Dynamic and Adaptive Routing Services for Data Integrity in Wireless Sensor Networks

RakeshReddy Gurrala*, Pratibha Gaddampally**
*Information Technology, JNTUH University, Hyderabad
** Computer Science and Engineering, JNTUH University, Hyderabad

ABSTRACT
In real time the applications running in WSN can have different requirements pertaining to QoS. The important needs of a WSN are to ensure low delay and high quality of service in terms of data integrity. Many schemes came into existence to achieve these two requirements. However, it was understood that both requirements cannot be fully satisfied at the same time. To overcome this problem a multi-path dynamic routing algorithm is built in this paper which resolves the issue and provides high quality data integrity and low delay. This is achieved by using different paths and sending packets of applications through different routes keeping the QoS requirements in mind. Data fidelity is thus improved for applications where data integrity is very importance. At the same time the proposed scheme reduces end-to-end delay. The proposed scheme is tested with NS2 simulations. The results revealed that the scheme is effective and adaptive to the runtime situations in WSN.

Index Terms **–** Wireless Sensor Network, adapting routing, multipath routing, data integrity

I. INTRODUCTION

Wireless Sensor Network (WSN) is a collection of nodes that are spread across geographical area. The nodes in the network are known as sensor nodes. These nodes are responsible to collect data from surroundings and ensure that the data is sent to a special node known as sink node. Sink node gets data from sensor nodes in many to one fashion. Each sensor node can act as both transmitter and receiver. They can take care of receiving data from other nodes and transmitting data to the next nodes for proper communication. The data being sensed needs to be sent to base station correctly. In other words, it is essential t ensure data integrity so as to make the data reliable and actionable. The data received by the sink node can be used for effective decision making. Especially, the WSN which is deployed in hostile environment needs to be protected from attacks and the data integrity plays a vital role. Figure 1 shows a typical WSN.
There are many applications of WSN both in civilian and military landscapes. These networks are becoming popular in different sectors. For instance, WSN can be used for surveillance, controlling operations, monitoring people, monitoring patients, monitoring buildings and infrastructure to mention a few.

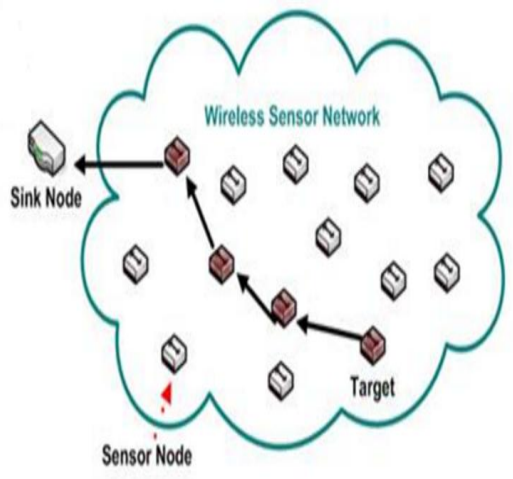

Figure 1 – Wireless Sensor Network

In this paper we proposed a scheme which is adaptive to routing and ensure low delay and high data integrity. The work of this paper is meant for improving QoS in WSN by adapting to the runtime situations with respect to different kinds of traffic. The remainder of the paper is structured as follows. Section II provides review of literature. Section III presents proposed scheme. Section IV presents experimental results while section V concludes the paper.

II. RELATED WORKS

Many of the protocols that are equipped with QoS provisioning have drawbacks in terms of path discovery and resource management [3], [2], [1]. In other words those protocols were causing overhead for end-to-end path discovery. Many researchers contributed to enhance QoS in WSN. In [7] explored gradient routing mechanism based on two-hop neighbour information. Another approach known as geographic forwarding was focused in [6]. Earliest Deadline First (EDF) with MAC protocol was explored in [5] for improving quality of service. Scheduling policy and reduction of missed deadlines were studied in [4] by exploiting notion of velocity.

Packet priority concept and dynamic packet states concept were explored in [8] and [9] respectively. However, both the approaches need to know global topology in order to achieve this. LOCALMOR was proposed in [12] which make use of energy, reliability and latency for classifying applications. Probabilistic QoS guarantee and service differentiation were the main focus in [3] where SPEED mechanism is used in order to satisfy the delay performance requirements for different kinds of traffic. Generally traffic in networks can be considered to be of two types. Delay sensitive and delay insensitive are the two categories. The former cannot tolerate delay while the latter can tolerate it. In [10] a protocol by name Energy-Efficient and QoS based Multipath Routing was proposed in order to improve the reliability using XOR based forward error correction mechanism. This mechanism ensures the improvement of reliability in WSN.
Another researcher in [11] considered residual energy, delay and reliability for employing a model which works for both real time and non real time traffic. It classifies applications in to two categories such as critical and non-critical. The names imply the meeting of the two categories. The critical applications are sensitive while the non-critical applications are not sensitive to delay and other requirements.

III. PROPOSED SCHEME

The proposed scheme is descried here. Between the source and destination there is network traffic. The traffic might be either delay sensitive traffic or high-integrity traffic. The delay sensitive traffic is, generally, to be given priority in order to ensure that the packets are transmitted without delay. On the other hand, the high – integrity traffic needs to be given priority so as to ensure that the data integrity is not lost. Keeping this in mind our scheme is formulated based on the following aspects that motivate the proposed work.
Delay sensitive packets occupy buffers and available bandwidth that cause problems with high-integrity traffic.
High integrity data packets makes use of shortest paths and block them. This causes the delay – sensitive traffic to reach destination with increased number of hops.
When high integrity packets occupy buffers, it causes the queuing delay in delay-sensitive packets in the network.
To avoid this problem, we designed and implemented a mechanism that takes care of dynamic routing in such a way that the shortest paths are used by delay – sensitive packets while the packets that need fidelity uses alternative routes so as to ensure that the delay sensitive data is given high priority.

IV. EXPERIMENTAL RESULTS

Experiments are made with NS2 simulations. The simulations show WSN with proposed scheme deployed. The sensor nodes directly communicate with base station. There is no concept of clustering. The results are as follows.

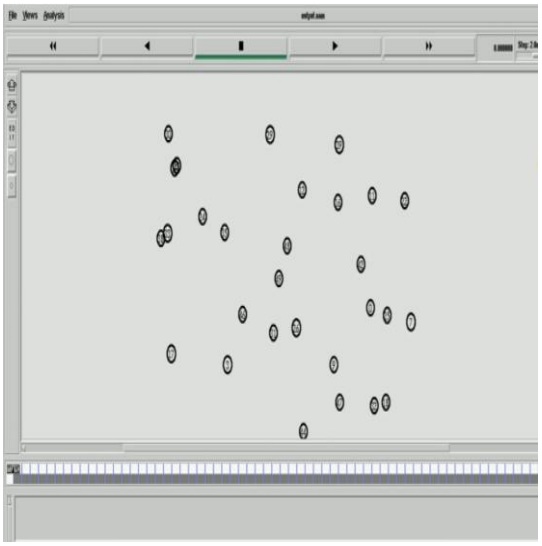

Figure 2 – Shows forming of WSN

As shown in Figure 2, the WSN is formed with sensor nodes scattered in geographical area. It is the starting point in the simulation.

Figure 3 – Shows WSN

As shown in Figure 3, the WSN is formed with sensor nodes scattered in geographical area. The nodes are numbered so as to identify nodes easily.

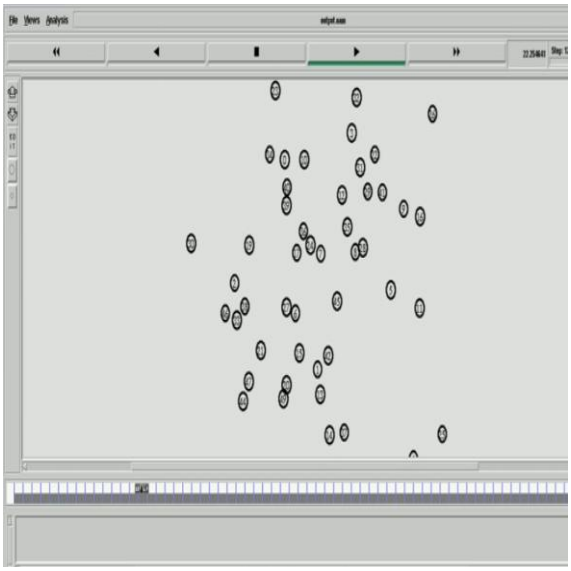

Figure 4 – Shows WSN with all nodes

As shown in Figure 4, the WSN is formed with sensor nodes scattered in geographical area. The nodes are numbered so as to identify nodes easily. This is the complete network which initiates protocol propagation.

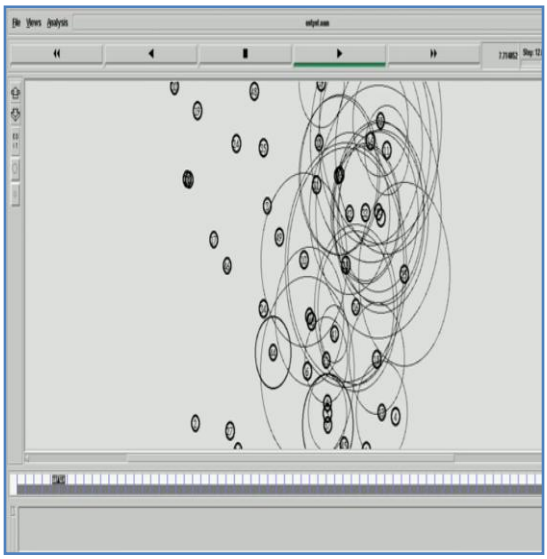

Figure 5 – Shows WSN with all nodes

As shown in Figure 5, the WSN is formed with sensor nodes scattered in geographical area. The nodes are numbered so as to identify nodes easily. The simulation takes care of data integrity and ensures delay sensitive traffic to be given importance.

As shown in Figure 6, it is evident that there is performance difference presented in the graph using 40 sources. The results reveal the difference between the two data series plotted in the graph.

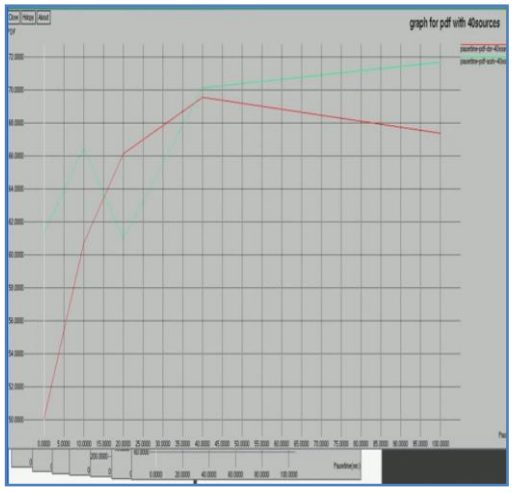

Figure 6 – shows performance difference 40 sources

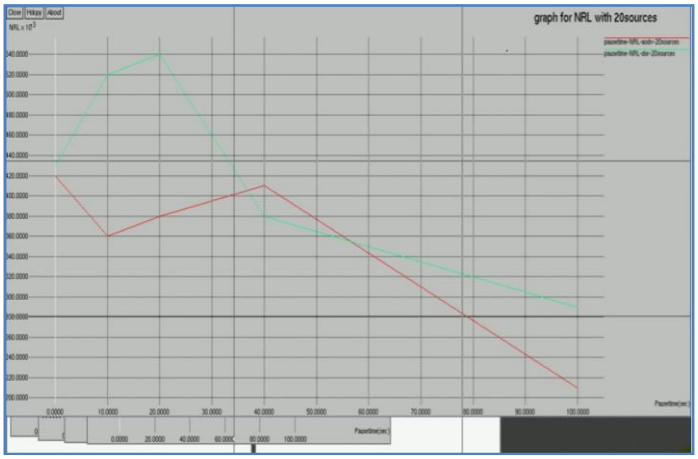

Figure 7 – Shows performance difference with 20 sources

As shown in Figure 7, it is evident that there is performance difference presented in the graph using 40 sources. The results reveal the difference between the two data series plotted in the graph.

V. CONCLUSION AND FUTURE WORK

In this paper we studied WSN with respect to delay and data integrity. Delay and data integrity are the two important requirements that are to be part of QoS services of WSN. However, the existing schemes exhibited tradeoffs between the delay and data integrity. In this paper we strive to propose a new scheme that helps in achieving both the QoS requirements. The scheme is based on the multipath routing and using QoS requirements of different applications. Based in the requirements, the packets are sent to different paths that have been identified in order to minimize delay and ensure high data integrity. We built a multi-path dynamic routing algorithm this paper which resolves the issue and provides high

quality data integrity and low delay. This is achieved by using different paths and sending packets of applications through different routes keeping the QoS requirements in mind. Data fidelity is thus improved for applications where data integrity is very importance. At the same time the proposed scheme reduces end-to-end delay. The proposed scheme is tested with NS2 simulations. The results revealed that the scheme is effective and adaptive to the runtime situations in WSN.

REFERENCES

[1] S. Chen and K. Nahrstedt, "Distributed quality-of-service routing in ad hoc networks," IEEE J. Selected Areas Commun., vol. 17, no. 8, pp. 1488–1505, Aug. 1999.

[2] B. Hughes and V. Cahill, "Achieving real-time guarantees in mobile ad hoc wireless networks," in Proc. IEEE Real-Time Syst. Symp., 2003.

[3] E. Felemban, C.-G. Lee, and E. Ekici, "MMSPEED: Multipath multi-speed protocol for QoS guarantee of reliability and timeliness in wireless sensor networks," IEEE Trans. Mobile Comput., vol. 5, no. 6, pp. 738–754, Jun. 2003.

[4] C. Lu, B. Blum, T. Abdelzaher, J. Stankovic, and T. He, "RAP: A real-time communication architecture for large-scale wireless sensor networks," in Proc. IEEE 8th Real-Time Embedded Technol. Appl. Symp., 2002, pp. 55–66.

[5] M. Caccamo, L. Zhang, L. Sha, and G. Buttazzo, "An implicit prioritized access protocol for wireless sensor networks," in Proc. IEEE Real-Time Syst. Symp., 2002, pp. 39–48.

[6] T. He, J. Stankovic, C. Lu, and T. Abdelzaher, "SPEED: A stateless protocol for real-time communication in sensor networks," in Proc. IEEE 23rd Int. Conf. Distrib. Comput. Syst., 2003, pp. 46–55.

[7] P. T. A. Quang and D.-S. Kim, "Enhancing real-time delivery of gradient routing for industrial wireless sensor networks," IEEE Trans. Ind. Inform., vol. 8, no. 1, pp. 61–68, Feb. 2012.

[8] S. Bhatnagar, B. Deb, and B. Nath, "Service differentiation in sensor networks," in Proc. Int. Symp. Wireless Pers. Multimedia Commun., 2001.

[9] B. Deb, S. Bhatnagar, and B. Nath, "ReInForM: Reliable information forwarding using multiple paths in sensor networks," in Proc. IEEE Intl Conf. Local Comput. Netw., 2003, pp. 406–415.

[10] J. Ben-Othman and B. Yahya, "Energy efficient and QoS based routing protocol for wireless sensor networks," J. Parallel Distrib. Comput., vol. 70, no. 8, pp. 849–857, 2010.

[11] M. Razzaque, M. M. Alam, M. MAMUN-OR-RASHID, and C. S. Hong, "Multi-constrained QoS geographic routing for heterogeneous traffic in sensor networks, ieice transactions on communications," IEICE Trans. Commun., vol. 91B, no. 8, pp. 2589–2601, 2008.

[12] D. Djenouri and I. Balasingham, "Traffic-differentiation-based modular qos localized routing for wireless sensor networks," IEEE Trans. Mobile Comput., vol. 10, no. 6, pp. 797–809, Jun. 2010.

AUTHORS

Mr.Rakeshreddy Gurrala, working as Assistant Professor in the Department of Information Technology at Keshav Memorial Institute Of Technology (KMIT), Hyderabad. I did my M.Tech in Information *Technology* from JNTUH and B.Tech in Information Technology from JNTUH. My research interests network security and wireless sensor networks and mobile computing.

Ms.G.Pratibha is working as Assistant Professor in the Department of *Computer Science and Engineering* at Matru Sri Engineering College (MECS), Hyderabad. I am pursuing Ph.D at JNTUH Hyderabad. I had 10 years of teaching and 4 years of research experience. I published 7 International Journals and attended 4 International/National Conferences. My research interests **NLP,Data Mining, Automata, Compiler Design**