Review of Multicasting Techniques in MANETs

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Abstract— MANETs are made up of mobile nodes that dynamically form network and disseminate the information throughout the network. Each node act as both router and a host. There are several challenges in MANETs like routing, speed scalability, dynamic network topology, QoS, Security, Network Overhead, Energy efficiency etc. Routing is classified into two categories i.e. unicast routing and multicast routing. The multicast routing is the very challenging task because multicasting requires the information to be transmitted from source to multiple destinations all at once. There are several multicasting protocols evolved to perform multicasting such as AODV, MAODV, AM Route, CAMP etc. In this paper, some multicasting protocols are reviewed.

Key words: Mobile Ad Hoc Network, Multicasting, Routing Protocols

I. INTRODUCTION

Mobile Ad Hoc Networks are made of portable nodes like laptops, mobile phones which are able to dynamically form a network as well as communicate through the network. The requirement of multicasting in such a network is situated in military service, disaster recovery as well as emergency operations. Multicasting is a bandwidth conserving technology that reduces traffic by delivering single stream of information to many receivers simultaneously. Since, MANETs have dynamic topology, the node movement with time resulting in wireless-link failure across nodes. If the mobile nodes in the MANET move rapidly, they have to repair the routes to achieve node to node communication to forward the packets [6]. Hence multicast protocol should be able to handle the link breakages and find new optimal paths, if required. A number of multicast routing protocols have been proposed to resolve these problems. Every multicast routing protocol has its advantages, drawbacks and aims at a specific application [10]. Finally, the expected standard for multicast routing protocols in the ad-hoc networks is very likely to decrease its energy consumption and control traffic overhead at the same time; it should be able to respond rapidly to link failure and addition caused by mobile node movements.

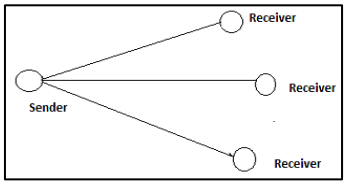

Fig. 1: Multicasting

II. FEATURES OF MULTICASTING PROTOCOLS

There are several characteristics as well as challenges that should be taking into consideration when developing a multicast routing protocols, such as the dynamic topology of ad hoc networks, constraints energy, lack of network scalability, the different characteristics between wireless links and wired links such as limited bandwidth and poor security[6][7]. A good multicast routing protocol should involved characteristics as below

- Control overhead: The bandwidth limitation is very significant in MANETs. Hence design of multicasting protocol should minimize the control packets transmitted for maintaining multicast group.
- Quality of service: It is essential in multicast routing and time sensitive data transferred in a multicast session.
- Dependency on the unicast routing protocol: It is very hard for the multicast protocol to work in heterogeneous networks. Therefore, the multicast routing protocol is independent of unicast routing protocol.
- Resource management: Resource management like power management and memory usage are important issues to create ad-hoc networks which work well in Multicast routing protocol. To reduce the number of packet transmissions, multicast routing protocol try to reduce the power resource. To minimize memory usage, it should use minimum state information.
- Robustness: For various reasons, data packets can be dropped in mobile ad-hoc networks (MANETs).This process causes a low packet delivery ratio (PDR). That's why, a multicast rout-ting protocol should be robust enough to withstand the movement of nodes and achieve a high packet delivery ratio.

A. Classification of Multicast Routing Protocols

A Number of multicast routing protocols have been proposed for Ad hoc networks, which are divided into tree based, mesh based and hybrid multicast routing protocols [3].

- Tree-based Multicasting: It establishes and maintains a shared multicast routing tree to send data from a source to receivers of a multicast group. There is only a single path between a pair of source and receiver. It is further divided into two approaches such as shared tree-based and source tree-based. Examples of tree-based multicast routing protocols are MAODV; AMRIS etc.It provides high data forwarding efficiency at expense of low robustness.
- Mesh-based Multicasting: These protocols sustain a mesh. In which connected component of the network containing all the receivers of a group. There may be more than one path between a pair of source and receiver. Examples of mesh-based protocols are ODMRP, FGMP, CAMP; PUMA etc.It provides better robustness than tree-based protocols. But forwarding-overhead is high in mesh based protocols.
- Hybrid-based Multicasting: This approach is the combination of tree-based and mesh-based approach. It achieves better performance than tree-based and mesh-based. Examples of Hybrid-based approach are ASTM, AMRoute etc. The main advantages of hybrid protocol are high robustness and low network load.

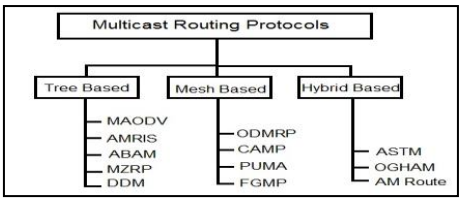

Fig. 2: .Multicasting protocols [3]

- Multicast Ad hoc On-Demand Distance Vector Routing Protocol (MAODV): MAODV is the multicast extension of AODV protocol. MAODV is based on shared trees on-demand to connect multicast group members. MAODV has capability of unicast, multicast and broadcast. It can be obtained route information when searching for multicast. When node want to join a multicast group or it has data to send to the group but does not has a route to that group, it originates a RREQ message. Only multicast group members respond to join RREQ [9].The advantages of MAODV are loop free routing, quick tree construction etc. MAODV has some disadvantages such as long delay, high overhead.
- Core Assisted Mesh Protocol (CAMP): It is mesh – based protocol. It establishes and maintains a multicast mesh, which is a subset of network topology that provides multiple paths between source-receiver pair and ensures that the shortest paths from receivers to sources are the part of a group's mesh. Multiple cores are defined to assist in join operations. So CAMP eliminates the need for flooding. Receiver-imitated approach for receivers to join a multicast group. A node sends a JREQ toward a core if none of its neighbors' is a member of the group, otherwise it simply announce its membership using either reliable or persistent updates[4].If core are not reachable from node that needs to join a group, the node broadcasts its JREQ using an ERS, which eventually reaches some group member. In addition CAMP supports an alternate way for nodes to join a multicast group by employing simplex mode. The main advantages of CAMP are better bandwidth allocation and good scalability. The network convergence is main drawback of CAMP.
- On-Demand multicast routing protocol (ODMRP): It is a source initiated mesh-based routing protocol. Here concept of forwarding group is used for multicast packet delivery. Only those nodes can forward data packets which are the members of forwarding group. When multicast sources have data to send but do not have routing or membership information, they flood a JOIN DATA packet. When node receives non duplicate JOIN DATA packets, it stores upstream node ID and rebroadcasts the packet. When JOIN DATA packet reaches a multicast receiver, the receiver creates a JOIN TABLE packet and broadcasts to the neighbours.When node receives the JOIN TABLE packet, it check whether or not the next node ID of one of the entries matches its own ID. If the node finds that it is on the path to the source and thus is part of the forwarding group. It then broadcasts its own JOIN TABLE packet built upon matched entries. The JOIN TABLE packet is thus propagated by each forwarding group member until it reaches the multicast source through shortest path [10].The main advantages of ODMRP are simplicity, robustness to high mobility, high packet delivery ratio, and scalability to large number of nodes, low channel and storage overhead. An ODMRP has some drawbacks such as complex topology, extreme control overhead.
- Source Routing–based multicast protocol (SRMP): It is on-demand protocol. It uses a mesh topology to connect each multicast group member, by providing a richer connectivity among members of a multicast group. SRMP uses the concept of FG nodes to create a mesh for each multicast group. To avoid channel overhead and to improve scalability, SRMP applies source routing mechanism defined in dynamic source routing protocol [4].The main advantages of SRMP are robustness, low channel overhead etc. The main drawback of SRMP is long delay in case of high mobility.
- Forward Group Multicast protocol (FGMP): It is mesh-based routing protocol. This creates a multicast mesh on demand. It is based on the forwarding group concept [4]. FGMP keeps track not of links but of group of nodes which participate in packet forwarding. SRMP is independent proto-col. It has loop free routing. The main drawback of FGMP is that it is feasible only in small networks.
- AMRoute: It is a hybrid-based multicast routing protocol. It creates a multicast shared-tree over mesh. It creates an efficient and robust shared multicast tree for each group. In AM Route protocol, each group has at least one logical core which is responsible for group members and tree maintenance. Each group member declares itself as a core for its own group of size1.Each core periodically floods JREQs to discover other joint mesh segments for the group [8]. AM Route has some drawbacks like route formation, non-optimal tree creation etc. There are several drawbacks of AM Route like loop existence, non-optimal tree creation and high overhead.

Protocol	Topology	Routing Scheme	QoS Support	Loop Free	Dependance Unicast Protocol
MADOV	Tree	Reactive	No	Yes	Yes
SRMP	Mesh	Reactive	Yes	Yes	No
AMRoute	Hybrid	Proactive	No	No	Yes
DDM	Tree	Reactive	No	Yes	No
FGMP	Hybrid	Reactive	No	Yes	No
CAMP	Mesh	Proactive	Yes	No	Yes
ODMRP	Mesh	Reactive	Yes	No	No
PUMA	Hybrid	Reactive	No	Yes	Yes
AMRIS	Tree	Reactive	No	Yes	No

Table 1: Comparison of Multicasting Protocols

III. CONCLUSION

This paper presents the classification of multicast routing protocols according to topology. The main issues required in the design of efficient ad hoc networks are also given. Each protocol has its own advantages, drawbacks and is well suited for certain scenarios. Finally we concluded that it is difficult to tell that any particular class of algorithm is best for all scenarios.

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