A Survey Study on Zone and Energy Based Clustering Routing Protocol for Mobile Adhoc Networks

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Abstract— *The field of multicast routing protocols are consists of many research factors while in those this is concerned with the zonal and resource efficiency. The paper consists of brief review of many popular existing multicast protocols and their comparison in relation to efficiency and security. The research survey is done on the basis of enhancement work of existing protocols over each other. In this paper we propose a Zone and Resource Efficient Protocol (G-ZRP). The G-ZRP protocol no requirement have preserved state information for zonal and resource efficient packet transmission in active environment. However, it is stimulating to implement zone based, resource and energy efficient multicast in MANET due to the trouble in group membership management and multicast packet transmission.*

Keywords—G-ZRP, Multicast routing protocols, MANET, Group membership management and multicast packet transmission

I. INTRODUCTION

In this survey analysis, we propose a Zone and Resource Efficient Protocol (G-ZRP), which can scale to a vast network size and clustering size and give powerful multicast packet transmissions in an element mobile ad hoc network environment. The approach is intended to be straightforward; hence it can work more proficiently and dependably. We present much virtual architecture for more energetic and flexible membership management and packet forwarding in the vicinity of high system elements because of unsteady remote channels and continual node movements. Both the data packets and control messages will be transmitted along proficient tree-like ways, moreover, unique in relation to other tree-based protocols, there is no compelling reason to explicitly create and keep up a tree structure. A strong virtual-tree structure can be structured amid packet forwarding with the direction of node positions. Besides, G-ZRP makes utilization of position data to support consistent packet forwarding. The protocol is intended to be thorough and independent. As opposed to tending to just a particular part of the issue, it presents a zone-based plan to efficiently handle the group membership management, and exploits the membership management structure to effectively track the areas of all the group parts without falling back on any outside area server. The zone structure is virtually structured essentially and the zone where a node is found can be calculated based on the node position and a reference origin. Unique as ordinary group structures, there is no compelling reason to include a convoluted plan to make and keep up the zone. To avoid the need of system wide periodic flooding of source data, we acquaint Source Home with track the positions and locations of every last one of sources in the system.

A. Mobile Adhoc networks (Wireless Sensor Networks)

MANETs are gaining up force on the grounds that they help recognizing network services for mobile clients in zones with no prior communications infrastructure, or when the utilization of such framework obliges remote expansion. Mobile networking is one of the most important technologies supporting pervasive computing. Amid the most recent decade, progresses in both hardware and software strategies have brought about mobile ad hoc network is an accretion of remote nodes that can rapidly be set up anyplace and whenever without utilizing any prior system base. It is a self-sufficient framework in which versatile hosts joined by remote connections are allowed to move randomly and regularly go about as switches in the meantime. The movement types in ad hoc systems are truly not quite the same as those in a framework wireless network.

B. Stateless protocols in MANETs

Multicast is a major service for supporting data trades and collective job execution among a group of clients and empowering cluster based machine framework plan in a distributed environment. The routing protocols are principally ordered into three classifications: Proactive, Reactive & Hybrid. Hybrid approach utilizes the peculiarities of reactive and proactive approaches. A large portion of hybrid routing approaches are outlined as an issue or layered system schema. One of the tasks of G-ZRP protocol is to make the system dependable and versatile. G-ZRP is additionally giving better multicast packet transmission in dynamic environment. The fundamental part of G-ZRP is to make the system well effective & give the depandability to the adhoc system & enhances the execution capacities term of the adhoc system. So as to support more solid and versatile communications, it is basic to decrease the states to be kept up by the system, and make the routting not altogether affected by topology changes. As of late, a few area based multicast protocols have been proposed for MANET.

II. LITERATURE REVIEW

The field of multicast routing protocols is relatively very much familiar to researchers around the world. Because of this fact, there is lots of material available for motion detection and video detection to review. After reviewing a number of IEEE journals and conference from ACM digital library and SJPL library, I had gained access to a few journals that proved to be useful for my research project.

Multicast Communication

In multicast communication data is delivered to a number of nodes which are geographically dispersed in a deployment field and there is no restriction on the boundary for data transmission. It is the simultaneous delivery of information to a group of destinations in the network, using the best efficient strategy to distribute the messages over each link of the network only once and creating copies only when the links to the destinations divided. Researchers have proposed many algorithms for multicast communication in wireless sensors networks, however these algorithms are efficient for some parameters and may perform poor for certain other important parameters. The existing multicast approaches can be classified into tree based, mesh based, Geocast and rendezvous based approach, which are as follows.

a. Tree Based Approach

In this approach a tree is constructed from source to multicast group members. Various algorithms are used for tree construction due to the dynamic nature of sensor nodes, which changes the tree structure after some time. Tree based approach can be further divided into a) Source based tree construction b) Destination based tree construction. In source based tree multicast routing protocols the tree construction and the tree initiation starts from source node. This requires that the source node must have information about receiver addresses and topology in a multicast group. These protocols, therefore, have high overhead due to traffic control. In case of mobile sensors the overhead is higher as compared to the static sensors. The tree based multicast routing protocols require a minimum number of copies of each data packets which decrease the traffic load and bandwidth utilization. These protocols establish a single route in a multicast group to send data from one node to another node.

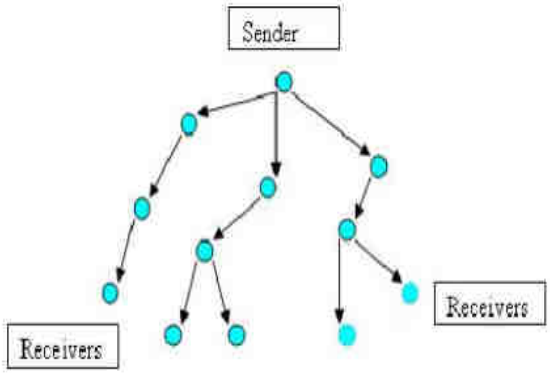

Fig. 1: Multicast Communication Scenario in a Tree

The multicast routing protocols working on tree based approach are as follow:

- **Multicast Ad hoc On-demand Distance Vector Routing Protocol (MAODV)**

MAODV discover routes for data transfer in on demand manner. Whenever a node wants to send data, it first broadcasts the address of its destination node and then waits for reply from that particular destination node. Whenever the destination node receives that requested packet it reply through the same route to sender node and the data is forwarded towards the sender node. However there are some researches issues need to be resolved in MAODV.

1. MAODV protocol has high overhead. This protocol discovers the routes in “on demand” manner therefore

before transferring actual data, destination address is broadcasted throughout the network. This technique delivers extra data through the network which causes overhead and more bandwidth is consumed.

2. MAODV protocol has high delay in message delivery to the destination node. The source node will wait until a suitable route is discovered to access the destination.

- **Branch Aggregation Multicast (BAM) Protocol**

Akihito Okura et al proposed a new multicast protocol for multicast communication in wireless sensor network known as Branch Aggregation Multicast protocol (BAM). The BAM protocol does not divide the network in multicast groups resulting in decrease of communication overhead. Furthermore there are no extra messages in the network to join, to leave or any acknowledgement from the base node in a multicast group. This approach also decreases the bandwidth utilization and energy consumption in the energy constraint wireless sensor networks. This behavior of BAM shows that it's an energy efficient protocol. Another property of BAM protocol is that it can work with any other protocol in wireless sensor network. Therefore this protocol can perform better in heterogeneous networks where multiple protocols are involved in communication process. BAM protocol uses two approaches for communication:

1. Single Hop Aggregation (S-BAM) S-BAM is responsible to aggregates radio transmission within a single hop and also enables single transmission to multiple intended receivers. This helps to reduce the redundant communication.

2. Multiple Path Aggregation (M-BAM) M-BAM also aggregates multiple paths into few and controls the range of radio transmission, so it decreases the number of branches.

These two approaches can be combined in many situations which are known as Single Multiple- Branch Aggregation Multicast protocol (SM-BAM). This techniques of merging both approaches helps to reduce overhead as well as energy consumption.

- **Optimized Distributed Multicast Routing Protocol (ODMRP)**

Yang Min et al proposed another protocol for multicast protocol in wireless sensor network known as Optimized Distributed Multicast Routing Protocol (ODMRP. This protocol is an improved version of distributed multicast routing protocol (DMRP). The major problem in old protocols was that they did not consider multi sinks in the network. ODMRP uses tree based approach for multicast communication. The construction of the multicast tree is based on shortest path from source to sink node. In ODMRP protocol the communication process is initiated from the source node therefore ODMRP is source based tree protocol.

Whenever a specific event occurs then the source node flood the invitation message towards all sink nodes in the network. After receiving the invitation message sink nodes send an acknowledgment to source node for confirmation. All nodes through which the invitation message passes and reaches to sink nodes are followed by acknowledgement message sent by sink nodes stores the whole routes IDs. This is basically a two phase process in which invitation message is first sent and then acknowledgement is received.

However following are the drawbacks of ODMRP,

1. ODMRP protocol has high overhead because of the two phase communication problem in which invitation message is sent and then acknowledgement is transferred.

2. ODMRP has high delay because of route establishment between source and multiple sinks.

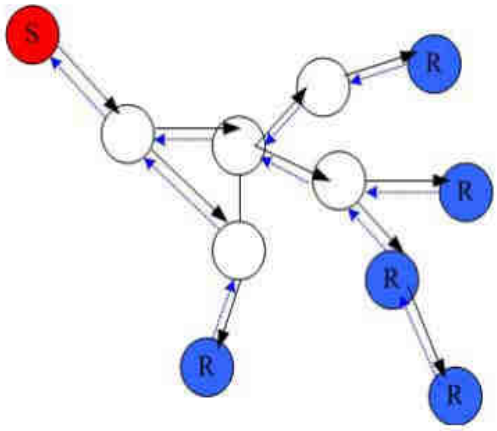

Fig.2: Two Phase Process of ODMRP

- **Very Lightweight Mobile Multicast System (VLM)**

VLM is an advanced version of LWMP using PTNT approach for multicast communication. In this approach every node is identified by its ID. The ID consists of multiple portions

personal identification of sensor node, as well as identification of that multicast group to which the node belongs. Whenever a sensor node wants to become a member of multicast group it sends a request for subscription to any member of the same multicast group. For communication between sensor and sink node unicast routing is used in a multicast group while communication between sink node and sensor nodes is handled with the help of multicast. VLM uses flooding mechanism for transfer beacons to under lying sensor nodes. As clear from research article VLM in comparison with other protocols has high delay, overhead and scalability problems.

1. VLW is not an energy efficient protocol therefore it is not suitable for wireless sensor networks.

2. VLM has very high overhead, delay and scalability issues.

3. This protocol does not support real time communication therefore it is not suitable for wireless sensor actor network.

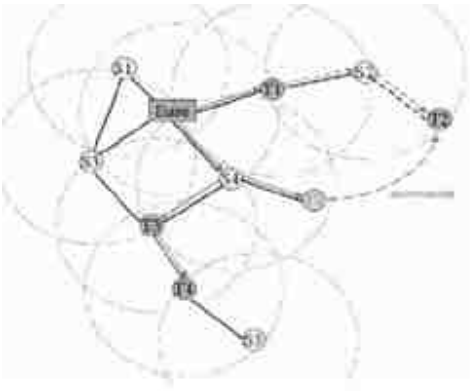

Fig.3 WSN with a root base station, Movement of node T2 changes the topology of the multicast tree

- **Lightweight Protocol for Multicast (TNT/PTNT)**

Due to limited resources in wireless sensor networks Qing Ye, et al proposed a new light weight approach for multicast communication. They introduced track and transmit (TNT) approach to check the position of sink node, which is capable to move from one place to another place in the network. When sink node position is tracked then data is transferred towards sink. The original TNT approach was not too much efficient therefore the author proposed an improved form of TNT known as Priced track and transmits (PTNT). The new approach PTNT is more efficient than TNT as clear from simulation results. As compared to TNT and VLM2, which are old approaches, PTNT has lower overhead and delay. Maximum number of packets is received in PTNT at destination.

PTNT approach has the ability to be easily implemented in both scenarios either static or mobile of wireless sensor network. The sink nodes broadcast beacon messages continuously in the network. When a sensor node receives the beacon it acknowledges it and identifies the shortest path information. PTNT consider the distance to destination as a price and when distance decreases price also decreases. Therefore PTNT gives the guarantee that after each routing step the data packet will be nearer to destination as compared to previous step. This protocol is designed for small networks therefore any change in network size and nodes density affect the performance of this protocol. It also consumes a lot of energy by continuously sending beacons and receiving acknowledgements not making it an energy efficient protocol.

The LWMP protocol resolves certain issues of delay and mobility in multicast communication but still there are few issues in this protocol due to which this protocol may not be feasible for implementation in wireless sensor actor network (WSAN).

1. LWMP has high overhead because of its extra traffic generated for tracking and transmission.

2. This protocol cannot handle the mobility of sink nodes whenever it moves back and forth in the network, although we cannot restrict a node's movement.

3. LWMP is not an energy efficient protocol due to high consumption of energy.

4. LWMP has scalability issues and any change in the network size and node density decreases its efficiency and reliability.

5. This protocol does not support real time communication and therefore cannot be implemented in wireless sensor actor networks (WSANs).

❖ **Mesh Based Approach**

This approach is more reliable, although expensive for multicast communication as compared to other approaches. The mesh based approach provides multiple paths to access

any node in the network. However it is deficient as it increases network resource utilization. This is not affordable in many situations especially in sensor network where we have very limited amount of energy in each sensor node. Ravindra et al (2004) proposed a mesh based protocol known as "Unified Multicasting through Announcements" called PUMA for mobile adhoc networks. This protocol is based on multicast announcements, where a core is elected for a group. This core informs other routers about its own distance from core as well as to next hop to the core node. It eliminates the overload problem as it uses dedicated links so that each connection can carry its own load. It is more reliable and robust approach such that if one link fails it does not affect other links. However there is no mesh based protocol for multicast communication in Wireless Sensor Networks (WSNs).

❖ **Geocasting Based Approach**

In multicast communication unlimited data can be delivered to a number of nodes which are geographically dispersed in a deployment field, putting restriction on the boundaries of network. In contrast to multicast communication the geocast communication puts restrictions on the boundary of destination nodes. Therefore data packets are delivered to a set of nodes lying within a specific geographical area. A geocast group member is defined by its geographical location. Few types of geocast protocols have been developed like flooding-based, routing-based and cluster-based protocols. Examples of these approach are Location-Based Multicast algorithm (LBM), and Geocast Adaptive Mesh Environment for Routing (GAMER). An advantage of geocast approach is that it performs efficiently in heterogeneous networks. However, it is limited up to certain geographical area.

- **Geographic Multicast Routing Protocol**

Juan A. Sanchez et al proposed a new protocol based on geocast approach in 2006 known as Geographic multicast protocol. GMR protocol was much efficient and reliable protocol for multicast communication. However the main drawback of this protocol was high overhead and maximum bandwidth utilization. To resolve these issues the author by itself in 2007 made it bandwidth efficient.

GMR uses its neighbor's information to forward the data packets from source to destination. Therefore it is necessary that each node may know about its neighbors. The bandwidth utilization and overhead is decreased to avoid flooding in GMR protocol. Whenever a node wants to send data it simply forwards it to its neighbor which have information about their own neighbors so the data is forwarded towards destination without overhead but still it faces some delay. The protocol performance is measured through "cost over progress" scheme where cost is number of neighbor selected. If number of neighbor selected is high it means that the cost will be higher. Similarly the progress is achieved when the data packet becomes nearer to the destination in each step.

- **Hierarchical Geographic Multicast Routing (HGMR)**

Dimitrios Koutsonikolas et al proposed a new protocol for multicast communication that is combination of two important protocols GMR protocol and HRPM protocol. HGMR protocol inherits the quality of HRPM protocol in scalability, Delay, overhead and state information maintenance. Further, it also resolves the issue of energy inefficiency in HRPM protocol and do not waste the nodes energy like GMR and HRPM protocols. HGMR protocol handles the efficient routing with the help of multicast groups. Each multicast group is controlled with an Access Point/Rendezvous Point (AP/RP) as used in HRPM protocol except that in HGMR protocol numbers of AP/RPs are not too large as in HRPM. To join a multicast group, each node sends a JOIN message to the RP and then wait for its response. Whenever a source node wants to transfer data, it follows the unicast forwarding mechanism to propagate data to each AP.

Each access point use different relay points for data forwarding. RP is the in charge of this network which may cause the rapid energy consumption and affect the network life time. After above discussion it is clear that HGMR protocol satisfies most requirements of multicasting in wireless sensor networks. However, there are still some problems in HGMR protocol. They are:

1. HGMR Protocol does not support real time multicast communication in sensor network. Although delay in this protocol is lower comparatively to other existing protocols, its not to the required standard for the WSANs.

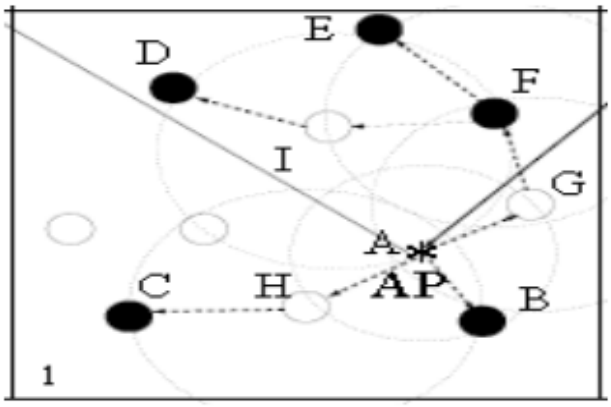

Fig.4 Data delivery in HGMR and localized neighbors selection scheme

2. HGMR is not an energy efficient protocol because existence of Rendezvous Point (RP) is responsible for rapid energy consumption.

3. HGMR is designed for static wireless sensor networks. This protocol cannot perform efficiently in WSANs as in wireless sensor actor network both sensor nodes and actor nodes are mobile.

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III. COMPARISON OF DIFFERENT MULTICAST PROTOCOLS IN SENSOR NETWORK

From the above analysis, it is clear that existing multicast protocols are not capable to be implemented in WSANs for efficient and secure multicast communication. It is due to the fact that they have high overhead, high delay and high energy consumption because of control traffic. Some of the protocols are dependent on RPs which rapidly consume energy and decrease network life. Moreover, the scalability problem also arises when they are widely dispersed. These protocols also do not support real time communication which is much important in WSANs. Table I shows the comparison of existing multicast protocols in WSNs.

Table I Comparison of Multicast Protocols

Protocol	Overhead	Delay	Scalability	Statelessness	Energy Efficient	Multicast Groups	Real Time
BAM	Low	Low	Yes	Yes	Yes	No	No
MAODV	High	High	Yes	No	No	Yes	No
GMR	High	High	No	Yes	No	No	No
ODMRP	High	High	Yes	No	No	Yes	No
HRPM	Low	Low	Yes	Yes	No	Yes	No
HGMR	Low	Low	Yes	Yes	Yes	Yes	No
LWMP	High	Low	No	Yes	No	No	No
VLMP	High	High	No	Yes	No	Yes	No

IV. PROPOSED PROTOCOL

Nodes in G-ZRP make what we call "multicast areas" focused on them. There are a few approaches to make these areas, yet for ease it can be accepted that every multicast locale compares to one quadrant of the system, for a framework focused at the node, as demonstrated in Figure 4.3. At the point when a client launches a request to send a packet to a multicast group, information is passed down to the Multicast module in the Network layer of the protocol stack. Once the G-ZRP module gets this packet, it recovers the group list from its group table, compares the group nodes' area with the multicast locales, and figures a virtual node area for every multicast locale.

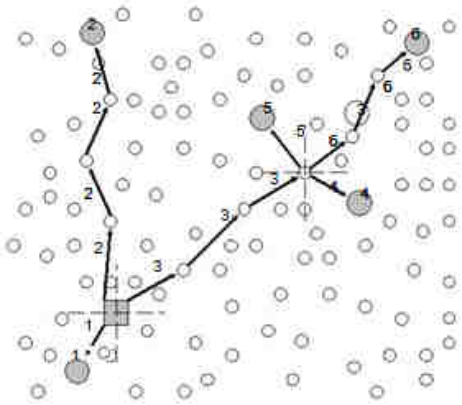

Figure 4.3 Example showing how G-ZRP delivers multicast packets

G-ZRP imitates the packet for every multicast district that contains one or more multicast parts and attaches a header comprising of a list of end of the line nodes (multicast parts) in that area, TTL (Time to Live) value, and a checksum esteem. The destination of the packet is a "virtual node" for that multicast area, which can be resolved in a few routes, yet for directness it can be thought to be the geometric mean of the areas of all the multicast parts in the multicast district. At last, all packets for all multicast locales are passed down to the MAC layer, which telecasts them to the node's neighbors. The node closest to the area of the virtual node (as controlled by recipient based conflict at the MAC layer) will assume liability for sending the packet.

The source node is the square node. Multicast parts are shaded loops, and virtual nodes are specked rounds. Since each terminus node will turn into a virtual node toward the end, they are all indicated with spotted loops. The number on the side of the lines demonstrates the end of the line of that packet.

V. CONCLUSION

In this paper, a brief review and comparisons of numerous existing multicast routing protocols is presented. After that a zone-based and resource efficient protocols is proposed. Current multicast protocols by and large depend on different tree structures and consequently intermediate nodes need to keep up tree states or routing states for packet delivery. In this paper, we exhibited another stateless multicast protocol for WSNs called Zone and Resource based Protocol (G-ZRP). G-ZRP utilizes geographic area data to direct multicast packets, where nodes discrete the system into geographic "multicast areas" and divide from packets relying upon the areas of the multicast parts.

G-ZRP stores a terminus list inside the packet header; this terminus list gives data on all multicast parts to which this packet is focused on. Subsequently, there is no requirement for a multicast tree and in this manner no tree state is stored at the intermediate nodes.

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