Clustered based Mobility Prediction in MANET

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Abstract

Mobile ad hoc networks are self-organizing and self-configuring multi-hop wireless networks capable of adaptive re-configuration when they are affected by node mobility. A mobile ad hoc network is composed of peer nodes with equal networking capabilities which are able to function as mobile routers i.e., to forward packets and maintain routes. Packets can be forwarded in multi-hops from the source nodes to the destination nodes with no need for underlying fixed network infrastructure (e.g. routers and base stations). Therefore, mobile ad hoc networks are not constrained in their deployment by any need for underlying infrastructure and they can be deployed rapidly in situations where wireless access to a backbone is impossible and an infrastructure is difficult to install (e.g., disaster recovery). In mobile ad hoc networks (MANETs), the network topology is autonomously formed and continuously changes, due to the mobility of the nodes. Clustering allows us to organize the topology in a structured manner. The association and dissociation of nodes to and from clusters perturb the stability of the network topology, and hence reconfiguration of the system is often unavoidable. Several existing on-demand clustering algorithms update that topology if needed. In this paper, an improvement to the existing clustering algorithm is done under the energy parameter specification. The effective route is here defined for clustered communication. An inter cluster and intra cluster communication is here performed under mobility vector. In this work, distance and energy adaptive algorithm is suggested to generate the effective communication route and analyze the work under different parameters which enhances the stability of the network in a more efficient way.

Keywords: MANET, Clustering, Infrastructure, NS2

I. INTRODUCTION

Wireless networks give the concept of distributed architecture so that the sharing of information as well as resources can be done effectively. In last few years, different kind of ad hoc networks come into the existence. With the advancement of internet and the growth of personal computers, the use of mobile computers is been increased very fast. There are different mediums of performing the communication over the network. This all results an effective sharing of information and resources. While performing the communication in such network there is the requirement of more effective information sharing techniques. These kind of information transmission includes the static and dynamic network types and to define the bidirectional links between the system without defining any wired connection as well as without setting up a static infrastructure. This kind of network does not require any administrative intervention. These networks are called ad hoc network.

A mobile network [5] is defined as a wide public area network in which number of mobile nodes is connected. Mobility is the key property of such kind of network. These kinds of networks perform the communication with multiple nodes under multiple controller devices. A mobile network is defined as a distributed network that have different kind of communicating devices such as mobiles, laptops etc. This kind of networks performs the multi-hop communication over the network. The data is transmitted over these networks using radio waves. The presented work is about to perform the analysis of mobile network under different real time scenarios so that the work includes the discussion on mobile network in details. This chapter contains the details about the mobile networks, its architecture and the motivation of the network.

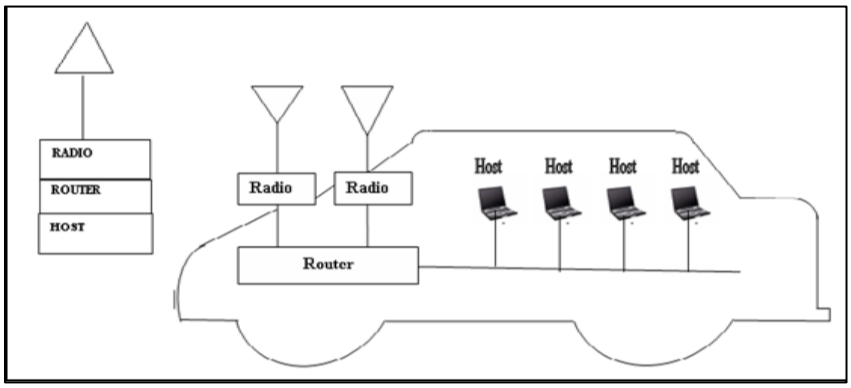

Fig. 1.1: An Example of MANETs

II. CHARACTERISTICS OF MOBILE NETWORKS

The main vector that differentiates a mobile network with any other network type is the used communicating devices called mobile devices. The mobility is the main feature of such networks. Due to the mobility, the special feature points considered here is the design solution of such kind of network. The issues associated and the characteristics difference between fixed networks and MANETS is the mobile nature of the nodes. To control the mobility network and the communication over the network, there is no requirement of any such design issue associated with the network type [7]. The characteristics associated with the work are listed as under are:

A. Network Size

The size of a network is defined in terms of network area as well as in the form of network nodes. To coordinate the network under distributed control mechanism, these two vectors are considered. A Mobile network can perform a long distance communication upto LOS by using the multi hop communication. Because of this the network is applicable for rescue areas such as forest etc.

B. Connectivity

The connectivity is defined in the form of link selection for the next node. To identify the neighbor of a node, the coverage range analysis is done over the nodes. The nodes that come under the coverage area are considered as the connectivity nodes. The bidirectional communication is performed with these networks. The local interference is the factor while considering the connection problem.

C. Networks Topology

Actually, the mobile networks are not dependent on the topology and can provide the output in any topology free networks. The nodes can be placed at random positions in such networks. But in some specific conditions such as in classroom sessions the topology can be setup so that effective throughput will be drawn from the network. The network also subjective to the connectivity type respective to the topology such as centralized connective system or random positioned networks are basic types of such topological architecture.

D. Bandwidth Constrained Links:

Wireless links are defined with lower capacity analysis under the hardwired connections. They are defined under the radio signal so that the long distance communication is possible. The channel bandwidth depends on the signal propagation. This connection can be defined under the bandwidth capacity. While performing the communication the factors included are the link quality analysis and the bit error rate.

E. Energy Constrained Operation

A mobile network requires some energy to start the communication. To provide this energy, the batteries are attached with mobile devices. The battery backup is the major factor to perform the communication when the mobile device is away from the energy source. As some operation is performed on this mobile device some amount of energy is lost. In the rescue systems, the energy vector is the critical so that more energy backup devices are taken to provide reliable communication.

F. Security

In a mobile ad-hoc network, the nodes are shared and the information travels among multiple nodes before the final delivery. In such case, it is required for communication to maintain the security so that no intermediate node or any external node captures the communication information. Such kinds of network also suffer from different kind of security threats such as DOS attack. As of the public network, mobile network suffer high security risks and having the problem of stolen information and heavy traffic that gives the insecure wireless link over the network.

G. Autonomous

Another property of the mobile networks is the communication without any centralized administration. The communication over such network is performed by the host and later on controlled by the routers. To perform the distance communication in hybrid networks, the switches and other cross link devices can be used.

H. Distributed Operation

These kind of networks does not having any centralized control to perform the network operations. The network is distributed among the terminals. The nodes includes in the network collaborate so that each node can participate over the network and it is able to achieve the secure routing over the network.

I. Multi-Hop Routing

To enable the infrastructure free communication as well as long distance communication, the multi hop communication is provided by mobile network. The next hop selection is here done based on the best node election in neighboring nodes. It requires the destination selection while moving through the intermediate nodes so that effective communication will be performed while forwarding through the nodes.

III. MOBILITY PREDICTION METHODS AND THEIR APPLICATIONS

We classify the mobility prediction methods for mobile ad hoc networks into three categories as follows (Figure 1.2):

1) Movement history based prediction methods, which predict the "future" location of a mobile user based on his movement history (i.e., previous user movement patterns).
2) Physical topology based mobility prediction methods, which base their prediction on the use of the characteristics of MANET's physical topology and therefore, require the use of a Global Positioning System (GPS) to obtain exact node location and mobility information.
3) Logical topology based mobility prediction methods, which choose a logical topology of the MANET (e.g. a clustering structure) over which they apply their prediction process. On the contrary to the previous category, they do not require exact location and mobility information and thus they do not make use of a GPS. Estimated values of node location and mobility information may be obtained by other means (e.g, using signal attenuation versus travelled distance to estimate inter-node distances, or inferring the mobility of each node from how different is the neighborhood of the node over time).

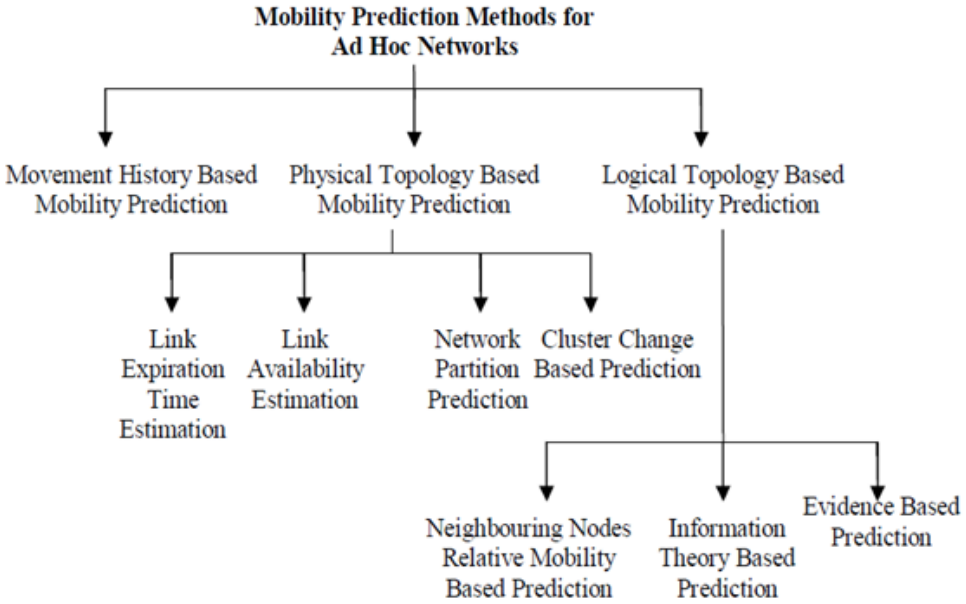

Fig. 1.2: Classification of mobility prediction methods

IV. RELATED WORK

In the existing work, there are number of author's defined work on mobile network under different parameters. Different authors defined the specifications based on different topologies, scenarios and the scenes. The work done by earlier researchers under different parameters are discussed in this chapter.

In year 2012, Chirag Kumar has performed a work on the performance of mobile network in realistic environment. Author has analyzed the work under different real time situations and defined work on different simulators. The work is here been checked on different scenario, shapes to attain the effective output from the system. The node analysis over the system is performed in obstacle condition. The work also include the network limitation identification so that the improvement over the network can be achieved in near future[1]. Another work on QOS optimization to resolve different issues in mobile network was considered by R.Lakshmi Priya in year 2009. Author defined a study work on the different ideas respective to the QOS optimization in mobile network. Author presented the work with different implementation work with qualitative restrictions. The work includes the comparative analysis to achieve the effective throughput from the work.In year 2006, Patrick Stuedi presented a throughput analysis on multi hop mobile network respective to the network capacity. The capacity is the major property, perform the analysis based on network strength estimation based on physical parameters such as propagation, unidirectional links, scheduling etc. The work is based on the probabilistic capacity calculation by performing the graph scheduling over the network. The capacity analysis is defined under the realistic network model under different configuration model. The analysis is performed in

ns2 environment based on throughput analysis on sink node[9]. In year 2007, J Abdullah presented a GA based QOS routing approach for the mobile network under the mobility constraint. The work is to analyze and improve the route quality under the random mobility model. The work also defined respective to the fitness variable and the GA based QOS optimization. The work is performed on the DSR protocol. The GA is the intelligent optimization tool that is used to achieve the efficiency as well as reliability over the network[6].

In year 2006, Dijiang Huang has explored a work on the traffic analysis under the unlink ability measure for a mobile network. The work is based on two major analytical approaches called statistical approach and the evidence based approach. These two approaches are used in a series to identify the unlink ability over the network as well as its effect over the network. The network transmission model respective to channel definition and analysis is presented in this work. The analysis is performed on the receiver side based on the evidence theory to obtain the maximum throughput over network[2]. In year 2009, A Simulation based analysis is performed on AODV protocol by Md. Monzur Morshed. The author has analyzed the network under the protocol specification for the different parameters. The parameter includes the efficiency, reliability, loop free routing etc. The Author has defined different network scenarios and performed the variation in terms of network delay, jitters etc and the relative effective is analyzed and presented in the form of graphs. The work is the verification of performance of AODV protocol under different network formations as well as the parameters [8].

In year 2008, Quan Le-Trung presented a work to analyze the effect of load balancing on mobile network. Mobile network is one of the busy network. The author is includes the hybrid metric discussion based on quantitative analysis in terms of packet transmission ratio over the network under ad-hoc routing protocol. The work is about to perform analysis to get better performance in terms of packet delivery ratio and transmission delay at the cost of signaling overhead. In year 2006, Moussa Ayyash presented a work on the performance analysis respective to the network infrastructure. The author has performed the analyze the network based routing protocol optimization under different metrics and the behaviors. The author has proposed a QOS virtual backbone to achieve the robustness for routing and monitoring. The QOS is basically selected based on routing and monitoring. The work also includes the stability and availability analysis respective to the bandwidth analysis[9].

In year 2009, Patrick Sondi has defined the protocol based service optimization for the voice communication in mobile ad hoc network. The author has presented a network Extended OLSR protocol that will work on voice communication and provide the best effort routing and the high quality of service in the real time environment. The work also includes the confirmation for end to end delay analysis and the jitter constraint for the network formulation. The author has discussed the delivery ratio with better perspective[10]. In same year Thomas J. Sapienza has provided an evolutionary mechanism to optimize the quality of service for the wireless network. The work presented by the author includes the network design under parameter specification with wireless communication effects such as power control, routing failures, erratic development model etc. The work also includes the real world scenario specification under the scalability and some other parametric models. The author has presented a polynomial complete model using the evolutionary programming to overcome the network delay and to improve the network effectiveness and the quality of service. The author also suggested the use of associative memories and the genetic algorithm during the QOS analysis phase

Pedro Garcia Lopez has presented a topology specific approach to perform the service optimization for mobile network. The author has performed work on multicast network for the OLSR protocol. The work includes the improvement over the communication efficiency over the work with the change in network topology

V. PROPOSED WORK

In this present work an improvement to the existing clustering algorithm is done under the energy parameter specification. The effective route is here defined for clustered communication. An inter cluster and intra cluster communication is here performed under mobility vector. In this work, distance and energy adaptive algorithm is suggested to generate the effective communication route and analyze the work under different parameters which enhances the stability of the network in a more efficient way.

A. Network Model

In this work, the system will consist of a different kind of network with the following assumptions, in which:

- The clustered network is defined where each cluster is controlled by the cluster head called controller node.
- The network includes the inter cluster and intra cluster communication.
- The communication is performed via cluster head.
- Location of all nodes and coordinators is dynamic.
- If the coordinator nodes is present, it will control a set of nodes
- A network can have one or more coordinator depending on the network size and density.

B. Cost Model

In order to be able to compare the various network topologies and the scenarios some parameters are required to estimate the network cost. The network cost is basically in terms of communication over the network. Here the communication estimation is further divided in few parameters

1) Number of Packets Transferred:

It is basically the throughput that represents the number of packets successfully received by the sink node. The receiving packets are compared with sending packets and the ration represents the throughput.

The throughput is given by

$$\text{Throughput} = \frac{\text{Number of Packet Received}}{\text{Number of Packets Sent}} \times 100$$

2) Number of Packets Lost:

It is the parameter according to which the cost of network will be estimated. It is just opposite to the previous cost estimator. It defines the number of packets lost over the network. The reason of lost can be some attack, delay or the transmission ratio. Here we are comparing the packet loss ratio respective to the communication over the network on different topology, scalability and clustering parameters.

3) Data Rate:

It defines the data rate on which the communication is performed. The data rate is defined in terms of bit rate and byte rate. This rate is also defined with delay parameters also. Here the delay is because of setup phase. For the actual topological comparison we keep the data rate constant. The data rate can vary over the communication over the network.

4) Delay Rate:

It is basically the delay in setup phase. For different topologies the delay rate can be different.

If the delay rate is high it can slow down the communication and can result in terms of packet loss over the network. Here the work is presented in form of delay analysis over the network.

C. Assumptions

The assumptions associated with this presented work are given here under

- The nodes are defined in fixed geographical area.
- Nodes are defined with energy specification.
- The energy dispersion with each communication activity is constant.

D. Flow Chart

The presented work is actually the construction of the network algorithm with scene and scenario specification so that effective network construction is been defined. The algorithm is here been defined in the form of network construction and communication steps.

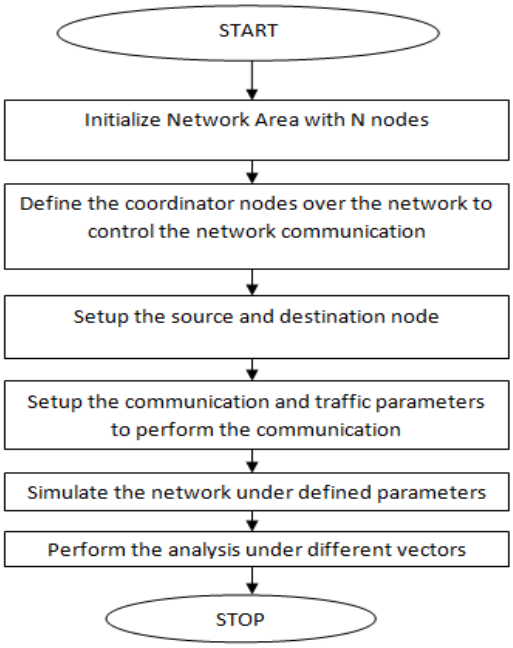

Fig. 1.3: Flow of work

VI. SIMULATION RESULTS

The simulation is done using NS2, i.e., Network Simulator version 2. NS2 is an event driven simulation tool that is used to study the dynamic nature of communication networks.

The parameters used in the simulation are shown below –

Table 2:
Simulation parameters

Parameters	*Values*
Number of Nodes	*50*
Protocol	*AODV*
Simulation Time	*100 Sec*
Packet Size	*512*
MAC protocol	*802.11*
Coverage Range	*990x990*
Network Type	*Clustered*
Network Type	*Clustered*
Mobility Model	*Random Directional*
Number of Clusters	*5*

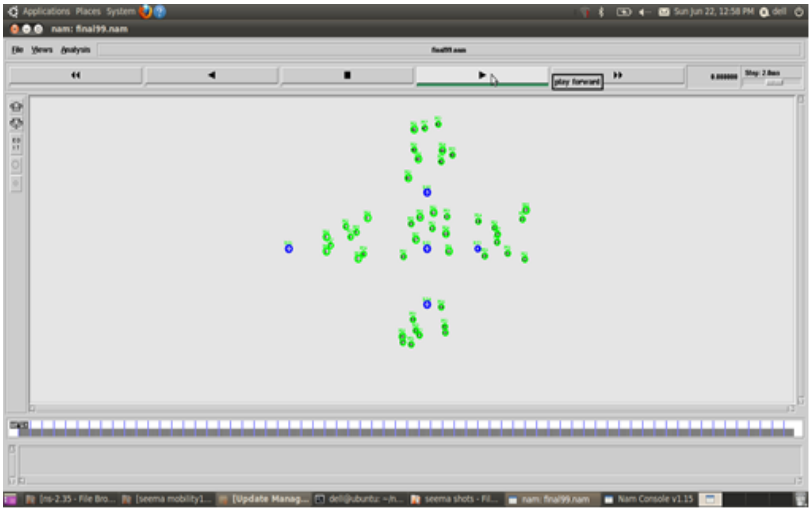

Fig. 1.4: Clustered Architecture

Here figure 1.4 is showing the clustered architecture of network node placement. The network is divided in 5 clusters at the initial phase. The cluster member selection is here defined under the distance parameter.

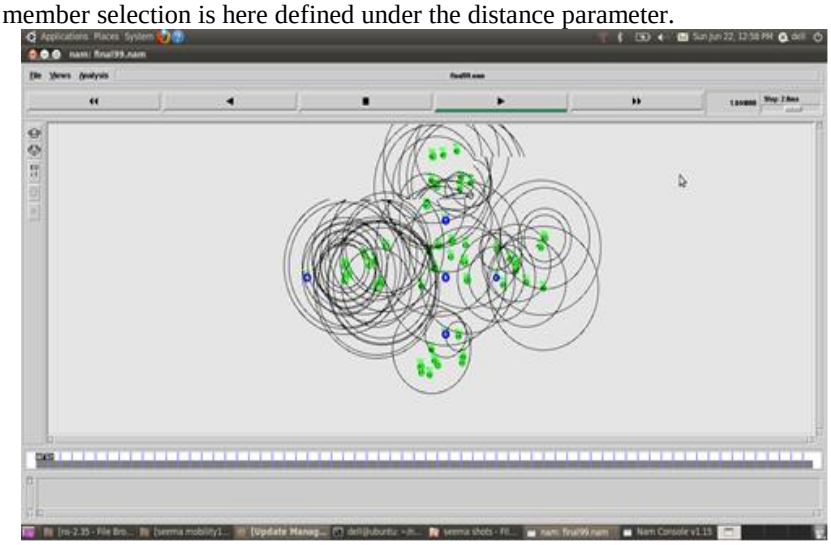

Fig. 1.5: Clustered Architecture (Coverage Range)

Here figure 1.5 is showing the clustered architecture of network node placement. The network is divided in 5 clusters at the initial phase. The cluster member selection is here defined under the distance parameter. Here the blue nodes represent the cluster nodes and the green nodes represent the energy effective mobile nodes. The circles are defined to represent the coverage of nodes.

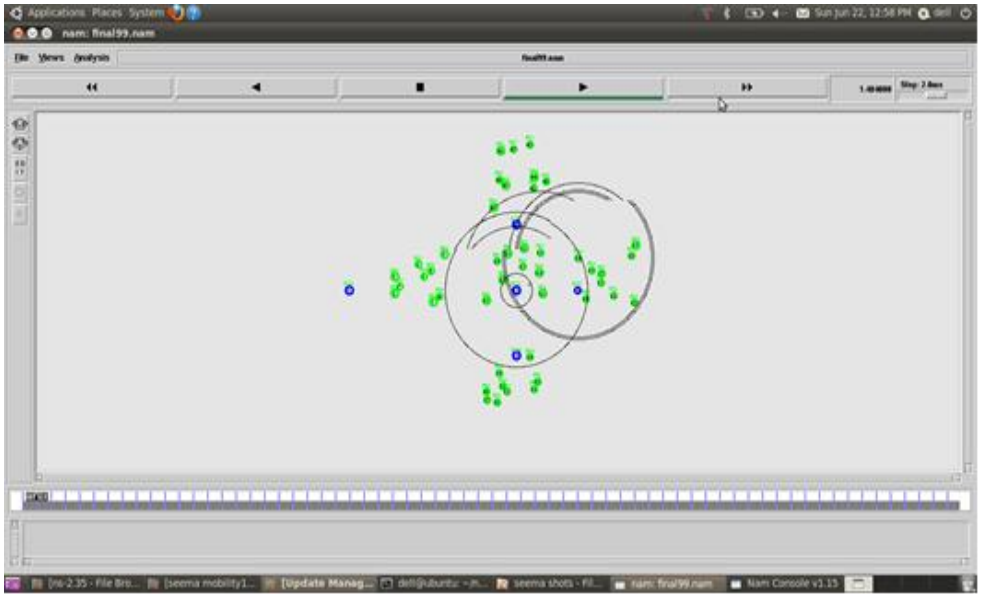

Fig. 1.6: Clustered Architecture (Route Identification)

Here figure 1.6 is showing the clustered architecture of network node placement. The network is divided in 5 clusters at the initial phase. The cluster member selection is here defined under the distance parameter. Here the blue nodes represent the cluster nodes and the green nodes represent the energy effective mobile nodes. The network nodes represent the route identification phase.

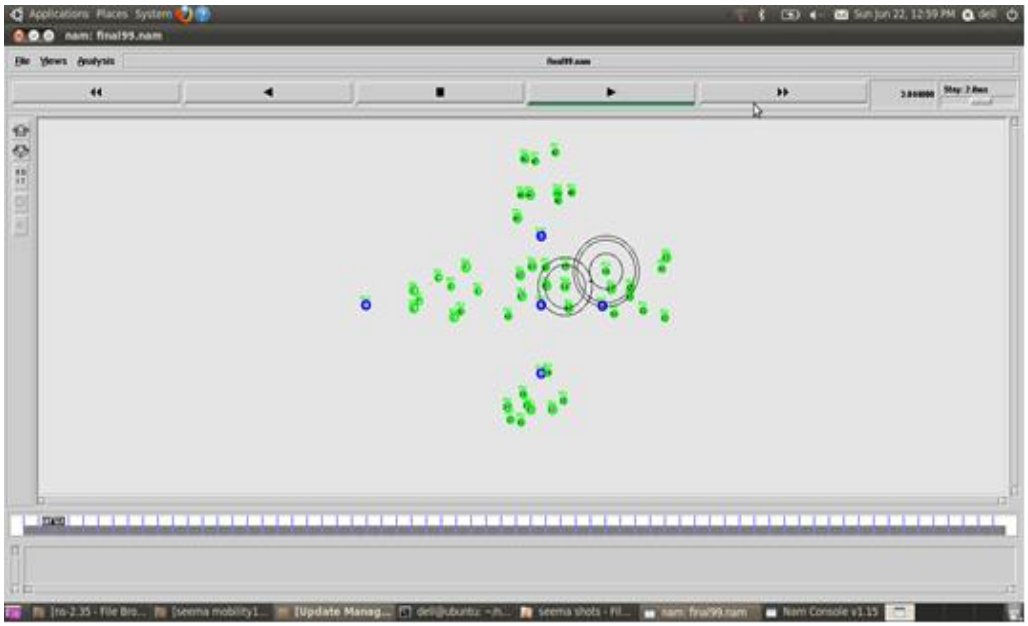

Figure 1.7: Clustered Architecture (Route Generation)

Here figure 1.7 is showing the clustered architecture of network node placement. The network is divided in 5 clusters at the initial phase. The cluster member selection is here defined under the distance parameter. Here the blue nodes represent the cluster nodes and the green nodes represent the energy effective mobile nodes. The network nodes represent the route generation phase.

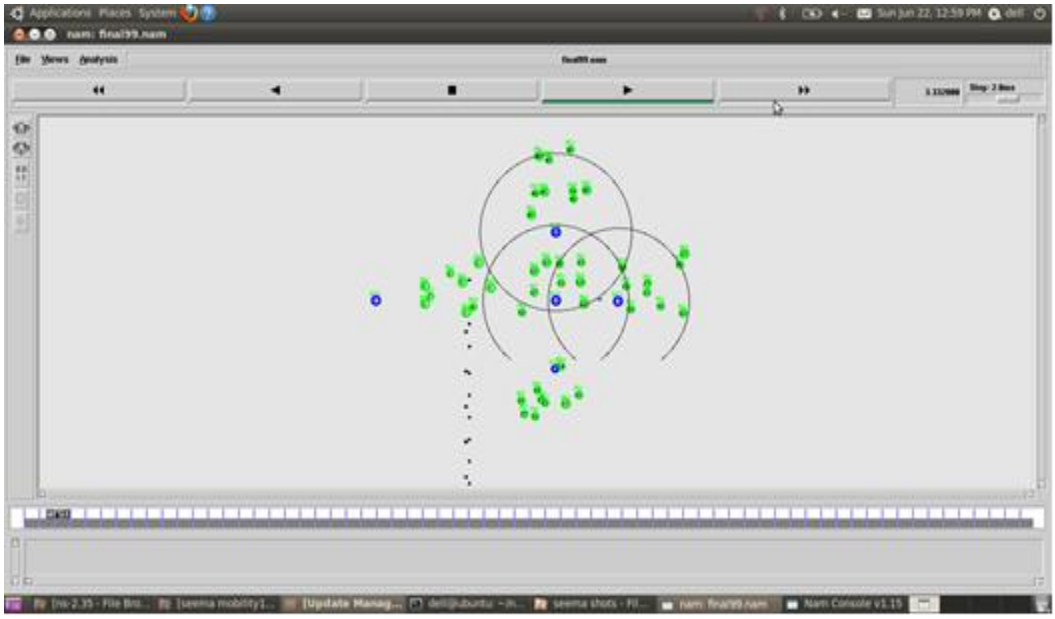

Fig. 1.8: Clustered Architecture (Communication)

Here figure 1.8 is showing the clustered architecture of network node placement. The network is divided in 5 clusters at the initial phase. The cluster member selection is here defined under the distance parameter. Here the blue nodes represent the cluster nodes and the green nodes represent the energy effective mobile nodes. The network nodes represent the route based communication over the network. The figure is also showing the data drop over the communication.

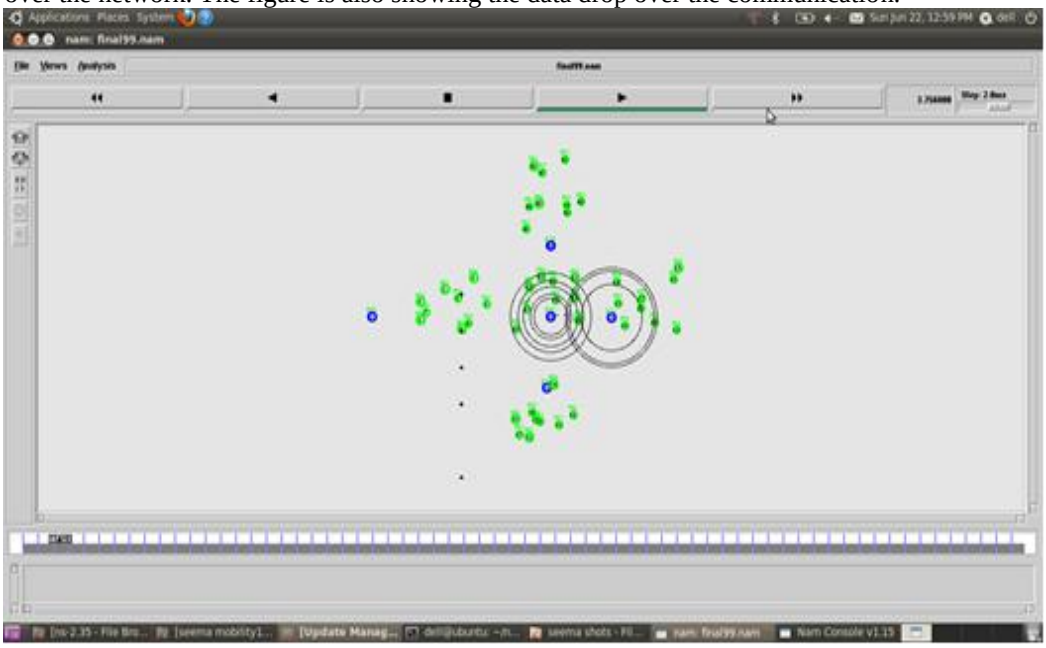

Fig. 1.9: Clustered Architecture (Inter Cluster Communication)

Here figure 1.9 is showing the clustered architecture of network node placement. The network is divided in 5 clusters at the initial phase. The cluster member selection is here defined under the distance parameter. Here the blue nodes represent the cluster nodes and the green nodes represent the energy effective mobile nodes. The network nodes represent the inter cluster communication over the network. The figure is also showing the data drop over the communication.

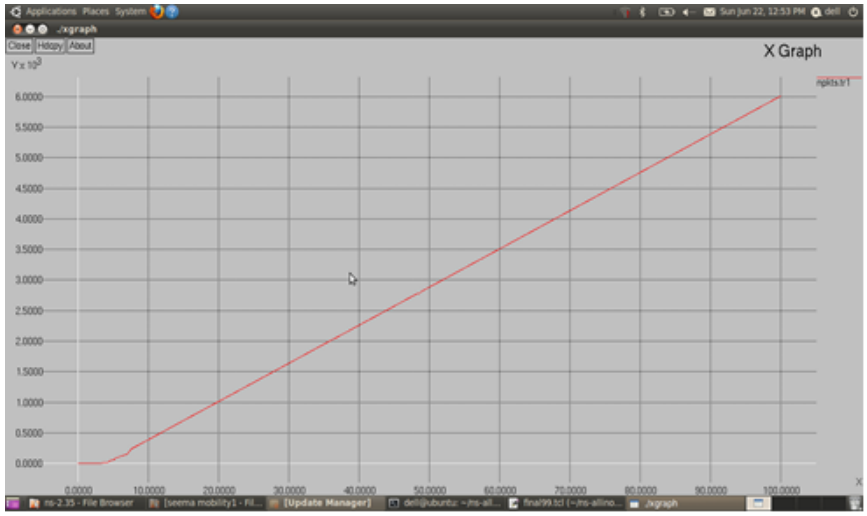

Fig. 1.10: Packet Transmission Analysis

Here figure 1.10 is showing the packet communication analysis over the network. Here X axis represents the simulation time and y axis represents the packet loss over the network. Figure shows that the communication is being increased over the networks.

Fig. 1.11: Packet Loss Analysis

Here figure 1.11 is showing the Packet Loss Analysis over the network. Here X axis represents the simulation time and y axis represents the packet loss over the network. Figure shows, the as the cluster formation is done, the packet loss is increased initially after that as the route established no more packet loss occur. As the route reconfiguration over the network is performed, the packet loss occur.

Fig. 1.12: Packet Loss Rate Analysis

Here figure 1.12 is showing the Packet Loss Rate Analysis over the network. Here X axis represents the simulation time and y axis represents the packet loss rate over the network. Figure shows, the as the cluster formation is done, the packet loss is increased initially after that as the route established no more packet loss occur. As the route reconfiguration over the network is performed, the packet losses occur.

VII. CONCLUSION AND FUTURE WORK

A mobile network is one of the most busy and required public area networks. One of the most challenging properties of mobile network is mobility vector. The nods work is defined in the form of cluster network. Here the nodes are defined with energy constraint. The clusters are initially created in the form of distance based analysis. The work is here defined in the form of clustered mobile communication in real scenario. In this work, directional mobility model is considered for communication over the mobile network. Here the inter cluster and intra cluster communication is performed over the network. The work includes the cluster based communication within the network for both inter and intra cluster communication. The intelligent cluster selection technique is defined based on throughput, capacity and idle rate based evaluation. The work is here been implemented in NS2 environment. As future work, we can use other mobile agents for formation of clusters.

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