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DYNAMIC BANDWIDTH CONTROL ALGORITHM FOR RELIABLE DATA DISSEMINATION IN WIRELESS SENSOR NETWORKS

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Abstract

The present invention relates to a system for data collection in wireless sensor networks. The object is to provide an improved Quality of Services using bandwidth control sectoring technique in wireless sensor networks, to reduce higher energy utilization by sensor nodes. The nodes are randomly deployed in the network. There are sectors formed according to the equal number of sector heads. There is one sink node which collects data from sector heads. Common nodes are deployed randomly to transmit data packets to the respective level 1 node within a sector. Thus, bandwidth will be controlled, and congestion in the network is reduced. Dynamic bandwidth control technique achieves the various quality of services parameters of wireless sensor networks. QoS like latency (delay), energy efficiency, delivery ratio, loss ration including throughput. This paper shows the best protocol for data dissemination in wireless sensor networks. This is designed for achieving maximum QoS of wireless sensor networks.

***Keywords*:** *Bandwidth control sectoring technique (DBA)Congestion control,Sector head, Quality of Services (QoS), Wireless sensor networks (WSNs),*.

1. Introduction

Wireless Sensor Networks [1] can be define as a self-organized and infrastructure-less sensor networks to monitor physical and environmental conditions such as temperature, sound, vibration, pressure, motion etc pass their data through the network to a sink node or base station, where the data can be collected and analyzed in the system. [4][12] A sink or base station act as an interface between users and the sensor network. One can retrieve required information from the network by inserting queries and gathering results from the sink.[13]

Typically, a wireless sensor network contains hundreds or thousands of sensor nodes. The sensor nodes can communicate with base station using radio signals.[5][6] A wireless sensor node is prepared with sensing and computing devices, radio transceivers and power components. The individual sensor nodes in a wireless sensor network (WSN) have limitation are limited storage capacity, processing speed and communication bandwidth. After the sensor nodes are deployed in network, they are responsible for self-organizing an appropriate network infrastructure often with multi-hop communication with them.[7][8] Wireless sensor devices respond to queries sent from a base station to perform specific task.[9] Global Positioning

System and local positioning algorithms can be used to obtain the information related to location and position of the sensor nodes.[10][11]

2. Literature Survey

In order to energy consumption, author purposed a new method in this paper to optimization Low Energy Adaptive Clustering Hierarchy (OLEACH) to improve existing LEACH and LEACH-C by selecting cluster according to the remaining energy of nodes dynamically. In this new technique sensors cluster-heads calculating the amount of energy remaining after each round. As the minimum percentage of energy for the selected is determined in advance and consequently limiting its performance and nonstop coordination task, the new hierarchical routing protocol is based on energy value threshold avoiding the creation of a group leader, to ensure consistent performance of the whole network.

The energy efficient clustering algorithm for WSNs has been introduced. Detailed simulations of wireless sensors network environment demonstrate that our approach is a good to increase the period of network and has the ability of extending the life span of the whole network. From our point of view O-LEACH will work in dynamic networks as well as in static networks. In this paper we evaluated O-LEACH only on static networks. This protocol should be tested on dynamic networks as well.The simulation results show that proposed algorithm achieve longer stability by comparison to original LEACH and LEACH-C and improve lifetime and stability of nodes.[1]Dynamic traffic control technique is introduced by author Bharadwaj. This technique is implemented by using WSN. Sensors are used to discover the traffic congestion for dynamically manage the traffic. Dynamic traffic control has overcome the disadvantages of static traffic control. The major disadvantage of static traffic control is sometimes it may block the emergency vehicles likei.e. ambulance because of traffic congestion. In this technique, Traffic Control Unit, Monitor Unit, and Roadside Unit are used to efficiently control the traffic congestion. RFID reader is used to reading the unique RFID code for an emergency vehicle as well as it sends to the monitor unit. Sensors, proximity switch, and RFID tags are used by monitor unit to count the normal vehicles and emergency vehicles. Count information of the vehicle is sent to the traffic control unit. After receiving count information of vehicles, the signals are changed dynamically. Author has compared the results of static traffic control technique and dynamic traffic control technique. Results are taken for time used by vehicles from source to different destination as well as time is calculated by using speed and distance. Dynamic traffic control technique works for all situations. Reduces the traffic delay and saves the throughput time of travel are the advantages of the dynamic traffic control technique.[2]

The author Weiqi Chen has proposed joint QoS provisioning and congestion control technique for the multi-hop wireless network. This technique is implemented by combining two techniques. One is Differentiated Queuing service and second is semi-TCP. Advantages of these techniques are provided per-packet granular QOS as well as systematic hop by hop congestion control. Using Joint technique two parameters getting by authors. These are flexible and adaptive for the dynamic multi-hop wireless network. In the joint technique, DQS is used for QoS in the logic layer and semi TCP is used for congestion control issue in the transport and MAC layer. Author has solved the different issues of the existing system. Those issues are delay estimation, overdue packet handling issue, ACK mechanism, and cross-layer design. Using joint technique author has improved the performance of total throughput and reduces

the total latency in the (multi-hop) i.e. multiple hops (levels) wireless network. The results are taken for data transfer-ratio and average end to end delay parameter. Using joint technique author has achieved different advantages. Those are handled overdue packets, transfer ratio and decreased total-latency for the multi-hop wireless-network.[3]

3. Proposed System

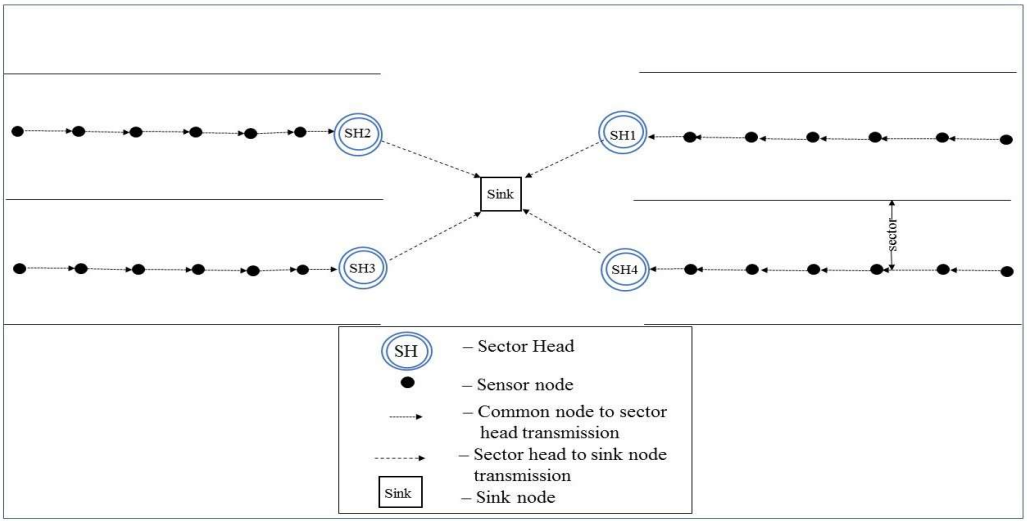

Figure 2 :- Architecture of Dynamic bandwidth control technique

In above figure we can see that nodes are randomly deployed in the network. There are sectors formed according to the equal number of sector heads. Due to less capacity of the communication channel and less availability of bandwidth for packet transmission, congestion over the network increases which directly affects the QoS parameters like de- lay, throughput, energy efficiency, packet delivery ratio, reliability. In the proposed system sectoring technique will reduce bandwidth problem and traffic congestion problem. There is one sink node which collects data from sector heads. Common nodes which are deployed randomly transmit data packets to respective level 1 nodes within a sector. Sector heads are nothing but level 1 node. In this way bandwidth will be controlled and congestion in network will be reduced.

DBA Algorithm:

Step 1 - START
Step 2 - Initialization of scenario.
Step 3 - Initialization of sink node equal to zero. Step 4 - Set hop count (level) to all nodes.
Step 5 - Determine the nodes which are one hop away from sink node i.e Find out level one nodes.
Step 6 - Assign level one nodes as sector head.
Step 7 - Formation of sectors depending on the total number of sector heads.
Step 8 - Common nodes within a sector transmit the data packets to their sector head.
Step 9 - Sector heads transmit the collected information to sink node.
Step 10 - STOP

Firstly, initialization of scenario will be done and initialization of sink node = 0 will be carried out. Set hop count to all nodes to determine the levels of nodes in the network. Next step is to find out the nodes which are one hop away from sink node. Determine those nodes as level 1 nodes. Level 1 node are near to sink node so next step is to determine level 1 nodes as sector head (SH). Due to less capacity of the communication channel and less availability of bandwidth for packet transmission, congestion over the network increases. In this case formation of sectors will control bandwidth. Form sectors equal to the total number of level 1 nodes i.e. sector head. After formation of sectors data transmission will be carried out. Data transmission is done within sector. Common nodes within a sector transmit data packets to sector head. Sink node collects data packets from level 1 nodes i.e. sector head. In this way bandwidth will be controlled and congestion in network will be reduced.

4. Result Analysis

In this scenario total no of 30 nodes are deployed in sector form in 1000m* 1000m area for simulation. One node is assigned as data collector node i.e. sink node. Remaining 29 nodes are working as a source node. Rate of data transmission is changing from 10 to 50 packets per sec. i.e. reporting rate of data transmission to the sink node. MAC Protocols like CSMA ,TDMA and 802.15.4. used for performance analysis and these results are comparing with proposed MAC DBA. AODV routing protocol is used for searching short distance path for data transmission.50 bytes packet size is fixed for this scenario along with 30 nodes.

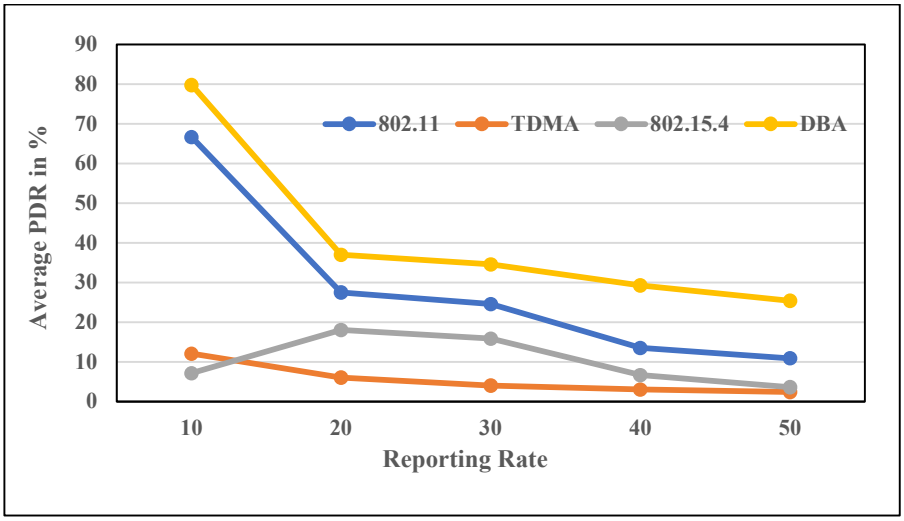

Figure 3. Average PDR for RR

Above graph shown Average PDR (Packet Delivery Ratio) for reporting rate. Dynamic bandwidth control technique is extremely better as compare to existing MAC protocols. In case of heavy traffic like 50 packet transfer per sec it can increase the reporting rate of node but in case of less traffic like 10 packet transfer per sec it can act as a normal MAC with constant reporting rate. In normal packet delivery gives 20% better result as compare to carrier sensor multiple access protocol (CSMA) protocol, 70% as compare to Time division multiple access protocol (TDMA) and 75% as compare to 802.15.4 protocol. In heavy packet delivery 15 to 25% better as compare to CSMA, TDMA and 802.15.4. as result shown the DBA protocol a maximum number of packets will be delivered and minimum number no of packet will be drop. In above graph 802.15.4 protocols has weakest reporting rate.

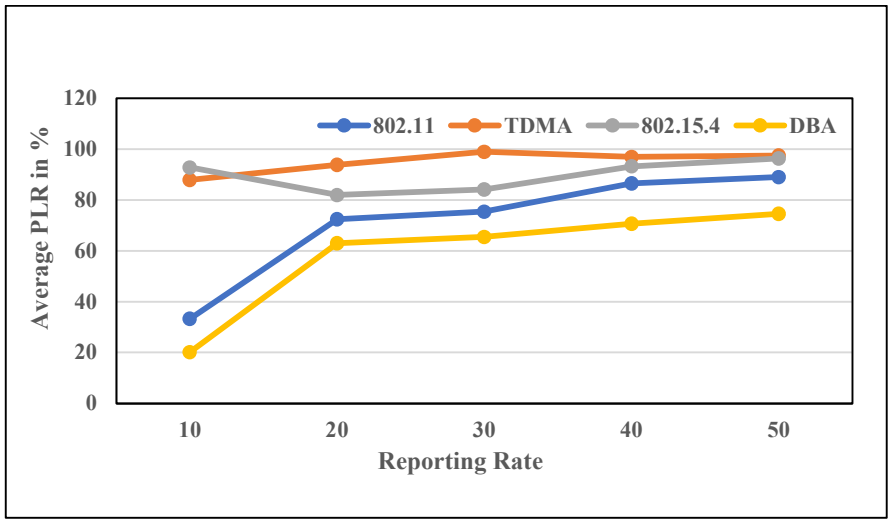

Figure 4. Average PLR for RR

Above graph shows average PLR (Packet Loss Ratio) for Reporting rate. The packet loss ratio represents the ratio of the number of lost packets to the total number of sent packets from sensor node to base station. Congestion is one of the main factors of packet loss. In normal reporting rate CSMA protocol drops 70% packets, TDMA and 802.15.4 protocol drops 90% packets and as compare to other protocols with DBA only 20% packet drops. The reporting rate is 50 the DBA protocol gives 20% better result as compare to other MAC protocols. Tables of the PLR shows the TDMA and 802.15.4 protocols have more packet loss and CSMA and DBA has a less packet loss.

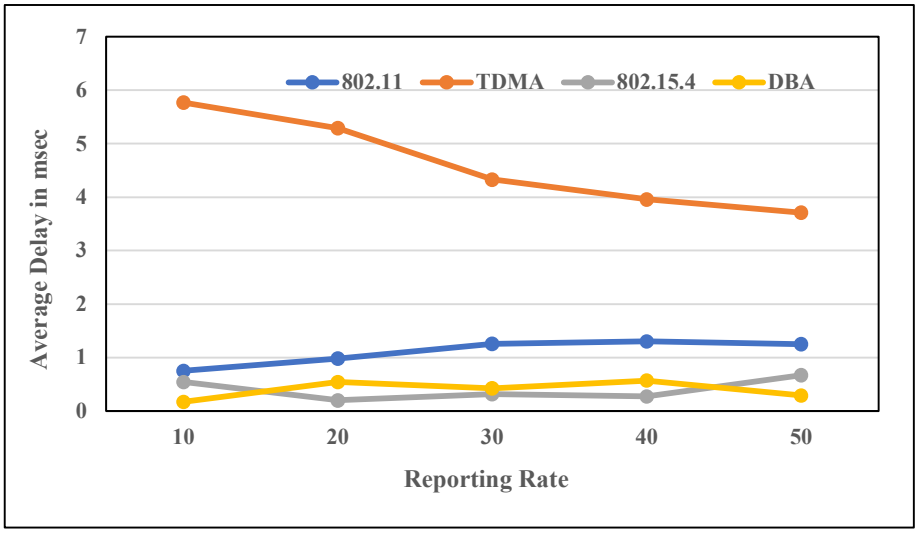

Figure 5. Average Delay for RR

Above graph shows the average end-to-end delay for reporting rate. End-to-End delay means time takes by the packet to travels to reach from source to destination node. Number of packets transfer using TDMA protocol takes more time than the other protocols. CSMA also takes more time. The number of packets transfer via DBA protocols takes less time as compare to other protocols to reach destination. The other protocol like 802.15.4 also takes less time but the number of packets is increase delay is also increases but in case of DBA protocols number of packets increase delay time will be decrease.

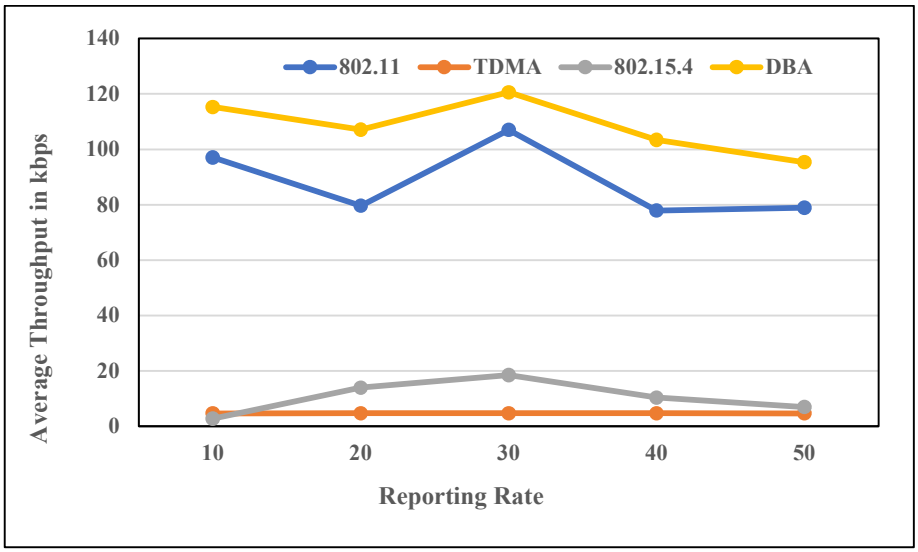

Figure 6. Average Throughput for RR

Above graph shows Average throughput for reporting time. The DBA protocol gives better results when it is compared to CSMA. The Control overhead in DBA protocol is also less when it is matched with DBA protocol shown in table. The other MAC protocols like TDMA and 802.15.4 as compare to DBA has less throughput. When nodes send 10 packets per sec using DBA and CSMA protocol has 90 to 95% throughput but in case of sending 50 packets DBA protocol has 90% throughput and in CSMA protocol has 70% reporting rate. In TDMA and 802.15.4 protocol have lowest throughput i.e. 0 to 20.

5. Conclusion

A DBA – bandwidth control sectoring protocol is a novel protocol designed for congestion control and achieving QoS parameters of wireless networks. This protocol gives drastically better result as compare to existing MAC protocols like CSMA, TDMA and 802.15.4. DBA protocol gives almost 17-20% better result for PDR, 15-20% better result for PLR, 5 to 10% better result for delay and 20 to22% better result for network throughput as compare to second best protocol CSMA. DBA is almost 40 to 50% better as compare to TDMA and 802.15.4 for all QoS parameters. Sectoring technique in DBA helps to reduce heavy traffic, congestion and improve performance of the network. In future work we will implement hybrid MAC protocol which will be combination of CSMA and DBA Protocol for better network performance.

References

[1] SepehrEbrahimi Mood & Mohammad MasoudJavidi. Energy-efficient clustering method for wireless sensor networks using modified gravitational search algorithm. Evolving Systems (2019)

[2]]H.Oudani, S.Krit, M. Kabrane , K. Karimi, M. Elasikri, K. Bendaoud, H. El Bousty, L. Elmaimouni. Minimize Energy Consumption in Wireless Sensor Network Using Hierarchical Protocols. 2017 International Conference on Engineering & MIS (ICEMIS) 8-10 May 2017. 2575-1328

[3] Yan-Xiao Li, Lian Qin, Qian Liang. Research on Wireless Sensor Network Security. 2010 International Conference on Computational Intelligence and Security. 11-14 Dec. 2010

[4] J. Li, H. Y. Zhou, D. C. Zuo, K. M. Hou, H. P. Xie and P. Zhou. Energy Consumption Evaluation for Wireless Sensor Network Nodes Based on Queuing Petri Net. Hindawi Publishing Corporation International Journal of Distributed Sensor Networks Volume 2014, Article ID 262848

[5] SohailJabbar, Abid Ali Minhas, Muhammad Imran, Shehzad Khalid and KashifSaleem. Energy Efficient Strategy for Throughput Improvement in Wireless Sensor Networks. Sensors (Basel). 2015 Feb; 15(2): 2473–2495.

[6] International Journal of Engineering Trends and Applications (IJETA) – Volume 4 Issue 3, May-Jun 2017 Rohit Kumar, Er. Sandeep Kad. Energy Efficient Protocols for Wireless Sensor Networks -A Review. International Journal of Engineering Trends and Applications (IJETA) – Volume 4 Issue 3, May-Jun 2017

[7] Gang Yang, TiantianXu, Mingfei Liang. Research on static clustering for wireless sensor networks. 2011 Second International Conference on Mechanic Automation and Control Engineering 15-17 July 2011. Hohhot, China

[8] Deepak Goyal, Malay RanjanTripathy. Routing Protocols in Wireless Sensor Networks: A Survey. 2012 Second International Conference on Advanced Computing & Communication Technologies 7-8 Jan. 2012. 10.1109/ACCT.2012.98

[9] Abin John Joseph, U.Hari. Hexagonally Sectored Routing Protocol For Wireless Sensor Networks. International Journal of Engineering Research & Technology (IJERT) Vol. 2, May – 2013 ISSN: 2278-0181

[10] Mohamed Amine Kafi, DjamelDjenouri, Jalel Ben-Othman, NadjibBadache. Congestion Control Protocols in Wireless Sensor Networks: A Survey. IEEE Communications Surveys & Tutorials (Volume: 16 , Third Quarter 2014). 1369 – 1390

[11] Viktor Richert, BijuIssac, and NaumanIsrar. Implementation of a Modified Wireless Sensor Network MAC Protocol for Critical Environments. Hindawi Wireless Communications and Mobile Computing Volume 2017, Article ID 2801204

[12] MohammadrezaBalouchestani, KaamranRaahemifar, and Sridhar Krishnan. Increasing the Reliability of Wireless Sensor Network with a New Testing approach Based on Compressed Sensing Theory. 2011 Eighth International Conference on Wireless and Optical Communications Networks. 24-26 May 2011

[13] Joseph Kabara and Maria Calle. MAC Protocols Used byWireless Sensor Networks and a General Method of Performance Evaluation. Hindawi Publishing Corporation International Journal of Distributed Sensor Networks Volume 2012, Article ID 834784

[14] Priyanka Sharma, Garimella Rama Murthy. Mathematical Modelling of Energy Wastage in Absence of Levelling & Sectoring in Wireless Sensor Networks. January 2017 International Journal of Communication Networks and Distributed Systems 19(1):84

[15] Mingwei Li, Yuanwei Jing. Feedback Congestion Control Protocol for Wireless Sensor Networks. 2012 24th Chinese Control and Decision Conference (CCDC). 1948-9439

[16] Manivannan, T., and P. Radhakrishnan. "Preventive Model on Quality of Service in IOT Applications." *Int. J. Mech. Prod. Eng. Res. Dev* 10.3 (2020): 1247-1264.

[17] Barusu, M., et al. "Irrigation, fertilizing and weed cutting in the row crops with iot controlled robot." *Int. J. Mech. Prod. Eng. Res. Development (IJMPERD)* 8.3 (2019).

[18] Ravi, Srivel, Arokiaraj David, and Mohammed Imaduddin. "Controlling & calibrating vehicle-related issues using RFID technology." *International Journal of Mechanical and Production Engineering Research and Development* 8.2 (2018): 1125-1132.

[19] Aggarwal, N. E. H. A., et al. "Congestion control for Internetusing fuzzy logic: A review." *International Journal of Computer Networking, Wireless and Mobile Communications* 3.1 (2013): 335-338.

[20] Babu, M. Sudheer, and V. Mahalakshmi Naidu. "BRTS Performance and Evaluation of Vishakhapatnam." *TJPRC: International Journal of Traffic and Transportation Engineering & Research (TJPRC: IJTTER) 2. 1, Dec 2017, 23* 34.

[21] Tanveer, Shakera. "Application of Graph Theory in Representing and Modelling Traffic Control Problems." *International Journal of Mathematics and Computer Applications Research (IJMCAR) ISSN (P)* (2016): 2249-6955.