can be divided into two categories: hard and soft. The so-called “hard fault” is when a sensor node cannot communicate with other nodes because of the failure of a certain module (e.g., communication failure due to the failure of the communication module, energy depletion of node, being out of the communication range of entire mobile network because of the nodes’ moving and so on). The so-called “soft fault” means the failed nodes can continue to work and communicate with other nodes (hardware and software of communication module are normal), but the data sensed or transmitted is not correct.

3. Related Work

Network mapping based on node resources represents an attractive paradigm in the design of wireless sensor network. In this paper, we presented a distributed and dynamic recovery protocol CoMN2 which handles node failure in WSNs. As it is unknown whether such crash causes a network partitioning or not, we provide a technique based on network mapping deciding if a node should be replaced or not. Simulations show that CoMN2 achieve more than 40% improvement of the network lifetime. For the future work, we plan to reduce the network recovery delay of our approach by investigating the optimal routing path to follow to join the sink. There is significant work can be done which include the detection of node failure in wireless sensor network and Evaluating Wireless Sensor Network on Quality of Services Using Mobile Sink Nodes.

4. Problem Formalation and Purposed Work

In this paper, various reactive, proactive and hybrid protocols are going to be evaluated under the applications generating congestion and node failure. Various matrices will be used to gather the information about the behavior of the protocols under these heavy applications and a conclusion will be carried out. Parameters for Quality of service would be throughput, failure of nodes, network load, response time and overhead. These parameters will distinguish the normal working of the network and QoS in network. This research, will present better solution for quality of service by improving quality in between wireless nodes. This research will reflect the node failure and the will provides solutions for it.

4.1 OBJECTIVES

- To study various techniques of recovering from node failure.
- When should we replace the damaged node and which nodes are vital for the Functioning of the network?
- How can we handle unpredictable dynamics of the networks?
- Implement the congestion avoidance technique for wireless sensors networks.
- Study the variation in the results by using different parameters.

5. Methodlogy of Research Work

The procedure adopted to accomplish the above mention objective is given below:

- Study of OPNET simulator software with its various tools like: Network Editor, Node Editor, Process Editor, Probe Editor, Animation tool and Simulation tools.
- Conduct objective function.
- Then collecting the required data using Probe editor, statistical results are obtained using Analysis tool. After processing the data using Filter tool, I checked the dynamic behavior of node functionality using Animation viewer.
- Data collected at high node densities and heavy traffic network load using the selected network routing protocols and analyzed.
- Then compared the analysis of these routing protocols to generate a comparison reports along with comparison graphs. The results are good agreement with the objective Comparison is also done on the basis of parameters such as:
- Retransmission Count (% age)
- Network Load (bits/second)
- Throughput (bits/second)

6. Results and Discussions

This research focused on providing optimized approach for congestion control and node failure in wireless sensor network by introducing mobile sink scheme in distributed grids in wireless sensor field. In this chapter, various network models to carry out the simulations are discussed. At the end of this chapter, results obtained from various simulations in the form of graphs are presented. Future work is also suggested. First we have decided the multi-hop environment and then implement various parameters like queue size, grid area, number of nodes and position of nodes etc. Main concept has been implemented with implementation of mobile sinks as we have placed mobile sinks in the network according to the density of the nodes.

In this simulation there are five scenarios, in which there are wireless sensor nodes in 7 clusters. There are 10 sensors in each sector. In first scenario there is a simple network of 35 nodes 1 server. In improved scenario we replace the base stations of clusters by mobile sinks, which improves it performance. In this we improves the performance in case of node failure in wireless sensors networks by placing mobile sinks.

In this experiment there are 5 scenarios, in first scenario there is a simple wireless sensor network with multi-hop with basic parameters with 35 nodes. In our experiments there are 4 applications which are to be considered. There is one server in this network.

6.1 Simulation Result Parameters

- **Throughput (bits/second)**
- **Load (bits/second)**
- **Page Response Time (seconds)**

After choosing metrics, the simulation is done for 6 minutes for each scenario. Then results are obtained as: **1.Throughput (bits/second)-**In congestion, throughput of the network is less as compared to the improved network with mobile sinks. With mobile sinks output of the network increases by 13.65%. Performance of the first network is decreased by 10% on the other hand in improved network performance is decreased by 6 % during the node failure.

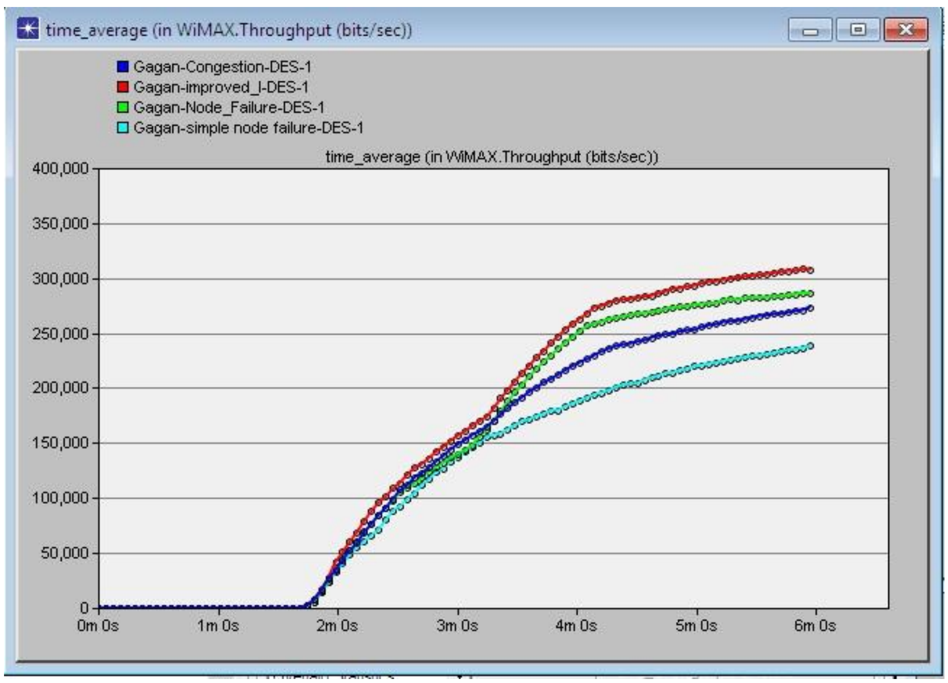

Fig 1. Throughput

Table 1. Throughput

Sr. no	Time (min)	Congestion	Simple Node Failure	Improved	Node Failure
1	**2**	43865	43190	50969	44617
2	**3**	149009	141707	157039	140538
3	**4**	223625	196265	263275	251762
4	**5**	255772	225975	295537	276551
5	**6**	273454	244840	308012	286253
Average Throughput		189145	170395	214966	199944

2. Load (bits/second)-In congestion there is less load as compared to the improved network because in improved network, performance of the network increases due to this load is increases. In improved network we use mobile sinks which improves the performance of the network.

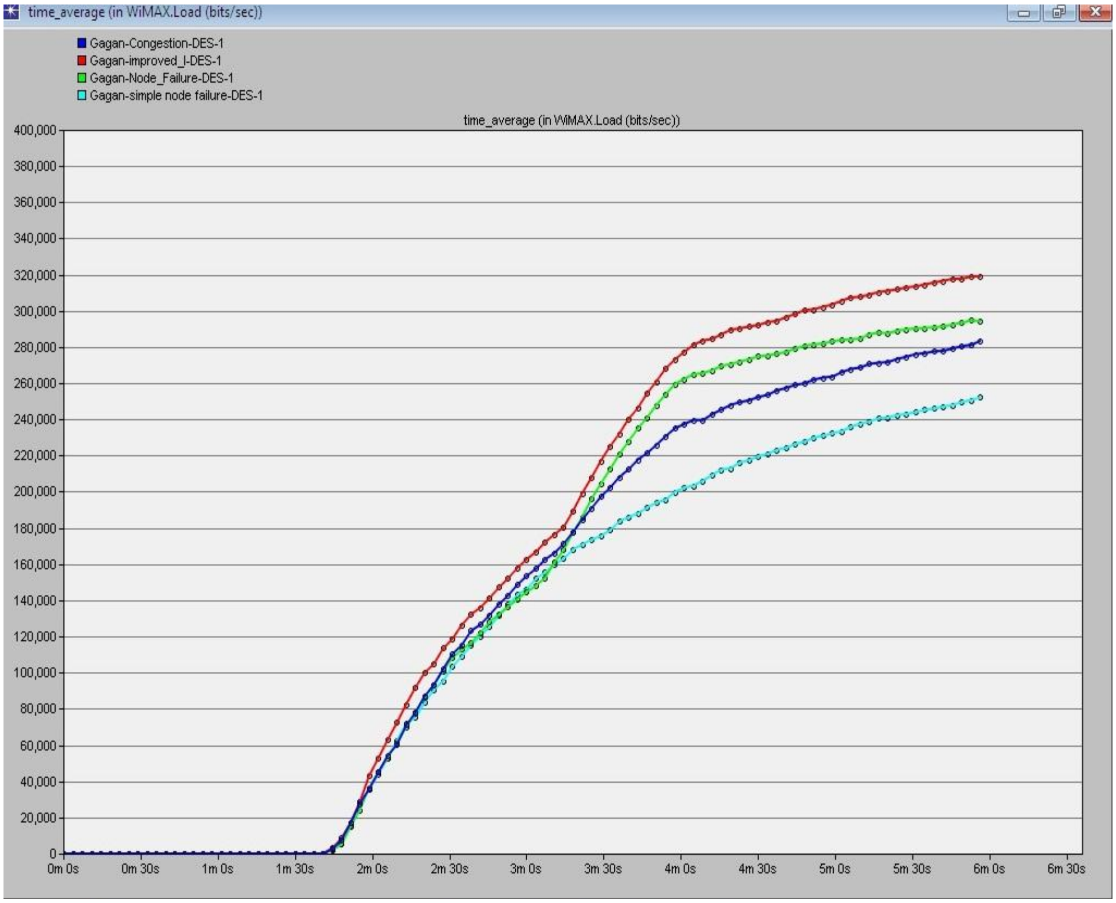

Fig 2. Load (bits/sec)

Fig2. shows the network load, in case of congestion average load is 197106, in improved network average load is 223548 and during the node failure load is decreased to 206091 than the improved.

Table 2 Load (bits/sec)

Sr. no	Time (min)	Congestion	Simple Node Failure	Improved	Node Failure
1	2	45055	44230	52958	45238
2	3	153524	146355	162830	144634
3	4	237432	202283	277324	262366
4	5	266095	233441	305603	283914
5	6	283427	252252	319028	294304
Average load (bits/sec)		197106	175712	223548	206091

3. Page Response Time (seconds)-In this work page response time in congestion is higher than the "Improved network" and during the "Node Failure" in the network. Less the response time increases the throughput of the network. Fig 4.7 shows average response time congestion, "Improved network", Node Failure 0.57300 seconds, 0.35337 and 0.34719 respectively. Response time is less in "Improved network" as compared to the other. This result shows that by adding mobile sinks to the simple network increases the throughput of network. Difference between the page response time "Improved network" and "Node failure" is very less.

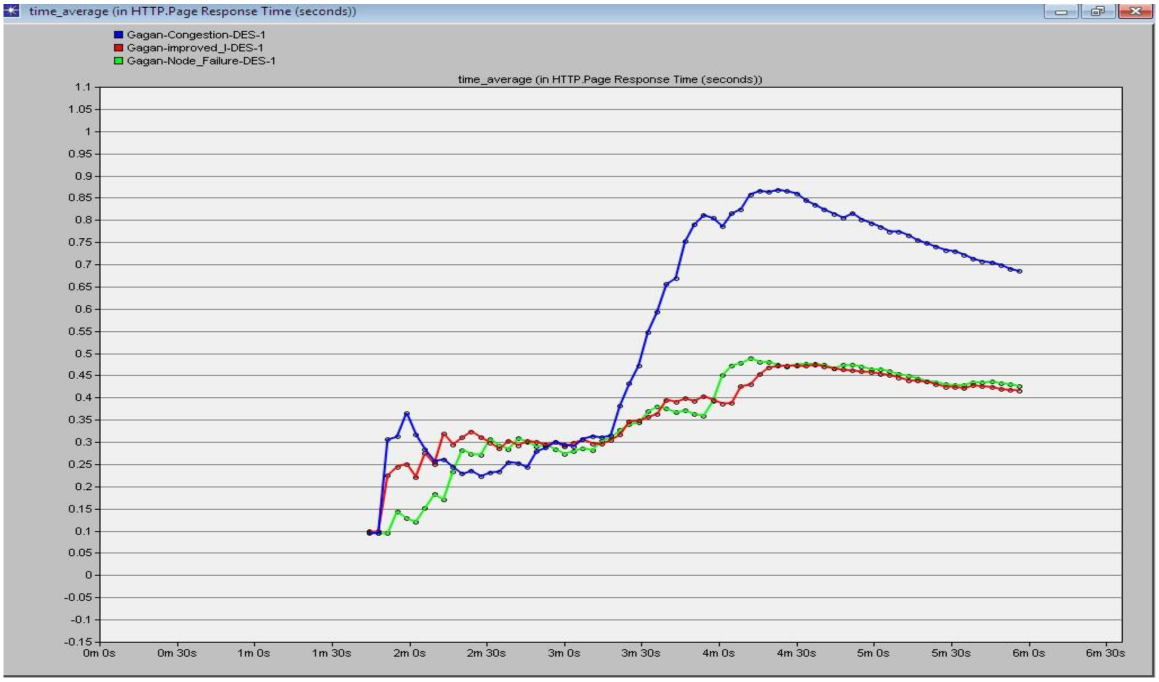

Fig .3 Page Response Time (seconds)

Table no.3 Page Response Time

Sr. no	**Time(seconds)**	**Congestion**	**Improved**	**Node Failure**
1	**2**	0.31620	0.22076	0.12002
2	**3**	0.29425	0.28946	0.27387
3	**4**	0.78532	0.38675	0.45029
4	**5**	0.78468	0.45382	0.46385
5	**6**	0.68457	0.41606	0.42796
Average(seconds)		0.57300	0.35337	0.34719

7. Conclusion

Congestion avoidance is the main reason for development of various schemes which can provide better quality of service. Mobile sink is the concept based on quality of service for saving resources. Our research is based on the node failure recovery carrying capacity by dividing sensor network in to different clusters and implements the mobile sinks according to the density of the network. Proposed scheme with mobile sink communication shows better results in term of throughput. It has less response time than multi-hop networks. Traffic receives and traffic sent is also high in case of mobile sink scheme as compared to the normal multi-hop scheme and multi-hop with congestion scheme. The Retransmission attempt is also more in case of multi-hop and congestion scenario as compared to proposed scheme. Mobile sinks have movement according to the propagation model defined in simulation. Main feature of mobile sinks is to fetch data from various nodes according to the closest distance from the nodes. Comparison has been done with multi-hop network. The mobile sink concept could provide better solution to the congestion avoidance in wireless sensor network. Network performance is measured in terms of throughput, load, traffic received and sent and page response time. After the intensive simulations done by using a discrete event simulator called OPNET, it has been concluded that performance in case of mobile sink is better than the multi-hop network.

8. Future Scope

We have considered the mobile sink scheme for avoidance congestion and node failure recovery in wireless sensor network nodes. Our proposed work shows better solution to congestion in wireless senor network. Further we can test the mobile sink concept with distribution of the grid environment and can save energy level by innovative way of clustering.

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