Turkish Online Journal of Qualitative Inquiry (TOJQI)

Volume 12, Issue 3, June 2021: 4540 - 4552

Research Article

A Scalable Time Distributed Mobility Selection Scheme for Reactive Zone based routing protocol on Mobile Adhoc Network

Jim Mathew Philip[1], Dr. A N Jayanthi[2]

Abstract

In mobile Adhoc networks, Network communication between mobile nodes increases the collision and congestion on route discovery which reflects in the degradation of the network performance. In order to mitigate the routing issue, importance of the Zone Clustering of the nodes has to be considered. In this paper, we propose a novel Scalable Time Distributed mobility Selection Scheme for reactive routing of Mobile Adhoc Network under channel access, Channel Aggregation and zone clustering of nodes under uniform and non uniform traffic patterns. However proposed protocol utilizes the trace file for channel allocation to the data communication. Trace file is collected through the carrier or channel information in the clustered nodes to form the channel state information. The clustering of node based on zone and time is to increase the scalability and lifetime of the network by grouping the mobile nodes with constrainst like location similarity or node density similarities. The objective is to increase the scalability by generating the multiple cluster zones with cluster head through Cooperative Clustering. Cooperative Clustering is carried out using Particle Swarm Optimization to determine the optimal zone radius of nodes. Clusters facilitates for graceful channel migration between one another to form dynamic migration zones to facilitate the information or packet dissemination and dynamically reforms clusters according to each node's routing requirement, Node density, and queue length. The results of simulation carried out on Proposed Routing protocol demonstrate the superiority in terms of throughput and computational complexity compared with zone based routing protocols on range and radius of mobility scenario.

Keywords: mobile Adhoc Network, Zone Based Routing, Channel Allocation and Migration, Cluster based Routing

[1]Assistant Professor(Selection Grade)/CSE, Sri Ramakrishna Institute of Technology, Coimbatore
[2]Associate Professor/ECE, Sri Ramakrishna Institute of Technology, Coimbatore

1. Introduction

Mobile Adhoc Network (MANET) is self organizing dynamic infrastructure free network topology with rapid deployment and capable of dynamically reconfiguring without any administration. MANET is applicable to various type of application such as military operation, disaster operation, medical operation and commercial operations etc. The usage of the MANET is increasing exponentially as supporting application is evolving. Due to exploration of node packet request, importance of the resource of the network such as Bandwidth, buffer space and battery power has been increased [1].

The Critical task for the MANET is the Zone Clustering of nodes and Medium Access Control of nodes in the data link Layer as it controls the access of the channel usage to ensure the efficient bandwidth utilization and reliable data transmission within specified zone radius [2]. MAC is also responsible for resolving the conflicts between the nodes for channel access. Key requirement of the MAC protocol is to maximize the bandwidth utilization and to provide effective node capabilities on the heterogeneous and non uniform traffic patterns in the Network. While zone based routing eliminates the usage of additional relay point, transmitter and receiver as it uses the cluster head to packet transmission. In addition Channel Coordination can be carried out effectively by grouping of the nodes together as cluster according to each node's bandwidth, node queue length, and node location [3]. The clustering based routing protocol for MANET with certificate revocation model is discussed in [16].

The clustering of node can be carried out either in terms of Spatial or temporal constraints of the nodes propagating in the network. In Existing, Cooperative Clustering is established in order to establish the group based on the similarity between the access points and nodes on many aspects. It dynamically reforms clusters according to each node's bandwidth requirement, energy use, and traffic type [4]. Similarly to mitigate the performance degradation of the network, Scalable time distributed mobility selection for reactive routing of the Mobile Adhoc Network is proposed in this paper.

The proposed technique addresses the channel coordination for both uniform and non uniform Traffic patterns. In order to reduce the node density usage and handover, Access point Selection scheme is enabled. The Access point selection should be carried out based on information of link layer and routing layer of nod on each zone by aiming to reduce the transmission delay. Channel hopping sequence is determined by the distance, Radius and delivery constraints of transmitting data of the mobile nodes. Additionally based on Channel condition and node distance in the zone, data migration will be achieved to maintain the throughput.

The rest of the paper is categorized as follows: In Section 2, the review of literature on Zone based distributed routing protocols is provided. Detailed specification of proposed routing protocol has been defined in Section 3. The simulation results and performance evaluation of proposed routing protocol against various measures are presented in Section 4. Finally paper is concluded in Section 5 with final summary and future research directions.

2. Related Work

There are many approaches to the problem of the Traffic management and channel utilization in the Mobile Adhoc Network on basis of zone based routing. The Approaches are as follows

2.1. Dynamic Channel Allocation scheme

In this model, the number of frequency carriers is adaptive and dependent on the traffic of the network. The frequency carriers in the channel are adaptively changes to the traffic pattern.

Carrier changes occur based on traffic [4]. The channel is periodically synchronized for negotiation and contention. Channel Allocation model increases the transmission opportunities of the less utilized channel against network degradation. Dynamic channel hopping sequence is based on the linear programming model. The model adopts optimal balance between radius of the node on their network availability and channel utilization within specified delay along throughput constrainst.

2.2. Dynamic Frequency /Time Channel Allocation

In this Model, the number of channels is scalable and adaptive on time varying traffic exploration of the network by balancing the channels with same frequency carrier. It is effectively used between two neighbouring nodes in the particular zone. The concept of channel is now based on time/frequency division. Optimal channel allocation is subject to delivery probability and throughput constraints. It also dynamically adjusts the transmission order of the nodes and transmission duration based on channel state information.

3. Proposed Model

In this section, Scalable Time Defined Network infrastructure and Channel coordination and allocation of mobility nodes was discussed as it is composed of cooperative clustering of the nodes, access point selection and Channel migration. Channel Sensing is employed to collect the channel state information with inclusion of spatial and temporal information of the nodes.

3.1. Network model –MANET

Mobile Ad hoc Networks is established with capability of transmitting and receiving the data packets among source and destination nodes. In some cases, transmitting node will be used as intermediate nodes. Each mobile node in a MANET propagates in the network with dynamic topology using MAC protocol as it assign a unique ID with IP address. These allocations change its links to other nodes frequently in order to avoid link breakage between nodes. Transmission Range of the nodes is equal and node link is bi directional.

The MANET is usually represented as undirected graph. The effective routing protocol for MANET is equipped with zone based routing to continuously maintain the information required to properly route traffic with cluster head to eliminate frequent link failures. Network is represented as

Let consider Graph G as

G= (V, E) Eq.1

Where

V is the Set of nodes & E is the set of the Edges

3.2. Zone based Clustering of Nodes

Due to nodes mobility in MANET topology, clustering of the nodes is achieved on generation of zone as cluster with cluster head which collects the periodic update of each node in the cluster along link state. Each link state of node sends periodic updates to its cluster head becomes to be an important consideration to alleviate the network overhead in a large-scale network. Through clustering, the topological changes of nodes within a cluster do not affect the total network structure as network is exploring with dynamic queue for data transmission.

The clustering of nodes mitigates degradation of the network on ensuring the performance of data transmission with various queue lengths. Further cluster head selection is selected among the set of node in particular zone is computed on basis of network density, Radius between node and link state. These categories considered an important criterion to be considered because the Cluster Head will be the co-coordinator in Clustered nodes. Clustering of node is carried out based on the following constrainst such as location similarity and node density similarity.

3.2.1. Clustering of Node on basis of Location Similarity

The set of node clustered based on the location similarity among the nodes and achieved clustered node is considered as non – overlapping nodes. The constraints to form cluster is node should be direct neighbour with optimal zone radius. Table 1 represents the parameter used for protocol modelling.

Parameter	Description
N	Number of nodes in the network
r	Zone radius
N_r	Network Radius
D	Inter hop distance
I_s	Link State

Clustering of the node is carried out for channel scheduling and routing on network parameters. The categories of the node are Cluster Head, gateway and ordinary node. It is used to enhance the channel throughput. In this Clustering, Computation of the traffic management is carried out as follows

Clustering of Node $C = \lambda \sum_{k=0}^{n} (r * d)^2 L^R$ ….. Eq.2

Where

R is used determine the area of the network,

L is average path length to the destination,

N is density of the node

Number of traffic session generated by every node is λ

3.2.2. Clustering of Nodes based on Node Density Similarity

The set of nodes clustered based on the node density similarity. The condition for node to be cluster head is based on large node degree (i.e large number of one hop neighbours). The clustering node usually collects speed of the node, battery power and node degree respectively. The nodes is one hop neighbourhood is calculated using algorithm

Algorithm 3.1: Cluster Formation

N_i denotes the set of the node

Exchange Hello Message between the one hops neighbour nodes

Calculate Node Density N^d

For (i=0 to N)

Set N^d Max = Threshold

If (N_i^d >= N^d Max)

Set N_i^d as Node Density

Else

Check next node

Calculate Node Degree N^r

For (i=0 to N)

Set N^r Max = Threshold

If (N_i^r >= N^r Max)

Set N_i^r as Node degree

Else

Check next node

Calculate Cluster head

If (Node with high density = = Node with Highest Node degree)

Set particular Node as Cluster Head

Else

Prioritize based on other condition

The Figure 1 describes the architecture of the cluster head formation among the available node in the MANET topology.

3.3. Trace File generation using Channel Sensing

The channel resources are managed in terms of Trace file to form channel state information by channel sensing and it is distributed by cluster heads. Trace files is collection of information about the Node characteristics described in terms of buffer space, Bandwidth etc. The Channel sensing intrinsically incorporated with normal functioning of the node. Trace File is generated to access and control channel against the uniform and non uniform Traffics.

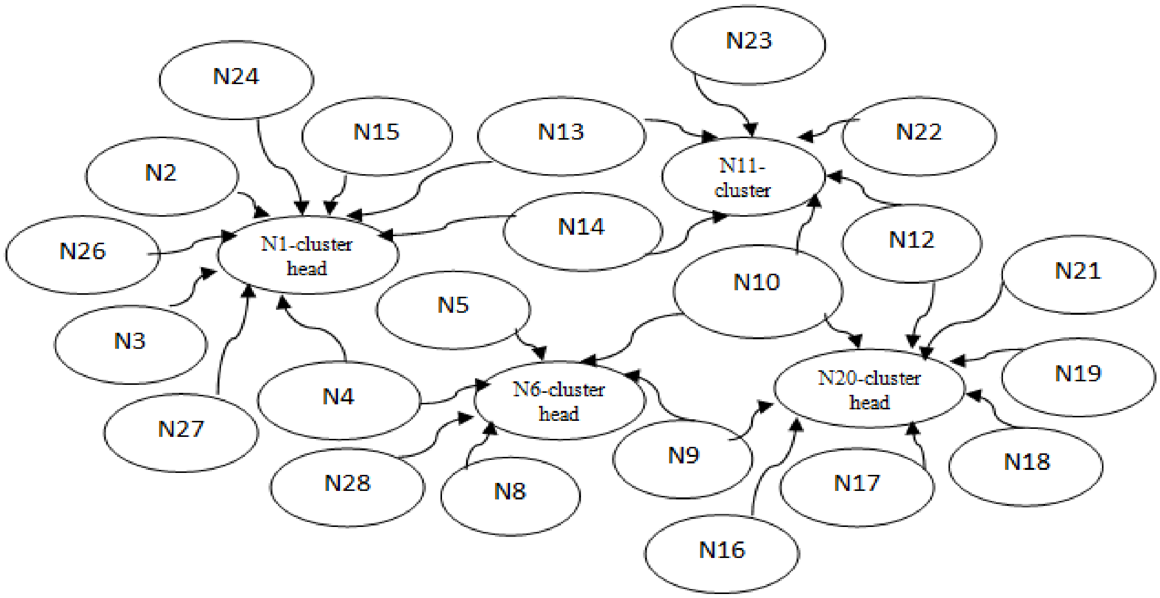

Figure 1: Cluster head Formation based on Node Radius

3.4. Cooperative Clustering

Its objective is to increase the scalability by generating the multiple cluster head. Cluster heads be decision nodes which provides the information of node in the particular zone towards selecting the transmission top for packet transmission to destination node. The Network channel has segmented to data transmission on basis of the network transmission queue length and node density. Clusters or zone containing node are guaranteed to have a desirable number of common channels with optimal radial distance for data transmission control which facilitates for channel migration between one another to form dynamic migration zones to facilitate the information dissemination and dynamically reschedules the nodes in the clusters according to each node's traffic management.

The Cooperative Clustering is enabled for spatial reuse of resource to increase the network performance. Large no of traffic and collision can be reduced by usage of the cluster heads. As name stands it is combination of multiple clustering schemes such as Energy based clustering and Traffic based clustering. Gateway node is responsible for connection of adjacent cluster. It further reduces the interference in multiple access broadcast environment.

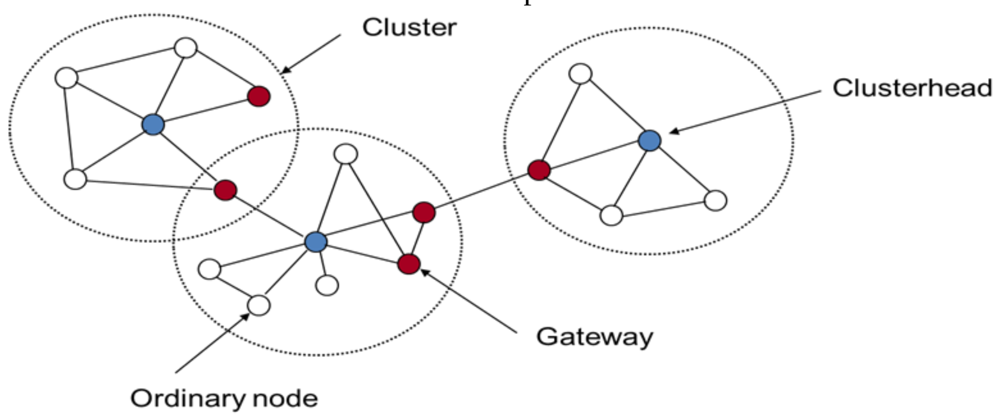

Figure 2: Architecture of Cooperative Clustering

As figure 2 depicts, clusterhead is responsible for collaboration of the clusters and resource allocation. For resource allocation, Cluster head computes the degree of the each cluster node towards cooperation between two clusters for data communication is as follows

Degree difference can be calculated for cluster cooperation as

$$\Delta_v = |d_v - \delta| \quad \text{.......... (Eq.3)}$$

Sum of Distance between the neighbours is calculated as

$$D_v = \sum_{v' \in N(v)} \{ dist(v, v') \}$$

Mobility of the node will acts as important criteria for cooperative clustering. During heavy Traffic in the network, employment of load balancing factor can reduce the congestion and network degradation, it is given by

$$LBF = \frac{n_c}{\sum_i (x_i - \mu)^2} \quad \text{.......... (5)}$$

Where n_c is number of cluster head,

x_i is the cardinality of the cluster

μ is the average number of neighbors of a cluster head

The updates are periodically gathered by cluster heads in order to reduce the communication cost and avoid the delay as far as possible.

3.5. Scalable Time Distributed Mobility Selection Scheme Protocol

3.5.1. Access point Selection

Channel Access point selection is to aggregate the channel to data dissemination using link state scheduling using Particle Swarm Optimization (PSO). The utility function is designed based on the QOS requirement and energy consumption. Evolutionary network traffic management strategies incorporating PSO approach corresponds to the Access point Selection. The channels with different widths are allocated to the APs. Non-overlapping channels are considered since assigning non-overlapped channels is beneficial.

Cluster head aims to associate with an appropriate AP to satisfy the QoS requirement is achieved based on evaluation of the bandwidth. Due to the variations in both channel-widths and received signal strengths, it may obtain various bandwidths from the APs that can be defined as

$$R_{i,j} = \gamma_{i,j} B_j \quad \text{......... (6)}$$

Where B_j denotes the channel-width of AP

$\gamma_{i,j}$ is efficiency factor of the bandwidth

During evolutionary traffic, the expected bandwidth for communication with Access point can be calculated as

$$R_{i,j} = O_{i,j}\ \gamma_{i,j} B_j\ /(n_j+1) \qquad (7)$$

Where $O_{i,j}$ represents bandwidth loss Factor

n_j represents non-increasing convex function

The AP Selection strategy is denoted by the index of the selected AP. The mixed strategy yields the best outcome to determine the number of message generated per such query. Strategies can be efficiency factors, Link state information, Radial distance of the nodes in the zone, consumption factors and QoS requirements in terms of fitness function. Particular optimization determines best features for effective prediction of the risk rate on the patient on particular and future treatment patterns. In this best trajectory has to be computed using fitness function.

Predicted Access point $V = v = v + c_1 * rand * (pBest – p) + c_2 * rand * (gBest – p)$

Where V is the Projection of the Access point

P is the particle or feature of Node information by cluster head

c_1 is the weight of Node information in the particular Zone

c_2: weight of feature information among entire Network space

pBest: best position of the feature in local zone

gBest: best position of the feature in entire Zone

rand: random variable

Compute fitness criteria $\sum_{m=k}^{n-1} \mathrm{Sim}(\boldsymbol{\delta}_i^j(x_k) - \boldsymbol{\delta}_i^j(x_{m+1})) + F(x_n)$

Optimal Node ON(f)

As a result, optimal node as access point has been selected for data transmission to the destination on managing traffic and mitigating network delay effectively. It is considered to effective on exploitation of the network size and increase in the traffic.

4. Simulation Analysis

In this Section, proposed Scalable Time Defined Mobility Selection Scheme using reactive zone based routing protocol for Mobile Adhoc Network has been simulated using NS2 Simulator. On extensive experiment, the network properties and its performance measure of the network against dynamic traffic and time varying mobility has evaluated in terms of throughput, Packet delivery ratio, Network Overhead and packet loss has been demonstrated. The Proposed protocol extends the state of art approaches related to zone based routing especially Distributed Channel Access protocol through inclusion of Access point Selection using PSO constraints. The proposed protocol used to improve the network performance through proper channel coordination between clusters based nodes. In the Simulation, the set up of the network is described in the following table 2

Table 2-Simulation Parameters used to build a protocol

Simulation Parameter	**Value**
Simulator	NS2
Network Topology Size	1000m *1000m
Number of Mobile Nodes employed	100,200, 250
Node Transmission Power	0.5mW/Hz
Mobile Node Channel Width	5,10,15,20 MHz
Bandwidth of the Entire Network	2Mbps,4Mbps
Network Traffic type	CBR
Pause Time	10s,20s
Data Packet size	256bytes or 512 bytes
Network Buffer size	100 packets
Simulation Time	20 Minute, 30 minutes, 40 Minuyes

In extensive simulation Source node for data transmission has been selected randomly to packet size is mentioned previously in the table 2. Further it is intended to send route request packet to cluster head to identify the suitable access point for data transmission to destination in selected intervals of after every 10s. The available path of network is determined by optimal selection of zone with reference to intermediate node against the node density and energy levels of the nodes using the cluster head.

The Protocol has been time synchronized initially. The hop is computed using PSO algorithm to determine the optimal access point and use the nearest neighbor algorithm to determine the shortest path for packet routing on segmented channel conditions [15]. Node energy consumption at different rates during transmission, reception, idle waiting and sleeping is calculated for evaluation of the proposed model.

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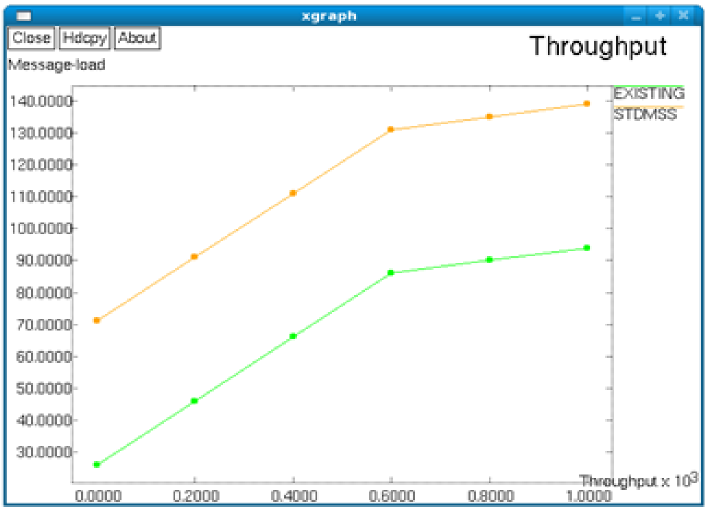

Figure 3: Performance Analysis of Proposed Framework against Existing Technique through Throughput

On observations of the proposed framework to dynamic traffic can determine optimal states in short span of time in case of sudden node failure, they aspect increase the throughput of the system by effective scheduling the data traffic to other available channel in terms of cooperative clustering mechanism . The proposed cluster head selection algorithm in cooperative clustering is capable of identifying new data rate and new route to data forwarding on the available paths.

Throughput computation is given as follows

Throughput = (Transmission Rate of the Node)* Scheduled Trip Time of Predicted path for Data Transmission on specified channel

The evaluation of the throughput is described in the figure 3. The network throughput of the network is to the total collected network density mbps. Throughput degradation can be avoided using Access point Selection strategies

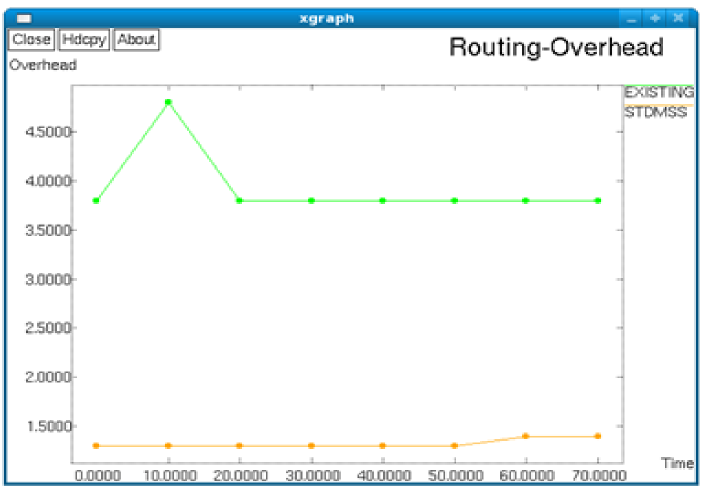

Figure 4: Performance Analysis of Proposed Framework against Existing Technique through Routing overhead

The total number of successful packet transmissions divided by the total number of received data packets in particular time period yields the overhead of the network. In all the mobility cases, the Access point Selection using PSO on zone based routing protocols have much higher delivery ratios. The routing overhead is given in the figure 5

Routing overhead $R_d = 100\% * \frac{nd - ne}{nd}$

The routing overhead is calculated from the initialization of the node. Total rate of packet transmissions and receptions in the destination are also depicted considering the packet size of 100 or 200 bytes on heterogeneous traffic condition. Table 3 concludes the performance values of the different metrics on evaluating the channel allocation using access point selection algorithm. It is depicted in the figure 4.

Table 3 – Performance Evaluation of Zone based Routing mechanism in the MANET

Technique	Throughput in mbps	Overhead in mbps	Packet Delivery Ratio	Routing Latency
Dynamic Channel Allocation Mechanism (DCAM)- Existing	75.58	10.23	95.78	0.35
Scalable Time Defined Mobility Selection Scheme Protocol (STDMSS)- Proposed	79.26	12.59	99.85	0.25

Packet delivery ratio is computed as the ratio of the number of packet information and query information received by the access point to transmit to destinations node in the available queue length with respect to radius between nodes on dynamic traffic condition and channel conditions. Performance evaluation has been described in the figure 5.

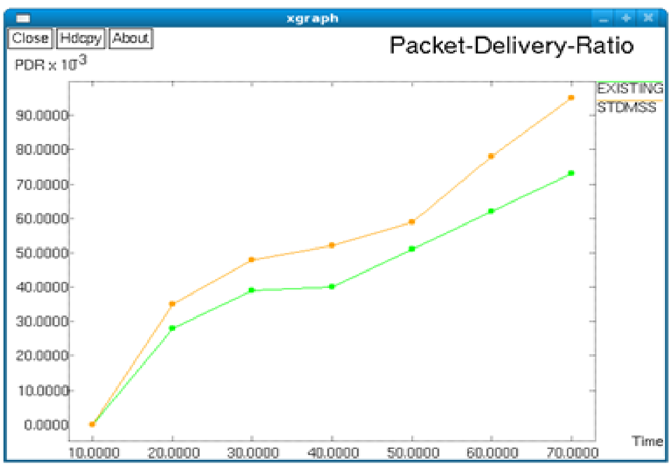

Figure 5: Performance Analysis of Proposed Framework against Existing Technique through Packet Delivery Ratio

The Routing Latency are the overall traffic in the network which effects the data transmission, hence it is controlled by inclusion of the effective strategies in the channel allocation through placement of access point. In parallel, data routing mechanism is defined strong to handle additional complication of the node. The figure 6 describes the evaluation of the routing latency against various techniques towards large sizes of data transfers.

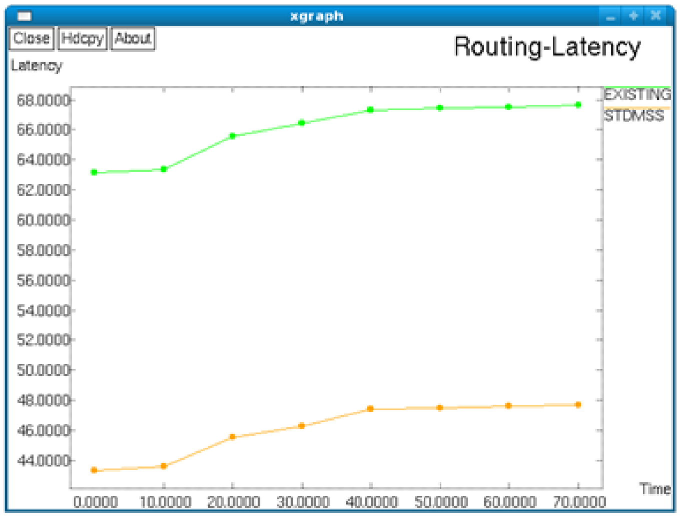

Figure 6: Performance Analysis of Proposed Framework against Existing Technique through Routing latency.

From Simulation analysis it is proved that energy utilization and throughput maximization through employment of optimal solution for channel access has improved as compared against state of routing protocol and also performance evaluation depicts the scalability and reliability of the evaluated framework.

Conclusion

We design and implemented on Scalable Time Defined Mobility Selection Scheme protocol on MAC layer. Channel Access constrained zone based routing protocol has shown to be effective scheme as it collects the node information by generating trace file whereas reducing the overhead of the channel bandwidth. Cooperative clustering provides better way for resource utilization and channel utilization during any failure of path. The Proposed model increased the network throughput of the heavy traffic network with effect of node energy consumption and packet delivery ratio utilizing the effective strategies on the access point selection. It has been demonstrated that proposed model has fast response time allowing the network to manage its changing traffic patterns.

References

[1]. L. Gao, and X. Wang, “A game approach for multi-channel allocation in multi-hop wireless networks,” in Proc. 9th ACM Int. Symp. Mobile Ad Hoc Netw. Comput., 2008, pp. 303–312.

[2] Yin S. and Lin, X.: ‘MALB: MANET Adaptive Load Balancing’, IEEE 60th Vehicular Technology Conference VTC 2004- fall, 2004, 4, pp. 2843-2847.

[3] M. Felegyhazi, M. Cagalj, S. Bidokhti, and J.-P. Hubaux, “Noncooperative multi-radio channel allocation in wireless networks,” in Proc. IEEE 26th Conf. Comput. Commun. May. 2007, pp. 1442–1450.

[4] I.Katzela, and M. Naghshineh, “Channel assignment schemes for cellular mobile telecommunication systems: A comprehensive survey,” IEEE Pers. Commun., vol. 3, no. 3, pp. 10–31, Jun. 1996.
[5] L. Yen, J. Li, and C. Lin, “Stability and fairness of AP selection games in IEEE 802.11 access networks,” *IEEE Trans. Veh. Technol.*, vol. 60, no. 4, pp. 1150–1160, Mar. 2011.
[6] K. Zhu, D. Niyato, and P. Wang, “Network selection in heterogeneous wireless networks: evolution with incomplete information,” in *Proc. 2010 IEEE WCNC*.
[7] D. Niyato and E. Hossain, “Dynamics of network selection in heterogeneous wireless networks: an evolutionary game approach,” *IEEE Trans. Veh. Technol.*, vol. 58, no. 4, pp. 2008–2017, May 2009.
[8] M. Transier, H. Fubler, J. Widmer, M. Mauve, and W. Effelsberg, “A Hierarchical Approach to Position-Based Multicast for Mobile Ad-Hoc Networks,” Wireless Networks, vol. 13, no. 4, pp. 447-460, Aug. 2007.
[9] P. Namboothiri and K. Sivalingam, “Capacity analysis of multihop wireless sensor networks using multiple transmission channels: A case study using ieee 802.15.4 based networks,” in Proc. IEEE 35th Conf. Local Comput. Netw., Oct. 2010, pp. 168–171.
[10] Michael J. Neely, “Dynamic Data Compression for Wireless Transmission over a Fading channel”, University of Southern California, http://www-rcf.usc.edu/_mjneely.
[11] P. Kyasanur and N. Vaidya, “Routing and Link-Layer Protocols for Multichannel Multi-Interface Ad Hoc Wireless Networks,” ACM SIGMOBILE Mobile Computing and Comm. Rev., vol. 10, pp. 31-43, 2006.
[12] X. Fang, C. Zhu, and P. Fan, “Greedy-based dynamic channel assignment strategy for cellular mobile networks,” *IEEE Commun. Lett.*, vol. 4, no. 7, pp. 215–217, July 2000.
[13] S. Sen, R. R. Choudhury, and S. Nelakuditi. CSMA/CN: carrier sense multiple access with collision notification. IEEE/ACM Transactions on Networking (ToN), 20(2):544–556, 2012.
[14] W. Zhou, K. Srinivasan, and P. Sinha. RCTC: Rapid concurrent transmission coordination in full duplex wireless networks. In Proc. of IEEE ICNP, pages 1–10, 2013.
[15] S. Liu, L. Lazos, and M. Krunz. Thwarting control-channel jamming attacks from inside jammers. IEEE Transactions on Mobile Computing, 11(9):1545–1558, 2012.
[16] Shajan Joseph, A Rajaram, “A Novel secure and efficient clustering based routing protocol for MANET with certificate Revocation,” International Journal of Computer Technology and Applications (IJCTA), 10(20):41-52, 2017.