Performance Comparison of Routing Protocols of MANETs using Vector and Random way point Mobility Model

Narinder Pal, Renu Dhir

Department of Computer Science & Engineering
Dr. B. R. Ambedkar National Institute of Technology, Jalandhar

Abstract**—** MANET is combination of mobile nodes which uses multi hop transmission for communication. Due to highly dynamic topology, routing in MANET is challenging task, moreover presence of malicious nodes make the overall network very insecure. We study both the availability and the duration probability of a routing path that is subject to link failures caused by node mobility. In particular, we focus on the case where the network nodes move according to the Vector mobility model and Random Way Point mobility model, and we derive both exact and simple and approximate expressions of these probabilities. By obtained results, we study the problem of selecting an optimal route in terms of path availability. Finally, we propose an approach to improve the efficiency of Reactive Routing protocols.The main classes of MANET routing protocols are Proactive, Reactive and Hybrid. In this paper we compare performance of Proactive routing protocol by focusing on Optimized Link State Routing (OLSR) and Reactive Routing Protocol by focusing on Ad Hoc On Demand Distance Vector (AODV) and Gathering-based Routing Protocol (GRP). In this paper our simulation tool is OPNET modeller. The performance of these routing protocols is analysed by three metrics: delay, network load and throughput. This paper presents a performance analysis of three Mobile Ad Hoc Network (MANET) routing protocols – AODV, OLSR and GRP under the two mobility models i.e. Vector Mobility Model and Random Way Point. The final evaluation results to obtain route stability, so as to Improve routing efficiency as well by Vector mobility model.

Keywords**—** MANET, AODV, OLSR, GRP, OPNET Simulator, Vector Mobility Model, Random Way Point Mobility Model

I. INTRODUCTION

MOBILE wireless networks are receiving an increasing interest due to the possibility of ubiquitous communications they offer. In particular, mobile ad hoc networks (MANETs) enable users to maintain connectivity to the fixed network or exchange information when no infrastructure, such as a base station or an access point, is available. This is achieved through multihop communications, which allow a node to reach far away destinations by using intermediate nodes as relays. The selection and maintenance of a multihop path, however, is a fundamental problem in MANETs. Node mobility, signal Interference and power outages make the network topology frequently change; as a consequence, the links along a path may fail and an alternate path must be found. To avoid the degradation of the system performance, several solutions have been proposed in the literature, taking into account various metrics of interest. A method that has been advocated to improve routing efficiency is to select the most stable path [1], [2], [3],[6], so as to avoid packet losses and limit the latency and overhead [5] due to path reconstruction (routing instability).

Here we focus on vector and random way point mobility model [1], and we consider nodes moving according to the vector mobility model, According to such model, each node alternates periods of movement move phase) to periods during which it pauses (pause phase); at the beginning of each move phase, a node independently selects its new direction and speed of movement [1], [2], Speed and direction are kept constant for the whole duration of the node move phase.

II. AD-HOC ROUTING PROTOCOLS

This section describes the main features of three protocols AODV (Ad hoc On-demand Distance Vector) [1] and OLSR (Optimized Link State Routing) [2], GRP (Gathering-based Routing Protocol) [3] deeply studied using OPNET14.5.

A. AODV ((Ad hoc On-demand Distance Vector)

AODV is an on-demand routing protocol. The AODV [9] algorithm gives an easy way to get change in the link situation. For example if a link fails notifications are sent only to the affected nodes in the network. This notification cancels all the routes through this affected node. It builds unicast routes from source to destination and that's why the network usage is least. Since the routes are build on demand so the network traffic is minimum. AODV does not allow keeping extra routing which is not in use [10]. If two nodes wish to establish a connection in an ad hoc network then AODV is responsible to enable them to build a multihop route. AODV uses Destination Sequence Numbers (DSN) to avoid counting to infinity that is why it is loop free. This is the characteristic of this algorithm. When a node send request to a destination, it sends its DSNs together with all routing information. It also selects the most favorable route based on the sequence number [10]. There are three AODV messages i.e. Route Request (RREQs), Route Replies (RREPs), and Route Errors (RERRs) when the source node wants to create a new route to the destination, the requesting node broadcast an RREQ message in the network [9]. The RREQ message is broadcasted from source node A to the destination node B. The source node A broadcasts the RREQ message in the neighbour nodes. When the neighbour nodes receive the RREQ message it creates a reverse route to the source node A. This neighbour node is the next hop to the source node A. The hop count of the RREQ is incremented by one. The neighbour node will check if it has an active route to the destination or not. If it has a route so it will forward a RREP to the source node A. If it does not have an active route to the destination it will broadcast the RREQ message in the network again with an incremented hop count value. The procedure for finding the destination node B. The RREQ message is flooded in the network in searching for finding the destination node B. The intermediate nodes can reply to the RREQ message only if they have the destination sequence number (DSN) equal to or greater than the number contained in the packet header of RREQ.

The intermediate nodes forward the RREQ message to the neighbor nodes and record the address of these nodes in their routing cache. This information will be used to make a reverse path for RREP message from the destination node. The RREP reached to the originator of the request. This route is only available by unicasting a RREP back to the source. The nodes receiving these messages are cached from originator of the RREQ to all the nodes.

When a link is failed an RERR message is generated. RERR message contains information about nodes that are not reachable. The IP addresses of all the nodes which are as their next hop to the destination.

B. OLSR (Optimized Link State Routing)

It is a proactive routing protocol and is also called as table driven protocol because it permanently stores and updates its routing table. OLSR [2][8] keeps track of routing table in order to provide a route if needed. OLSR can be implemented in any ad hoc network. Due to its nature OLSR is called as proactive routing protocol. Multipoint relay (MPR) nodes in the network do not broadcast the route packets. Just Multipoint Relay (MPR) nodes broadcast route packets. These MPR nodes can be selected in the neighbor of source node. Each node in the network keeps a list of MPR nodes.

This MPR selector is obtained from HELLO packets sending between in neighbor nodes. These routes are built before any source node intends to send a message to a specified destination. Each and every node in the network keeps a routing table. This is the reason the routing overhead for OLSR [8] is minimum than other reactive routing protocols and it provide a shortest route to the destination in the network. There is no need to build the new routes, as the existing in use route does not increase enough routing overhead. It reduces the route discovery delay.

C. GRP (Gathering-based Routing Protocol)

Gathering-based Routing Protocol [9] combines the advantages of Proactive Routing Protocol (PRP) and of Reactive Routing protocol (RRP). Supporting the delay sensitive data such as voice and video but it consumes a great portion of the network capacity. While RRP is not suitable for real-time communication, the advantage of this approach is it can dramatically reduce routing overhead when a network is relatively static and the active traffic is light. However, the source node has to wait until a route to the destination can be discovered, increasing the response time.

The goal of the proposed routing protocol (GRP) [5] is to rapidly gather network information at a source node without spending a large amount of overheads. It offers an efficient framework that can simultaneously draw on the strengths of PRP and RRP.

III. EXPERIMENTAL SET UP

We used Network Simulation OPNET (optimized Network Engineering Tool) Modeler version 14.5 in our evaluation. The OPNET is a discrete event driven simulator . It simulates the network graphically and its graphical editors mirror the structure of actual networks and network components. The modeler uses object-oriented modeling approach. The nodes and protocols are modeled as classes with inheritance and specialization.

The simulation parameters are summarized in table 1.

Table 1: Network Parameters

Parameter	**Value**
Simulator	Opnet 14.5
Area	3.5×3.5 Km
Wireless MAC	802.11
Number Of Nodes	25
Mobility Model	Vector Mobility,Random Waypoint Mobility
Data Rate	11 Mbps
Routing Protocols	AODV,OLSR and GRP
Simulation Time	5 minutes

The development language is C. The simulation is performed to evaluate the performance of routing protocols with the vector mobility and random waypoint mobility issue at FTP traffic. Therefore, different simulation scenarios consisting of 25 nodes for AODV OLSR and GRP is considered. The nodes were randomly placed within certain gap from each other in 3.5×3.5 km office environment for 25 nodes. The constant FTP traffic is generated in the network explicitly i.e. user defined via Application configuration and Profile Configuration. Every node in the network was configured to execute AODV, OLST and GRP respectively. The simulation time was set to 5 minutes and all the nodes were configured with defined mobility in space.

IV. PERFORMANCE PARAMETERS

The following Performance Metrics has been used for evaluating the performance of various MANET routing protocols:

Network Load: The statistic represents the total data traffic (in bits/sec) received by the entire WLAN BSS from the higher layers of the MACs that is accepted and queued for transmission

End-to-end Delay: Represents the end to end delay of all the packets received by the wireless LAN MACs of all WLAN nodes in the network and forwarded to the higher layer. This delay includes medium access delay at the source MAC, reception of all the fragments individually, and transfers of the frames via access point, if access point functionality is enabled.

Throughput: Represents the total number of bits (in bits/sec) forwarded from wireless LAN layers to higher layers in all WLAN nodes of the network.

V. RESULTS

The simulation results are shown in this section in the form graphs. Graphs show comparison between the three protocols by varying different numbers of sources on the basis of the above-mentioned metrics:

End To End Delay

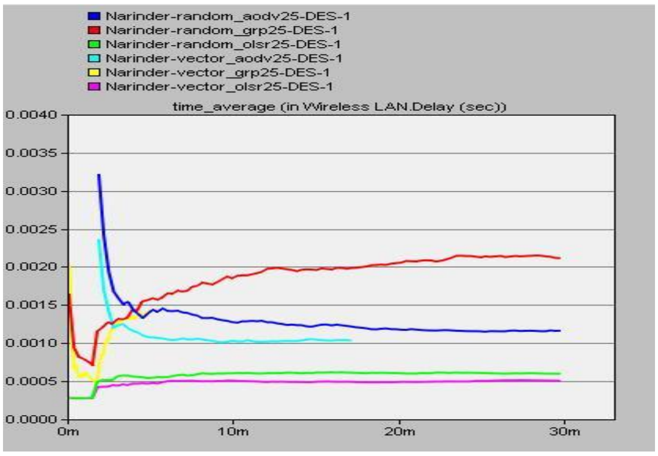

Fig 2: End-to-end Delay

Figure 2 shows the performance of AODV, OLSR and GRP by evaluating End to End Delay with Vector Mobility and random waypoint mobility Model 25 numbers of sources(S) with FTP traffic. It is the result of the time of data packets delivered to the destination nodes minus the time of data packets transmitted by the source nodes, and then divided by the number of data packets received by destination nodes. Represents the end to end delay of all the packets received by the wireless LAN MACs of all WLAN nodes in the network.

Throughput

The average throughput for the network with 25 nodes is shown in Figure 3 which reflects the usage degree of the network resources for the typical routing protocols. It is the total number of bits (in bits/sec) forwarded from wireless LAN layers to higher layers in all WLAN nodes of the network. With, the maximum throughput is approximately 45.77kbps. Throughput increases quickly for OLSR with increased number of nodes. While AODV and GRP on the other hand has difficulties in finding routes when number increases, which clear from the figure.

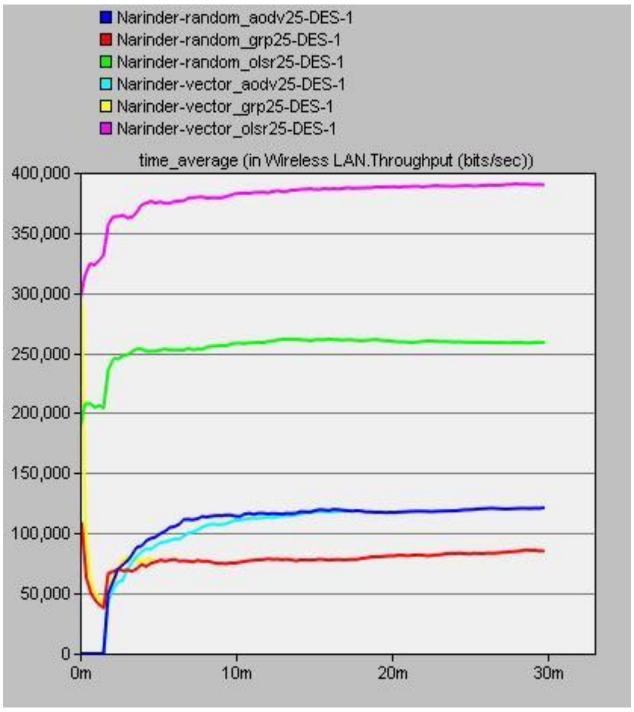

Fig 3: Throughput

Figure 3 shows that OLSR perform better then AODV and GRP routing protocols.

Network Load

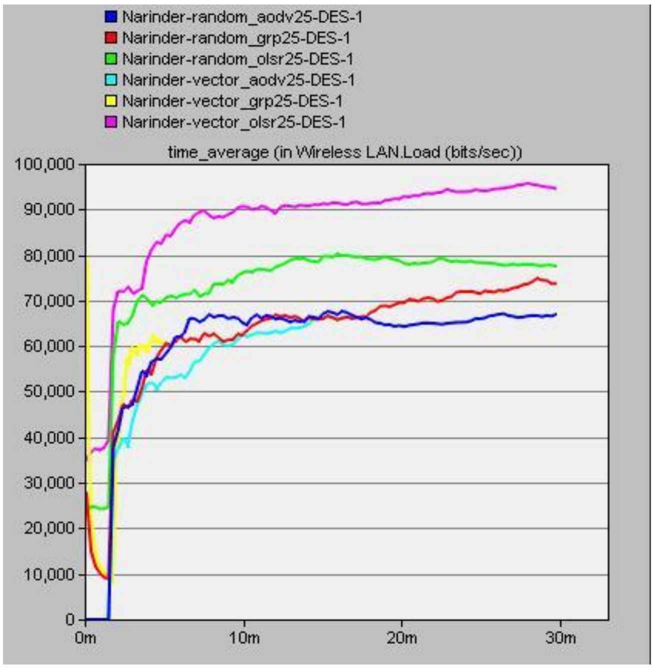

Fig 4: Network Load

Figure 4 shows Network Load. Here network load for Vector Mobility and random waypoint mobility. It is the total data traffic (in bits/sec) received by the entire WLAN Here AODV for both mobility models having lesser network load than others, while OLSR has the highest Network Load in the network.

Conclusion and Future Scope

In this paper we evaluated the three performance measures i.e. Network Load, End-to-end delay and Throughput with different mobility models (Vector Mobility model and and Random Waypoint Mobility model) and FTP as traffic type. From the extensive simulation results, it is found that OLSR shows the best performance in terms of throughput, and end-to-end delay. In future, utilizing these performances we can design such a protocol that can be suitably provide data integrity as well as data delivery in highly random mobility network.

Acknowledgment

The author is thankful to the Department of Computer Science and Engineering, Dr. B. R. Ambedkar National Institute of Technology, Jalandhar for providing the computing facilities to carry out this work. He is also thankful to his guide Dr. Renu Dhir and his parents for their continuous support.

References

[1] Dimitri Perrin, Hiroyuki Ohsaki 2012 Impact of Mobility and Topology on Information Diffusion in MANETs. IEEE.
[2] Dimitri Perrin, Hiroyuki Ohsaki 2012 Impact of Mobility and Topology on Information Diffusion in MANETs. IEEE.
[3] Shaveta and Krishan Kumar Saraswat 2012 Pursue Shortest Mobility Model and Its Comparison in MANET. VSRD International Journal of CS & IT Vol. 2 (6) pp 462-472
[4] Anil Bhasin , Dinesh Kumar 2012. Comparative Study of Chain Mobility Models using Reactive Routing protocols. International Journal of Computer Applications (0975 – 8887) Volume 42– No.9, March 2012
[5] K. Sreenivasulu1, Mr. A.L. Srinivasulu 2011. Improving Routing Efficiency Based On Random Direction Mobility Model In Manets. International Journal of Smart Sensors and Ad Hoc Networks (IJSSAN) Volume-1, Issue-1.
[6] Juan-Carlos Cano and Pietro Manzoni 2011. Group mobility impact over TCP and CBR traffic in Mobile Ad Hoc Networks. IEEE
[7] Sabina Baraković, Suad Kasapović, and Jasmina Baraković 2010. Comparison of MANET Routing Protocols in Different Traffic and Mobility Models. Telfor Journal, Vol. 2, No. 1,.
[8] S. R. Biradar, Hiren H D Sharma, Kalpana Sharma, Subir Kumar Sarkar, Puttamadappa C 2009. Performance Comparison of Reactive Routing Protocols of MANETs using Group Mobility Model IEEE.
[9] Liu Tie-yuan, CHANG Liang, Gu Tian-long 2009 Analyzing the Impact of Entity Mobility Models on the Performance of Routing Protocols in the MANET. IEEE.
[10] Suresh Kumar, R.K. Rathy and Diwakar Pandey 2009. Traffic Pattern Based Performance Comparison of Two Reactive Routing Protocols for Ad-hoc Networks using NS2. 2ndIEEE International Conference on Computer Science and Information Technology.
[11] Opnet Technologies, Inc. “OPNET Simulator,” Internet: www.opnet.com, date last viewed: 2009-12-21.
[12] S. R. Biradar, Hiren H D Sharma, Kalpana Shrama and Subir Kumar Sarkar 2009. Performance Comparison of Reactive Routing Protocols of WSNs using Group Mobility Model”, IEEE International Conference on Signal Processing Systems, pages 192-195.
[13] N.Aschenbruck, E.Gerhands-Padilla, P.Martini 2008. A Survey on mobility models for Performance analysis in Tactical Mobile networks. Journal of Telecommunication and Information Technology, Vol.2 pp.54-61.
[14] K. Salah, P. Calyam, and M. I. Buhari 2007. Assessing Readiness of IP Networks to Support Desktop Video

Conferencing Using OPNET. Journal of Network and Computer Applications, no. pp.1-23.

[15] K. Akkaya and M. Younis 2005. A survey of Routing Protocols in Wireless Sensor Networks. Elsevier Ad Hoc Network Journal, pp 325-349.

[16] S. R. Biradar1, Hiren H D Sarma2, Kalpana Sharma3, Subir Kumar Sarkar4 , Puttamadappa C5, "Performance Comparison of Reactive Routing Protocols of MANETs using Group Mobility Model" IEEE(2009).

[17] Vishal Sharma, Harsukhpreet Singh "Performance evaluation of reactive routing protocol in MANET networks using GSM based voice traffic applications" Optik - Int. J. Light Electron Opt. Elsevier pp. 201-204 June 2012.

[18] Liu Tie-yuan, CHANG Liang, Gu Tian-long "Analyzing the Impact of Entity Mobility Models on the Performance of Routing Protocols in the MANET". IEEE (2009).

[19] Manijeh Keshtgary and Vahide Babaiyan in "Performance Evaluation of Reactive, Proactive and Hybrid Routing Protocols in MANET" International Journal on Computer Science and Engineering (IJCSE) vol. 4, pp. 248-254 February 2012.

[20] 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.