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Multicasting Routing Protocols in Wireless Ad hoc Network – A Comprehensive Survey

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Abstract—*Wireless ad hoc networks and devices are becoming widespread as they support enormous applications anywhere and anytime. In wireless mobile communications, the mobile node is the only one hop away from base stations. The type of Mobile Ad Hoc Network (MANET) has no constant structure or fundamental supervision. A network is required to guarantee a set of measurable pre specified service attributes to applications in terms of end-to-end performance using certain Quality of Service (QoS) parameters such as delay, bandwidth, and jitter. This paper reviews the various kinds of multicasting types and routing protocols in MANET.*

Keywords—Routing, Ad hoc network, Multicasting, Quality of service, Mobile ad hoc network

I. INTRODUCTION

Mobile Ad Hoc Networks (MANETs) are defined as a set of multi-hop wireless mobile nodes facilitates communication among mobile nodes without centralized control. There is no fixed established infrastructure. The wireless links are highly error prone in such network and the network can go down due to nodes mobility and interference. Thus, routing in MANET is a critical task due to highly dynamic environment. For efficient routing understanding the characteristics, functionality, benefits and limitations are must achieve high performance [1]. When a destination receives the packets sent by other source then plays an additional role as a router, in routing the data packets which are destined to some other node. Major areas of applications of MANETs include military applications, disaster recovery places and rescue operations in case of emergency [2].

Minimal configuration absence of infrastructure and quick deployment make them convenient for emergency situations other than military applications. The existing On Demand Multicast Routing Protocol (ODMRP) exhibits a high packet delivery proportion even at high flexibility of nodes. But ODMRP grieves from control overhead with increase in the network size and with increase in number of sources. In [3], author has proposed an efficient multicast routing protocol for MANETs. This protocol has minimized the control overhead by classifying the bases into Active and Passive categories resulting in control overhead minimization by about 30% compared to ODMRP which contributes to the scalability of the protocol.

The arrangement of the paper is as follows. Section II gives the related work. Section III presents the types of multicasting. Section IV gives the conclusion.

II. RELATED WORK

An exhaustive literature survey has been prepared on multicasting routing protocols and its various types in wireless ad hoc network.

- QoS based multicasting type

The QoS needs of applications using multimedia data in MANET has become necessary to provide and has made possible due to advancement in the technology. Experimental evaluations can be carried out in a simulated environment. The performance results of simulation experiment prove that the protocol presented in [4] outperforms the ODMRP which is type of multicasting protocol with mesh topology.

- Mesh based multicasting type

A network sender multicast routing protocol (NSMRP) is proposed in [5] is a mesh based protocol for ad hoc networks.To forward data and control packets to all multicast group members, the mesh is created, where group sender select central node called as mesh sender (MS) periodically.The joining invitation message to a group will be flooded periodically to all group members by MS. The performance improvement achieved of NSMRP showing reduced overhead when the maximum mobility speed is varied or increased number of multicast groups or senders.

The traditional routing methods of static network cannot be applied in their present form in dynamic MANETs which suffers from frequent link breakages resulting into varying topology. In this regard the use of multicast communication in such dynamic environment greatly decreases the communication cost along with providing efficient utilization of bandwidth.The unicast protocol following the strategy of Dynamic source routing (DSR) technique is modified in SRMP protocol [6] to achieve enhanced performance. To connect the group members, the SRMP first constructs a mesh to provide robust against mobility. The future link states, maximum battery life on the paths are predicted to get stable paths for power conserving.The comparative study of ODMRP and ADMR protocols is performed to show the performance improvement of SRMP in terms of throughput based on

successful transmission with reduced network overload resulting into longevity of the lifetime. The key aspects of SRMP such as forwarding group selection, data routing and maintenance is detailed.

The increased attention of the researchers towards efficient method for group communications using multicast technique in MANET has made the urge to develop efficient robust scalable protocols. However it is very difficult task to develop such protocols considering group membership management and the maintenance of multicast structure in dynamic environment of MANET.The Robust Mesh-based Multicast Protocol (RMMP) proposed in [7] considers the best features both mesh and tree based multicast protocols which help in reducing data recovery time when route fails. The robustness of RMMP to recover data transmission in presence of route failure is justified through simulation.The working of RMMP is twofold. First to construct multicast structure based on binary tree to distribute transmission averagely among member nodes and other is to provide a second-route discovery scheme which will reduce the number of articulation nodes to eliminate loss of data packets. The suitability of RMMP in heavy traffic loads achieves high packet delivery ratio.

The author in [8] has shown that reducing the number of forwarding nodes reduces data overhead experienced by mesh-based multicast ad hoc routing protocols.It has been demonstrated that minimizing the number of forwarding nodes is equivalent to the problem of computing the minimal cost multicast tree.

The polynomial shortest path heuristic can be used to approximate the problem of connection of group of receivers to the source in most of the multicast routing in MANET. The main intension of multicasting is to achieve good bandwidth utilization when group communication is most likely to take place in the network. The shortest path heuristic does not setup an optimal multicast delivery infrastructure in terms of bandwidth consumption.The construction of multicast delivery mesh based on nearest participant heuristic without compromising delay performance method is used in Bandwidth Optimized and Delay-Sensitive (BODS) algorithm [9]. The Steiner-trees is used in the multicast path setup algorithm of the BODS and it can be integrated with any of the existing mesh-based multicast routing strategies to enhance their performance. The BODS is integrated into the ODMRP and performance is evaluated. The simulation results shows that ODMRP has attained improved delivery ratio and 30% reduction in data overhead when compared with the original ODMRP.

This specifies routing techniques to illustrate multicasting in wireless ad hoc networks. The mobile and wireless networking has gain importance due to mobile devices. The main challenge is to meet head-on applying multicast communication in applications where mobility is unlimited and network is prone to frequently failures [10].

Routing protocols developed for wireless sensor networks are used to send messages from sources to destinations. These protocols are classified as unicast, broadcast or multicast. Unicast routing sends a message from source node to a single destination or sink. Broadcasting sends a message from a source sensor node to every other node in the network. Multicasting delivers messages from a single source to a set of destinations nodes. Multicasting protocols support better utilization of resources and minimize the consumption of network resources. Sending one copy of the data to each destination using unicast is not same as multicast routing [11].

Applications of MANET are enormous such as habitat monitoring, fire detection in forests, pollution monitoring and so on. In many of applications multicast is of great demand. These applications require sensors to send the same report to several sinks whose positions are known in advance. In such scenarios, it is essential to count on an efficient multicasting mechanism being able to improve the overall consumption of resources in the network. It is must to reduce consumption of network resource. These scarce resources has multicast routing protocols to find very well-organized multicast distribution area by making use of a less amount of control information [12].

Multicasting communication act as one major operation to support many applications of MANETs that accomplish group communication rather than individual. Multicast routing protocols have gained increased importance in MANETs as they effectively provide coordination among nodes a set of nodes. The development of efficient QoS multicast routing protocols has gained greater importance for multimedia applications such as video conferences, military and rescue operations.The multimedia applications require the design of efficient multicast routing protocols satisfying the application specific QoS demand.To maintain up to date information about the network, the physical area is divided into hexagonal cells of same size and election is performed to get leader and backup leader nodes.The efficient routing in PBQMRP is performed in consideration of nodes positions for data packets delivery to all the receivers. The performance improvement of PBQMRP in terms of less packet drop ratio with significant reduction in control overhead is achieved when compared with On Demand Multicast Routing Protocol (ODMRP).

All nodes are randomly classified into two types, group-0 and group-1A. In addition two multicast trees (tree0 for group-0 and tree-1 for group-1) were constructed in power-aware dual-tree-based multicast routing protocol (PDTMRP) for MANETs [13] to achieve the load balance. Performance enhancement of PDTMRP over MAODV and RMAODV schemes is justified through simulation.

Wide variety of applications and services are well supported by multicasting. The inefficiency of the protocol is experienced when protocol developed for single source in a multicast group of MANET is extended to multi-

source multicasting.The inefficiency can be overcome by using shared forwarding tree and multi-path routing in shared-tree-based multi-source multicast routing protocol (STMRP), which provides efficient multicasting in the multi-source multicast environment without losing multicast efficiency and maintains the delivery ratio [14].

The core-based tree based on heuristic genetic algorithms (GAs), has been applied over a high-altitude platform (HAP)-satellite platform. Hybrid cost bandwidth-delay GA considers the features of both CCDB-GA and HULK-GA to develop a QoS constraint based algorithm to minimize the overall cost per link of the considered multicast tree.The hybrid platforms take advantage of the single characteristics of the satellite and HAP segments. The joint bandwidth-delay metrics is found useful when load to be balanced traffic, relating to both QoS constraints. The larger trace but higher propagation delay experienced in satellite segment.However slow propagation delay, permitting QoS constraints based on maximum end-to-end delay to be met the HAP segment present [15].

III. MULTICASTING TYPES

This section shows various types of multicasting routing techniques in wireless ad hoc network.

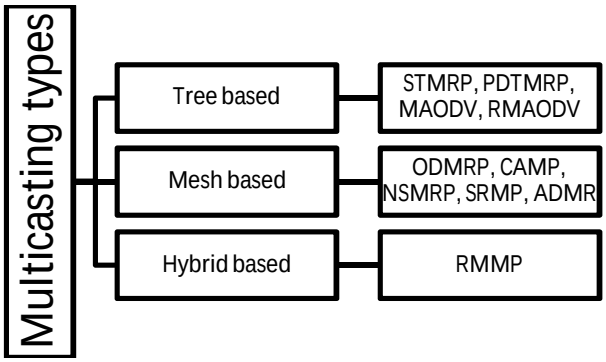

Fig 1. Types of Multicasting

There are various types of multicasting based routing protocols. The major classifications of multicast routing protocols are given in Figure 1.

i. Tree based multicasting

The tree based multicasting type contains single path between a source and receiver pair. It is used for data forwarding. Examples include STMRP, PDTMRP, MAODV, RMAODV multicasting routing protocols.

ii. Mesh based multicasting

Mesh based multicasting routing protocol contains multiple paths between source and destination pairs. Examples include ODMRP, NSMRP, SRMP, ADMR, CAMP multicasting routing protocols.

iii. Hybrid based multicasting

Hybrid based multicasting protocols combines both the features of tree based and mesh based multicasting routing protocols. This type of routing protocols depends on the distribution paths for all the group members for construction. RMMP is a best example of hybrid based multicasting type of routing protocol in MANET [16].

IV. CONCLUSION

MANETs have a less transmission range. Henceforth nodes that relies with the transmission range can communicate directly with each other, while intermediate nodes is needed to forward flow between nodes that are unable to communicate directly. The limited transmission range, limited memory, limited storage capabilities, and limited power are serious challenges facing MANETs. This resulted into significant attention about multicast routing. In multicasting, a source node is sending the same contents to a certain set of nodes in the network. Due to the irregular positions and association of mobile data in MANETs, classical routing protocols used on wired networks are not suitable for MANETs In MANETs, network source work in the group to carry out a given task, therefore, multicasting finds important place in MANETs. The paper has given the study of different types of multicasting routing protocols and suitable protocols for various applications in wireless ad hoc network. The network needs are constrained by the service requirements of end user applications

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