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Performance Analysis of Cluster Based Routing Protocol for MANET Using RNS Algorithm

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Abstract *— In the recent year wireless network technology avoids the expensive method ofthe installations of cables for the data connection between devices within various locations. Mobile Adhoc Network (MANET) is a self-organizing, dynamic and multi-hop wireless adhoc network. MANET may contain a large number of mobile nodes. This type of network without requires any fixed infrastructure. In such a network, the computing devices are maintaining network connectivity co-operatively. In networks, nodes can be able to move from one location to another and make synchronization with their neighbor nodes. Due to the mobility of nodes, topology in the network can change dynamically and nodes can be added and removed at any time in the network. One of the important aspects of a MANET is the limitation of the amount of available energy and the network lifetime. The tremendous amount of using mobile nodes in wireless communication medium makes energy efficiency a fundamental requirement for MANET. In MANET which nodes in the network based on restricted battery power and computational resource. In this paper proposed a new routing algorithm named Route Node Selection (RNS) to improve remaining residual energy for find the path from source to destination for hop1, hop2 and so on until reach the destination. Finally proposed RNS algorithm provides better performance compare to existing Load Balancing Cluster (LBC) routing algorithm and also increased remaining residual energy with number of nodes, transmission range, and mobility is increased.*

Keywords: Clustering, MANET, Power Aware, Throughput, Residual Energy, Overhead.

I. INTRODUCTION

MANET is a self-organized multi hop wireless network. Due to the movement of nodes, they generate dynamic topology and this dynamic nature of the topology; it imposes lots of challenges and possesses several intrinsic characteristics. As the MANET exist without infrastructure. So, this type of network is particularly useful in military/search, rescue and other tactical situations where cellular infrastructure is not available or not reliable. However, this class of network has lots of challenges and issues compared to infrastructure based network. Each node in MANET must forward traffic and hence act as a router. So, maintaining routing information and forwarding packets by nodes are a challenging task. Because the dynamic topology makes node goes out of coverage from each other and hence frequent rout failure occurs. In case of route failure packet will lost and hence the node need to re discover the path to the destination. These reformations of path incur additional overhead to routing protocol for MANET. Other challenges of MANET a part from dynamic topologies are limited achievable bandwidth, heterogeneous communication links, and limited battery power. Due to these features routing in MANET is a challenging task and drawing considerable attention among researchers.

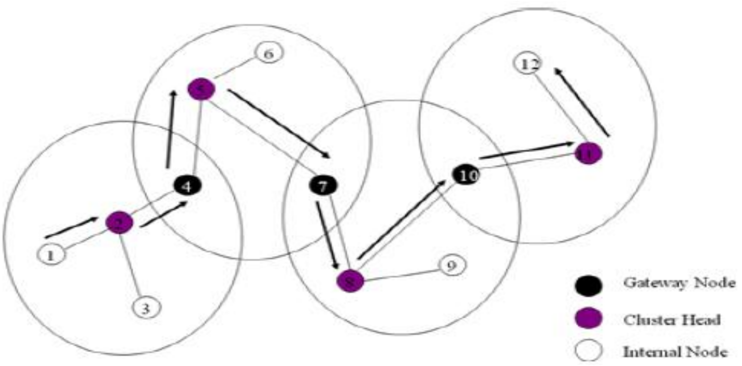

Figure 1. Clustering in MANET.

Cluster based routing can controls the routing overhead inside a cluster by forming group among themselves and selecting a coordinator (CH) for routing. Clustering makes possible a hierarchical routing in which paths are recorded between clusters instead among groups. This increase the life time of the network as well improves routing efficiency. The ordinary node within a cluster communicates via the CH. A special node called Gateways exists in the topology. The

Gateway is a special node in acluster but not the CH and still it forwards on behalf of the cluster. Ordinary nodes send the packets to their cluster head that either distributes the packets inside the cluster, or (if the destination is outside the cluster) forwards them to a gateway node to be delivered to the other clusters. By replacing the nodes with clusters, existing routing protocol scan be directly applied to the network.

II. LITERATURE REVIEW

Performance comparison of routing protocol in MANET have been studied and discussed by Prabu, K. et al. (2012). Designing Energy Routing Protocol with Power Consumption Optimization in MANET were discussed and analyzed by Shivashankar et al. (2014). Routing Mechanisms for Mobile Ad hoc Networks based on the Energy Drain Rate have been analyzed by D. Kim et al. (2006). Device-energy-load aware relaying frameworks for heterogeneous mobile ad hoc networks have been discussed by W. Liu et al. (2011). Hybrid cluster routing: Efficient routing protocols for mobile ad hoc networks were analyzed by X. Niu, et al. (2006). Energy efficient routing in MANET through edge node selection using ESPR algorithm were discussed and analyzed by Prabu, K. et al. (2014). Efficient clustering schemes for large and dense mobile ad hoc networks (MANETs) have been analyzed by J. Y. Yu, et al. (2006). An Efficient Weighted Distributed Clustering Algorithm for Mobile Ad Hoc Networks have been discussed by A. Hussein, et al. (2010). A Study on the Clustering Scheme for Node Mobility in Mobile Ad-hoc Network were studied and discussed by H.J. Cha, et al. (2014). Adaptive topology controls for mobile ad hoc networks were analyzed by A. A. Jeng, (2011). Optimized replication strategy for intermittently connected mobile networks were discussed and analyzed by C. Poongodi, et al. (2012). Performance evaluation and simulations of routing protocols in ad hoc networks were analyzed by L. Layuan, et al. (2007). A Cluster-Based Distributed Hierarchical IDS for MANETs have been discussed by B. Pahlevanzadeh, et al. (2008). Clustering algorithms for ad hoc wireless networks have been studied by Y. Chen, et al. (2004).

III. PROPOSED CONCEPT

Performance Analysis

The significant technical challenge in MANET is to ensure the lifetime of the network. This is because the network nodes have limited in battery power. These characteristics indicate restrictions on the connectivity between nodes and packet transmission efficiency within the network. Apart from these characteristics, themost critical problem is downed node due to the network partition. Since the conservation of energy, the battery life span maximization is an important thing. For this, energy efficient routing algorithms should be applied instead of the conventional routing algorithm. The most widely routes in the network use more battery energy, so that sudden depletion will occur. For the conservation of battery energy of nodes within the network, there are different types of power aware routing algorithms and mechanisms exist.

Routing Node Selection (RNS) Algorithm

```
// Node have Forward Capacity and present within Range or same cluster
// (Node move towards destination is more preferable).
// Node present Maximum distance from Source node and have Sufficient Transmission
// Power of that transmission alone, and that node is already participate in election at any one
// cluster range (to avoid malicious node)
BEGIN
        if node N_i have F_C
        then {
        if N_i within Range || Same cluster
        then  {
        if N_i Present Max distance from Source S
        then  {
        if N_i have Sufficient T_P
        then   {
                if N_i already participate in cluster election in any one cluster
                  {
                        Add F_N (N_i)
                else
                        Reject N_i
        } } } } }
STOP
```

Notations

F_N - Forward Node
S - Source Node
N_i - Node i
F_C - Forward Capacity
Max - Maximum Transmission Range
T_P - Transmission Power

Forward Capacity Node (F_C): When a sender broadcasts a packet, then based on the greedy approach, it selects a subset of 1-hop neighbors as its forwarding nodes to forward the packets. Node *N1* assigns a weight to each of its neighbor which represents the combination of neighbor's battery lifetime and its distance to *N1*. For a neighbor *h1* of *N1*, the weight can be determined by the following equation:

$$F_C = BL_{h1} + D_{h1}$$

Where, F_C is Forward Capacity Node, BL_{h1} is the battery lifetime of h1, and D_{h1} is the distance of h1 (neigh) from node N1.

Transmission Range (T_R): Transmission range is thus calculated mathematically by using the following formula:

$$T_R = \sqrt{\frac{nd_d / nd_c}{CoverageArea}}$$

Where, T_R is Transmission Range, nd_d is the desired node degree, nd_c is the current node degree, and Coverage area equals the area covered by the environment.

Transmission Power (T_P): Transmission power for transfer the packet from source to destination node at time interval t to mathematically calculated as follows:

$$T_P = \frac{T_x}{T_t}$$

Where, T_P is Transmission Power, T_x is transmission Energy, and T_t is time taken to transmit data packet.

Methodology Diagram for Route Node Selection (RNS)

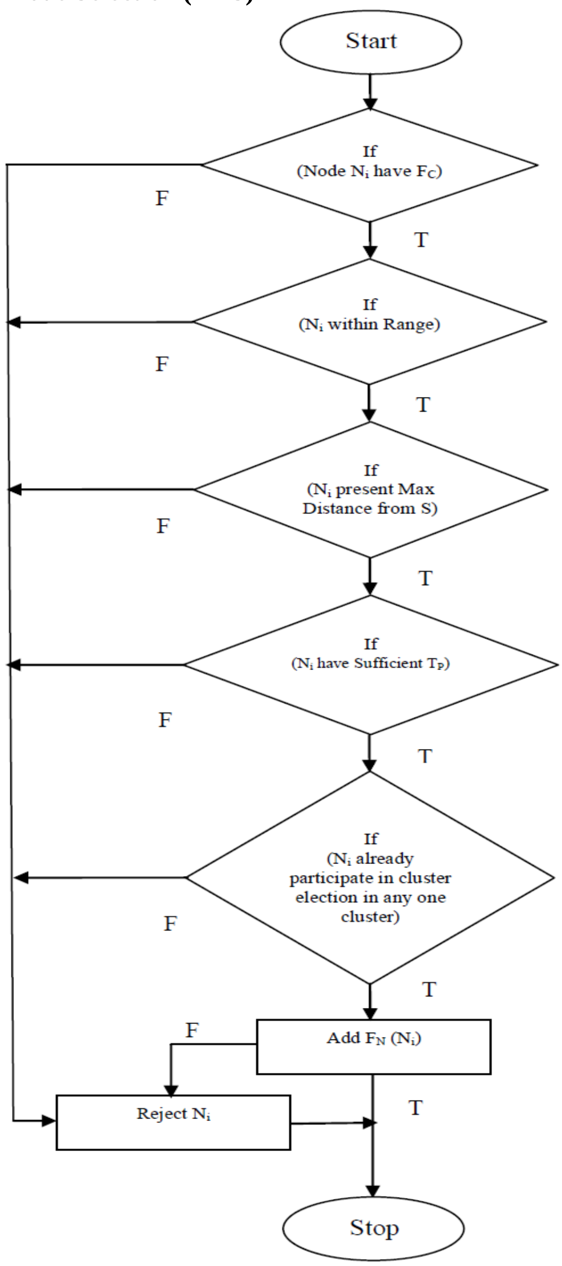

Figure 2. Methodology Diagram for Route Node Selection (RNS).

In the above methodology diagram process for route node selection based on the forward node capacity within the transmission range and also maximum distance from the source node have sufficient transmission power for find the path from source to destination until reach the destination. Other node will be rejected. The same procedure for route node selection to find the path from source to destination for hop1, hop2, and so on until reaches the destination.

IV. RESULTS & DISCUSSION

Simulation Configurations:

To facilitate the comparison of the simulation results with other research works, the default scenario setting in NS2 has been adopted. The maximum hops allowed in this configuration setting are four. Both the physical layer and the 802.11 MAC layer are included in the non-wired extension of NS2, where the total bits transmitted is calculated using application layer data packets only and total energy.

Table 1.Simulation Parameters

Parameters	Values
Simulation area	1,000 m * 1,000 m
Number of nodes	60
Average speed of nodes	0–25 meter/second
Mobility model	Random waypoint
Number of packet senders	40
Transmission range	250 m
Constant bit rate	2 (packets/second)
Packet size	512 bytes
Node beacon interval	0.5 (seconds)
MAC protocol	802.11 DCF
Initial energy/node	100 joules
Antenna model	Omni directional
Simulation time	500 sec

In this section performance analysis of proposed Route Node Selection (RNS) algorithm and existing Load Balance Clustering (LBC) protocol for MANET through simulation NS2.

Remaining Residual Energy: Remaining energy will be calculates at the time interval t. In MANET the consumption of battery power occur because of sending and receiving of data packets. If a node remains energy active in the network then utilize it. If the node is in sleepy mode or ideal mode in the network then the battery power starts depletion process. The performance analysis of power is the total number ofrouted data packets by each node in MANET versus the residual battery power of that node is considered as the performance metric. The residual battery power of a particular node can be calculated using the following equation.

$$\textit{Residual Battery power of a node } i = \sum_i \textit{power of node } i \textit{ at time } t$$

The total power of node can be calculated using the following equation.

$$\textit{Total Power} = \sum_i \textit{energy of node } i \textit{ at time } t$$

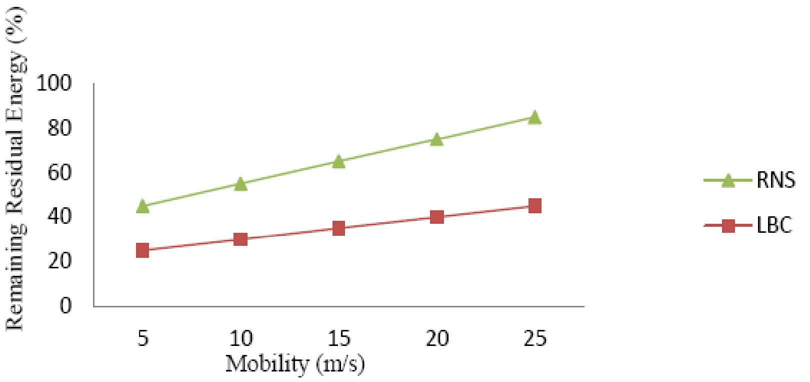

Figure 3. Remaining Residual Energy (Kbps) Vs. Mobility (m/s).

In this part performance analysis of proposed Route Node Selection (RNS) algorithm with existing Load Balancing Cluster (LBC). Fig. 3 shows that the proposed RNS algorithm provides better performance compare to existing algorithm and also increased remaining residual energy with mobility is increased.

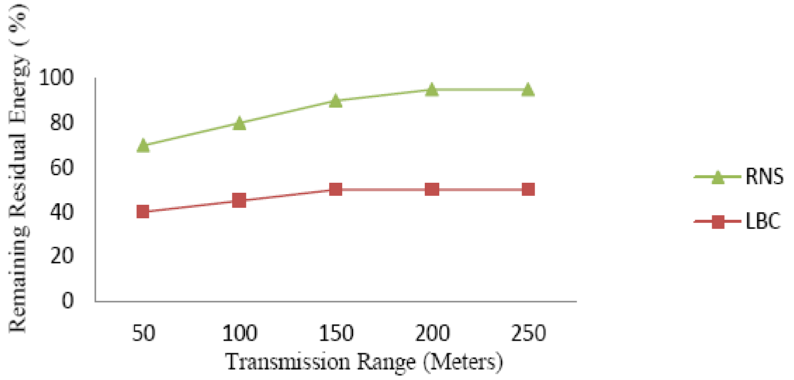

Figure 4. Remaining Residual Energy (Kbps) Vs. Transmission Range (Meters).

In this part performance analysis of proposed Route Node Selection (RNS) algorithm with existing Load Balancing Cluster (LBC). Fig. 4 shows that the proposed RNS algorithm provides better performance compare to existing algorithm and also increased remaining residual energy with Transmission Range is increased.

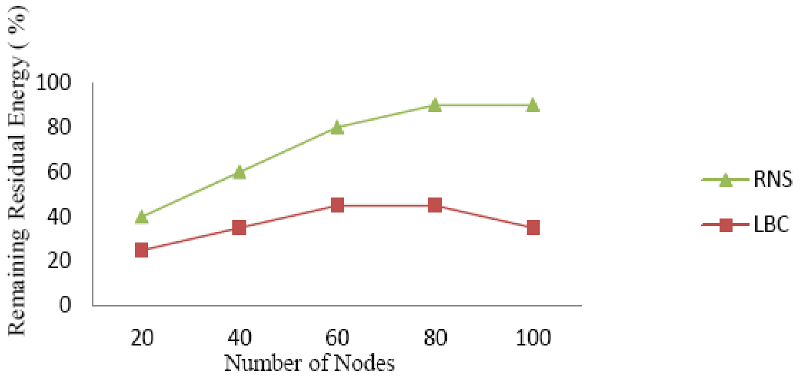

Figure 5. Remaining Residual Energy (Kbps) Vs. Number of Nodes.

In this part performance analysis of proposed Route Node Selection (RNS) algorithm with existing Load Balancing Cluster (LBC). Fig. 5 shows that the proposed RNS algorithm provides better performance compare to existing algorithm and also increased remaining residual energy with Number of Node is increased.

V. CONCLUSION

Many clustering algorithms based on different optimization objectives have been proposed. In clustering based algorithms on many optimization objectives have been proposed in the recent research years. Specially, most of the researchers turn to his research in cluster in Mobile Adhoc Networks (MANETs), cause it performance is better compare to ordinary networks. In clustering algorithm it is proposed the idea of assigning a unique identity address to each node in the network and then broadcasting to all the neighbour nodes. If a node belongs to multiple clusters, it may be viewed as a gateway between clusters. Many algorithms the construction of clusters may be promptly completed, so the number of Cluster Head (CH) may become undesirably high. In this paper proposed a new routing algorithm named Route Node Selection (RNS). This proposed algorithm increased remaining residual energy compare to existing Load Balancing Cluster (LBC) algorithm with mobility is increased, transmission range is increased, and also number of node is increased.

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