Evaluation of an Energy Efficient Cluster Based Routing in MANET

Jaspinder Singh, Meenakshi Sharma

Abstract— Mobile Ad-hoc will be a vital part of next generation network due to its flexibility, infrastructure less nature, and ease to maintenance, auto configuration, self-administration capabilities, and cost effectiveness. In MANET Cluster base routing protocol play a significant role in formation of cluster at low energy cost. Energy efficient cluster formation in MANET is one of the major issue because energy of one node in cluster may affect all other nodes and also effect on the life time of the cluster Head. This paper propose an algorithm technique – which is "Signal and Energy Efficient Clustering (SEEC)" base on the Signal level and energy of the nodes to increase the life time of Cluster head. Its emphasis on the cluster maintenance and formation at low cost the resources used that are signal strength, battery power of the node. The Performance metrics are packet delivery ratio, Network Life time, Throughput. The simulation will be done using NS2 network Simulator.

Index Terms— Cluster, Cluster Head (CH), Energy level, Signal Strength, Routing, CBRP, MANET.

I. INTRODUCTION

Mobile Ad-hoc Network is a wireless network of mobile computing devices that are connected by multi-hop wireless links. MANET are highly dynamic network as there is deployment of central base station is neither economic nor easy. The node involved in MANET function as router as well as host to exchange packets to other nodes in the network. In MANET node has properties to move and synchronize with their neighbor's. Due to mobility of nodes, connection in the network can change dynamically and node can add or removed at any time. MANET has no fixed fundamental Structure. MANET might potentially be used in various applications such as mobile classrooms, battlefield communication, remote conferencing and disaster relief applications. MANET has its own routing protocols which can be compromised with frequent route exchange, dynamic topology, bandwidth constraint and multi-hop routing. An ad hoc routing protocol is a convention, or standard, that controls how nodes decide which way to route packets between computing devices in a mobile ad hoc network. The primary challenge in building a Mobile Ad hoc Network is equipping each device to continuously maintain the information required to estimating Link and mobility characteristics of network. MANET classified by two categories on the basis of their routing techniques. These techniques are flat routing and cluster base routing.

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In flat routing all nodes transfer a data to base station for communication [2]. In cluster base routing has cluster head, which responsible for route between node and base stations.

Cluster base routing is superior then flat routing in energy efficiency, due to decreasing amount of data transmission. In Cluster base routing each mobile node divide into group of networks with 2 hop diameter. These disjoint set or overlapping set are define as clusters. In each clusters one node is selected as Cluster Head other as member node. Cluster Head maintain the information in the cluster. Cluster base routing protocol find routes faster with minimizing flooding technique.

A. *Lexis Used in CBRP*

1) Node ID: Unique Identification of all node within a cluster e.g. IP Address and MAC address of the nodes.
2) Cluster: A collection of nodes in which a particular node elected as head node. Each cluster has unique ID of the cluster head. Cluster may be overlapping or disjoint group of nodes. Nodes belong to the cluster has recognized by their head ID.
3) Cluster members: Nodes which are not participate in neither cluster gateway nor a cluster head are represented with the members of the cluster.
4) Cluster Head: leader node of the cluster which play vital role for routing and data transferring.
5) Cluster Gateways: node that link information between two clusters.

B. *Theoretical Data Arrangements Used in CBRP [2]*

It has following fields

- Identification of Linked cluster head
- Gateways of the adjoining clusters.
- The role of the neighbour

Table 1. Format of Cluster Adjoining Table

ADJOINING_CLUSTER_ID	GATEWAY	LINK_ STATUS

C. *Neighbor Table [2]*

It has following fields

- The ID of the neighbour that it has connectivity
- Role of the neighbour.
- Link status.

Table 2. Format of Neighbour Table

NEIGHBOR_ID	LINK-STATUS	ROLE

D. Route Consideration

Cluster base routing Protocols base on source routing. It Contain two Process. One is route discover and other one is actual packet transfer [1]. Route Request (RREQ) support for find the destination node with the help of flooding to neighboring Cluster head. Initial Route Request is flood hello message to all node it contain neighboring cluster head node, adjacent gateways, member nodes. Source node broadcast the RREQ to the Destination Node and get acknowledgment from the destination node with the form of RREP (Route Reply) to source node. The problem faced by the CBRP is energy consumed by the head node due to this cluster has short life time. The goal of this paper propose an algorithm technique – which is "Signal and Energy Efficient Clustering (SEEC)" base on the minimized flooding strategies to increase the life time of Cluster head. Its emphasis on the cluster maintenance and formation at low cost the resources used that are signal strength, battery power of the node. The rest of this paper is organized as follows. Section 2 reviews some related work; Section 3 gives a proposed work; Section 4 gives an algorithm; Section 5 gives a Simulation results; we conclude with Section 6.

II. RELATED WORK

In this section we will give overview on different Routing Protocols in MANET. Priti Garg, et. al. "Comparative Performance Analysis of Two Ad-hoc Routing Protocols", International Conference on Network and Electronics Engineering IPCSIT vol.11, pp 99-104, 2011 [2]. The author of this paper reports various issues by analyse the comparative performance of Ad hoc routing protocols; Its associated on-demand and hybrid protocol; these protocols are TORA (temporally ordered routing algorithm) and DSR (Dynamic Source Routing). This paper compare these protocols under different environmental circumstances and calculates their comparative performance with respect to numerical metrics; throughput, average delay, packet delivery ratio and routing load under the simulation NS-2 for the complete simulation results. It has been found that DSR and TORA protocol and variation arises in mobility of packets, time intermission between the packets transmitted and packet size of packets transmitted in throughout. Numerous mechanisms of cluster head choice occur with an objective to deliver established and effective routing in the MANET system [1], [4], and [5]. Various mechanisms support not altering the cluster head to ease the signalling overhead involved in the process, which also makes the chosen node usage of their resources higher.

III. PROPOSED METHODOLOGY

The main disadvantage that identified in related work is short lifetime of the cluster head. Cluster head dies because of extra power indulgence. The main focus of propose the SEEC (Signal and Energy Efficient Clustering) algorithm is preventing the cluster head and re-selected the cluster head when energy and signal fall to the threshold value. The proposed algorithm pay attention toward the cluster head formation and avoid re-election of CH keeps it's alive. Cluster head formation will done when the energy and signal reach to the threshold value. The Node which has higher energy and signal level elected as the cluster head. SEEC maintain table for processing these table are 'Cluster Head table' and 'Routing Table' in each cluster.

A. Improved Data Format of Hello Message

Node participant's MANET transmission hello message in hello _intervals of Seconds. Seconds; a nodes HELLO message contain its 'Cluster Adjacency Table'. Figure 2 show the modified head format of the hello message new field added in hello messages are Signal Strength', 'Battery Power Level' which help to formation of cluster head (CH).

Table 3. Layout of HELLO Packet

Node ID	Node Status	**Signal Strength**	**Battery Power Level**
……	……	……	……
Neighbor ID	Neighbor Status	Connection Status	Adjacent Cluster ID
…….	……	……	……

B. Proposed Data Structure for Head Table

Cluster head maintain the signal strength, power level of all node and proposed a new format of cluster head. In head tables entries each node maintain the record of the signal and energy level

Table 4. Layout of Head Table

Node ID	**Signal Strength**	**Power Strength**

C. Cluster Formation

At the Time of cluster formation each node in the network broadcast Hello message to the other neighbour node and compare their value of parameters like Signal Strength, energy. The node which has higher value of signal and power are declared as head node of the cluster. When the power and signal of cluster head node fall below the threshold value re-election of cluster head taken.

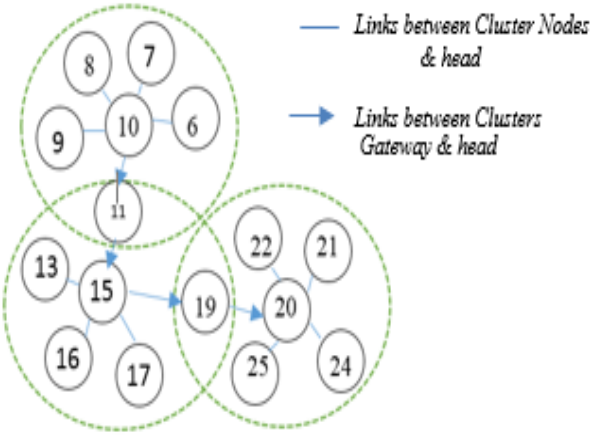

Figure 1. Cluster Formation

Figure 1' shows cluster architecture where 'node 10', 'node 15' and 'node 20' are cluster heads of clusters. 'Node 11' and 'node 19' act as cluster gateways, and rest of them are cluster nodes or member nodes. The inter-cluster communication between the adjoin cluster can be done with the help of the cluster head. For Example communication between the 'node 7' and 'node 16' done with the help of cluster Head 'node 10' and 'node15' through gateway 'node 11'. In clustering process cluster head play the main role for communication through the gateway node. Gateway node provide connection between the inter-clusters.

Node 10's Head Table

Node ID	Signal Strength (%)	Power Strength (%)
10	89	91
11	74	82
9	62	57
8	66	69
7	71	54
6	69	72

Node 20's Head Table

Node ID	Signal Strength (%)	Power Strength (%)
20	82	92
21	75	77
25	68	72
24	66	72
22	45	64
19	75	79

Node 15's Head Table

Node ID	Signal Strength (%)	Power Strength (%)
15	80	88
13	72	79
16	70	77
17	64	73
11	75	78
19	69	54

Node 15's Neighbor Hood

Neighbor Hood ID	Neighbor Status	Link Status
19	Member	Bi
11	Member	Bi
13	Member	Bi

Node 6's Adjacent Table

Adjacent Cluster ID	Gateway	Link Status
15	11	Bi

Node 6's Adjacent Table

Adjacent Cluster ID	Gateway	Link Status
10	11	Bi
20	19	Bi

Figure 2. Example of Table Maintained in Cluster Nodes

IV. PROPOSED ALGORITHM

The SEEC algorithm firstly sorts the node with the lowest ID as the cluster head, 'CH' and stores information to the Head table, 'HTABLE' which has three entities: node ID, signal level and power level of the node. Head table 'HTABLE' store information of signal strength and the power level all node in descendent order. The node which has higher value of signal and power are declared as head node of the cluster. If the signal strength or the power level of CHEAD drops with their respective threshold value then next node to the CHEAD in the HTABLE which has high signal and power value elected as cluster head.

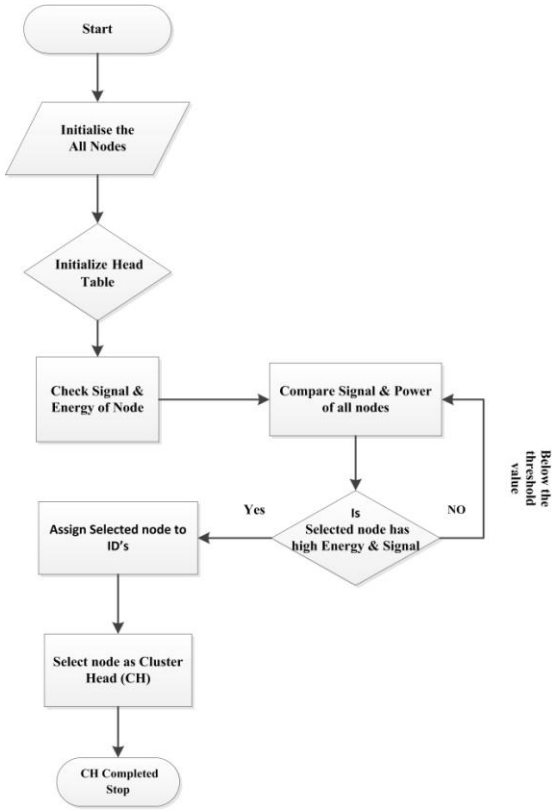

Figure 3. Flow Graph Representation of Algorithm

V. SIMULATION AND RESULTS

The SEEC algorithm was deployed using our Ns2 simulator. The simulation is performed 1300m*1300m area and nodes are deployed randomly in the simulation area. The purpose of simulations was to compare QoS parameters in wireless MANET networks with SEEC algorithm in Energy efficient cluster base routing. For simulation evaluations, we chose following QoS parameters:

A. *Average Throughput* – is the amount of data moved successfully from one place to another in a given time period.

$$Throughput = \frac{Number\ of\ delivered\ packet \times Packet\ size \times 8}{Total\ duration\ of\ simulation}$$

B. *Packet Delivery Ratio* – Packet delivery ratio is the fraction of packets sent by the application that are received by the receivers and is calculated by dividing the number of packets received by the destination through the number of packets originated by the application layer of the source.

C. *Network life time:* Time until the head node or Cluster head nodes in the network runs out of energy.

In the simulation of algorithm, the following results are obtained. These are the simulation results of algorithm, Signal and Energy Efficient Clustering (SEEC).

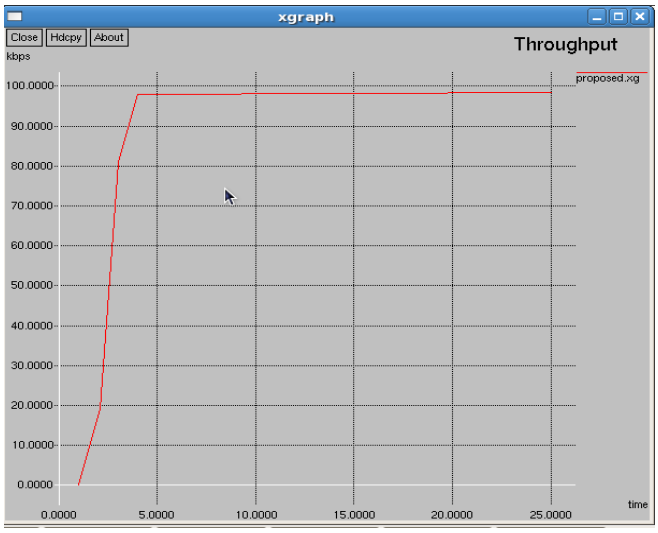

Figure 4. Average Throughput

Fig. 4 shows the average values of throughput for wireless network with the using of SEEC algorithm technique. From results we see that the higher value of average throughput was achieved with use energy efficient cluster base routing protocol due to minimizing the flooding between the inter-connected clusters. Formation of cluster head with high strength of signal and energy will increase the network capability to transmit the data to the destination node on the interval of time and faster.

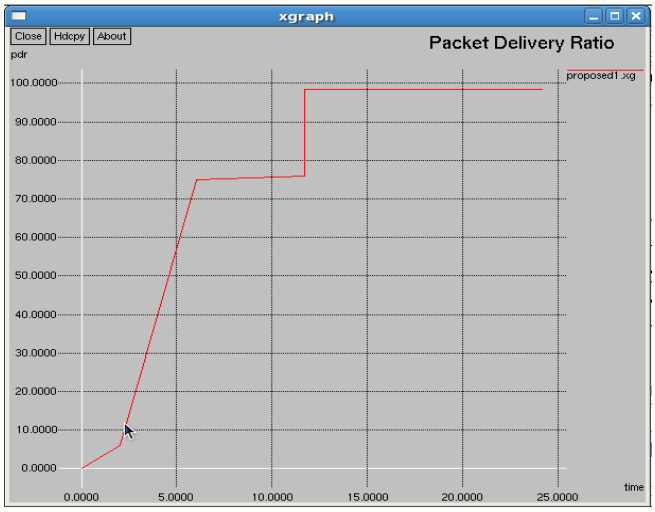

Figure 5. Packet Delivery Ratio

Fig. 5 shows the packet delivery ratio for Cluster base routing with using SEEC algorithm technique. From results we see that the higher value of a packet delivery ratio was achieved due the high signal and bandwidth of the cluster head node.

Fig. 6 shows the network life time of the cluster head node. The result obtained that with the increase of energy consuming node. The network life time will degrade because the energy and the signal are the key factor on which the Cluster head node perform tasks. With degrade the value of energy the life of node will also effected.

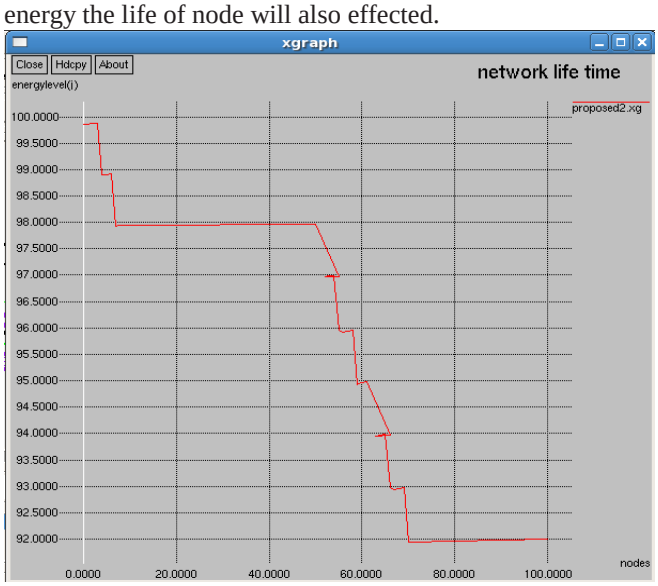

Figure 6. Network Life Time

VI. CONCLUSION

In this paper, Simulation using NS2 for an energy efficient cluster base routing is carried out. The name of the algorithm is "Signal and energy efficient clustering" base on the Signal level and energy of the nodes to increase the life time of Cluster head. Its emphasis on the cluster maintenance and formation at low cost the resources used that are signal strength, battery power of the node. The main motive of this paper is to keep alive the head node and avoid re-election of cluster head.

Our future work is to purpose a new algorithmic technique to improve the life time cluster and prevent from the hidden node that consume the energy power of node.

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