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Multicast Routing Protocol in Mobile Ad-hoc Network- A Survey

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Abstract-A self-Configuring, an independent infrastructure less network of wireless hosts communicate through wireless links by forming a temporary network (Mobile Ad-hoc Network) in a dynamic manner. MANET operates without centralized administration. Since nodes in MANET is free to move independently in any direction, and will therefore change its links to other devices frequently. So, routing in such situation is a complicated task, to this the resources of the wireless nodes are limited. Routing protocols should incorporate QoS metrics in route finding and maintenance, to support end-to-end QoS. Whenever a node needs to send same data in parallel to several destinations and with the intention of saving the resources of the nodes in the network, multicasting can be used instead of multiple unicast data Transmissions. This paper presents a coherent survey of existing multicasting solutions for MANETs. It presents various classifications of the current multicast routing protocols, discusses their operational features, along with their advantages and limitations, and provides a comparison of their characteristics according to several distinct features and performance parameters along with technological challenges that protocol designers and network developers are faced with.

Key words- Energy, bandwidth, efficiency, complexity, packet delivery ratio.

I. INTRODUCTION

Mobile ad hoc networks (MANETs) comprise either fixed or mobile nodes connected wirelessly without the support of any fixed infrastructure or central administration. The topology of an ad hoc network is highly dynamic due to the arbitrary movement of each node. The nodes are self-organized and can be deployed "on the fly" anywhere, any time to support a particular purpose. Two nodes can communicate if they are within each other's transmission range; otherwise, intermediate nodes can serve as relays (routers) if they are out of range (multi-hop routing). These networks have several salient features: rapid deployment, robustness, flexibility, and inherent mobility support, highly dynamic network topology the limited battery power of mobile devices, limited capacity, and asymmetric/unidirectional links.

In recent years, a number of multicast protocols for ad hoc networks have been proposed. Based on the routing structure, they can broadly be classified into two categories: tree-based protocols and mesh-based protocols. In recent years, a number of multicast protocol for ad hoc networks have been proposed. Based on the routing structure, they can broadly be classified into two categories: tree-based protocols and mesh-based protocols. In tree-based protocols, there exists a single path between any sender-receiver pair. Tree-based protocols have the advantage of high multicast efficiency (which is defined as the ratio of the total number of data packets received by all receivers to the total number of data packets transmitted or retransmitted by senders or intermediate nodes). However, tree-based protocols are not robust against frequent topology changes and the packet delivery ratio (which is defined as the ratio of the number of data packets delivered to all receivers to the number of data packets supposed to be received by all receivers) drops at high mobility. Mesh-based protocols provide redundant routes for maintaining connectivity to group members. The low packet delivery ratio problem caused by link failures is alleviated due to redundant routes. Mesh-based protocols are robust to node mobility. However, redundant routes cause low multicast efficiency. MANETs are envisioned to support advanced applications such as military operations,civil applications (e.g. audio and video conferencing, sport events, telematics applications (traffic)), disaster situations (e.g. emergency and rescue operations, national crises, earthquakes, fires, floods), and integration with cellular systems C.-K. Toh *et al.* (2002) and C. Perkins *et al.* (2000).

In this paper, we conduct a comprehensive survey of current multicast routing protocols for ad hoc networks. [1] is the first paper to present the performance comparison study of ad hoc multicast routing protocols. [2] Introduces multicast protocols and discusses some ongoing directions. [3] Does similar work to ours. Compared with these works, we include some newly proposed protocols, have a further comparison of protocols and discuss the associated advantages and disadvantages in more detail.

II. ROUTING IN MANETS

Routing is one of the core problems of networking for delivering data from one node to the other. Wireless ad-hoc networks are also called Mobile ad-hoc multihop networks without predetermined topology or central control. This is because MANETs can be characterized as having a dynamic, multihop, potentially rapid changing topology. The aim of such networks is to provide communication capabilities to areas with limited or no existing communication infrastructures. A MANET is usually formed by mobile nodes using wireless communications. It uses a peer-to-peer multihop routing instead of a static network infrastructure to provide network connectivity. Since nodes can move around, enter and leave the network, the network topology can change rapidly, which in turn requires a lot of communication for a node to keep a static picture of the topology. Moreover, as mobile nodes operate on battery power, which limits the amount of data they can transmit, recharging is necessary.

Today most of mobile devices have less memory and processing power than standard Personal Computers (PCs). Due to these constraints, protocols use for routing must be able to adapt to changes in the topology and should minimize the number of packets used for maintaining the routes. Links between nodes are not always bidirectional but can be unidirectional also, which is a another issue in MANET.

A. ***Multicasting***

Wireless applications, like emergency searches, rescues, and military battlefields where sharing of information is mandatory, require rapid deployable and quick reconfigurable routing protocols, because of these reasons there are needs for multicast routing protocols. There are many characteristics and challenges that should be taking into consideration when developing a multicast routing protocols, like: the dynamic of the network topology, the constraints energy, limitation of network scalability, and the different characteristics between wireless links and wired links such as limited bandwidth and poor security. Routing of data packets can be either unicast or multicast transmission. Unicast transmission, in which a packet is sent from a single source to a specified destination, is still the predominant form of transmission on LANs and within the Internet while Multicasting is the networking technique of delivering the same packet simultaneously to a group of clients. Unicast transmission denotes the method of attaining a feasible route from the source towards a destination node.

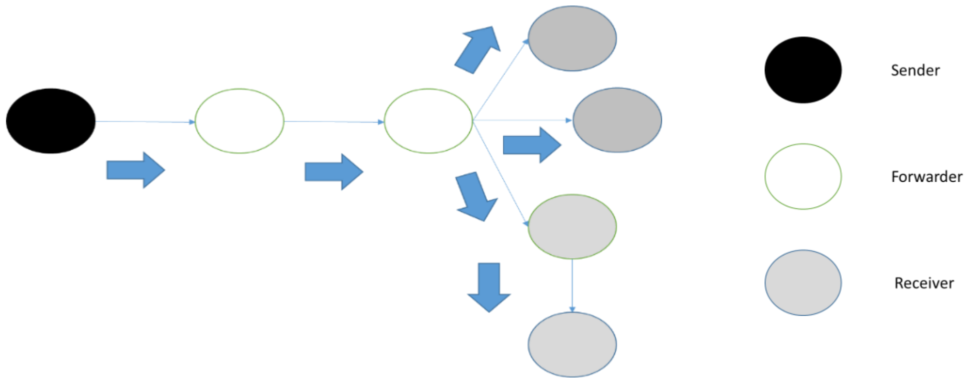

Fig. 1. Multicasting: Formation of feasible tree

On the other hand, multicast transmission denotes the process of attaining a feasible tree with root as source and leaf nodes as the destination(s). Multicasting is a more efficient technique in comparison with unicast routing in supporting group communication based applications and hence is an important aspect of future network development.

In recent years, many group oriented applications have gained a lot of importance that are developed to deploy in MANETs. The application fields of these networks can be several: military(i.e. it is possible to equip soldiers with devices in enemy environments so that they could communicate each other), videoconferencing, corporate communications, personal area network, i.e. printers, PDA, mobile phones, business indoor application (i.e. meetings, symposium, demos), civilian outdoor application (i.e. taxis, cars, sport stadiums),emergency application(i.e. emergency rescue operations, police, earthquakes), home intelligence device, Vehicle-to-vehicle communication in smart transportation, distance learning, Personal Area Networks connecting mobile devices like mobile phones, laptops, smart watches, and other wearable computers, and distribution of software, stock quotes, news, etc.

B. ***Benefits of Multicasting***

The multicast technology offers great advantages to the success of some advanced applications Abdussalam Nuri Baryun and Khalid Al-Begain *et al.* (2008). A few of these advantages are presented below.

- Datagram received only by the interfaces that want it (making it great for node discovery),
- Group address,
- Messages are UDP so there is no connection setup or teardown.
- Decreases sender nodes and routers processing.
- Decreases energy utilization.
- Can be used across WAN.
- Increases the throughput of wireless link between the sender and receiver(s).
- The cost of the network resources is reduced through the passing band economy in the links.
- The cost of the network resources is reduced through the passing band economy in the links.
- Decreases data delivery delay.
- Increases the efficiency of data transfer.

- The economy of network resources associated to the reduction of the load in the applications and servers makes the network less susceptible to jams, and, therefore, more available to be used.

C. Need for Multicast Routing Protocols

MANET has a dynamic topology and hence, the locations of the nodes change with respect to time resulting in wireless-link failure across nodes. To achieve node to node communication, the nodes have to repair the routes rapidly. So, the multicasting routing protocol should handle, minimize the energy consumption at nodes, manage the link-breakages and control traffic overhead, and find new optimal paths. Numerous multicast routing protocols have been proposed to solve these problems where every multicasting routing has its own benefits and limitations.

III. CLASSIFICATION OF MULTICAST ROUTING PROTOCOLS

As discussed in the earlier section, due to the numerous advantages provided by multicast routing and to support different group applications, several multicast routing protocols have been designed.

There have been a number of multicast routing protocols which are classified into two types:

- Tree-based protocols
- Mesh-based protocols..

Various proposals classifying the multicast routing protocols exist in literature. O. Tariq, F. Greg, and W. Murray *et al* (2005). has categorized these protocols into flooding, hybrid, stateless, tree structure, mesh based protocols with the performance evaluation of these protocols in MANETs. We investigate these protocols and point out the associated advantages and disadvantages.

Some classifications are:

- Based on the path redundancy
- Based on the mode of route computation
- Based on the efficiency of energy
- Based on the QoS metrics

A. Tree-based Multicast Routing Protocols

1) Based on Path Redundancy:

This category is identified based on the number of paths available between a source and the destinations. The fault tolerance of the network can be indicated by this classification if in case of redundancy of paths to the destination. In this aspects we have two major classifications- Tree structure and mesh based routing protocols. However, researches carried out to combine the advantages of both of these classes of protocols have resulted in the development of hybrid-based approach.

Tree-based multicasting is a well-established concept used in several wired multicast protocols to achieve high multicast efficiency. In tree-based multicast protocols, there is only one path between a source-receiver pair. Hence, a multicast tree is formed by considering all the routes from a sender to all the receivers. These protocols send least possible duplicate data packets through the edges of the multicast tree and hence effective in terms of bandwidth utilization. However, due to the movement of nodes, link failures occur and entire tree needs to be reconfigured, which results in some delay in the delivery of data packets. If there is more than one source, then the protocols must either form a shared tree or store multiple trees, one individual tree for every source. Using a shared tree for routing the data packets result in less optimal paths. Storing multiple trees leads to overhead both in terms of control and storage. Some of the protocols that belong to this category are MAODV, AMRIS, AODV, ALMA.

Tree-based multicast protocols can be classified into two types: source-tree-based multicast routing protocols and shared-tree-based multicast routing protocols. In a source-tree-based protocol, a single multicast tree is maintained per source, whereas in a shared-tree-based protocol, a single tree is shared by all the sources in the multicast group. Shared-tree-based multicast protocols are more scalable compared to source-tree-based multicast protocols._ In source-tree-based multicast routing protocols, an increase in the number of sources gives rise to a proportional increase in the number of source-trees. This results in a significant increase in bandwidth consumption in the already-bandwidth-constrained network. But in a shared-tree-based multicast protocol, this increase in bandwidth usage is not as high as in source-tree-based protocols because, even when the number of sources for multicast sessions increases, the number of trees remains the same. Another factor that affects the scalability of source-tree-based protocols is the memory requirement. When the multicast group size is large with a large number of multicast sources, in a source-tree-based multicast protocol, the state information that is maintained per source per group consumes a large amount of memory at the nodes. But in a shared-tree-based multicast protocol, since the state information is maintained per group, the additional memory required when the number of sources increases is not very high. Hence shared-tree-based multicast protocols are more scalable compared to source-tree-based multicast protocols. The rest of this section describes some of the existing tree-based multicast routing protocols for ad hoc wireless networks. Some of the tree-structured multicast routing protocols are stated below briefly to provide some idea about the features of these protocols.

***MAODV*:** MAODV E. M. Royer and C. E. Perkins *et al*. (1991) is a shared-tree-based protocol that is an extension of AODV to support multicast routing. In MAODV, all members of a multicast group are formed into a tree (which includes non-member nodes required for the connection of the tree), and the root of the tree is the group leader. Multicast data packets are propagated among the tree. In MAODV, Hello packets are flooded within the network with TTL set to one in order to ensure connectivity with the neighbours. Each node in the network maintain three tables namely; Request Table, Routing Table (RT) and Multicast Routing Table (MRT) E.M. Royer, and C.E. Perkins *et al*. (1999).

In MAODV, the group leader is the first node joining the group and announces its existence by Group Hello message flooding. An interested node P sends a join message toward the group leader. Any tree node of the group sends a reply message back to P. P only answers an MACT message to the reply message with minimum hop count to the originator. Then a new branch to the shared tree is set up (see Figure. 2).

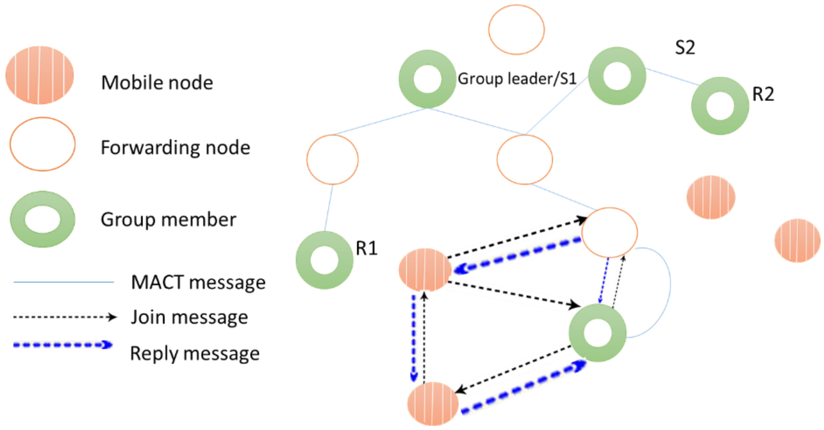

Figure 2. The joining procedure in MAODV.

MAODV is not flexible as it relies on unicast routing protocol, AODV. Moreover, multicast group leader is a single point of failure in MAODV.
Advantages: With the unicast route information, the multicast tree can be constructed more quickly and efficiently.
Disadvantages: The group leader continues flooding Group Hello messages even if no sender for the group exists.

2) *Based on the Mode of Route Computation:*

This category of multicast routing protocols is based on how and when the routes are computed and maintained. In this view, there are two classes of multicast routing protocols namely, Table-driven and On demand.

Table-driven multicast routing protocol is one in which routes to all destinations are computed prior to data transfer. Each node stores this routing information in the routing table and gets aware of the network topology.

On-demand multicast routing protocol doesn't pre-compute the routes but does it on demand by the source when required. This class follows an event driven mechanism. Some of the multicast protocols that come under this category are ODMRP and MAODV. Both of these are reactive protocols

3) *Based on Efficiency of Energy:*

Since, the nodes in MANETs are wireless and not stationary, they run on battery power with limited energy before the batteries are recharged. If the battery of any node in the network drains, it stops its functions resulting in routing problems. Hence, residual energy of a battery is an important parameter that has to be considered while developing efficient multicast routing protocols for MANETs. This class of protocols focuses on proliferating the lifetime of the nodes in the MANETs by using the battery power efficiently J. Li, D. Cordes, and J. Zhang, *et al*. (2005), and D. Axel, *et al*. (2005).Some of the protocols of this category are MWIA K.S. Lau, and D. Pao et al. (2006), RB-MIDP and D-MIDP M.X. Cheng, J.H. Sun, M. Min, et al. (2006)Two specific approaches for achieving energy efficiency are briefed below.

Energy Efficient Multicast Routing: A notion on energy efficient multicast routing has been proposed by J. Li, D. Cordes, and J. Zhang, *et al*. (2005). The idea presented is to assign weight to each node with its transmission power and form a graph such that weights are represented between edges. To achieve efficiency in energy, a multicast tree having minimum total energy cost has to be formed. It is an NP-hard problem. A cover set having all the non-leaf nodes is built level-by-level by choosing the shortest route from the sender to the nodes in the uncovered set. This heuristic approach by choosing the nodes with maximum energy develops the multicast tree efficiency.

Energy Conserving Routing in Wireless Ad hoc Networks: Another approach for achieving energy efficiency proposed by Chang and Tassiulas et al. (2000) is forming routes with minimum number of hops that leads to low energy cost. It may seem that finding the shortest distance will also decrease the utilization of the energy. But this method of forming shortest paths result in more energy utilization of the hosts along these paths and the battery energy of the remaining hosts in the network is left unused. Hence, they present a routing scheme in order to maximize the duration of the nodes considering mainly the source and destination groups and the traffic load in the routes between them. A category of flow redirection and augmentation algorithms are developed which address and maintain equilibrium between the energy resources and the energy utilization rates of the nodes. This approach increases the lifespan of the network in comparison with the use of minimum transmitted energy routing algorithm.

Bandwidth-Efficient Multicast Routing Protocol: BEMRP T. Ozaki, Jaime Bae Kim, and T. Suda *et al.* (2001) is a sender-tree-based protocol which emphasizes on high multicast efficiency. BEMRP requires each new member to set up a branch with the fewest new forwarding nodes being added to the multicast tree.

A route optimization process is also introduced to detect and remove unnecessary forwarding nodes .When a new node P wishes to join a group, it globally floods a join message into the network. Only tree nodes respond to the join message and will reply the one along the shortest path to P. P then selects the shortest path to connect to the tree node. In order to enhance multicast efficiency, BEMRP requires a tree node to changes to a new parent Q if it receives a multicast packet from Q and Q is closer to the sender than its parent (the route optimization process, see Figure. 3).

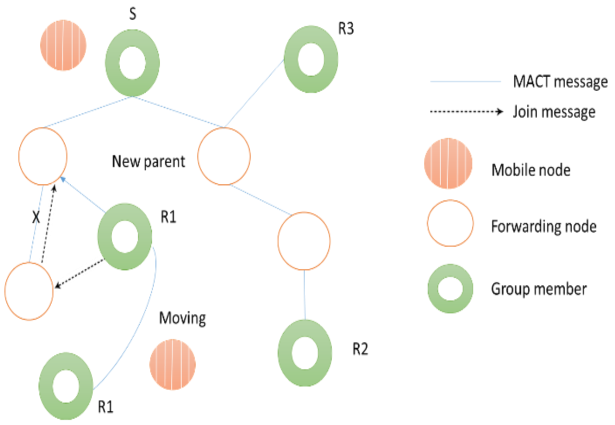

Figure 3. The route optimization process in BEMRP.

Advantages: 1.It achieves higher multicast efficiency. 2 The path optimization process eliminates redundant paths gradually that leads to higher efficiency and lower packet transfer delay. 3 It incurs low control overhead at low mobility. Disadvantages: 1 Joining and re-joining of a node take long time and consume high bandwidth. 2 The failure of a shared link affects several receivers.

4) DDM: The Differential Destination Multicast Protocol:

DDM L.-S. Ji and M. S. Corson *et al* (2003) is a sender-tree-based protocol that is designed for small group. DDM has no any multicast routing structure. It encodes the addresses of group members in each packet header and transmits the packets using the underlying unicast routing protocol. When a node P is interested in a multicast session, it unicasts a join message toward the sender of the session. The sender adds P into its member list (ML) and unicasts an ACK message back to P. DDM has two operation modes: stateless mode and soft-state mode. In stateless mode, the sender includes a list of all receivers' addresses in each multicast packet. According to the address list and the unicast routing table, each node receiving the packet determines the next hop for forwarding the packet to some receivers, and will partition the address list to distinct parts for each chosen next hop. For example, in Figure. , the sender S delegates A to forward the packet to R1 and R2. A then sends the packet to R1 and forwards it to E.

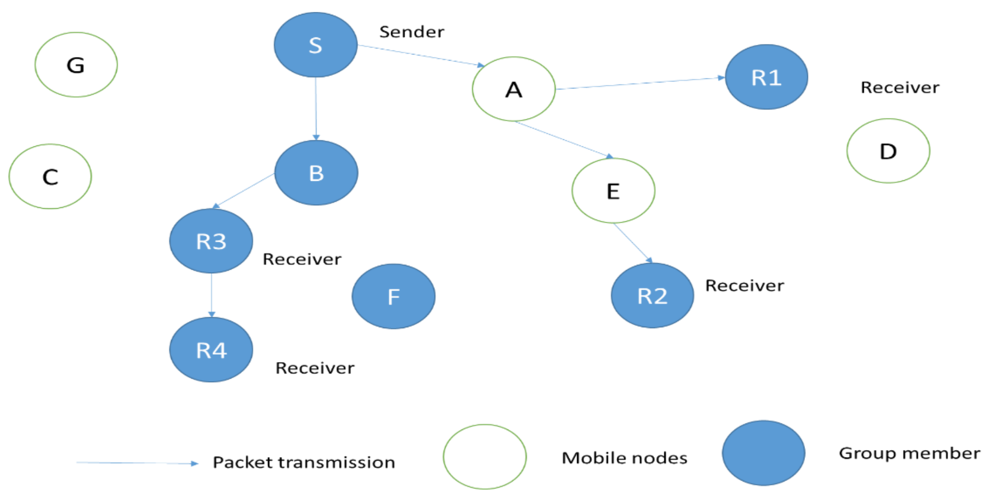

Figure. 4. Packet transmission in DDM.

In order to reduce the packet size, DDM can operate in soft-state mode. Each node in soft-state mode records the set of receivers for which it has been the forwarder. Each multicast packet only describes the change of the address list since the last forwarding by a special DDM block in the packet header. For instance, if R4 moves to another place and loses connection to R3, the DDM block in the packet header describes that R4 is removed. Then B knows that it only has to forward the packet to R3.

Advantages: 1. No storage overhead is required for group members when DDM operates in stateless mode. 2. No control overhead is incurred on the multicast routing structure.

Disadvantages: 1. It has to rely on underlying unicast routing protocols. 2. It is not mentioned how a receiver knows who the sender is. 3. It requires a specific packet header and this increases complexity.

B. Mesh-based Multicast Routing Protocols

1) ODMRP: On-Demand Multicast Routing Protocol:

ODMRP S. J. Lee, W. Su, and M. Gerla, *et al.* (2002) provides richer connectivity among group members and builds a mesh for providing a high data delivery ratio even at high mobility. It introduces a "forwarding group" concept to construct the mesh and a mobility prediction scheme to refresh the mesh only necessarily. The first sender floods a join message with data payload piggybacked. The join message is periodically flooded to the entire network to refresh the membership information and update the multicast paths. An interested node will respond to the join message. Note that the multicast paths built by this sender are shared with other senders. In other words, the forwarding node will forward the multicast packets from not only this sender but other senders in the same group (see Figure. 5).

Advantages: 1.It proposes an effective "forwarding group" concept. 2. The offering of shortest paths reduces data delivery latency. 3. The mobility prediction scheme lowers control overhead at mobility.

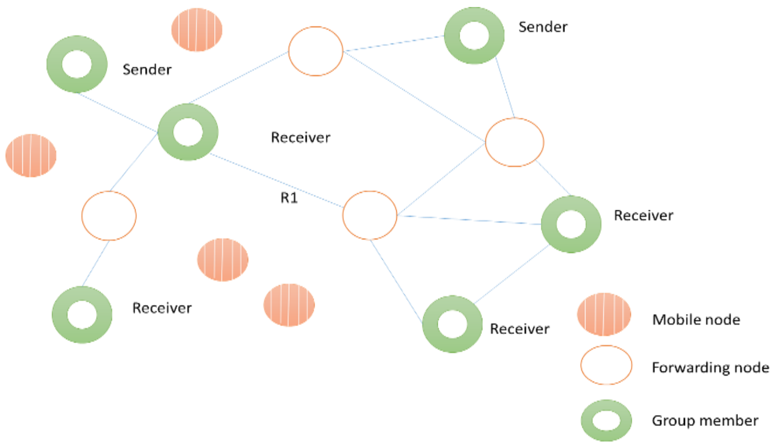

Figure. 5. The multicast mesh in ODMRP.

Disadvantages: 1.It suffers from excessive flooding when there is a large number of senders. 2. The duplicate transmissions waste bandwidth at low mobility.

2) NSMP: Neighbour Supporting Ad Hoc Multicast Routing Protocol:

NSMP S.-J. Lee and C.-K. Kim, *et al.* (2000) utilizes the node locality concept to lower the overhead of mesh maintenance. For initial path establishment or network partition repair, NSMP occasionally floods control messages through the network. For routine path maintenance, NSMP uses local path recovery which is restricted only to mesh nodes and neighbour nodes for a group. The initial mesh creation is the same with that in MANSI. Those nodes (except mesh nodes) that detect reply messages become neighbour nodes, and neighbour nodes do not forward multicast packets. After the mesh creation phase (see Figure.6), all senders transmit LOCAL_REQ messages to maintain the mesh at regular interval. Only mesh nodes and neighbour nodes forward the LOCAL_REQ messages. In order to balance the routing efficiency and path robustness, a receiver receiving several LOCAL_REQ messages replies a message to the sender via the path with largest weighted path length.

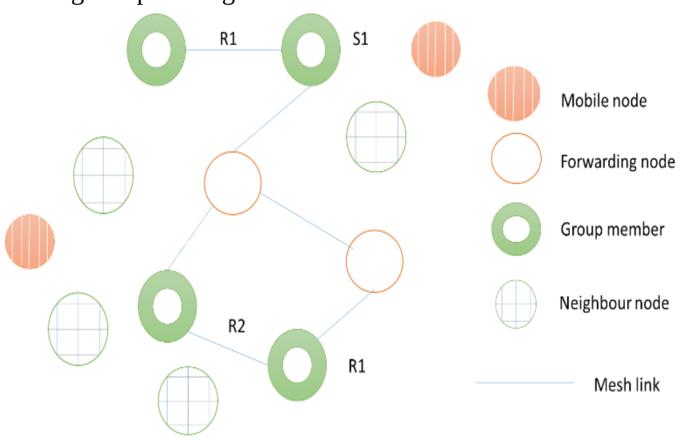

Figure. 6. The mesh structure in NSMP.

Advantages: 1. A new member can join a group more quickly than other soft-state protocols. 2. It strikes a balance between routing efficiency and path robustness. Disadvantages: 1. It takes long time on mesh maintenance since each member waits for a period to select the best path. 2. More non-group nodes are involved in a multicast session.

3) MANSI: Multicast Protocol for Ad Hoc Networks with Swarm Intelligence:

MANSI C.-C. Shen and C.-P. Jaikaeo *et al.* (2005) relies on only one core node to build and maintain the mesh and applies swarm intelligence to tackle metrics like load balancing and energy conservation. Swarm intelligence refers to complex behaviours that arise from very simple individual behaviours and interactions. Although each individual has little intelligence and simply follows basic rules using local information obtained from the environment, globally optimized behaviours emerge when they work collectively as a group.

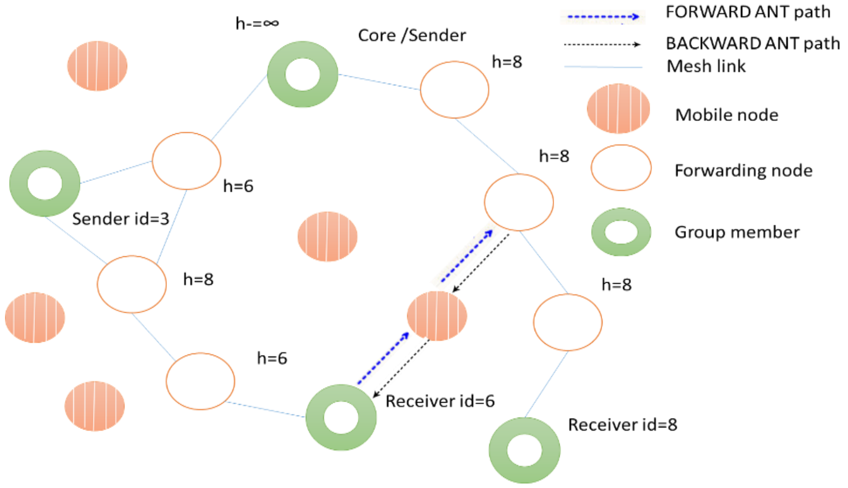

Figure. 7. The ANT exploring process in MANSI.

MANSI utilizes this characteristic to lower the total cost in the multicast session. The sender that first starts sending data takes the role of the core node and informs all nodes in the network of its existence. Reply messages transmitted by interested nodes construct the mesh. Each forwarding node is associated with a height which is identical to the highest ID of the members that use it to connect to the core node. After the mesh creation, MANSI adopts the swarm intelligence metaphor to allow nodes to learn better connections that yield lower forwarding cost. Each member P except the core node periodically deploys a small packet, called FORWARD ANT, which opportunistically explores better paths toward the core (see Figure. 7). A FORWARD ANT stops and turns into a BACKWARD ANT when it encounters a forwarding node whose height is higher than the ID of P. A

BACKWARD ANT will travel back to P via the reverse path. When the BACKWARD ANT arrives at each intermediate node, it estimates the cost of having the current node to join the forwarding set via the forwarding node it previously found. The estimated cost, as well as a pheromone amount, is updated on the node's local data structure. The pheromone amounts are then used by subsequent FORWARD ANTs that arrive at this node to make a decision which node they will travel to next. MANSI also incorporates a mobility-adaptive mechanism. Each node keeps track of the normalized link failure frequency (nlff) which reflects the dynamic condition of the surrounding area. If the nlff exceeds the threshold, the node will add another entry for the second best next hop into its join messages. Then the additional path to the core node increases the reliability of MANSI.

Advantages: 1. The swarm intelligence makes MANSI applicable to different performance metrics. 2. It utilizes a mobility-adaptive mechanism to adapt to the degree of mobility.
Disadvantages: 1. Implementation complexity is high. 2. Swarm intelligence may be not useful at high mobility.

4) ACMRP: Adaptive Core Multicast Routing Protocol:

ACMRP S.-H. Park and D.-Y. Park, *et al.* (2004) presents an adaptive core mechanism in which the core node adapts to the network and group status. In general mesh-based protocols, the mesh provides too rich connectivity and results in high delivery cost. Hence, ACMRP forces only one core node to take responsibility of the mesh creation and maintenance in a group. The adaptive core mechanism also handles any core failure caused by link failures, node failures, or network partitions. A new core node of a group emerges when the first sender has multicast packets to send. The core node floods join messages and each node stores this message into its local cache. Interested members reply a JREP message to the core node. Forwarding nodes are those nodes who have received a JREP message. If a sender only desires to send packets (it's not interested in packets from other senders), it sends an EJREP message back to the core node. Those nodes receiving this EJREP message only forward data packets from this sender. If a new sender wishes to send a packet but has not connected to the mesh, it encapsulates the packet toward the core node. The first forwarding node strips the encapsulated packet and sends the original packet through the mesh.

ACMRP proposes a novel mechanism to re-elect a new core node which is located nearby all members regularly. The core node periodically floods a query message with TTL set to acquire the group membership information

and lifetime of its neighbouring nodes. The core node will select the node that has the minimum total hop count of routes toward group members among neighbouring nodes as the new core node.
Advantages: 1. It incurs low control overhead. 2. The proposed adaptive core mechanism enhances overall performance.
Disadvantages: 1. Every node must have the ability to encapsulate and de-capsulate data packets. 2. A node not interested in a group may be the core node for the group.

IV. DISCUSSION

We discuss the features that a multicast routing protocol should consider and point out directions for designing the protocol. Basically, the design should take three issues into consideration: robustness, multicast efficiency, and control overhead. Thus, the mesh structure is more appropriate to be the multicast routing structure. A mesh that is built and maintained by only one core node is robust to low mobility and can avoid duplicate transmissions. An excellent mesh-based protocol should be designed with the connectivity adapted to the degree of mobility. General multicast protocols often provide shortest paths between senders and receivers. Although shortest paths have low data delivery latency and low probabilities of link failures, they reduce multicast efficiency. Hence, the protocol should strike a balance between multicast efficiency and path lengths.

At last, a mesh may be partitioned because of node movement. Several protocols merge separated meshes by requiring the core node with highest IP address (or other criteria) to be the new core of the merged mesh. This merging procedure is inefficient and time-consuming. In our opinion, it is better for one of the group members that detect more than one mesh existing to be the new core node. This is because that these members are located in the middle of these separated meshes.

V. CONCLUSIONS

In this paper, I have reviewed a wide range of multicast routing protocols designed for MANETs. I classify all multicast routing protocols into two categories: tree-based protocols and mesh-based protocols. Thus for each protocol, a summarized properties which describes the operation, and list the strengths and weaknesses. Then, I have suggest directions for the design of a novel protocol EGMP, where supporting efficient location search of the multicast. An important concept is zone depth, which is efficient in guiding the tree branch building and tree structure maintenance, especially in the presence of node mobility. Nodes self-organizing into zones, zone-based bidirectional-tree-based distribution paths can be built quickly for efficient multicast packet forwarding. I plan to investigate this protocols and make our survey more complete in our future work.

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