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Network Capacity Enhancement of MANETs using Multicast Routing Protocol

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ABSTRACT: Mobile ad hoc networks (MANETs) are application of wireless ad-hoc network. It was demonstrated that node-to-node and node-to-roadside interchanges designs will exist together in MANETs to give street security, route, and other roadside administrations. Correspondence abilities in node are the premise of an imagined in MANET or Intelligent Transportation Systems (ITS). This paper proposed, on demand multicast routing protocol which at first define all parameters and develop algorithm which can achieve desired result. The work is upheld by broad recreation comes about which show the adequacy of the proposed techniques in finding a close ideal arrangement. Using ODMRP protocol is best configuration for network model and due to it reduces cost of RSU. Implementation and simulation is performed using MATLAB 8.3 software. Simulated results shows the proposed protocol gives significant better results in terms of throughput, end to end delay, packet delivery ratio etc.

KEYWORDS: MANET, Protocols, MATLAB, Routing, N2N, N2I.

I. INTRODUCTION

Currently, the increasing number of node has caused some problems. One of them is a traffic jam and often accidents occurred, so these problems lead to a need of a technological system that can help us reducing those negative effects. Intelligent Transportation System (ITS), one of promising answers, is a combination of intelligent transportation system with information technology to improve accessibility, efficiency and security of transportation. ITS technology could provide real-time information to road users related to the road situation such as when there are traffic accidents or congestions occurred on a particular road area. The presence of this technology could give solutions or alternatives for road users can avoid the traffic jam. ITS also can support information about the condition of existing node for the vicinity, so it can help users to avoid the accident. One of ITS technologies that are still in development is Mobile Ad-Hoc Network (MANET) [1].

MANET currently still has some obstacles to its development that requires much cost for development and testing. So far there is still no country that has really applied the MANET system commercially. On the other hand, the development and research about MANET is still ongoing although MANET network modeling has been done in the form of simulation [1]. The frequent exchange of routing vectors or link state tables, triggered by continuous topology changes, yields excessive channel and processing overhead. Limited bandwidth, constrained power, and mobility of network hosts make the multicast protocol design particularly challenging. To overcome these limitations, we have developed the on-Demand Multicast Routing Protocol (ODMRP). ODMRP applies *on-demand* routing techniques to avoid channel over head and improve scalability. It uses the concept of *forwarding group* [5], a set of nodes responsible for forwarding multicast data on shortest paths between any member pairs, to build a forwarding *mesh* for each multicast group.

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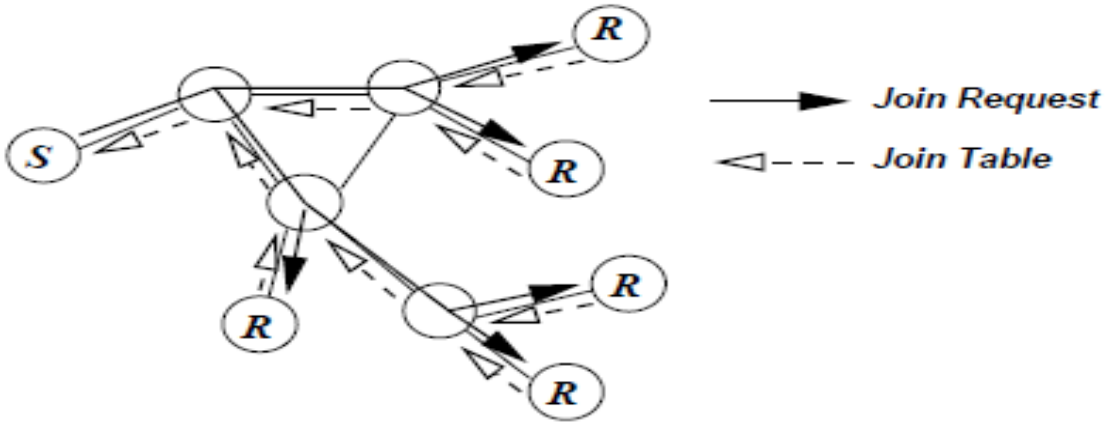

Figure 1: On-Demand Procedure for Membership Setup and Maintenance

II. RELATED WORK

The MANET research has been conducted by some. In [1] Y. Chen *et al.* presents from theory to experimental evaluation: resource management in Software -Define Mobile Networks, they have done experiments on MATLAB open Flow enable new degrees for the management of wireless and wired resources in dynamic Mobile environment.
In [5] A. Khan et al., present AODV is under CBR traffic for MANET nodes operated through Okumura Propagation Model with queue technique as well as DYMO performs well in free space propagation model using queuing technique, also summarize as the node density increases in network throughput performance decreases. Further DRAODV routing protocol is designed and implemented in order to improve the QoS over AODV routing protocol under variable transmission range. In A. Singh,[6] et al., presents a localization based algorithm which will help to provide information about the localized and non-localized nodes in a network. In this approach DREAM protocol and AODV protocol are used to find the localizability of a node in a network. DREAM protocol is a location protocol which helps to find the location of a node in a network whereas AODV is a routing protocol it discover route as and when necessary it does not maintain route from every node to every other. To locate the mobile nodes n/w node identification algorithm is used. With the help of this algorithm localized and non-localized node can be easily detected in respect of radio range. This method helps to improve the performance of a module and minimize the location error and achieves improved performance in the form of UDP packet loss, received packet and transmitted packets, throughput, routing overhead, packet delivery fraction.
In [7], Amrit *et al.* presents simulation of Mobile movement in MANET. This simulation explains all functions as both directions and also conducts testing for MANET applications and protocols. In [8] Hannes *et al.* presents a tutorial survey on MANET, a testing in directed and wireless multi-hop feasibility of N2N and N2I communications based on wireless local area. In [9] Ian *et al.* proposes a Software Define MANET: architecture and services, this work describes some of the different operational and service modes that can be provided for MANET technology.
This section will explain and describe the evolutionary background of MANET as well as information about the MATLAB to support MANET implementation.

A. MANET Overview

MANET has two ways communication namely Node to Node (N2N) with Ad-Hoc type and Node to Infrastructure (N2I) with each unit of Road Site Unit (RSU) and mobile network (e.g 4G / LTE). These communication types are explained in figure 1.

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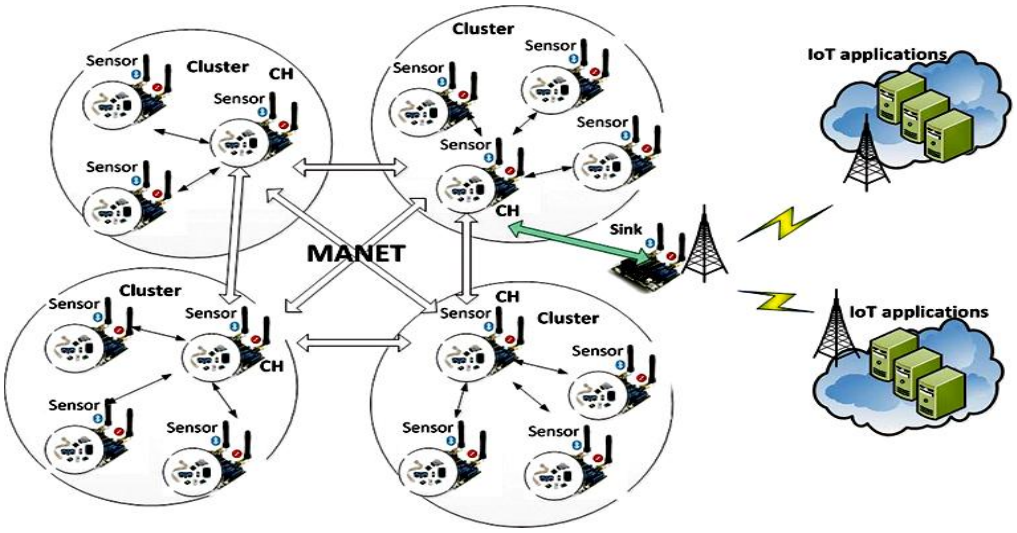

Figure 2: MANET routing model

MANET is a high speed data communications technology for a node. This technology is wireless based and has several protocols for data communication namely unicast, multicast, geocast, mobicast and broadcast protocol. Connectivity in MANET uses IEEE 802.11 on 5.9 GHz wave. MANET's traditional services include node and road safety services, traffic efficiency, management services and infotainment services. Traffic efficiency and management services are aimed to improve traffic flow and traffic coordination and to provide local information and maps. In terms of infotainment service, MANET is expected to support information such as multimedia data transfer and global internet access. [6]

B. MATLAB for MANET

Networking devices have multiple controls and data flow operations in the same device. One of the controls is network management plane. This plane is used to configure each network node separately. The static nature of the current network does not allow full control configuration plane. The main concept of MATLAB is to offer control management for users to manage hardware forwarding of each network element.

The easiest thing MATLAB could support for MANET is by making RSU MATLAB-enabled for example using a controller like in Open Flow switches. In addition, the scope of the controller could be extended to protocol that could act as end users and could be abstracted as elements included in data such as RSU and other infrastructure nodes. Therefore, the protocol could be triggered by the controller for its performance such as the deployment of multi-hop N2N data. [7]

III. PROPOSED WORK

The main contributions of this dissertation will be-

- To overcome above limitations, we need to analyse performance of protocol in MANET in term of throughput, delay and packet drop.
- The N2N ad-hoc communication protocols without RSU coverage are designed and simulated in MATLAB and performance analysis results will be more reliable.

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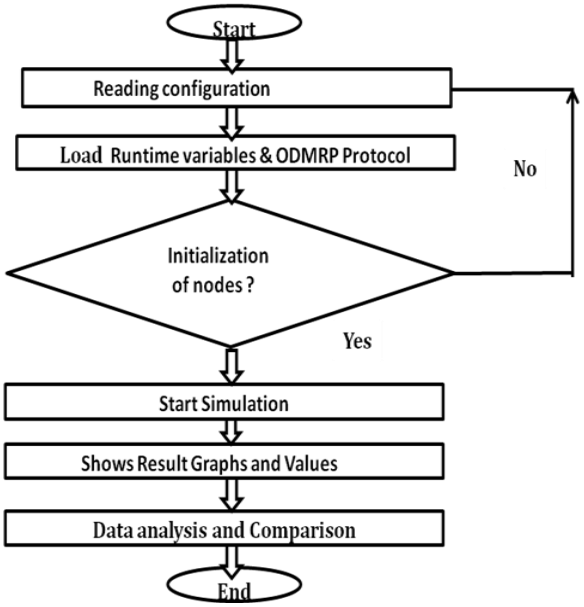

Figure 3: Flow Chart

In this study, a simulator that is used for simulation is MATLAB and SIMULINK. This simulator is installed on windows 10 which run on virtual machine. For writing the script we use .m file in MATLAB and also to show the visualization [8].

There are two measurement scenarios in this research. The first one is measurement of throughput, drop and delay of communication in one RSU, and the second one is measurement of throughput, packet drop and delay of communication between two different RSUs. In MATLAB we design the MANET topology with 2 RSUs and 5-500 nodes (cars).

ALGORITHM

Step-1 reading configuration, runtime variables total packets generated in the simulation
Step-2 TODO: add topology builder and agent role for Nodes
PHY used, MAC protocol, Agents, Applications used in this simulation
Step-3 initial nodes, start discrete simulation, update topology matrix, and update plot graph and edges, move node

IV. RESULT AND ANALYSIS

In this simulation, several simulation scenarios are done with using 5-500 units of node (cars) and 2 nodes of RSU. Each scenario will measure performance parameters namely delay, throughput, and packet drop. There are 2 scenarios to be evaluated, first is N2N communication and second is N2I communication with two RSUs.

A. *Performance Evaluation N2N*

After the MANET topology has been designed, then perform some testing to see whether the N2N connection is already reachable each other. In this case, the node is defined as 'car'. The first simulation is to evaluate N2N communication.

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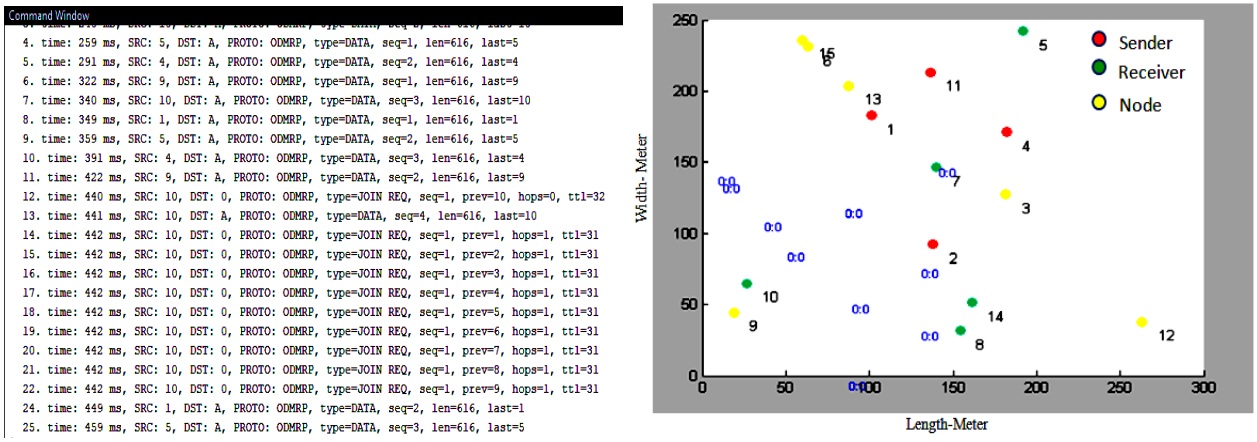
Inter-node communication:
In inter-node communication, node need only be concerned with activity on the road ahead and not behind.

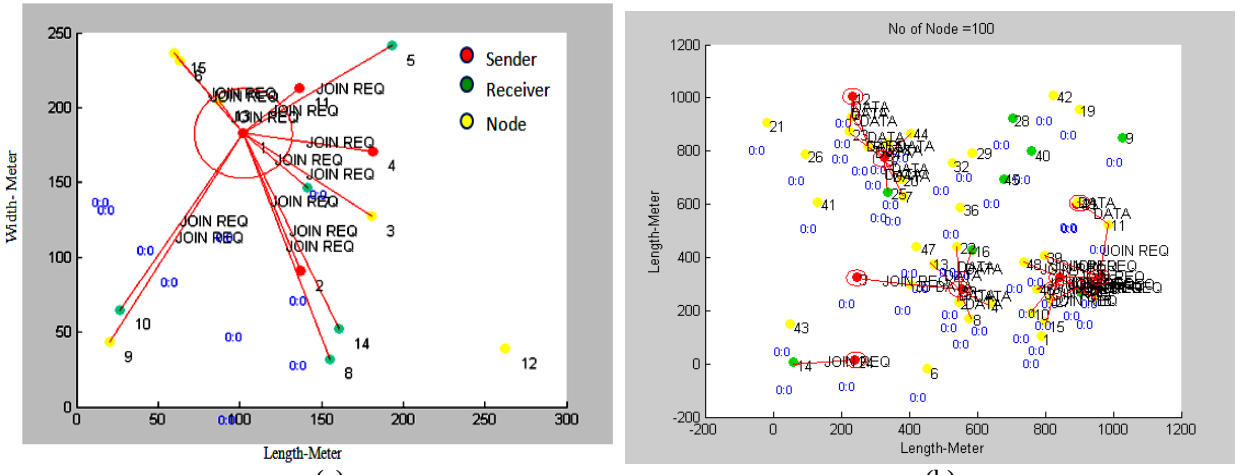
B. Performance Evaluation N2I Communication with two RSU

In the second simulation, two car is expected to be reachable each other in the different RSU coverage. Here N2I or N2RSU communication which has 2 RSU is designed and they communicate with the entire node (cars). Node-to-roadside communication configuration provides a high bandwidth link between node and roadside units. The roadside units may be placed every kilometer or less, enabling high data rates to be maintained in heavy traffic.



(a) (b)

Figure 4: (a) Simulation parameters (b) initializing simulation



(a) (b)

Figure 5: (a) & (b) Simulation of MANET using ODMRP

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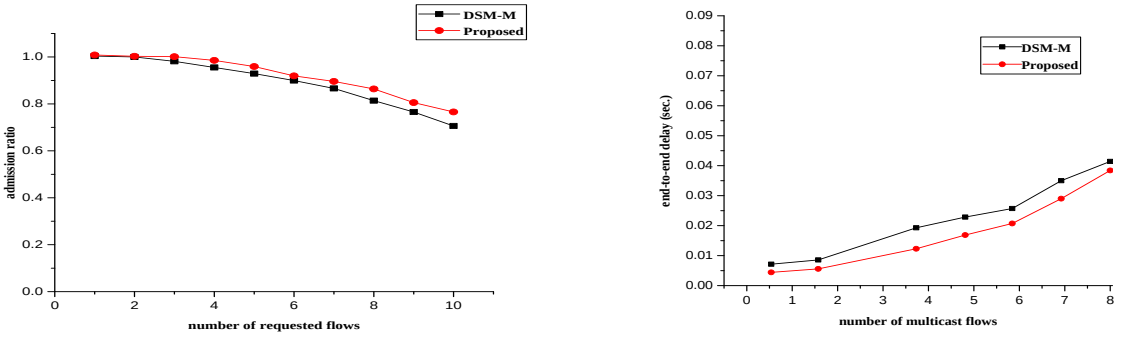
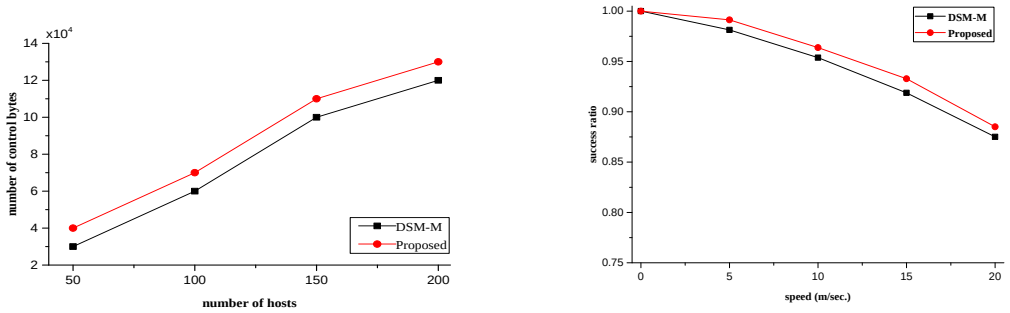


(a) (b)

Figure 6: (a) Number of request flows vs admission ratio (b) Number of multicast flows vs end to end delay

Figure 6 (a) presents the total number of entering nodes with respect to the generate request from node to other node and figure 6 (b) presents the number of multicast flows vs end to end delay. Delay should be minimum during transmission, more delay cause to low throughput. This graph clears proposed method gives reduced delay than previous methods.



(a) (b)

Figure 7: (a) Number of hosts vs number of control bytes (b) Node speed vs success ratio

Figure 7(a) presents the total number of hosts vs control bytes, so it should be more for good reliability of system and Figure 7(b) presents the graph between speeds of nodes vs the success ratio. When node is moving at slow speed then success ratio probability is more. So proposed method gives more success ration at high speed, it is also a significant better advancements than previous.

Table 1: Simulation parameters

Software	MATLAB 8.3.0.532
System Environment	Windows 10
Time	100 ms to 1000 ms
Destination	1-100
Source	1-100
Protocol	ODMRP
Length	1200-1200

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Table 2: Comparison of Proposed work with previous work

Sr No.	Parameter	Previous Work	Proposed Work
1	Packet Delivery Ratio	1%	6.2%
2	Average End To End Delay	0.005 ms	0-0.001 ms
3	Throughput Performance (Routing overhead)	5000Kbps	6800 Kbps

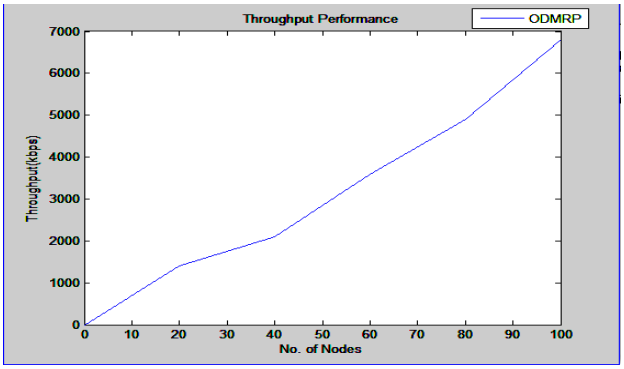

Figure 8: Throughput Performance

Figure 8 shows the performance of data rate or throughput. This is calculated by number of bits transmitted per second in ODMRP Protocol network.

V. CONCLUSION

An experiment of MANET simulation in a MATLAB has been done and the performance parameters have been evaluated such as end to end delay, throughput. Performance of ODMRP is compared with MAODV and AODV Protocols in terms of the performance parameters such as packet delivery ratio, Average end to end delay and routing overhead by using MATLAB for different number of nodes (upto100). From the results it is clear that at high mobility rate ODMRP performs better than other protocols. Therefore it can be say that network capacity enhancement of MANETs using multicast routing protocol is successful and significant improved.

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