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STUDY OF MULTICAST ROUTING PROTOCOL IN MANET

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Abstract—

Multicasting is a new wireless networking technique that works with groups of people on the network. In point-to-point or multipoint communications, multicast routing is critical. Multicasting allows wireless networks to communicate more efficiently, reliably, and securely than unicast routing. There are several multicast routing techniques available, some of which operate with wired networks and others with wireless networks; others function with both wired and wireless networks. Multicasting protocols for ad-hoc networks are examined in this study, with the goal of illustrating how they operate and demonstrating why they were developed. Simultaneously, comparisons are performed between the treatments to illustrate their benefits and drawbacks.

Keywords —*Multicasting, Multipoint's communications, Wireless.*

INTRODUCTION

A mobile ad hoc network (MANET) is a collection of wireless mobile nodes that dynamically build a network without the assistance of a central management. It is also known as a self-organized network since it is independent of infrastructure. Every node functions as a router. Their routing tables will alter automatically if the network topology changes. The mobile nodes may communicate with one another directly. The packets are also routed via certain intermediary nodes. Mobile ad-hoc networks are completely dispersed and dependable [6]. Personal area networking (cell phone, laptop, ear phone, wrist watch), Military environments (soldiers, tanks, planes), Civilian environments (taxi cab network, meeting rooms, sports stadiums, boats, small aircraft), and Emergency operations (search-and-rescue, policing, and fire fighting) all require rapidly deployable and quickly adoptable routing protocols. For these reasons, multicast routing protocols are required.

II. MULTICAST ROUTING

The sending of data packets to numerous nodes using a single multicasting address is known as multicasting. In a multicast group [2,] there may be more than one sender, which is referred to as

group-oriented computing. Several routing techniques are well-established in wired networks and may offer efficient multicast, however these protocols may fail in MANETs owing to some specific properties of MANETs. Some critical considerations should be considered while constructing multicast protocols [6] for mobile adhoc networks. It has continual delivery route updates, dynamic group membership, and minimal state information. The following properties should be included in a decent multicast routing protocol.

Robustness: In Mobile Ad-Hoc Networks, some data packets may be discarded for a variety of reasons (MANETs). A low packet delivery ratio is caused by the dropping process [6]. As a result, a multicast routing system must be strong in order to endure node mobility and maintain a high packet delivery ratio.

The ratio of the total number of received packets to the total number of sent data and control packets in the network is known as multicasting efficiency.

Control overhead: In MANETs, bandwidth limiting is critical. As a result, a multicast protocol's design should minimise the total amount of control packets sent to maintain the multicast group.

In most circumstances, quality of service is particularly important in multicast routing since the data delivered in a multicast session is time-sensitive.

Dependence on the unicast routing protocol: When the multicast routing protocol has to cope with diverse networks [6], the multicast protocol has a hard time working. As a result, the multicast routing protocol is distinct from the unicast routing system.

Resource management: In Multicasting, resource management concerns like as power and memory utilisation are key challenges that must be addressed in order for ad-hoc networks [6] to function well. Multicast routing protocols strive to decrease the amount of packet transfers while conserving electricity. It should utilise the bare minimum of state information to save memory.

III. MULTICAST ROUTING PROTOCOLS IN WIRELESS NETWORKS

A wireless network is a collection of mobile nodes linked together via wireless connections. As the nodes move about, the network's topology changes at random. The methods used to determine a route from a source node to a destination node cannot be directly employed in wireless networks due to dynamic changing topology [7] and a lack of central administration. As a consequence, various ad-hoc network routing techniques have recently been created. Because multicast routing is difficult.

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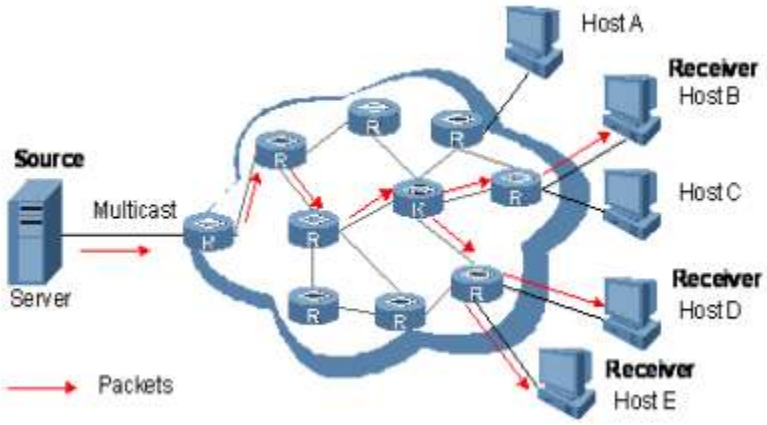

Fig 1: Multicast Routing.

Multicast routing protocols are classed in a variety of ways; some are categorised based on functionality [9], while others are classified based on structure. Because multicast routing is constantly evolving and unstable, this article provides a comprehensive overview of multicast routing systems.

Classification of Multicast Routing Protocols:

Based on the topology of the network, the multicast routing protocols [9] are classified into four types as shown in the following figure.

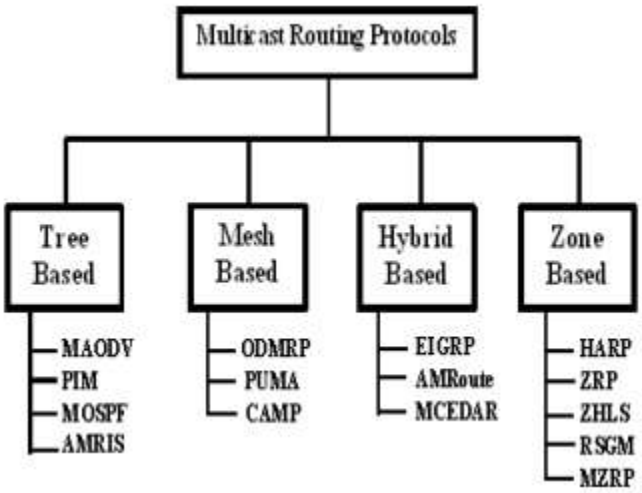

Fig 2: Classification of Multicast Routing Protocols

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IV. TREE BASED MULTICAST ROUTING PROTOCOLS

To convey data from a source to a destination, a tree-based multicast routing system creates and maintains a shared routing tree. These procedures are further divided into four categories, which are described below.

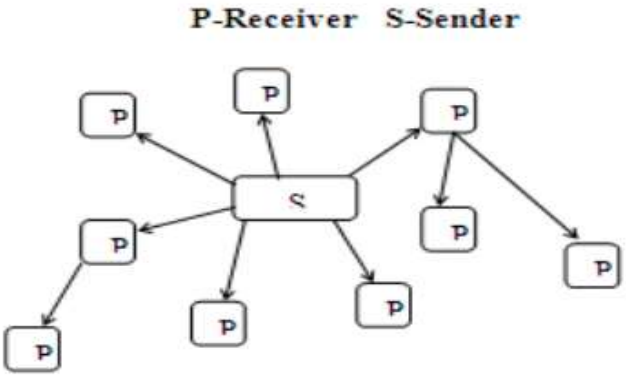

Fig 3: Tree Based Topology.

A. Multicast Ad-hoc on Demand Distance Vector Protocol (MAODV)

The Multicast Ad-hoc On-Demand Distance Vector protocol extends the Ad-hoc On-Demand Distance Vector protocol. It has the capacity to unicast and broadcast simultaneously. It may use multicast routing to send the data. When a node wants to join a multicast group, it sends a route request (RREQ) message, and it also does the same thing if it has data to broadcast to the group but doesn't have a route to that group. To join RREQ, only members of the multicast group react [6]. If an intermediate node gets a join RREQ from a+ node, it rebroadcasts the RREQ to its neighbours. However, if the RREQ is not a join request, any multicast group node may respond.

B. Protocol Independent Multicast Routing Protocol (PIM)

The Ad-hoc On-Demand Distance Vector protocol is extended by the Multicast Ad-hoc On-Demand Distance Vector protocol. It has the ability to broadcast and unicast at the same time. The data might be sent via multicast routing. A node sends a route request (RREQ) message when it wishes to join a multicast group, and it also does so if it has data to broadcast to the group but doesn't have a route to that group. Only members of the multicast group may join RREQ [6]. If an intermediate node receives a join RREQ from an a+ node, the RREQ is rebroadcast to its neighbours. Any multicast group node may reply if the RREQ is not a join request.

C. Multicast Open Shortest Path First Protocol (MOSPF)

Open Shortest Path Multicast Multicast Multicast Multicast Multicast Multicast Multicast Multi The first protocol is an OSPF (Open Shortest Path) extension that allows for efficient

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multicasting inside a network. This protocol uses IGMP (Internet Group Management Protocol) [12] to check multicast group membership by sending IGMP host membership queries and receiving IGMP host membership reports. OSPF Link State Advertisement flooding is used to send group information throughout the network (LSA). The routers utilise this information to construct the shortest path tree, with the source as the root and multicast recipients as leaf nodes. Each source-destination group pair receives its own shortest route. MOSPF provides quicker network convergence than the Distance Vector Multicast Routing Protocol (DVM RP).

D. Ad-hoc Multicast Routing protocol utilizing Increasing id-numberS (AMRIS)

MAODV avoids the drawbacks of AMRIS (Ad-hoc Multicast Routing Protocol) while using growing id numbers, which depend on a unicast protocol. AMRIS is an on-demand protocol that creates a shared multicast delivery tree and a shared tree for multicast data forwarding to accommodate numerous senders and receivers in a multicast session. A multicast session ID number is issued to each node in the network. The flow of multicast data is directed by the ID number ranking order [12].

V. MESH-BASED MULTICAST ROUTING PROTOCOLS

Mesh based protocols provide multiple paths between sender and receivers.

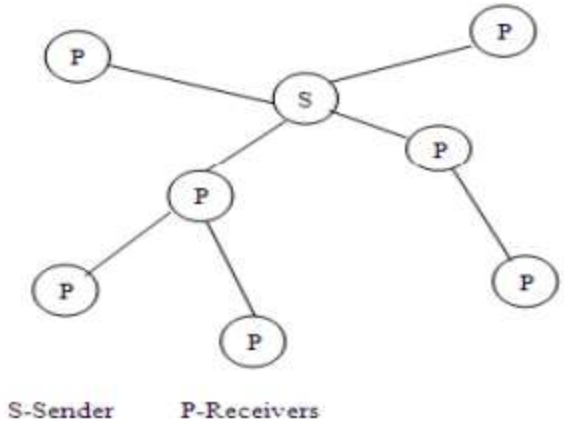

Fig 4: Mesh Bas e d Topology

A. On-Demand Multicast Routing Protocol (ODMRP)

The On-Demand Multicast Routing Protocol (ODMRP) is an on-demand mesh-based protocol [2] that uses a set of forwarding nodes to construct a mesh. These nodes forward data packets from the source to the destination and maintain a message cache to aid in the identification of duplicate data and control packets. A soft-state method is utilised to keep multicast group numbers consistent. Because of the lower channel/storage overhead and the increased connection, this protocol is more appealing in mobile wireless networks.

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B. Priority Unavoidable Multiple Access Protocol (P UMA)

It allows multicast packets to be sent from any of the sources to a specific multicast group. The spanning tree approach is comparable to the election algorithm employed here. It uses a distributed method to choose one of the receivers as the group's coordinator. The s ender s terminates a packet via the shortest route between the sender and the group's coordinator. The data packet is flooded with in mesh when it reaches a mesh member [9], and nodes keep a packet ID cache to delete duplicate packets.

C. Core-Assisted Mesh Protocol (CAMP)

CAMP [3] is a mesh based proactive multicast protocol. A node who wants to join multicast group has to search for the neighbors which are already mesh members [6]. If so, the node uses CAMP update message to announce its membership. In other cases node broadcasts request and try to reach the mesh members or sends join request to one of the core. CAMP has two types of mesh members

- Duplex member

- Simplex member

A duplex member is capable to send and receive multicast data and simplex member can only send out data multicast data packets.

VIII. PERFORMANCE METRICS

Due to the nature of MANET, under different mobility speed, number of senders, number of receivers, multicast group size and network traffic load scenarios [16], some of the protocols will be advantageous over the others. The performance evaluation metrics for multicast routing protocol includes the following: Data Packet Delivery Ratio: It is defined as the ratio of number of data packets successfully delivered to the number of data packets supposed to be received by the receivers of multicast group. Data Forwarding Efficiency: It is defined as the number of data packets transmitted per data packet delivered. It is also known as delivery efficiency [16]. The transmitted packets include all transmitted packets which are transmitted by the original sender of the packet and the retransmission of the same packet by the intermediate nodes. Protocol Efficiency: It is defined as the number of control packets transmitted per data packet delivered. It is also known as relative control packet overhead. This is helpful in measuring the efficiency of control packets for delivering data packets.

Table I: Comparison of Multicast Routing Protocols

Protocol	Multicast Topology	Loop Free	Dependence on Unicast Protocol	QoS Support	Perio -dic Msg
MAODV	Tree	Y	Yes	No	Yes
PIM	Tree	Y	No	No	Yes
MOSPF	Tree	Y	Yes	No	Yes
AMRIS	Tree	Y	No	No	Yes
ODMRP	Mesh	Y	No	No	Yes
PUMA	Mesh	Y	Yes	No	Yes
CAMP	Mesh	Y	Yes	No	Yes
EIGRP	Hybrid	Y	Yes	Yes	Yes
AMRoute	Hybrid	N	Yes	No	Yes
MCEDAR	Hybrid	Y	Yes	Yes	Yes
HARP	Zone	Y	Yes	Yes	Yes
ZRP	Zone	Y	No	Yes	Yes
ZHLS	Zone	Y	Yes	No	Yes
RSGM	Zone	Y	No	Yes	Yes
MZRP	Zone	Y	No	Yes	Yes

CONCLUSION

This article gives a broad overview of multicast routing protocols in ad hoc networks, as well as the key concerns that must be addressed when designing an effective ad hoc multicast routing system. The goal of designing these protocols is then described, followed by a short discussion of the operation processes. Table 1 shows a summary of various procedures. Finally, each multicast routing system attempts to tackle a specific issue, and each routing protocol has its own set of benefits and limitations. There is yet to be developed a protocol that can solve all ad-hoc network issues. As a result, there are several challenges in multicast routing methods that may be studied in order to improve multicasting in the future.

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