IJCSE International Journal of Computer Sciences and Engineering Open Access
Review Paper Volume-2, Issue-4 E-ISSN: 2347-2693

Performance Analysis of Cluster Based Routing Protocol for Ad hoc Networks

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www.ijcaonline.org

Received: 07/03/2014 Revised: 19/03/2014 Accepted: 22/04/2014 Published: 30/04/2014

Abstract— A Mobile Ad hoc Network (MANET) is a collection of wireless devices that can exchange information dynamically. The nodes in the network exchange information using the topology of the network. The ad-hoc network suffers from excessive traffic and maximum control overheads during route discovery. In this paper we have describe the clustering approach in ad-hoc network. The cluster based routing protocol (CBRP) divide the network in to small groups. The cluster head is elected to manage a cluster. Cluster heads in the network are responsible for information exchange. Using clustering approach flooding and overhead problems within the network can be effectively minimized.

Index Term— Cluster Based Routing Protocol, Cluster Formation, Lowest ID Algorithum, Route Discovery

I. Introduction

An Ad-Hoc network is a collection of mobile devices. The devices in the network communicate with each other without any centralized administration [1]. The devices in the network are free to move so network topology may changes dynamically. Nodes in the network are able to sense and thus discover the nearby nodes. Due to the limited transmission range of wireless network interfaces, multiple network "hops" may be needed for one node to exchange data with another across the network [2]. Each device in the network acts as router. The routes are formed when ever devices want to communicate with each other. Application of mobile ad-hoc network ranges from conference rooms to military operations. An Ad-Hoc network suffer from some disadvantages like network stability, control overheads, fault tolerance etc. Routing is active research area in the network. Many routing protocol works better for smaller network size. For large size network it is necessary to organize the network in to small groups to reduce the control overheads, bandwidth and battery requirements within the network. A cluster Based Routing Protocol (CBRP) can provide the solution to these issues.

II. Description Of CBRP Protocol

The basic mechanism of topology-based protocol is flooding. The node is flooded with control messages and finds the routes between source and destination. When number of nodes is more it may lead to network congestion. The cluster-based routing protocol (CBRP) was introduced by Jinyang Li [3]. The clustering architecture provides scalable network. The work divides the network in to several two-hop clusters [3]. Each node in the cluster will perform
following roles cluster head, gateway or members of the cluster. Initially all the nodes in the network are in undecided state. The undecided node set a timer and broadcast Hello message. The node changes the undecided state to member state as soon as it gets reply from cluster head. If undecided node does not get any reply from cluster head, node will either remain in undecided state or elect itself as cluster head. A node of the cluster is elect as gateway when it is common and single-hop away from the two cluster heads. Figure 1 shows the cluster structure. The cluster is identified by their respective cluster head [3].

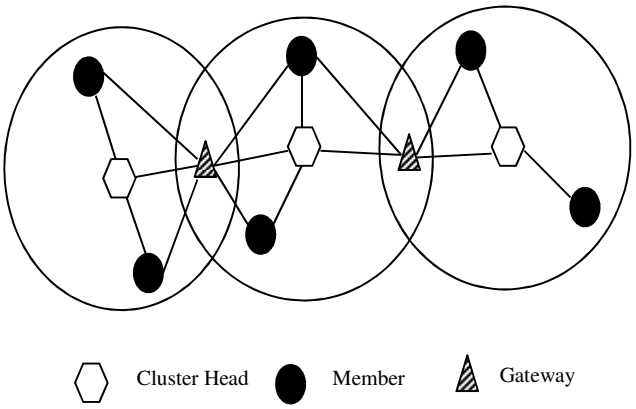

Figure 1. Cluster structure

The cluster elects cluster head using identifier-based clustering or using connectivity-based clustering. In identifier-based clustering a node elects itself as the cluster head if it has the lowest/highest ID in its neighboring nodes. In connectivity-based clustering the node is elected as cluster head, which has the highest number of neighboring nodes. In this work we use lowest ID algorithm for cluster head selection as it provide more stable cluster formation [4]. The cluster heads are responsible for routing in the network.

The inter cluster and intra cluster management is done using the neighboring table (NT) and cluster adjacency table (CAT) [5]. These two tables are updated using the HELLO messages broadcast by each node after specific interval of time. The neighboring table updates the information about neighboring node, their role and link status. The cluster adjacency table updates the information about the adjacent clusters.

When a source node wants to communicate with destination node, the source node initially checks the neighbor table. If

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the destination node id is present in the table it directly sends the information to destination node. Else it checks its routing table for finding the active route to destination node. If route is exists in table, it sends the data packet through this route. Else source node has to perform route discovery procedure for finding the routs to the destination node.

The route discovery procedure uses source routing [6,7]. The source node creates the route request packet (RREQ). Source floods the cluster head with RREQ packets. The cluster head then broadcast the RREQ packet in the network. Firstly packets are received by the gateways. Gateway node checks out the cluster head list. If destination node id is present in the list, it generates the route reply packet (RREP) and sends towards destination. Else it appends some additional information in route request packet (RREQ) and forward to corresponding cluster head. Cluster head checks its corresponding tables. If the destination node id is present in the list then that cluster head generate the unicast route reply packet (RREP) and send back to source node. If the destination node id is not present in the corresponding tables, it will append some extra information in RREQ packet and forward to the next adjacent cluster heads through their gateways and so on. This analogy is used to find the destination node. To reach up to destination node a loose source route is generated. The destination node generate unicast RREP packet. Using this packet a strict path is created. This path is used for data transmission from source to destination node.

III. Simulation

The Table 1 illustrates the parameters that we have been used for simulation. The simulation is done for various numbers of nodes. We have analyzed the performance of the cluster based routing protocol for its packet delivery ratio, end to end delay, and energy consumption by the network.

Parameters	Values
Simulation time	300 sec
Traffic type	CBR
Routing Protocol	CBRP
Pause time	25 seconds
Node speed	4 m/seconds
Number of nodes = N	25,55,75,95
Queue Length	100
Packet size	512 bytes

TABLE 1:- SIMULATION PARAMETERS

IV. Results

The results are drawn for packet delivery ratio, end to end delay and energy consumption of the network.

Packet delivery ratio (PDR):- The packet delivery in the network may define as difference between number of sent packets and received packets divided by total number of sent packet.

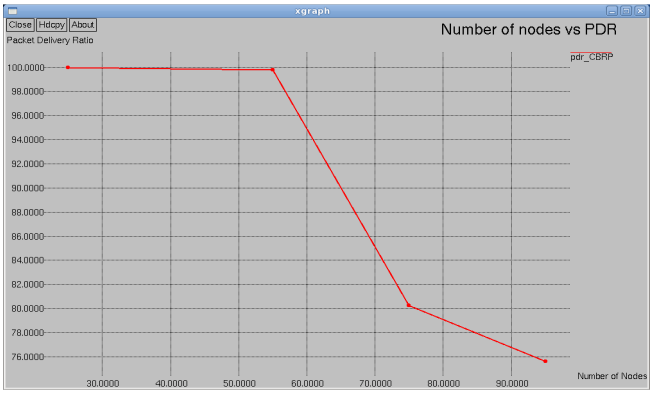

Figure 2. Number of Nodes vs Packet Delivery Ratio

End to end delay:- The end to end delay of a network specifies how long it takes for a bit of data to travel across the network from source node to endpoint.

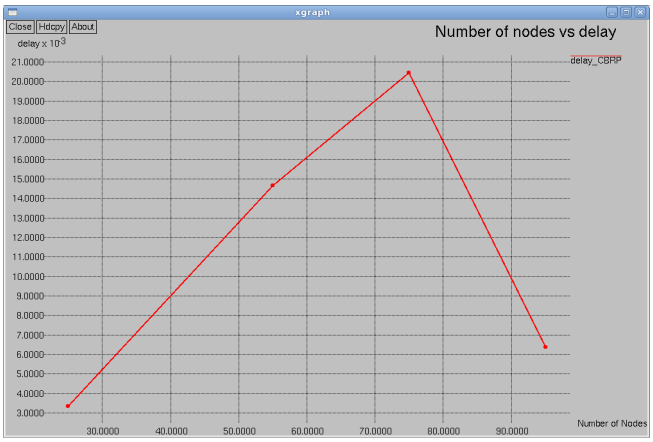

Figure 3. Number of Nodes vs end to end delay

Energy consumption:- The amount of energy consumed by the network is given by energy consumption parameter.

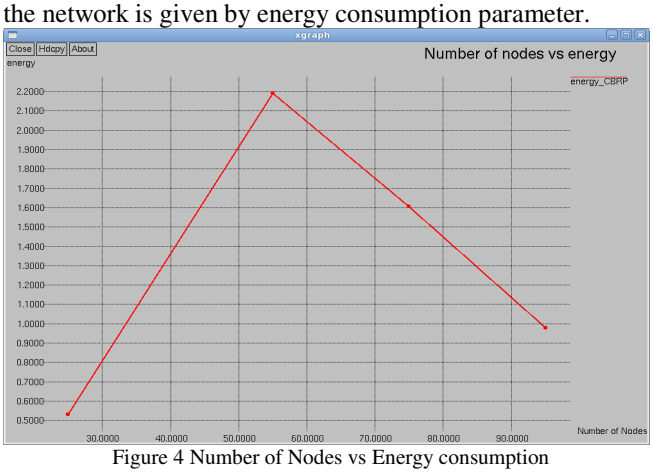

Figure 4 Number of Nodes vs Energy consumption

V. Conclusion

The nodes in the network are mobile nodes. The moving nodes are responsible for path failure which affects the performance of the network. The Packet delivery is good for small size network but decreases as we increase the number

of nodes in the network and correspondingly affects the delay and energy consumption in the network.

ACKNOWLEDGMENT

I would like to express my gratitude and appreciation to my guide Ms. Swati S Mahajan who has given her full effort in guiding me and encouraging me as well as to maintain the progress of my project work.

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