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Delay Analysis and Efficient Scheduling Policies for Multi-Hop Wireless Networks

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ABSTRACT

In this paper the delay performance of a multi-hop wireless network is analyzed in which the routes between given source-destination pairs are fixed. The back pressure algorithm and greedy partitioning algorithms are used. A new queue grouping technique to handle the complex correlations of the service process resulting from the multi-hop nature of the flows and their mutual sharing of the wireless medium is developed. A systematic methodology is presented to derive such lower bounds. The lower bound analysis provides useful insights into the design and analysis of optimal or nearly optimal scheduling policies.

Keywords: Multi-hop wireless network, delay, scheduling policy

INTRODUCTION

A wireless sensor network (WSN) must be made up of spatially distributed stand-alone sensors to monitor physical or environmental conditions, such as temperature. The most modern network are bidirectional and also make it possible to monitor the activity of the sensors.The development of wireless sensor networks has been based on military applications such as battlefield monitoring.Today, these networks are used in numerous industrial and consumer applications, such as the monitoring and control of industrial processes, the monitoring of the health of machines.

The WSN is built of "hubs" from some to a few hundred or indeed thousands, where each hub is associated to one (or now and then a few) sensors. Each such sensor arranges hub has regularly a few parts: a radio handset with an inside receiving wire or association to an outside radio wire, a microcontroller, an electronic circuit for interfacing with the sensors. and an vitality source, more often than not a battery or an implanted shape of vitality gathering. A sensor hub might change in estimate from that of a shoebox down to the estimate of a grain of clean, in spite of the fact that working "motes"(demo video) of honest to goodness tiny measurements have however to be made. The taken a toll of sensor nodes is additionally variable, extending from some to hundreds of dollars, depending on the complexity of the person sensor hubs. Estimate and taken a toll limitation on sensor hubs result in comparing imperatives on assets such as vitality, memory, computational speed and communications transfer speed.

Algorithms 1.Greedy Algorithm

A **greedy algorithm** is an algorithm that follows the problem solving heuristic of making the locally optimal choice at each stage with the hope of finding a global optimum. On some problems, a greedy strategy need not produce an optimal solution, but nonetheless a greedy heuristic may yield locally optimal solutions that approximate a global optimal solution.

2 Back Pressure Algorithm

The backpressure algorithm operates in slotted time, and every slot it seeks to route data in directions that maximize the differential backlog between neighboring nodes. This is similar to how water flows through a network of pipes via pressure gradients. However, the backpressure algorithm can be applied to multi- commodity networks (where different packets may have different destinations), and to networks where transmission rates can be selected from a set of (possibly time-varying) options.

Results

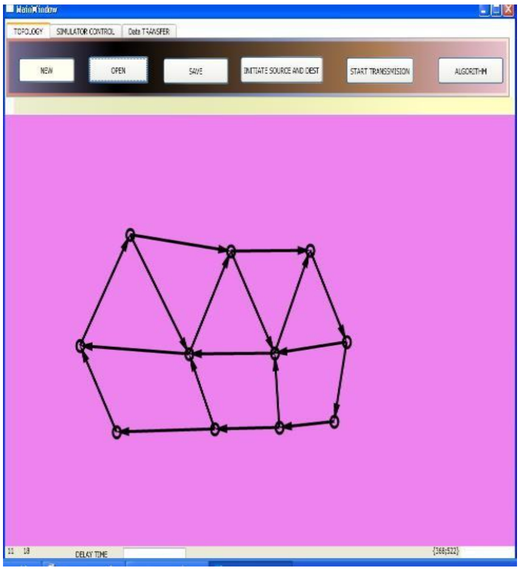

Fig 2 Application Start Window

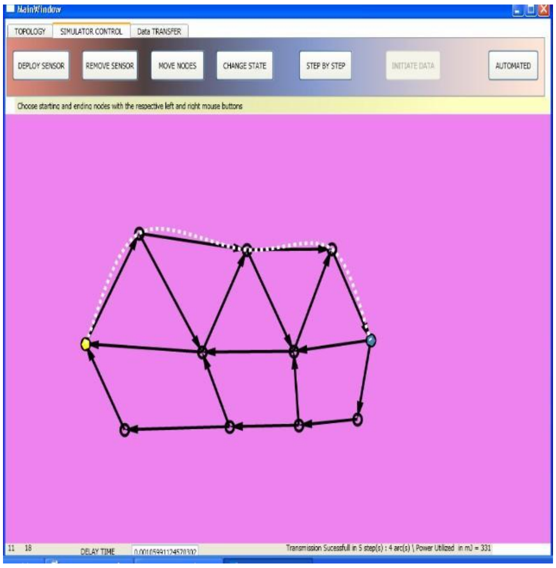

Fig 3: Select source and destination

The above window opens as the application start. We have three tabs Topology, Simulator Control and Data Transfer. At the project startup draw the network topology.

To choose the source node and destination node click on the initiate data button . Then select the source node and destination node. By default it will take back pressure algorithm and shows the path. For the above shown path it takes 5steps, 4 arcs and power utilized is 331mJ

Fig 4: Algorithm selection

If algorithm button in the topology tab is clicked. It displays select algorithm window. The back pressure algorithm is selected and it checks for all the available path sand shows or selects the path which is having low delay.

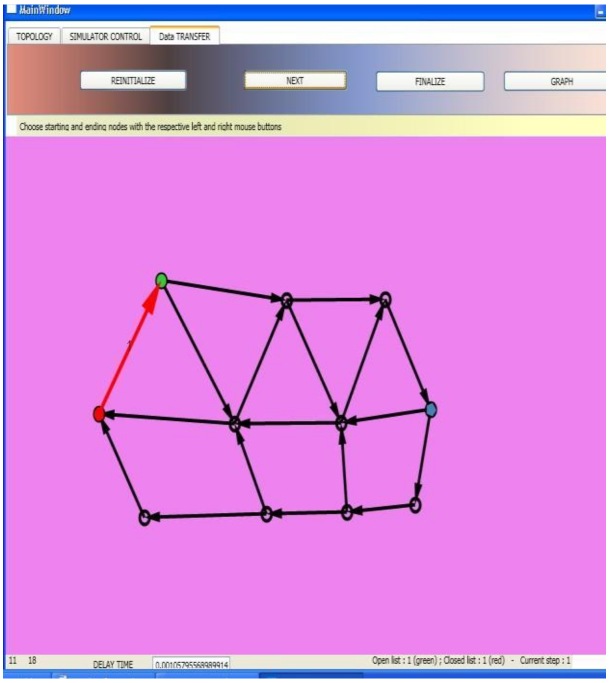

Fig 5 : Step1 transmission for back pressure algorithm

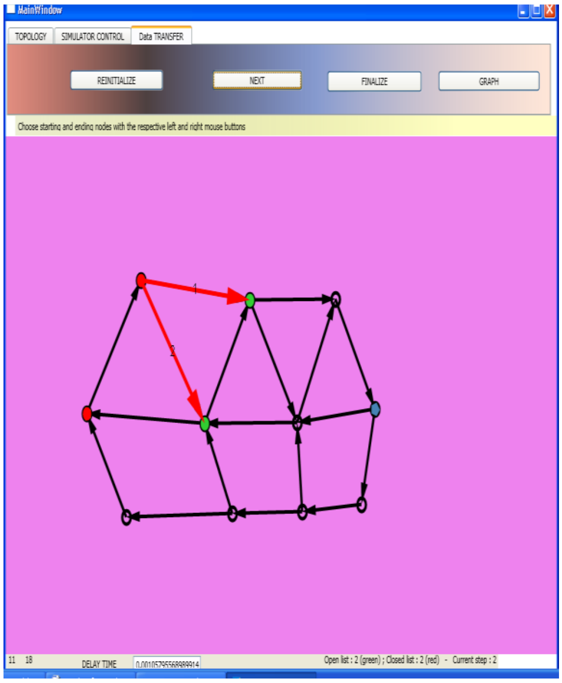

Fig 6: Step2 transmission for back pressure algorithm

The step by step button should be clicked in the simulator control tab and then in the data transfer tab click the next button. It shows the step by step transmission. The step1 transmission is shown in the above Fig 5. The Fig 6 shows step2 transmission. Likewise the step by step transmission till step5 will be carried out in a similar manner

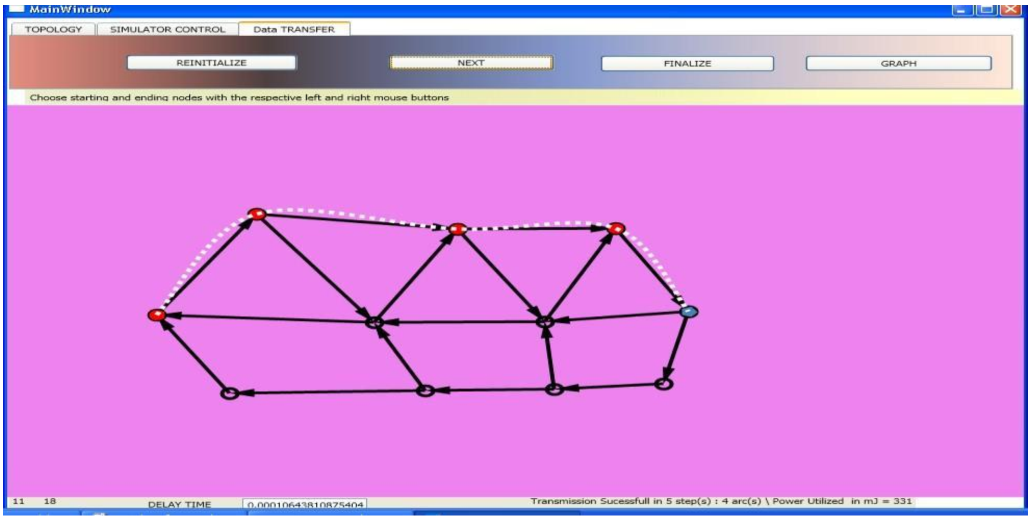

Fig 7: Final step transmission for back pressure algorithm

The application shows step5 or final step for transmission and shows the final delay time for the back pressure algorithm. The delay time for the transmission is 10ms.

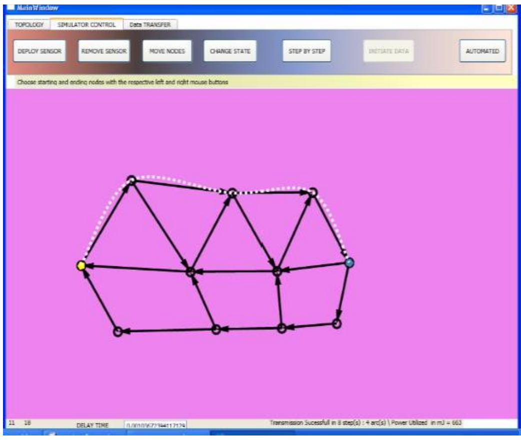
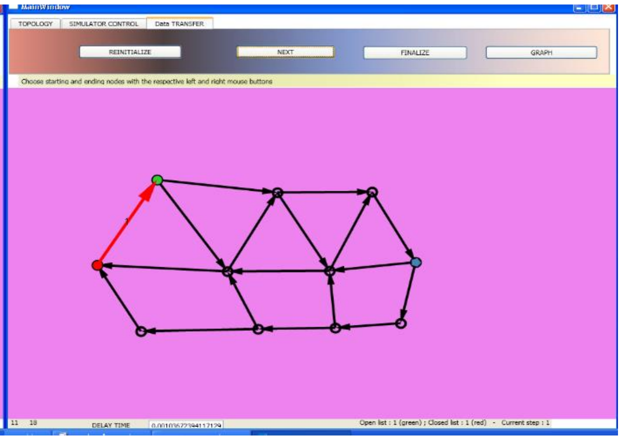

Fig 8:Select source and destination for greedy partitioning algorithm Fig9 : Step1 transmission for greedy partitioning algorithm

To choose the source node and destination node click on the initiate data button. Then select the source node and destination node. Select greedy algorithm and it shows the path. For the above shown path it takes 8steps, 4 arcs and power utilized is 663mJ.

The step by step button should be clicked in the simulator control tab and then in the data transfer tab click the next tab. It shows the step by step transmission. The application shows step1 transmission.

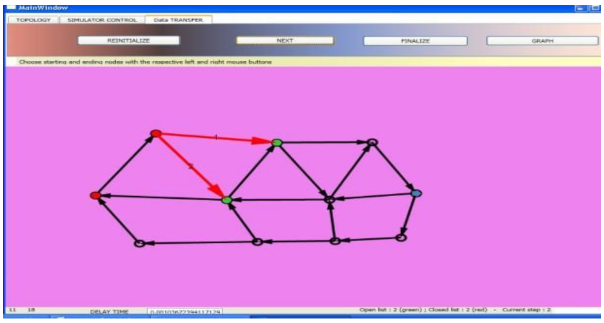

Fig 10: Step2 transmission for greedy partitioning algorithm

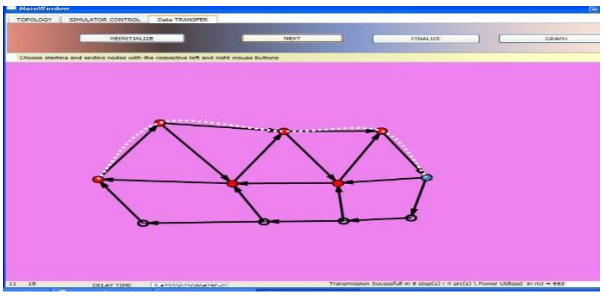

Fig 11: Step8 transmission for greedy partitioning algorithm

The application shows step2 transmission. Likewise the step by step transmission till step8 will be carried out in a similar manner.

The figure shows final step8 transmission. The delay time is 5.47sec and it is displayed. Greedy algorithm takes larger delay time compared to back pressure algorithm.

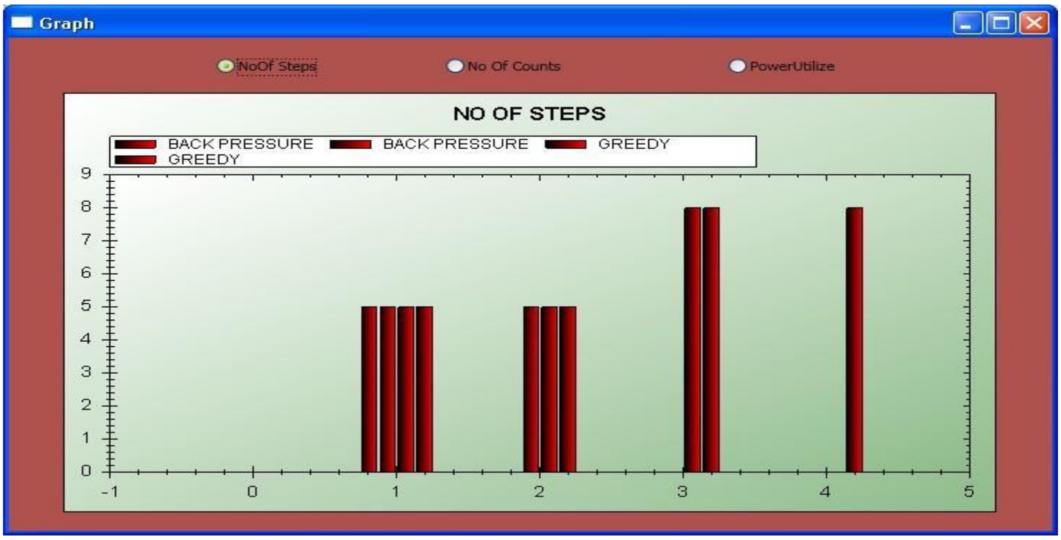

Fig 12: Graph shows number of steps

If graph button in the data transfer tab is clicked, the graph will be displayed. The graph shows number of steps for back pressure algorithm and greedy algorithm. For the application in which the number of steps should be less uses back pressure algorithm. For the application in which the number of steps should be more uses greedy algorithm.

Fig 13: Graph shows number of counts

The graph shows number of counts for back pressure algorithm and greedy algorithm. For the application in which the number of counts should less uses back pressure algorithm. For the application in which the number of counts should be more uses greedy algorithm.

Fig 14:Graph shows power utilized

The graph shows for power utilized back pressure algorithm and greedy algorithm. For the application in which power utilized is more uses greedy algorithm . For the application in which power utilized isless uses back pressure algorithm.

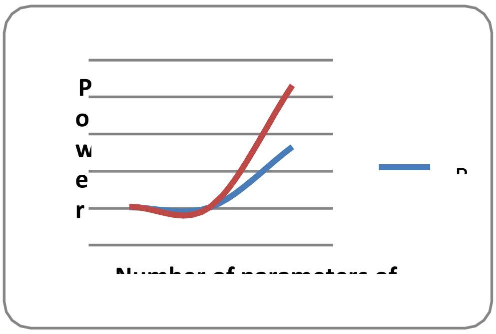

Fig 15: Graph for power utilization

The graph in the figure shows power utilization for back pressure algorithm and greedy partitioning algorithm.

CONCLUSION

In this paper, the new approaches are developed to reduce the bottlenecks in a multi-hop wireless networks based on greedy partitioning algorithm and back pressure algorithm and to indicate the average packet delay. By simulation it is able to prove that proposed scheme of the data transmission decreases the delay by using algorithms.

For future work, a plan to study simple heuristics that can approximate the optimal schedule may be considered. Emphasis is made in heuristic solutions that are easy to implement in a distributed fashion. Also, the analysis can be readily extended to handle channel variations. And also obtain policies that minimize a function of queue lengths at all times on a sample path basis.

BIBLIOGRAPHY

[1] Gagan Raj Gupta, Ness B. Shroff.Delay Analysis and Optimality of Scheduling Policies for Multi-Hop Wireless Networks.IEEE/ACM TRANSACTIONS ON NETWORKING, VOL. 19, NO. 1, FEB 2011.

[2] H. Balakrishnan, C. Barrett, V. Kumar, M. Marathe, and S. Thite.The distance-2 matching problem and its relationship to the maclayercapacity of ad hoc networks.*IEEE Journal on Selected Area inCommunications*, 22, 2004.

[3] P. Chaporkar, K. Kar, and S. Sarkar. Throughput guarantees throughmaximal scheduling in wireless networks. In *43rd Annual AllertonConference on Communication, Control, and Computing*, 2005.

[4] Leandros, T., and Ephremides, A. Stabilityproperties of constrained queueing systems andscheduling policies for maximum throughput inmultihop radio networks. IEEE Trans. Aut. Contr.3737, 12 (1992), 1936– 1948

[5] G. R. Gupta. *Delay Efficient Control Policies for Wireless Networks*.Ph.D. Dissertation, Purdue University, 2009.

[6] G. R. Gupta, S. Sanghavi, and N. B. Shroff. Node weighted scheduling.*SIGMETRICS-Performance'09*, June 2009.

[7] Xiaojun Lin and Ness B. Shroff.Joint Rate Control and Scheduling inMultihop Wireless Networks.June 2001

[8] Steven H Low and R.Srikant.A Mathematical Framework for Designing a Low-Loss, Low- Delay Internet. November 29, 2002.

[9] I. Keslassy and N. McKeown. Analysis of scheduling algorithms thatprovide 100% throughput in input- queued switches. In *39th AnnualAllerton Conference on Communication, Control, and Computing.Monticello,Illinois*, October 2001.

[9] S. Jagabathula and D. Shah. Optimal delay scheduling in networks with arbitrary constraints. In *ACM SIGMETRIC/Performance*, June 2008.

[10]H. Balakrishnan, C. Barrett, V. Kumar, M. Marathe, and S. Thite.The distance-2 matching problem and its relationship to the maclayercapacity of ad hoc networks.*IEEE Journal on Selected Area inCommunications*, 22, 2004.

[11] G. R. Gupta, S. Sanghavi, and N. B. Shroff. Node weighted scheduling.*SIGMETRICS-Performance'09*, June 2009.

[12] G. R. Gupta, S. Sanghavi, and N. B. Shroff.Workload optimality inswitches without arrivals.*MAthematical performance Modeling andAnalysis Workshop*, June 2009.

[13] Bo Ji, ChangheeJoo, and Ness B. Shroff.Throughput-optimal Scheduling in Multi-hop Wireless Networks without Per-flowInformation.July 2011

[14] S. H. Lu and P. R. Kumar. Distributed scheduling based on due dates and buffer priorities. *IEEE Transactions on Automatic Control*, pages1406–1416, 1991.

[15] M. J. Neely. Order optimal delay for opportunistic scheduling in multiuserwireless uplinks and downlinks.In *44th Annual Allerton Conferenceon Communication, Control, and Computing*, September 2006.

[16] T. Weller and B. Hajek.Scheduling nonuniform traffic in a packetswitchingsystem with small propagation delay.*IEEE/ACM Trans. Netw.*,5(6):813–823, 1997.

[17] Y. Xi and E. M. Yeh. Optimal capacity allocation, routing, and congestion control in wireless networks. In *International Symposiumon Information Theory*, July 2006.

[18]Gagan Raj Gupta and Ness B. Shroff.Practical scheduling schemes with throughput guarantees for multi- hop wireless networks.Computer Networks 54 (2010) 766–780.

[19] L. Ying, R. Srikant, A. Eryilmaz, and G. E. Dullerud.A large deviationsanalysis of scheduling in wireless networks.*IEEE Transactions onInformation Theory*, 52:5088–5098, 2006.

[20] G. R. Gupta and N. B. Shroff. Delay analysis for wireless networks withsingle hop traffic and general interference constraints. *IEEE Transactionson Networking*, 18:393 – 405, April 2010.

[21] M. J. Neely. Delay analysis for maximal scheduling in wireless networkswith bursty traffic. IEEE INFOCOM, 2008.