International Journal of Current Trends in Engineering & Research (IJCTER)
e-ISSN 2455–1392 Volume 2 Issue 3, March 2016 pp. 158 - 162
Scientific Journal Impact Factor : 3.468
http://www.ijcter.com

A Revised Approach to Receiver Based Multicasting in Ad-Hoc Networks

Rashmi M R

The National Institute of Engineering,
Manandavadi Road, Mysore, State Karnataka, India

Abstract— Multicast routing protocols typically rely on the a-priori creation of a multicast tree (or mesh), which requires the individual nodes to maintain state information.
In sensor networks where traffic is bursty, with long periods of silence between the bursts of data, this multicast state maintenance adds a large amount of overhead for no benefit to the application. Thus, Chen Hsiang Feng have developed a stateless receiver-based multicast protocol that simply uses a list of the multicast members (e.g., sinks), embedded in packet headers, to enable receivers to decide the best way to forward the multicast traffic. This protocol, called RBMulticast (Receiver-Based Multicast), exploits the knowledge of the geographic locations of the nodes to remove the need for costly state maintenance (e.g., tree/mesh/neighbor table maintenance), making it ideally suited for sensor network multicast applications. But the problem in this approach is that the packet delay is higher since each node does the region based broadcast procedure before forwarding and it takes time. Due to this the packet delay is higher. In this paper, we propose a approach to reduce the packet delay in the RBMulticast protocol. We test our solution in JProwler simulator and prove that by implementing our solution the packet delay is reduced by 48%.

I. INTRODUCTION

Communication in sensor networks is hindered by the limited energy capacity of the individual sensor nodes. Consequently, reducing the total number of packets transmitted throughout the network is essential for power conservation. For sensor networks with multiple sink nodes, multicast routing is an ideal approach to manage and reduce network traffic. Reducing the number of packets transmitted when multicasting data requires both shorter routing paths from the multicast source to the multicast members, as well as improved efficiency in terms of the total number of links the packets traverse to get to all the multicast members, i.e., the packet should be split off to different routing branches only when necessary. Shorter routing paths lead to reduced packet delay, and improved efficiency leads to a reduction in the energy consumption from transmitting fewer packets. These two properties are usually contradictory to each other, and algorithms must make a trade-off to best fit their requirements.

In the paper [1],author develop a novel multicast protocol called RBMulticast (Receiver-Based Multicast). RBMulticast is a completely stateless multicast protocol, using only location information with no tree creation or maintenance or even neighbor table maintenance, which makes it ideally suited for sensor networks. Packet routing and splitting packets into multiple routes relies solely on the location information of each multicast member, which is assumed to be known.

RBMulticast is a *receiver-based* protocol (as with the ExOR protocol [12]), which means that a sender can transmit packets without specifying the next hop node, because the potential receivers of this packet make the decision of whether or not to forward this packet in a distributed manner. This approach for transmitting packets means that routing is a result of the joint decisions of all participating nodes. Therefore, no routing tables are required within the sender node, as potential receivers decide on a valid route.

RBMulticast was motivated by the cross-layer protocol XLM [2], which is a receiver-based unicast protocol designed for WSNs. As in XLM, RBMulticast assumes a MAC protocol whereby receivers contend for channel access based on their assessed contribution towards forwarding the packet. Nodes with more energy and better links and nodes that make the most forward progress to the destination will contend earlier and hence have a higher chance to become the next hop node.

The solution works fine with good packet delivery ratio. But even for small networks the number of nodes at which the routing decision is to be made is higher and it cause delay. Also for each multicasting packet the same kind of processing is repeated. When the speed of movement of nodes is less, this is a burden and adds to lot of packet delay. Motivated by this fact, we propose a efficient solution to avoid this delay.

II. RELATED WORK

Existing multicast protocols for WSNs and mobile ad hoc networks (MANETs) generally use a tree to connect the multicast members. For example, the Takahashi-Matsuyama heuristic can be used to incrementally build a Steiner tree for multicast routing [3]. Additionally, multicast algorithms rely on routing tables maintained at intermediate nodes for building and maintaining the multicast tree [4].

Due to the specificities of WSNs, knowing sensor nodes locations is a reasonable assumption. In the location-based approach to multicast routing, nodes obtain location information by default as an application requirement (e.g., a home fire alarm would know where it is located) or as provided by a system module (e.g., GPS or a location-finding service). If location information is known, multicast routing is possible based solely on location information without building any external tree structure. For example, PBM [5] weights the number of next hop neighbor nodes and total geographic distance from the current node to all destination nodes and compares this to a predefined threshold to decide whether or
not the packet should be split. Geocast [6] delivers multicast packets by restricted flooding. Nodes forward multicast packets only if they are in the Forwarding Zone calculated at run time from global knowledge of location information..

RBMulticast differs from these approaches in that it is completely stateless and hence no costly state maintenance is required. PBM [5] uses a similar idea of stateless multicast but requires information about neighbor nodes. RBMulticast
further eliminates the requirement of knowing a node’s neighbors by using a receiver-based mechanism, and only the location of the nodes is needed for multicast packet routing.

Additionally, RBMulticast includes a list of the multicast members in the packet header, which prevents the overhead of building and maintaining a multicast tree at intermediate sensor nodes, because all the necessary information for routing the packet is included within the packet header. We believe that RBMulticast requires the least state of any multicast routing protocol and is thus ideally suited for WSNs Receiver-based communication is a different way of thinking about protocol design in that decisions are not required to be made at the sender side but instead are made at the receiver side.

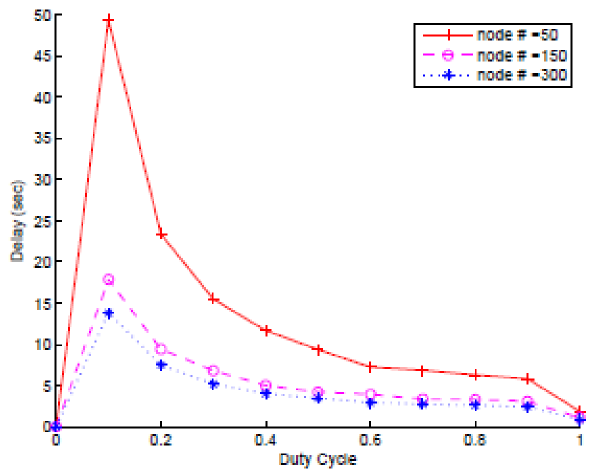
For example, a source node in ExOR [1] broadcasts packets that include a potential forwarders’ list inside the header, and these potential forwarders will contend to forward the packet through the use of different back-off times, which depend on the network distance to the destination. A source node in XLM [2] broadcasts packets with the destination’s geographic location in the header, and every receiver contends to forward the packet through the use of different back-off times, which depend on the geographic distance to the destination. In other words, in receiver-based routing, decision-making is deferred to the possible receivers, who make decisions in a distributed manner.

Receiver-based routing is different from “On-demand” or “Reactive” routing in that reactive routing calculates a route
at the time a packet is sent down to the MAC layer. For example, AODV [7] begins transmission by first sending a “Route Request” to create temporary routes among intermediate nodes and then transmits data packets through this route. The ability to transmit data without requiring a route to be formed is enabled via extra knowledge in the MAC layer and join decisions of sensor nodes. For example, nodes could be assigned an ID in a structured manner and hence next hop nodes are implied in the destination address itself.

In this case, packets are broadcast by the MAC layer, and only potential next-hop nodes relay it to the destination. As another example, nodes may have statistics (e.g., energy, channel quality) that could assist in making forwarding decisions. A source node can send an RTS packet, enabling potential receivers to contend for the ability to forward the packet, with the receiver node that has the best route being the first to return a CTS to receive this packet.

We simulated the use of RBMulticast under different network densities for large-scale WSNs. There are a total of either 50, 150 or 300 nodes randomly distributed throughout the simulation area. The source node is located at the bottom left corner (0, 0), and the multicast receiver nodes are scattered over the boundary of the region.

From this we see the delay is in order of seconds even for a network of 50 nodes. This becomes the objective for the paper to reduce this delay.



III. OVERVIEW OF PROPOSED SOLUTION

As we analyze the RBMulticast protocol, the delay is caused due to following factors.

1. The region based broadcast is done at each nodes.
2. The procedure is repeated for all the packets from a source within a short period of time.

Delay due to factor 1 cannot be reduced.

Suppose a source is sending 10 packets and for the first packet we do RBMulticast and learn the route, for the next 9 packets if the learnt route can be made use, the delay can be reduced. But the learnt route has to be kept in memory for a short period of time. This momentary state can be kept to reduce the delay introduced due to factor 2.

IV. DETAILS OF PROPOSED MECHANISM

A. Packet Processing At Nodes

A source node when it wants to a group of packets, it has to keep a session id value in the packet.

The session id is same for the W say 10 packets in the group of packets. The value of W can be adjusted based on the mobility speed of the node. For very low mobility W can be kept very high. In the later section we will provide a guidance mechanism to choose the W value.

For every W packets the session id is same. The session id should be uniquely generated using the source node id and the current time stamp.

The regions to forward the packet are found using RBMulticast and then the neighbors indentified are added into the cache against the session id. The entry is added to cache will following format (session id, forward_neighbours, validity).

The validity of packet is time the entry will remain in cache. It should be less than W milli seconds, which is the optimum time to process W packet.

For forwarding any packets, it session id is looked up in the cache, if its present the packet is forwarded to that forward_neighbours in the cache.

On expiry of validity the session id is removed from cache.

The intermediate node which receives the packet to forward also does same behavior. Due to this for a time of about W milli seconds the route is cached and the W packets can use this route and thereby we have avoided the RBMulticast region split and neighbor deciding for a time period.

B. Choosing W value

The choice of W value is dependent on the average mobility speed of the node in the network.

If the speed is high the route cannot be cached for a longer duration.

Let

V_{max} – Maximum average velocity

V_{min} – Minimum average velocity

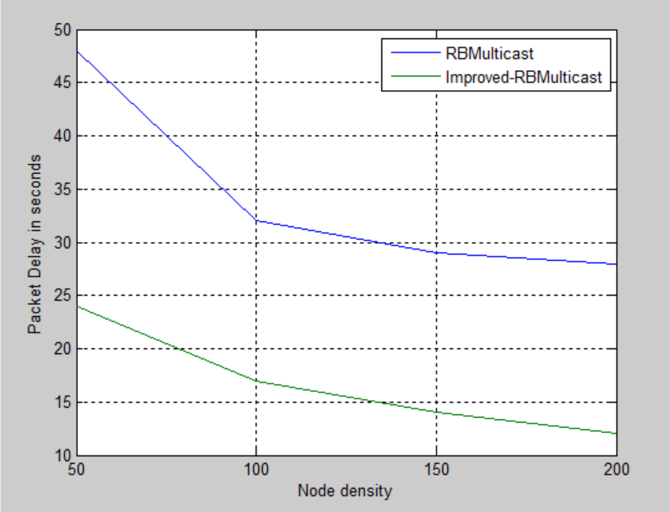
D = 20 msec

$W = D * V_{min} / V_{max}$.

V. PERFORMANCE ANALYSIS

We implemented the RBMulticast and the proposed extension for reducing delay using JProwler simulator. We simulated for different network density of 50, 100 and150 nodes. For each node density we measure the average packet delay with RB Multicast and proposed extension to RBMulticast.

From the measurements we found that average delay is reduced around 48% because of the proposed extension.



VI. CONCLUSION AND ENHANCEMENTS

In this paper, we improved the RBMulticast delay with our proposed solution. Though simulation we proved that out approach reduces the delay by around 50%. The route cached for a momentary time so it does not introduce much overhead.

In future, we plan to conduct more analysis on the choice of W for different mobility speed and find the optimum value of W.

REFERENCES

[1] S. Biswas and R. Morris, "Opportunistic routing in multi-hop wireless networks," *SIGCOMM Computer Communications Review*, vol. 34, no. 1, pp. 69–74, 2004.

[2] I. Akyildiz, M. Vuran, and O. Akan, "A cross-layer protocol for wireless sensor networks," in *Proc. of CISS 2006*, March 2006.

[3] K. Chen and K. Nahrstedt, "Effective location-guided tree construction algorithms for small group multicast in manet," *INFOCOM. Twenty-First* Annual Joint Conference of the IEEE Computer and Communications Societies. Proceedings. IEEE, vol. 3, pp. 1180–1189, 2002.

[4] A. Okura, T. Ihara, and A. Miura, "Bam: branch aggregation multicast for wireless sensor networks," *Mobile Adhoc and Sensor Systems* Conference, 2005. IEEE International Conference on, pp. 10 pp.–, Nov. 2005.

[5] M. M. andand Holger Fuler, J. Widmer, and T. Lang, "Positionbased multicast routing for mobile ad-hoc networks," *SIGMOBILE Mob.Comput. Commun. Rev.*, vol. 7, no. 3, pp. 53–55, 2003.

[6] Y.-B. Ko and N. H. Vaidya, "Geocasting in mobile ad hoc networks: Location-based multicast algorithms," *wmcsa*, vol. 0, p. 101, 1999.

[7] "Ad-hoc on-demand distance vector routing," Mobile Computing Systems and Applications, 1999. Proceedings. WMCSA. Second IEEE Workshop *on*, pp. 90–100, 1999.

[8] B. Karp and H. T. Kung, "GPSR: greedy perimeter stateless routing for wireless networks," in *MobiCom '00: Proceedings of the 6th annual* international conference on Mobile computing and networking. New York, NY, USA: ACM, 2000, pp. 243–254.

[9] V. D. Park and M. S. Corson, "A highly adaptive distributed routing algorithm for mobile wireless networks," *infocom*, vol. 00, p. 1405, 1997.

[10] "UPS: Unified Protocol Stack for Wireless Sensor Networks," under submission.

[11] H. Chen and Y. Li, "Performance model of ieee 802.11 dcf with variable packet length," *Communications Letters, IEEE*, vol. 8, no. 3, pp. 186

[12] Chen-Hisang Feng ," Stateless multicasting protocol for adhoc networks"

