



A Study on Various Features of Multicast Routing Protocols in Mobile Ad hoc Networks

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Abstract— *In mobile ad hoc networks the routing is performed using multi-hop routing from a source to a destination node (or) nodes. Here, the dynamic routing must be focused since they are infrastructureless networks involving a collection of mobile devices communicating over a wireless link. So, it requires a proper route for forwarding the data packets. The study focuses on some of the widely used multicast routing protocols designed to perform its task in accordance with its design criteria.*

Keywords— *Mobile Ad hoc Networks, Multi-hop Routing, Infrastructure less, Multicast Routing, Routing.*

I. INTRODUCTION

The MANET consists of a group of wireless communication devices which serves as a node thus setting up a network and communicates within and outside their range of transmission. Generally the communication between the mobile nodes happens via multi-hop links where each and every node acts as a router allowing the data packets to be forwarded to (or) from other nodes within the scope of the network. It does not require any central administrator (or) base station (or) access point since, it can be setup anywhere depending upon the need. But their operations are subjected to energy and bandwidth limitations.

A. Routing in Mobile Ad hoc Networks

The main problem focused in mobile ad hoc networks is routing since each node has the capability to act as a host and router. Each and every node within the network differs from one another in terms of energy, memory and dynamic nature. Routing can be defined as the process of choosing a path in a network for directing the packets from the source to a destination among different networks. The routing can be learned through,

A1. Static Routing

The static routing can be configured manually on a router by the network administrator. The routing table holds the entire information about the network that is connected directly to the router and is called as connected routes. The possible way for setting static routes is by configuring it manually.

A2. Dynamic Routing

The dynamic routing are known by the routers using a routing protocol. Here, the routing protocols find the routes from other neighbouring routers using the same routing protocols. These dynamic routing protocols know the path to reach the destination.

A3. Differences between Static and Dynamic Routing

Since the transmission range for a node is limited it cannot utilize static routing to transfer data outside its range of communication. So, it uses multiple hops for a node to transfer data from one node to any another node that is outside its transmission and provide network connectivity. These differences are clearly discussed in table 1.

TABLE I: DIFFERENCES BETWEEN STATIC ROUTING AND DYNAMIC ROUTING

Static Routing	Dynamic Routing
The routes are configured manually by the network administrator.	The routers make use of routing protocols to find routes.
It uses a connected route.	It uses the neighbor routers.
It is not possible for a node to communicate with a node outside its range.	It allows transmission of data outside the range of node.

As discussed in section 1.1.2, for a node to communicate with a node outside its transmission range it requires an intermediate node for transmitting packets from source of one network to the destination of another network. For satisfying the purpose it requires a routing protocol. Since due to the dynamic nature of ad hoc networks these routing protocols concentrates on providing assured packet delivery and it also handle the dynamic connectivity. The routing protocols must be capable enough to deliver packets from source to the destination through the path which can long for a certain period of time (Figure 1). In case if there occurs any change in routes the routing protocols should be smart enough for recovering the possible alternate paths. It clearly pictures that the protocols of a wired network does not suit directly for wireless networks.

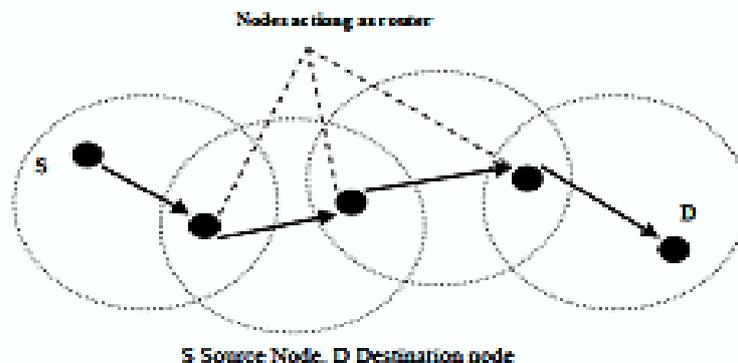


Figure 1: Packet Delivery form Source to Destination via Path

II. SALIENT CHARACTERISTICS OF MANET

The important characteristics of MANET are,

- Dynamic nature of the nodes.
- Limited Bandwidth.
- No static links between the links.
- It limits power since, the nodes in the network are operated using batteries.
- Security issues.

B1. Terminologies Used in Routing

The commonly used routing terminologies are briefed but they are not limited to,

i) Routing

It is process of communicating the data packets from one node to the other node within (or) outside its range of transmission.

ii) Router

It acts as a passage for directing the data packets among the network.

iii) Route Discovery

During communication when a source desires to establish a route to the destination, it searches across the network to find the destination (or) either an intermediate node containing the route to destination.

iv) Route Establishment

When a source wants to communicate with other nodes it broadcasts the requests all over the network and tries to communicate in order to transmit the data packets to destination.

v) Route Deletion

The route between the sender and the receiver are maintained until it is no longer needed in multicasting after which the route is removed using route deletion process.

vi) Routing Table

In MANET each and every node has the privilege to act as hosts and routers which periodically updates all the known routes for every other node into a table called the routing table.

B2. Communication Types in MANET

The possible types of communications that can be used in MANET are,

i) Broadcasting

It is a transmission technique in which a node can send information to all the other nodes within that network. It is called broadcasting since the communication happens form one to all the other nodes.

ii) Anycasting

It is a transmission technique between a single sender and several receivers among themselves within the group.

iii) Re-Broadcasting

It is a communication technique where a node broadcasts the sent information again to all the other nodes within the network.

iv) *Unicasting*

It is a transmission technique in which one source communicates the data packets to one destination (i.e) only two nodes can exchange the information. It is the operation that happens normally in a network. It is commonly used in ad hoc environment which serves as a base for constructing other types of protocols. It faces a problem while transferring data to multiple destinations which indirectly includes the need of multicasting.

v) *Multicasting*

It is a communication technique where a number of nodes can forward data packets to a set of nodes. It overcomes the problem of unicast by enabling data transfer to multiple destinations. It reduces the cost of transmission by avoiding sending the same data to more recipients.

III. DIFFERENCES BETWEEN UNICASTING AND MULTICASTING
TABLE III: DIFFERENCES BETWEEN UNICASTING AND MULTICASTING

Unicasting	Multicasting
The communication takes place between a source and a destination.	The communication takes place between a number of nodes and a set of nodes.
It is strictly allows to transfer data packets only between two nodes.	No such restrictions since it allows any number of nodes to participate in communication.
The cost of transmission between nodes are high.	The transmission cost between the nodes are low.
The same data are replicated to more recipients.	It avoids sending of same data to more recipients.

Since the MANET requires the information to be transmitted over a large network with low cost and even it requires more number of nodes to participate in a larger network multicasting suits better fulfilling the criteria. So, for the study purpose multicast routing is chosen. The key focus of multicasting in this study is that it can create copies to the destination when the links are split.

IV. MULTICAST ROUTING PROTOCOLS IN MANET

For transmitting the data packets to multiple receivers simultaneously MANET uses broadcasting. The broadcasting is subjected to consume large bandwidth and power which should be overcome. The multicasting is used for saving the bandwidth during communication by sending same data packets to multiple receivers. The figure 2 pictures the process of multicasting where the data packets are replicated among the networks.

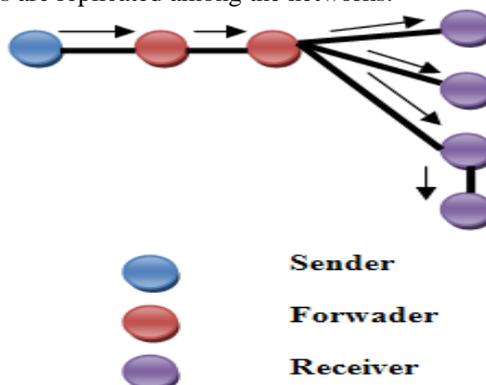


Figure 2: Multicast Communication in MANET

The multicast routing protocols used in MANET are divided and grouped into,

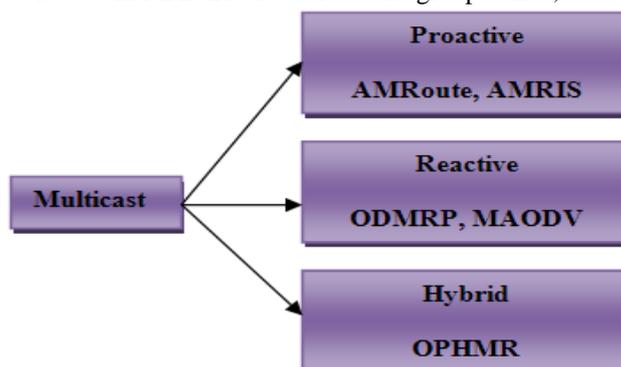


Figure 3: Multicast Routing Protocols in MANET

C1. Factors Affecting Multicast Ad hoc Routing Protocols

The sections discusses some of the factors affecting the multicast routing protocols but they are not limited to,

i) *Dynamic Operations*

Due to the dynamic nature of nodes in MANET, each node maintains a routing table with a set of values. Based upon the dynamic nature, the ad hoc demands a routing protocol to satisfy the above conditions.

ii) *QoS*

The routing protocols should strictly follow the quality of service for holding the traffics in real time situations.

iii) *Resource Management*

The lifetime of the node plays a major role in ad hoc environment, in case if the number of node decreases the network shall be partitioned into smaller networks for sustaining the lifetime for each node and hence the ad hoc routing protocols must focus on energy consumption.

iv) *Performance Metrics*

The following are the performance metrics that are widely used with wired and wireless networks.

- a) The end-to-end throughput must be increased.
- b) The end-to-end delay should be increased.
- c) Low power consumption.
- d) It should be able to balance the load between the network nodes.
- e) It should use shortest path to attain the destination.

v) *Free from Loops*

Due to temporary loops a fraction of packets is subjected to revolve around the network due to temporary loops. It proportionally increases the considerable consumption of bandwidth and power so, acyclic routes can provide a better solution.

vi) *Security*

The ad hoc networks make use of electromagnetic waves through the air so it is vulnerable to third party attacks. It should be protected for which some sort of security mechanisms are to be focused. It can make use of encryption and authentication.

C2. Proactive Multicast Protocols

In these protocols every node maintains an up-to-date route information to each and every node in the network. These routing information are communicated periodically throughout the entire network for maintaining regularity in routing table. Hence, a route to each and every node is available always regardless of whether it is needed (or) not. It is best suited for larger networks. Here, every node needs to update the route information for each and every other nodes into the routing table of every node.

TABLE IIIII: FACTORS INFLUENCING PROACTIVE MULTICAST PROTOCOLS

Factors	AMRoute	AMRIS
Structure	Tree	Tree
Loop Free	No	Yes
Unicast Routing Protocol Dependency	Yes	No
Scalability	Fair	Fair
Control Packet Flooding	Flat	Flat
Periodic Messages	Yes	Yes

C3. Reactive Routing Protocols

In reactive protocol the need for routing tables and their frequent updates are eliminated. Here, an on demand approach is used where the source node desires a route to the destination for which it does not hold any route information. A route discovery process is initiated by which a route is desired from source through a node by node fashion until it reaches the destination (or) intermediate node which the holds the route to the destination. For a node to transfer packet to another node the protocol searches for a route in an on demand fashion and establishes a connection in order to send and receive packets. The route discovery is done by flooding the packets throughout the network. These routes are maintained until the route is no longer needed and finally removes the route by route deletion process.

TABLE IVV: FACTORS INFLUENCING REACTIVE MULTICAST PROTOCOLS

Factors	ODMRP	MAODV
Structure	Mesh	Core based Tree
Loop Free	Yes	Yes
Scalability	Fair	Fair
Routing Hierarchy	Flat	Flat

Periodic Messages	Yes	No
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C4. Hybrid Routing Protocols

The routing protocols combine the proactive and reactive routing protocols and use the both. Here, the best features of proactive and reactive protocols are concatenated and a balance is found between both the protocols. The proactive protocols can be used only for smaller domains whereas the reactive protocols are employed to discover the nodes outside those domains.

Salient Features of OPHMR

- It generates on demand route paths.
- It is dependent upon Multicast Zone Routing where it builds a zone around every nodes and sends periodical updates within every zone.
- It improves the efficiency by using Optimized Link State Routing.
- It reduces the control overhead.
- It increases the life time of the node by extending the battery life of the nodes.
- It reduces the end-to-end delay and packet delivery ratio.

V. CONCLUSION

The MANET is anywhere, anytime network which provides low cost communication as compared with wired networks. The paper is based on the study of multicast routing protocols along with their characteristics and features from which it is observed that the routing should focus on the features like structure, loop free operations, scalability, increased end-to-end delivery, packet delivery ratio, minimized end-to-end delay, and reduced control overhead. Additionally the features like reduced control overhead, Increased lifetime of the node, Avoiding periodic messages should be addressed for improving the performance of the network.

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