International Journal Of Advances In Engineering And Management (Ijaem)
Volume 3, Issue 1 Jan-Feb 2021, Pp: 775-780 Www.Ijaem.Net Issn: 2395-5252

Enhanced Cluster Based Routing Protocol for MANET

Prof. Shatendra Dubey, Prof. Anurag Shrivastava, Neerja Dubey
NIIST, Bhopal (M.P.)
NIIST, Bhopal (M.P.)
NIIST, Bhopal (M.P.)

Submitted: 25-01-2021 Revised: 05-02-2021 Accepted: 08-02-2021

ABSTRACT–In mobile Ad Hoc network (MANET), Routing is the act of moving information from source to a destination in an internetwork. Our work is based on cluster head gateway switch routing protocol, we propose a new protocol called ECBRP (Enhanced Cluster Based Routing Protocol) is an on-demand routing protocol. ECBRP also improves the routing discovery by integrating the inter-cluster and the intra- cluster on-demand routing, such as AODV and DSR protocol i.e. AODV protocol to make connection between cluster head to cluster head and DSR protocol use to communicate with cluster member and cluster head. Finally this experiment is done in NS2 then we find to verify the enhanced protocol in increasing cluster stability and reduce redundant information, routing overload in the network and also improves the communication is very efficient.

Keywords: Clustering, routing protocol, Ad Hoc network, aodv, dsr

I. INTRODUCTION

Wireless cellular systems have been in use since 1980s. We have seen their evolutions to first, second and third generation's wireless systems. These systems work with the support of a centralized supporting structure such as an access point. The wireless users can be connected with the wireless system by the help of these access points, when they roam from one place to the other. MANET is a kind of wireless ad-hoc network and it is a self-configuring network of mobile routers (and associated hosts) connected by wireless links – the union of which forms an arbitrary topology. The routers, the participating nodes act as router, are free to move randomly and manage themselves arbitrarily; thus, the network's wireless topology may change rapidly and unpredictably. The idea of MANET is also called infrastructure less networking, since the mobile nodes in the network dynamically establish routing among themselves to form their own network on the fly. It is formed instantaneously, and uses multi hop routing to transmit information. MANET technology can provide an extremely flexible method of establishing communications in situations where geographical or terrestrial constraints demand a totally distributed network system without any fixed base station, such as battlefields, military applications, and other emergency and disaster situations. A sensor network, which consists of several thousand small low-powered nodes with sensing capabilities, is one of the futuristic applications of MANET.

Features

MANET has the following features:

1) Mobile Node: In MANET, every mobile node terminal is an autonomous node. It can perform as both a host and a router. In other words, we can say that besides the basic processing ability as a host, the mobile nodes can also perform switching functions as a router.

2) Distributed Function: The protocol should be distributed. It should not be dependent on a centralized controlling node. This is the case even for stationary networks. The control and management of the network is distributed among the mobile nodes. The dissimilarity is that the nodes in an ad-hoc network can enter or leave the network very easily and because of mobility the network can be partitioned.

3) Multiple routes: To reduce the number of reactions to topological changes and congestion multiple routes can be used. If one route becomes invalid, it is possible that another stored route could still be valid and thus saving the routing protocol from initiating another route discovery procedure. When delivering data packets from a source to its destination out of the direct wireless transmission range, the packets should be forwarded via one or more intermediate nodes.

4) Dynamic network: When the nodes are mobile, the network topology may change rapidly and unpredictably and the connectivity between the mobile nodes may vary with time. MANET should adapt to the traffic and propagation conditions as well as the mobility patterns of the mobile network nodes. Mobile nodes in the network dynamically establish routing among themselves as they move about, forming their own network on the fly.

5) Fluctuating link capacity: The nature of high bit-error rates of wireless connection might be more profound in a MANET. One end-to-end path can be shared by several sessions. The channel over which the terminals communicate is subject to noise, fading, and interference, and has less bandwidth than a wired network.
6) Demand based Procedure: To minimize the control overhead in the network and thus not misuse the network resources the protocol should be reactive. This means that the protocol should react only when needed and should not periodically broadcast control information.
In CGSR, nodes are divided into clusters. One cluster head is selected in one cluster using a certain algorithm. Cluster heads transfer the data between different clusters.When one source nodes sends a packet to its destination node, the packet is firstly sent to its cluster head. If the destination node is in the same cluster, the cluster head then forwards the packet to the destination node. If not, the packet will be transferred to another cluster head. The packet is forwarded from one cluster head to another cluster head until reaches the cluster header which includes the destination node. Finally, the packet is delivered to the destination node [14].

Node S (source) has to send data to node D (destination). S sends route requests to all the neighbouring cluster-heads, and only to the cluster-heads. When a cluster-head receives theroute request, it checks if the node D is in his cluster. If this is the case, the cluster-head sends the request directly to the destination. But when D isn't in the cluster, it sends the route request to all the adjacent cluster-heads. All cluster-head saves his address in the packet, so when a cluster-head receives a route request where his address is saved in the packet, it discards this packet. When the route request packet arrives at the destination, D replies back with the route that had been recorded in the request packet. When the source S doesn't receive a reply from the destination within a time period, it tries to send a route request again.

Figure 1 shows the working of our protocol. However, in a clustering network the cluster-head has toUndertake heavier tasks so that it night be the bottleneck of the network. Thus, reasonable clusterhead election is important to the performance of the Ad Hoc Network.

Developing a good dynamic routing protocol for Ad Hoc Network with rapid topology variation is not only the key of the network design, but also hot problem of research.

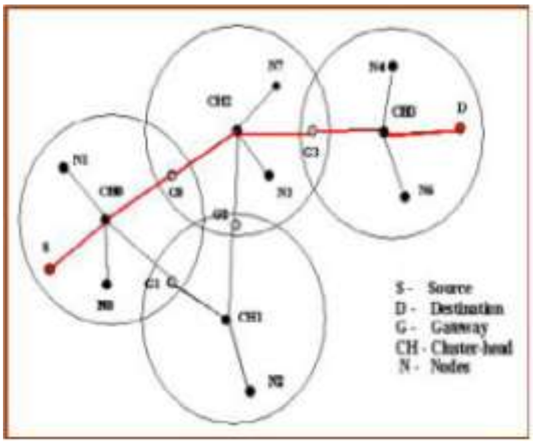


Figure 1.

II. RELATED WORK

Routing protocols form the heart of any MANET, which haven't evolved as much to support a large amount of mobile units. The performance of most routing protocols degrades with the increase in mobile nodes, leading to higher end-to-end delay, more dropped packets and low quality of service (QoS).

Existing routing protocols can be classified either by their behavior or by their architecture. The existing protocols can be broadly classified into three groups based on their behavior; reactive protocols (on demand), proactive protocols (table driven) and hybrid protocols that are a combination of reactive and proactive protocols. If classified by architecture, the protocols are either flat or follow a hierarchy.

A. Clustering Algorithms

Different clustering algorithms have different optimizations, such as minimum clusterhead election and maintenanceoverhead, maximum cluster stability, maximum node lifespan, etc. There are probably contradictions among these optimizations. Thus, heuristic Clustering algorithms are used to find sub-optimal solutions in common.

Lowest-ID (LOWID) algorithm [1] has the feature of simple calculation. If the cluster structure varies rapidly, the cluster maintenance overhead is relatively small. However, the clusterhead costs excessive resources so that the network lifespan is reduced.

Highest-degree (HIGHD) or highest-connectivity algorithm [2] has the advantage of less cluster number to reduce the packet delivery delay. But when a cluster has too many nodes, the throughput of each node will decline shapely. Additionally when the node has high mobility, the clusterhead updating frequency will increase dramatically, which greatly increase the maintenance overhead.

Distributed Mobility-Adaptive clustering (DMAC) algorithm [3] can reduce the clusterhead updating frequency obviously because the node with lowest mobility is elected as a clusterhead. Its disadvantage is that the frequent computation of node mobility weight costs large calculation overhead.

The above clustering algorithms only take into account one or two factors for the choice of clusterhead, whose optimization is not enough. Chatterjee et al. [4] described a clustering algorithm with weight defined as a combination of a few metrics including node degree, sum of distances to all neighbors, speed of node, and the cumulative time node serves as clusterhead.

B. Routing Protocols

In accordance with routing-driven model, Ad Hoc network routing protocols can be divided into table-driven routing Protocols (such as DSDV protocol [5]) and on-demand routing protocols (such as DSR, AODV protocol [6]). According to differences in network topology, they can also be divided into flat routing protocols and cluster routing protocols. The routing protocols based on clustering mechanism have CBRP and CGSR, etc.

CGSR (Clusterhead Gateway Switch Routing) [8] is in agreement on the basic DSDV protocol combining hierarchical routing mechanism. In the actual use, CGSR is more effective than flat routing protocols. Its drawback is that when the clusterhead changes frequently, nodes are busy in selecting clusterhead instead of data transmission.
The destination nodes in routing table are all the nodes in the same cluster, which reduces the size of routing table and increases the scalability of the network.

C. CBRP Protocol

CBRP (Cluster Based Routing Protocol) [9] is a cluster on-demand source routing protocol, having many similarities with the Dynamic Source Routing Protocol (DSR). By clustering nodes into groups, the protocol efficiently minimizes the flooding traffic during route discovery and speeds up this process as well. Its route shortening and local repair features make use of the 2-hop-topology information maintained by each node through the broadcasting of HELLO messages.

Compared with other routing algorithms, CBRP has small routing control overhead, less network congestion andsearch time during routing. In CBRP, clusterhead manages all cluster numbers all the information and behavior in each cluster, and finds the adjacent clusters for routing through the gateway node.
Lowest-ID algorithm is used for the clusterhead election.

III. ECBRP CLUSTERING ALGORITHM

We intend to integrate clustering with routing functionalities. The main design goals of our clustering scheme are:
1. The algorithm should use a routing protocol's control messages for cluster formation with minimal overhead.
2. The algorithm must operate in localized and distributed manners.
3. The algorithm must incur minimal cluster formation and maintenance overhead and support on-demand cluster formation.
4. The algorithm should minimize network-wide flooding and be scalable.

Our proposed scheme constructs or updates clustering architecture only when clusters' service is needed. The on-demand nature emanates from the demand driven nature of the AODV. Nodes that take part in clustering are known from topological information maintained in the CHs and individual nodes.

A. Clusterhead Election Algorithm

K-mean Clustering Algotitham-It is an algoritham to classify or to group Node based on attributes into k number of group where k is positive integer number.The grouping is done by minimizing the sum of squares of distances between Node and the corresponding Cluster Head.Thus the purpose of k-means clustering is to classify the Node.

The basic step of K-means clustering is simple. In the begining, we determine number of cluster K and we assume the Cluster Head (centroid) or center of these cluters. We can take any random nodes as the initial centroid or the first k-nodes can serve as the initial centroids.

Then the K-means algorithm will do the three steps below until convergence-
Iterate until Stable (= no node move group)
1) - Determine the centroid coordinate
2) - Determine the distance of each node to the centroids.
3) - Group the nodes based on minimum distance (find the closest centroid).

K-means is one of the simplest unsupervised learning algorithms that solve the well known clustering problem.

International Journal Of Advances In Engineering And Management (Ijaem)
Volume 3, Issue 1 Jan-Feb 2021, Pp: 702-712 Www.Ijaem.Net Issn: 2395-5252

This algorithm aims at minimizing an objective function, in this case a squared error function. The objective function

$$J = \sum_{j=1}^{k} \sum_{i=1}^{x} \| x_i^{(j)} - C_j \|^2$$

Where $\| x_i^{(j)} - C_j \|^2$ is a chosen distance measure between a cluster member xi and the cluster center Cj, is an indicator of distance of the n nodes (cluster members) from their respective cluster heads (centroids).

B. ECBRP Routing Algorithm

In ECBRP, the route discovery consists of intra-cluster routing and inter-cluster routing. In the cluster, a similar on-demand DSR routing is used to get the advantage that the clusterhead does not necessarily involve in communication in order to reduce its communication burden, extend its survival time and stabilize the cluster structure. In the inter-cluster, RREQ routing request packets are sent between adjacent clusters to form on-demand routing using AODV protocol.

1) Intra-cluster routing

In clustering process, the intra-cluster routing process communication is done with DSR protocol. Node creates a routing table on demand which destination nodes are all in the same cluster.

2) Inter-cluster Routing

The relationship between two adjacent clusters can be achieved through the intra-cluster routing information table, which sets up inter-cluster routing foundation. The use of on-demand approach of AODV protocol to inter-cluster route discovery reduces inter-cluster routing and maintenance costs.

ECBRP, when the need for inter-cluster routing search comes, the source node sends an inter-cluster routing request packet (RREQ) to its gateway node to obtain routing information within the adjacent cluster.

IV. SIMULATION OF ECBRP CLUSTERING ALGORITHM

In ECBRP, the route discovery consists of intra-cluster routing and inter-cluster routing. The AODV protocol sends many small packets compared to other reactive protocols such as DSR. Hence when the network's size increases, the degree of node also increases, causing network congestion. The use of clustering reduces this overhead by allowing localized route discovery and maintenance. The proposed ECBRP scheme uses clustering architecture and performs routing. In this section, we will discuss the mechanisms used by ECBRP to reduce routing overhead and allow scalability while achieving a good packet delivery ratio.

V. SIMULATION OF ECBRP ROUTING ALGORITHM

Simulation Environment

The NS2 simulation tool is used for performance evaluation. At the beginning of the simulation, 30 nodes were randomly placed within the simulation area of 600m x 600m. The transmission range was set at 50m. The random waypoint mobility model was used for simulating mobility. The pause time was 10 seconds. Other simulation parameters are shown in Table.

Parameter	Default values
Node Speed (m/sec)	20
Transmission Rate	4 pkts/sec
Traffic Model CBR,	2 sources
Packet Size	512 bytes
Simulation Time (sec)	120

In our simulation, number of nodes was varied between 15 and 65, and the transmission range was varied between 0 and 50. The nodes moved randomly in all possible directions with a maximum displacement of 10 along each of the coordinates. We assume that each cluster head is ideally able to handle 10 nodes in its cluster in terms of resource allocation. Therefore, the ideal degree was fixed at M =10 for the entire experiment. Due to this, the weight associated with D_v was rather high. The next higher weight was given to P_v, which is the sum of the distances. Mobility and Energy were given low weight and high weight. The values used for simulation were $c_{1=0.5}$, $c_{2=0.2}$, $c_{3=0.05}$ and $c_{4=0.25.}$ Note that these values are arbitrary at this time and should be adjusted according to the system requirements.

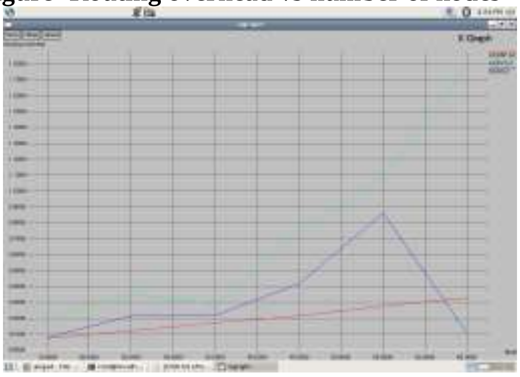
Also compared with AODV and DSR, the routing performance of ECBRP is simulated. The number of nodes is from 15 to 65, and the largest node moving speed is 20m /s. The data stream is randomly generated by Cbrgen of NS. Each CBR packet size is 512B. The stream rate is a packet per second. The network bandwidth is 1M with the wireless channel and MAC layer of IEEE802.11. The performance indicators simulated are packet delivery ratio, routing overhead. Simulation scene settings are randomly generated.

International Journal Of Advances In Engineering And Management (Ijaem)
Volume 3, Issue 1 Jan-Feb 2021, Pp: 775-780 Www.Ijaem.Net Issn: 2395-5252

Routing Overhead

From Fig., the routing overhead refers to the number of routing control packets transmitted over the number of data packets sent, fig shows that as the number of nodes increases, the routing overheads are upward, and the overhead of ECBRP is less than that of AODV and DSR.

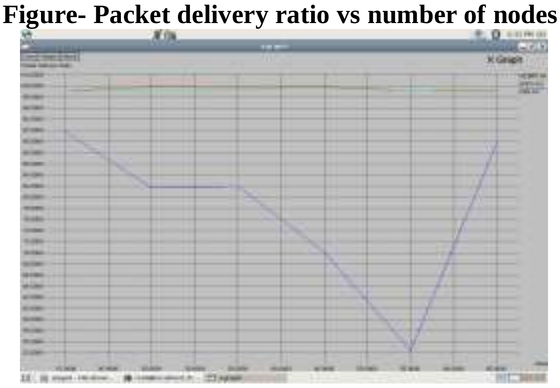
Figure- Routing overhead vs number of nodes



Packet Delivery Ratio

From Fig. shows that the packet delivery ratio is higher for the ECBRP than pure AODV and DSR protocol. The difference in the delivery ratios increases as the network's size increases, which shows the performance gained by the ECBRP based routing scheme.

Figure- Packet delivery ratio vs number of nodes



VI. CONCLUSION

This survey analysis has presented the most well known protocols for the routing function in mobile ad hoc networks. The analysis of the different proposals has demonstrated that the inherent characteristics of ad hoc networks, such as lack of infrastructure and rapidly changing topologies, introduce additional difficulties to the already complicated problem of routing. The comparison I have completed between the ECBRP (our proposed protocol), AODV and DSR. The statistical information is calculated in the mean value.

Based on the improvement of existing routing protocol such as table-driven and on-demand driven protocol, Enhanced Cluster Based Routing Protocol (ECBRP) is proposed, which makes cluster number and structure optimal, effectively solves the problem of blindly broadcasting routing control packets, reduces routing overhead, and shortens the route discovery time. NS2 simulation results show that the proposed algorithm has better performance in the MANET network of large scale and high mobility.

REFERENCES

[1]. M. Gerla, J. T. C. Tsai, "Multicluster, Mobile, Multimedia Radio Network," Wireless Networks, 1995, 1(3): pp. 255-265.
[2]. C. R. Lin, M. Gerla, "Adaptive Clustering for Mobile Wireless Networks," IEEE Journal on Selected Areas in Communications, 1997, 15(7): pp. 1265-1275.
[3]. S. Basagni, "Distributed Clustering for Ad Hoc Networks," International Symposium on Parallel Architectures: Algorithms and Networks, 1999, pp. 310-315.
[4]. M. Chatterjee, S. Das, D. Turgut, "WCA: A Weighted Clustering Algorithm for Mobile," Journal of cluster Computing (Special Issue on Mobile Ad Hoc Networks), 2002, 5(2): pp. 193-204.
[5]. C. E. Perkins, P. Bhagwat, "Highly Dynamic Destination-Sequenced Distance-Vector Routing (DSDV) for Mobile Computers," Computer Communication, 1994, pp. 234-244.
[6]. D. B. Johnson, D. A. Maltz, Y. C. Hu, "The Dynamic Source Routing Protocol for Mobile Ad Hoc Networks," IEFT Draft, 1999.
[7]. R. Sivakumar, P. Sinha, V. Bharghavan, "CEDAR: core-extraction distributed Ad Hoc routing algorithm," INFCOM'99, 1999, pp. 202-209.
[8]. G. Pei, M. Gerla, X. Hong, C. C. Chiang, "A wireless hierarchical routing protocol with group mobility," Proceedings of IEEE WCNC'99, 1999, pp. 1538-1542
[9]. M. Jiang, J. Li,Y. C. Tay, "Cluster based routing protocol (CBRP) functional specification," IETF Internet-Draft, 1999.
[10]. LU Hong, SUN Xuemei, REN Changming, "An Enhanced Weighted Clustering Algorithm for Mobile Ad Hoc Networks," Computer Engineering, 2006, 32(11): pp. 147-149.
[11]. CHENG Weiming, ZHENG Jianping, SHENG Lingzhi, "A Clustering Model for Mobile Ad Hoc Network," Journal of Com-

puter Research and Development, 2004, 41(4): pp. 674-678.

[12]. MENG Bin, ZHANG Yaoxue, "A Relationship-based Distributed Clustering Algorithm in MANET," Computer Science, 2005, 32(12): pp. 27-29.

[13]. SHAO Guangtao, "Research on Clustering Algorithm of Ad Hoc Network," Master's thesis, Kunming University of Science and Technology, 2008

[14]. Puyuan Zhao, "An Improved Cluster Header Switch Gateway Routing Protocol" IEEE2019, **IAEAC 2019**, pp. 57-61.

International Journal of Advances in Engineering and Management
ISSN: 2395-5252

IJAEM

Volume: 03 Issue: 01 DOI: 10.35629/5252

www.ijaem.net
Email id: ijaem.paper@gmail.com