Survey on Multicast Routing Protocols for Ad Hoc Networks

Athira V.
PG Scholar/Department of CSE,
Karunya University, Tamil Nadu, India,

Jeban Chandir Moses
Assistant Professor/Dept. Of CSE,
Karunya University, Tamil Nadu, India,

Abstract

The ad-hoc networks have no infrastructure. Some devices are equipped for wireless communication. In this each mobile host act as a router. Peer to peer and peer to remote communication can be performed. The sensors are distributed in ad-hoc way in wireless sensor networks. Sensors are the main components of wireless sensor networks. Due to the small size, sensors have low power, limited memory and energy constrained. Multicasting is the process of sending information from one sender to several receivers at the same time. The multicast routing can be done using several methods. The literature survey has been done in various protocols to know how the multicast routing is done efficiently.
Index terms – Wireless network, Multicast routing, Ad hoc networks.

1. Introduction

Wireless Sensor Networks (WSNs) consist of a large number of sensor nodes, which consist of sensing unit, data processing unit and communication components. The main parts of wireless sensor networks are sensors. Due to the small size, sensors have low power, limited memory and energy constrained. The sensors are distributed in ad-hoc way in wireless sensor networks. The ad-hoc networks have no infrastructure. Some devices are equipped for wireless communication. In this each mobile host act as a router. Peer to peer and peer to remote communication can be performed.
Many applications in this world require the data delivery to multiple destination nodes [10]. For this we have a tendency for using the conception of multicasting, as a result of it's a lot of more advantageous than multiple unicasts in terms of the communication prices. Multicasting could be a method of concurrently causation identical message from one supply to multiple destinations. It's necessary to cut back the total range of packet transmitted through the network because every node incorporates a restricted energy capability. For this many multicast routing protocol has been developed which may be classified as tree or mesh. In mesh primarily based multicasting there could also be quite one path between a pair of source and destination, this provide a lot of strength to tree primarily based multicast protocol. In tree primarily based multicast protocol there exist solely a single path between a pair of source and destination [10].

For the routing here at least one sender and several receivers are participating. The receivers groups are called multicast group. The router receives the packet and forward through its interfaces. The information about tree and multicast group update information are disclosed among the neighbour nodes. In some cases the multicast source and the nodes are mobile but the destinations are fixed and may be known. The traffic updates from a vehicle is sensed by the fixed roadside stations in a vehicular ad hoc network. The applications such as wildfire detection, pollution monitoring, etc are performed in the same way and there may be also the destination nodes have to be mobile. So the multicasting is done by the source node must know the locations of the multicast destination nodes [1] [2] [6].

The paper is organized as follows: Section 2 presents problem statement. Section 3 classifies the solutions against the multicast routing problem in ad hoc networks and the advantages and disadvantages of these solutions are discussed. The conclusion of the paper is given in section 4.

2. Problem Statement

Current multicast routing requires multicast tree (or mesh) creation, so that individual nodes have to maintain state information. The state maintenance adds large amount of communication, processing, and memory overhead. In some cases the multicast source and the nodes are mobile but the destinations are fixed and may be known. The traffic updates from a vehicle is sensed by the fixed roadside stations in a vehicular ad hoc network. The applications such as wildfire detection, pollution monitoring, etc are performed in the same way and there may be also the destination nodes have to be mobile. So the multicasting is done by the source node must know the locations of the multicast destination nodes.

3. Related Works

Several methods have been proposed in the literature for the multicast routing. In this section it gives a brief overview for the multicasting.

3.1 A Cross-Layer Protocol for Wireless Sensor Networks (XLM)

There are some strict boundaries between the layers. In the cross layer optimization this difficulties are removed and allow interactions between the layers. Here the conventional communication layer's information and the functionalities are combined to a single protocol. It guarantees less energy consumption and have highly efficient communication. The operations are based on the concept called initiative determination. For the efficient and reliable communication XLM performs received based contention, local congestion control, and distributed duty cycle operations. The initiative concept allows every node to determine whether to participate in communication or not [7].

First the node sends RTS packet to its neighbours. After receiving the RTS packet each neighbour nodes decides whether to participate or not in communication. These decisions are made based on the initiative determination. It is a binary operation. The nodes participate in communication if and only if the initiative is 1. The initiative is set to 1 according to four conditions. The first condition is that for the participation of nodes in communication, the received signal to noise ratio (SNR) of RTS packet must be above some threshold value. The second condition prevents congestion by limiting the traffic. The third condition also to be prevents congestion. Here the node does not have buffer overflow. The last condition is that the remaining energy must be above some minimum value [7]. The functionalities of XLM depend on these constraints. The advantages are highly reliable, high performance at low duty cycle. The disadvantage is end to end latency of XLM increases for low duty cycle.

3.2 Multicast Operation of the Ad hoc On-Demand Distance Vector Routing Protocol

Ad hoc On-Demand Distance Vector (AODV) is a packet routing protocol. It is a demand driven protocol. The route discovery is established if the route to destination is not known. The information about the destination nodes are maintained by a routing table [8]. The routing tables are associated with each node. The routing table fields are,

- Destination IP address
- Destination Sequence Number
- Hop Count
- Next Hop
- Lifetime

By receiving two message types, route requests (RREQ) and route replies (RREP) new entries are placed in the route table. If anode receives any of these messages and if it is not in the table then it is placed in the table and each entry consist of a lifetime. The validity is taken according to the length of the lifetime. If the routes are not used within the lifetime the routes are deleted from the table.

A node maintains a multicast routing table. The multicast route table fields are,

- Multicast Group IP Address
- Multicast Group Leader IP Address
- Multicast Group Sequence Number
- Hop Count to Multicast Group Leader
- Next Hops
- Lifetime

The third table is the Request table. The fields are,

- Multicast Group IP Address
- Requesting Node IP Address

AODV supports the three types of communication, Unicast, Broadcast and multicast. The link breakages are repaired [8]. The information are on-demand and loop free. The disadvantages are not scalable and location of group member could cause performance to differ.

3.3 A Multicast Routing Protocol for Ad-Hoc Networks

Multicast routing in ad-hoc networks is become simple with the introduction of Core-Assisted Mesh Protocol (CAMP). The notion of core based trees generalizes by CAMP and this leads to the introduction of Multicast meshes which have much efficient connectivity than trees. Each multicast group has a dedicated shared multicast mesh, the intention behind such shared meshes is to ensure and maintain the connectivity of multicast groups during the movement of network routers [4]. CAMP has made up of protection of multicast meshes and loop-free packet forwarding through such meshes. Multicast mesh group consist of a group, packets from any source in a group have forwarded with the reverse shortest path to the source. In other words the traditional multicast protocols based on source based trees. CAMP guarantees the reverse shortest path to each source in the multicast group within a finite time for every receiver [4]. The multicast packets have forwarded through the shortest paths from sources to receivers which are defined in the group's mesh. For a router to join in a multicast group, we need to limit the traffic and CAMP uses cores only to limit this traffic. The packet forwarding will not affect by the failure of cores. CAMP has the same architecture used in IP multicast. Each multicast group maintains a multicast mesh for information distribution. There is no chance to flooding of the networks when there are cores available.

3.4 On-Demand Multicast Routing Protocol (ODMRP)

ODMRP is a mesh based multicast method and uses the concept of forwarding group. The routes and maintenance of multicast group membership are on demand. There is request phase and a reply phase. When a source node wish to send a packet an advertisement packet, JOIN REQUEST is send to the entire network. If a node receives a non-duplicate JOIN REQUEST, then it stores the upstream node ID and then rebroadcasts the packets. If the packet reaches to the receiver then the information is updated to the Member Table [3]. JOIN TABLE are broadcasted to the neighbours if there any valid entries in the member table. After receiving the JOIN TABLE, the node checks the next node ID with its own ID. If there is matching between the nodes then the node is in correct path and it is a part of the forwarding group. FG_Flags are set and broadcasts JOIN TABLE [3]. The JOIN TABLE is in the forwarding group member until it reaches the multicast source. It builds a mesh of nodes and routes to receivers. The meshes of nodes are the forwarding group. The advantages are low channel and storage overhead, usage of up-to-date and shortest routes and robustness to host mobility. The disadvantages are not scalable and for mesh structure redundant information may be significant.

3.5 Adaptive Demand-Driven Multicast Routing in Multi-Hop Wireless Ad Hoc Networks (ADMR)

ADMR dynamically maintain the routing states only for active groups and for nodes in between the multicast senders and receivers. From the sender to the receiver the multicast data packets are forwarded through the shortest-delay path. The overhead and multicast routing state maintenance caused by nodes in the network move is efficiently balanced by receivers dynamically adapt the sending pattern of senders [9].
Whenever there should be a minimum of one source and one receiver within the network, the supply-based forwarding trees are created. ADMR monitors the route of the multicast supply application, and supported that may sight link breaks within the tree, yet as sources that became inactive and cannot be causing any further knowledge. Within the former case, the protocol initiates native procedures and so global repair if the native repair fails. Within the second case, multicast forwarding state is mutely invalid while not the necessity to send a particular ending message. To modify observance for link breaks within the multicast forwarding tree once the supply isn't causing knowledge quickly, ADMR sends a restricted variety of keep-alive at increasing inter-packet times. Once the supply has not sent any knowledge for a amount of your time that constitutes a major deviation from its causing pattern, the keep-alive stop and also the entire tree mutely expires. A major deviation from a supply's causing pattern is a sign that the source is probably going to be inactive for a short time, within which case it might be wasteful to keep up routing state within the network. ADMR also prunes individual branches of the tree mechanically, once they aren't necessary for forwarding. These pruning selections are supported lack of passive acknowledgements from downstream, rather than counting on the receipt of a particular prune message.

Each multicast information packet is forwarded from the sender to the multicast receiver's exploitation MAC-layer multicast transmissions on the shortest-delay path between nodes with forwarding state for the cluster. ADMR sometimes sends an existing multicast information packet instead as a network flood, taking the place of the multicast distribution of this existing packet. This knowledge packet flood is employed solely at occasional intervals and only new knowledge is being sent to the given multicast group [9]. The advantages are ADMR uses no periodic network-wide floods of management packets and may discover high quality without the utilization of GPS.

3.6 AMRIS: A Multicast Protocol for Ad hoc Wireless Networks

The idea behind AMRIS is to dynamically assign each node in a multicast session with an id-number. The ordering between id-numbers is employed to direct the multicast flow, and therefore the meagreness among them used for fast property repair. A multicast delivery tree stock-still at a special node known as Sid joins up the nodes collaborating within the multicast session. The connection between the id- numbers and Sid is that the id-numbers increase in numerical price as they radiate from Sid within the delivery tree. These id-numbers facilitate the nodes dynamically leave and be part of a session, moreover as adapt quickly to changes in link property. Messages to repair a link breakage are confined to the region wherever it happens.

AMRIS is an on-demand protocol that constructs a shared delivery tree to support multiple senders and receivers among a multicast session. The key concept that differentiates AMRIS from alternative multicast routing protocols is that every participant within the multicast session includes a session-specific multicast session member id (msm-id) [5]. The msm-id provides every node with a sign of its logical height within the multicast delivery tree. Every node except the foundation should have one parent that includes a logical height (msm-id) that's smaller than it.

AMRIS consists of two main mechanisms: Tree initialization and tree maintenance. Tree initialization is that the mechanism by that a multicast session is formed and publicized to nodes inside the ad hoc network. Nodes that have an interest in connection the multicast session then take part the initialization phase. Nodes those aren't curious about connection the multicast session square measure herein called U-nodes. It's necessary to notice that U-Nodes should still become a part of the multicast session later on once it's necessary for them to operate as intermediate nodes inside the delivery tree to forward multicast traffic. Tree maintenance is that the mechanism whereby nodes that become detached from the multicast delivery tree rejoin the tree to continue receiving multicast traffic, by executing a Branch Reconstruction (BR) routine [5]. Nodes that failed to be a part of the multicast session throughout the initialization phase additionally build use of BR to hitch the tree. AMRIS uses a soft state beacon approach to work out if a link has broken between two close nodes. The advantages are direct multicast traffic, fast native repair to delivery tree. The link may be weaker.

3.7 Receiver Based Multicast Protocol

In this section, we describe Receiver Based Multicast Protocol for Ad Hoc networks in detail. Receiver based routing protocol which is a stateless protocol. It does not require routing table and costly state maintenance. It is a cross-layer multicast protocol [2]. The packet routing, splitting of packets are done based on the destination nodes location. It does not require extra traffic to keep the up to date state information compared to other multicast protocols. For the multicast packet routing needs only the node's location and the multicast member's location. The forwarding of packets are done using two concepts called "virtual node" and "multicast region" [1]. Here use a quadrant approach where every multicast region corresponds to one quadrant of the network, for a grid targeted at the node. When a node receives a multicast packet, the network is divided into multicast regions and copies of packet are sending to every region that has one or more multicast members. Here assumes no information about the neighbour nodes and no routing tables, so assign a virtual node placed at the geographic mean of the multicast members for every multicast region. The virtual node is an imaginary destination for the multicast packet in that region.

The lists of multicast member's locations are stored inside the packet header. Thus prevents the overhead of building and maintaining the multicast tree at the intermediate nodes. The entire packet routing information is stored within packet header [1] [2] [6]. RBMulticast achieves far better performance in terms of latency and network traffic and high packet delivery success rate even in extremely dynamic networks.

4. Conclusion

In this paper we study many different protocols based on the multicast routing. Several multicast routing protocols for WSNs have been proposed but most of them rely on varied tree structures and so intermediate nodes have to maintain the tree states for packet delivery. RBMulticast uses geographic location data to route multicast packets. When a node receives a multicast packet, the network is divided into multicast regions and copies of packet are sending to every region that has one or more multicast members. Thus prevents the overhead of building and maintaining the multicast tree at the intermediate nodes.

The entire packet routing information is stored within packet header. RBMulticast achieves far better performance in terms of latency and network traffic and high packet delivery success rate even in extremely dynamic networks.

References

[1] C.-H. Feng and W.B. Heinzelman, "RBMulticast: Receiver Based Multicast for Wireless Sensor Networks," IEEE Wireless Comm. And Networking Conf. (WCNC '09) Apr. 2009.

[2] Chen-Hsiang Feng, Yuqun Zhang, Ilker Demirkol and Wendi B. Heinzelman, "Stateless Multicast Protocols for Ad Hoc Networks,"IEEE Transctions on Mobile Computing, vol. 11, NO. 2, Feb 2012.

[3] S.-J. Lee, M. Gerla, and C.-C. Chiang, "On-Demand Multicast Routing Protocol," Proc. IEEE Wireless Comm. and Networking Conf. (WCNC '99), vol. 3, pp. 1298-1302, 1999.

[4] J. Garcia-Luna-Aceves and E. Madruga, "A Multicast Routing Protocol for Ad-Hoc Networks," Proc. IEEE INFOCOM, vol. 2, pp. 784-792, Mar. 1999.

[5] C. Wu and Y. Tay, "AMRIS: A Multicast Protocol for Ad Hoc Wireless Networks," Proc. IEEE Military Comm. Conf. (MILCOM '99), vol. 1, pp. 25-29, 1999.

[6] N. Senthamilarasi and D. Adhimuga Sivasakthi, "Efficient Stateless Multicasting Using RBMulticast For Ad Hoc Network," International Journal Of Engineering And Science Vol.3, Issue 1 (May 2013), PP 20-24.

[7] I. Akyildiz, M. Vuran, and O. Akan, "A Cross-Layer Protocol for Wireless Sensor Networks," Proc. Conf. Information Science and Systems (CISS '06), Mar. 2006.

[8] E.M. Royer and C.E. Perkins, "Multicast Operation of the Ad-Hoc On-Demand Distance Vector Routing Protocol," Proc. ACM MobiCom, pp. 207-218, 1999.

[9] J.G. Jetcheva and D.B. Johnson, "Adaptive Demand-Driven Multicast Routing in Multi-Hop Wireless Ad Hoc Networks," MobiHoc '01: Proc. Second ACM Int'l Symp. Mobile Ad Hoc Networking and Computing, pp. 33-44, 2001.

[10] A. Jose, L. Lakshmanan and G. Samanth, "Receiver Based Multicasting Depends on the Geographical Location of Region" in Proc. IJACTE, 53-57, 2013.