Improving Quality of Service by Multipath Routing in Mobile ADHOC Networks Using RMA Algorithm

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Abstract

Mobile Ad Hoc Networks (MANETs) is an active research area with a number of proposals being made to support real-time applications that are based upon the interaction between the routing scheme and a QoS provisioning mechanism. This paper builds upon such ideas and presents QoS-aware Shortest Multipath Source (Q-SMS) routing protocol that have been shown to offer significant network improvement when compared to best protocol proposed schemes. Q-SMS essentially modifies the previously proposed SMS scheme to explicitly provide QoS assurance. The new proposed scheme allows nodes to obtain and then use estimation of the residual capacity to make appropriate admission control decisions. In this paper we compare a QOS-based, Robust Multipath Routing (QRMR) protocol for mobile ad hoc networks and a cross layer based multipath routing (CBRM) protocol to improve QoS in mobile ad hoc networks to allot weights to individual links, depending on the metrics link quality, channel quality and end-to-end delay is developed. This paper presents a new approach based on multipath routing backbones (MRB) for supporting enhanced QoS in MANETs. The objective of this multipath routing is to improve the reliability and throughput and favour load balancing. The bulkiness of our protocol achieves improved packet delivery ratio with reduced latency was established.

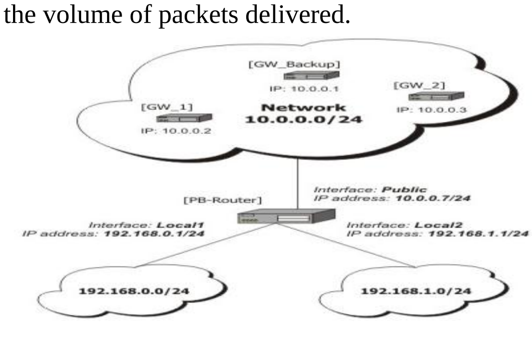
Index Term: Q-SMS, MANET, MRB, QRMR, Multipath Routing, CBRM

I. INTRODUCTION

Direction-finding schemes have encouraged a great deal of interest from the beginning of Mobile Ad Hoc Network (MANET) [1] investigate until the current time. Early work [2–4] listening carefully on finding feasible routes without considering information about the network status. In addition, without knowing the bottleneck capacity or throughput, the source may send more data than the bottleneck node on the route can accommodate. The overloaded node ultimately drops data which wastes capacity and unnecessarily consumes energy. Also, time is expended in transmitting such data. Therefore, data that eventually reaches its destination would have to wait longer in packet queues, resulting in a significantly increased delay. Although this may be acceptable for data only applications, many real-time applications require Quality of Service (QoS) support from the network. Possible QoS support can be achieved by finding a route to satisfy the application requirements.The cross-layer optimized energy-aware multipath routing protocol (EMRP) for mobile ad hoc networks (MANET) is proposed. By sharing the information among the physical layer, the MAC sub-layer and the network layer, EMRP efficiently utilizes the network resources such as the node energy and the link bandwidth. Simulation results show that the protocol prolongs the network lifetime, increases the volume of packets delivered, lowers the energy dissipation per bit of data delivery and shortens the end-to-end delay.

II. RELATED WORK

One of the basic characteristics of a mobile adhoc network (MANET) is the multi-hop connection, in which mobile nodes cooperate to relay traffic to the distant destination node that would otherwise be out of direct communication range. Therefore, nodes in MANET serve not only as hosts, but also as routers. The multi-hop connection can also increase network capacity and decrease the energy consumption for transmission. However, due to the frequently changing network topology and limited resources of energy and wireless bandwidth, routing in MANET is an extremely challenging task. Basically, the routing protocol which chooses the best route between the source and destination nodes to fulfill the multi-hop transmission is called single path routing. In cases of highly dynamic network topology and strictly limited resources, however, single path routing is not the best solution. Multipath routing protocols are then introduced, which provides redundant and alternative routes to assure successful data packet transmission and, at the same time, reduce the key relay nodes power consumption, alleviating the network partitioning problem caused by the energy exhaustion of these nodes. Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Another key issue in MANET protocol design is cross layer optimization. Based on the OSI 7-layer model, traditional network protocol design explicitly defines and strictly restricts the information exchanged between layers. However, this prevents efficient protocol design in MANET. For example, under the layering restriction, MANET routing protocols are unable to retrieve energy and location information from the underlying data link layer and physical layer and, thus, unable to calculate good routes based on such information. We will use the term "cross layer design" and "cross layer optimization" interchangeably hereafter to refer to protocol design and optimization based on the inter-layer exchange of information beyond the OSI-layer structure definition. Based on the rationale of multipath routing and cross-layer design, we introduce the Energy-aware Multipath Routing Protocol (EMRP)[15] for MANET. EMRP is a multipath routing protocol which uses information from the physical layer and the MAC layer in choosing routes, focusing on the energy efficiency and the overall network performance. Simulation results show that EMRP outperforms the traditional single path routing protocol in providing longer network lifetime and lower energy consumption per bit of information delivered. In addition, as in other multipath routing protocols, it reduces the end-to-end delay and improves the volume of packets delivered.



A. Rate monotonic algorithm (rma)

We had already pointed out that RMA is an important event-driven scheduling algorithm. This is a static priority algorithm and is extensively used in practical applications. RMA assigns priorities to tasks based on their rates of occurrence. The lower the occurrence rate of a task, the lower is the priority assigned to it. A task having the highest occurrence rate (lowest period) is accorded the highest priority. RMA has been proved to be the optimal static priority real-time task scheduling algorithm. The interested reader may see [12] for a proof. In RMA, the priority of a task is directly proportional to its rate (or, inversely proportional to its period). That is, the priority of any task T_i is computed as: *priority* $=(x+a)^n = \sum_{k=0}^{n} \binom{n}{k} x^k a^{n-k}$, where p_i is the period of the task T_i and k is a constant. Using this simple expression, plots of priority values of tasks under RMA for tasks of different periods can be easily obtained.

B. QoS-aware SMS (Q-SMS) Routing Scheme

A novel and practical QoS routing scheme referred to as the QoS-aware Shortest Multipath Source (Q-SMS) routing scheme is proposed. The proposed scheme modifies and extends the route discovery and maintenance of SMS [23] to provide QoS assurance. The QoS extension allows nodes to use their estimation of the residual capacity to make better admission control decisions. The Q-SMS routing scheme achieves high good output, low delays and overheads in the presence of mobility and traffic load and enables natural integration with the local residual capacity estimation.

This section describes the residual capacity estimation, route discovery with admission control, QoS route reply phase, and QoS route maintenance phase and path selection of the proposed scheme.

III. ROUTE DISCOVERY WITH ADMISSION CONTROL

Q-SMS is an on-demand QoS-aware routing scheme that utilizes a cross-layer design. Therefore, the routing scheme depends on the application requirements. Q-SMS finds a route to the destination by flooding the network with a QoS route request (QRREQ). Q-SMS extends RREQ packet format of SMS with the capacity constraint. The capacity constraint consists of the required capacity (C_{req}) and minimum available capacity (C_{min}) representing minimum capacity of the application and minimum available capacity (bottleneck capacity) of an outgoing link useful for path selection.

The source node records C_{req} and compares with the local residual capacity (C_{res}) of the outgoing link (by receiving link layer feedback from IEEE 802.11). If C_{res} is higher than C_{req}, the source node records the value of C_{res} in the C_{min} field which, initially is infinity (or a very large number) and broadcast the QRREQ packet to its neighbor nodes.

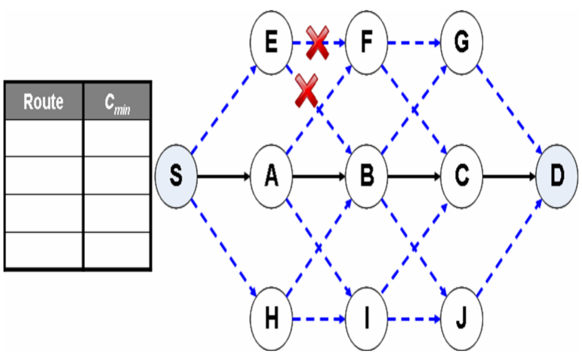


Figure1. Admission control in RREQ propagation

Figure 1 shows an example of Q-SMS route discovery with admission control, where S is the source node and D is the destination node. S initiates the route discovery phase by sending QRREQ packet to the neighbors with reverse shortest hop count [23] and capacity constraints. In this example, node A has sufficient capacity on its QoS portion of allocated capacity, so it forwards QRREQ to neighboring nodes. However, node E does not have enough capacity in the QoS portion, so it does not forward QRREQ to D through B and F even though it can reach D. In this fashion if QRREQ reaches the destination by satisfying the reverse shortest hop count and the capacity constraint, then the destination replies with a QRREP packet back to source node using the reverse path identified within the QRREQ packet.

A. Performance Metrics

We measure up to our Q-SMS protocol with the CBRM[13] and QRMR[14] protocol**.** We evaluate mainly the performance according to the following metrics, by the nodes.

Control overhead: The control overhead is defined as the total number of routing control packets normalized by the total number of received data packets.

Average end-to-end delay: The end-to-end-delay is averaged over all surviving data packets from the sources to the destinations.

Average Packet Delivery Ratio: It is the ratio of the No. of packets received successfully and the total no. of packets sent

Figure 1: Nodes Vs Delay

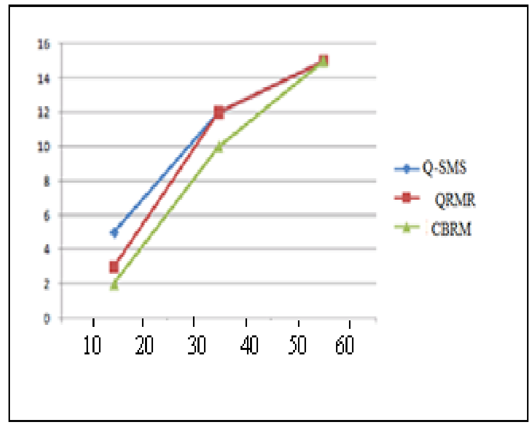


Figure 2: Nodes Vs Delratio

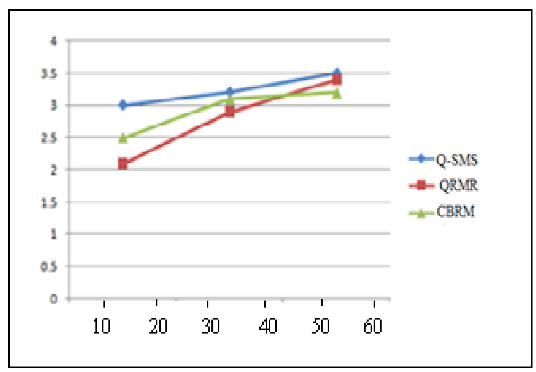


Figure 3: Nodes Vs Overhead

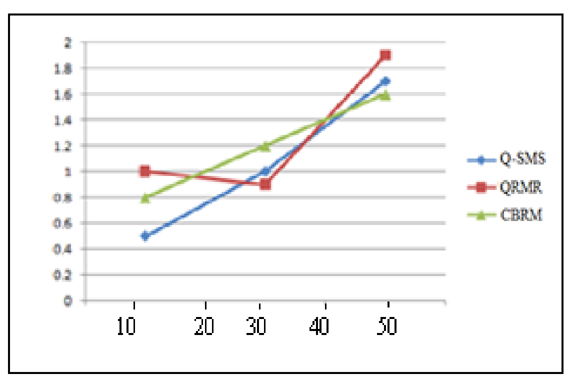


Figure 4: Speed Vs Delay

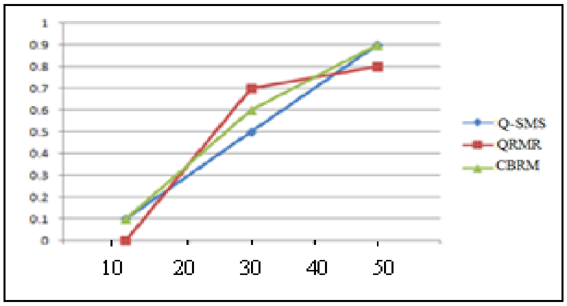


Figure 5: Speed Vs Delratio

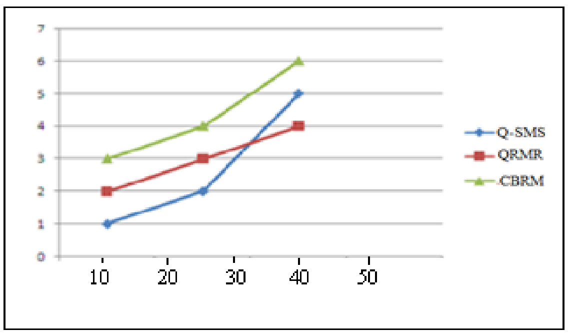
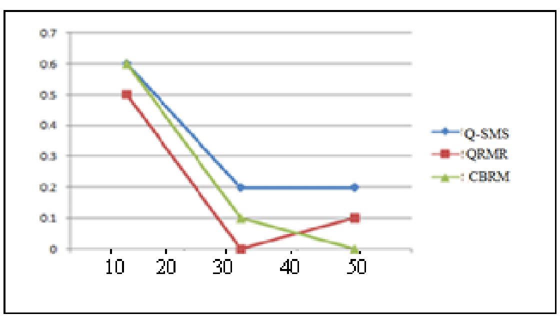


Figure 6: Speed Vs Overhead



IV. CONCLUSION

In this paper, a multipath routing protocol(Q-SMS) for mobile ad hoc networks is proposed and a comparative analysis is done with existing protocols. As a cross-layer design, QRMR utilizes the information from the physical layer and the Q-SMS protocol to select better routes. Mobile ad hoc networks require a complex management to efficiently exploit the networks resources also covering the heavily demanded QoS constraints in current multimedia applications. This paper presents a cross-layer design that tries to combine the functionality of the Routing layer with Medium Access Control (MAC) information and physical layer parameters to provide the routing algorithm with the more accurate information about the environment. Simulations results indicate that Q-SMS Protocol network lifetime and achieve lower energy dissipation per bit of data delivery, higher volume of packets delivered and lower end-to-end delay.

REFERENCES

[1] Xiaobing Hou and David Tipper, "Impact of Failures on Routing in Mobile Ad Hoc Networks Using DSR", in Web Protocols White Papers, University of Pittsburgh, November 2002.

[2] Mahesh K. Marina and Samir R. Das, "On- Demand Multipath Distance Vector Routing in Ad Hoc Networks", in proceedings of 9th IEEE International Conference on Network Protocols, pp: 14- 23, 11- 14 November 2001.

[3] Andre Schumacher, Harri Haanpaa, Satu Elisa Schaeffer, and Pekka Orponen, "Load Balancing by Distributed Optimization in Ad Hoc Networks", in proceedings of 2nd International Conference on Mobile Ad-hoc and Sensor Networks, vol. 4325, pp: 874- 885, Berlin- Heidelberg, 2006.

[4] Jangeun Jun and Mihail L. Sichitiu, "Fairness and QoS in Multihop Wireless Networks", in proceedings of 58th IEEE Conference on Vehicular Technology, vol. 5, 6- 9 October 2003, pp: 2936- 2940.

[5] Michael Gerharz, Christian de Waal, Matthias Frank and Paul James, "A Practical View on Quality-of-Service Support in Wireless Ad Hoc Networks", Proc. of the 3rd IEEE Workshop on Applications and Services in Wireless Networks (ASWN), Berne, Switzerland, July 2003, pp: 185-196.

[6] DucA.Tran and Harish Raghavendra, "Congestion Adaptive Routing in Mobile Ad Hoc Networks", IEEE Transactions on Parallel and Distributed Systems, Vol. 17, no. 11, November 2006.

[7] Xiaoqin Chen, Haley M. Jones, A .D .S. Jayalath, "Congestion-Aware Routing Protocol for Mobile Ad Hoc Networks", in proceedings of 6th IEEE Conference on Vehicular Technology,30 September- 3 October, Baltimore, 2007, pp: 21-25.

[8] Jianbo Xue, Patrick Stuedi and Gustavo Alonso, "ASAP: An Adaptive QoS Protocol for Mobile Ad Hoc Networks", IEEE Proceedings on Personal, Indoor and Mobile Radio Communications, vol. 3, pp: 2616- 2620, 7- 10 September 2003, Doi: 10.1109/PIMRC.2003.1259201.

[9] Jangeun Jun and Mihail L. Sichitiu, "Fairness and QoS in Multihop Wireless Networks", in proceedings of 58th IEEE Conference on Vehicular Technology, vol. 5, pp: 2936- 2940, 6- 9 October 2003, Doi: 10.1109/VETECF.2003.1286161.

[10] Ruth Ravenel, University of Colorado,Boulder ,"Rate Monotonic Analysis", Software Engineering Institute Carnegle Mellon University,Plttsburgh PA 15213.

[11] Michael Gerharz, Christian de Waal, Matthias Frank and Paul James, "A Practical View on Quality-of-Service Support in Wireless Ad Hoc Networks", Proc. of the 3rd IEEE Workshop on Applications and Services in Wireless Networks (ASWN), pp: 185-196, Berne, Switzerland, July 2003.

[12] Duc A. Tran and Harish Raghavendra, "Congestion Adaptive Routing in Mobile Ad Hoc Networks", IEEE Transactions on

Parallel and Distributed Systems, Vol. 17, no. 11, November 2006.

[13] S.VenkataSubramanian and Dr.N.P.Gopalan, "A QoS Based Robust Multipath Routing Protocol for Mobile Adhoc Network",in proceedings of IACSIT International Journal of Engineering and Technology Vol.1, No.5,December 2009,ISSN:1793-8236

[14] S.VenkataSubramanian , " A Cross Layer Based Multipath Routing Protocol to improve QoS In Mobile Adhoc Networks", ACEEE International Journal Of Network Security, Vol 1, No.1 ,Janauary 2010.

[15] Meng Li, Lin Zhang1,2, Victor O. K. Li2, Xiuming Shan1, Yong Ren1,"An Energy-Aware Multipath Routing Protocol for Mobile Adhoc Network", Department of Electrical and Electronic Engineering, University of Hong Kong, Pokfulam Road, Hong Kong, PRC, vli@eee.hku.hk.

[16] C.S.Murthy, B.S. Manoj, Ad hoc Wireless Networks Architectures and Protocols, Prentice Hall, NJ, USA, 2004.

[17] K.D.Sajal, A. Mukherjee, et al., "Improving quality-of-service in ad hoc wireless networks with adaptive multi-path routing," In Proceedings of IEEE Globecom 2000, San Francisco, CA, Nov. 2000, pp. 261-265.

[18] M.R.Pearlman, Z. J. Haas, et al., "Alternate path routing in mobile ad hoc networks," In the Proceedings of IEEE MILCOM 2000, Los Angeles, CA, Oct. 2000, pp.501-506.

[19] M.R.Pearlman, Z. J. Haas, et al., "On the impact of alternate path routing for load balancing in mobile ad hoc networks," In Proceedings of IEEE MobiHoc 2000, Boston, MA, Aug. 2000, pp. 3-10.

[20] S.J.Lee and M. Gerla, "Split multipath routing with maximally disjoint paths in ad hoc networks," In Proceedings of IEEE ICC 2001, Helsinki, Finland, June 2001, pp. 3201-3205.

[21] K.Wu and J. Harms, "Performance study of a multipath routing method for wireless mobile ad hoc networks," In Proceedings of the Ninth International Symposium in Modeling, Analysis and Simulation of Computer and Telecommunication Systems, Cincinnati, OH, Aug. 2001, pp. 99 -107.

[22] Lin C.R. and Liu, J.S., "QoS Routing in Ad Hoc Wireless Networks," IEEE Journal on Selected Areas in Communications, Vol. 17, no.8, pp. 1426-1438, Nov./ Dec. 1999.

[23] Xue, Q. and Ganz, A., "Ad hoc QoS on-demand routing (AQOR) in mobile ad hoc networks", J. Parallel Distrib. Comput. Vol. 63 pp. 154–165, 2003.

[24] Zhu, C., Corson, M.S., "QoS Routing for Mobile Ad Hoc Networks" in Proc. IEEE INFOCOM'02, New York, USA, June, 2002.

[25] Perkins, C.E., Belding-Royer, E.M., "Quality of Service for Ad-Hoc On-Demand Distance Vector Routing"draftperkinsaodvqos- .txt. July-2000.