COMPARISION OF DYMO AND GPSR ROUTINGPROTOCOLSIN MANET

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Abstract - Network simulation is the most predominant evaluation techniques in the area of computer networks. The simulation models can be developed by researchers for evaluating the behavior and performance of protocols for different networks. Widespread use of mobile and portable devices such as laptops, PDAs etc. makes the mobile ad hoc networks receive more attention for connectivity between these devices in real time. Various routing protocols have been proposed for MANETs but results in limited bandwidth, high throughput, end-to-end delay, packet delivery ratio and more energy consumption etc. In this paper, we will compare the routing protocols ”Dynamic MANET on Demand Routing Protocol” (DYMO) and ”Greedy Perimeter Stateless Routing” (GPSR) which are used for mobile ad hoc networks (MANET) and we will draw some conclusions from a simulation. This study was performed using a simulation model of DYMO and GPSR which we simulated from the OMNeT++ simulation environment. The number of nodes and the mobility speed is varied whereas other parameters remain constant. The performance of the protocols will be evaluated upon the values of ping loss rate under different scenarios created using varying number of nodes and speed.

Keywords - DYMO, GPSR, MANET routing protocols.

I. INTRODUCTION

A Mobile Ad-Hoc Network (MANET) is a temporary network which does not use any infrastructure by the collection of wireless mobile terminals. Advantages of MANET are ease and speed of deployment and independence on infrastructure. MANET could be a possible solution to situations like damage or loss of base station or overloaded cellular networks in crowded places such as sport stadiums or shopping malls. In MANET mobile devices are used as a terminal and router at the same time. Nodes should provide adaptive computing and self-configuration. MANET routing protocols have to deal with different conditions as bandwidth constraint, resource constraint such as computing power and battery as well as mobility of nodes and therefore changing typologies. Consequently, the design of better routing protocols is a really challenging task. One of the most difficult pre-conditions is that the routing from transmitter to receiver may change in any time due to add or drop of nodes. Most of the routing protocols have been designed for fixed networks with infrequent changes and typically assume symmetric links. However, algorithms used in wire networks do not work well in wireless and mobile environment. Different kinds of routing protocols for MANET have been proposed inthree categories: flat, hybrid and geographic position assisted routing protocols. In this project, we will compare the routing protocols DYMO and GPSR in a specific scenario. The performance of the studied protocols will be discussed [1]–[6].

Routing in mobile ad hoc networks is one of the biggest challenges such as end-to-end delay, packet delivery ratio, overhead, node mobility, energy efficiency, etc. Mainly there are three routing protocols to be classified into MANETs as follows:

a. Table driven or Proactive routing protocols: These protocols are exchanging topological information among the nodes. Each node broadcasts routing table periodically to its neighbours. The main advantages of such protocols are short response time and ability to find a good route from source to destination because of up-to-date information broadcasted by each node. Some examples are OLSR, DSDV and WRP [7].

b. On-demand or Reactive routing protocols: These protocols establish a route only when required at destination. They do not store all paths. A node does not broadcast the routing table periodically so it improves the network bandwidth. Some examples are AODV, DSR and ABR [7].

c. Hybrid routing protocols: These combine the proactive and reactive protocols, which will give a better solution when compared to both routing protocols. Each node proactively maintain a routing table for nodes and reactively finds a route to its destination. Some examples are ZRP, ZHL [7].

In MANET, the routing concept basically involves two steps:

i. Determine the optimal routing path initially,

ii. Transfer the information packets through the network.

Johansson et al. [8] studied three MANET routing protocols (DSDV, AODV and DSR) under different scenarios, including a disaster area scenario. The disaster scenario consists of three groups of nodes, representing three rescue teams and two fast moving nodes that represent vehicles. However, our work consists of one scenario including a specific number of moving nodes making the same movement in each experiment to maintain accuracy. Unlike with the scenario, as it involves rescue teams moving randomly. However, our work is similar to it, considering vehicles following a predetermined path.

Reina et al. [9] also used a disaster area mobility model to evaluate the performance of three reactive routing protocols, namely AODV, DSR and a modified version of AODV, called AOMDV, that supports multi-path routing. The authors measured the packet delivery ratio, throughput, routing load and end-to-end delay in the network. Wister et al. [10] evaluated if AODV and DYMO are appropriate routing protocols for rescue task applications, whereas we did it to compare between DYMO and GPSR. Unlike our work, nodes are randomly placed on the simulation area. The authors evaluated the protocols based on packet delivery ratio, throughput, routing overhead and energy consumption. This paper is divided into sections as follows. In Section II, the protocols DYMO and GPSR are described. The simulation tool employed in the work, namely OMNET++, is explained in Section III. Section IV is destined to the performance analysis and finally, Section VI concludes the paper.

II. PROTOCOL DESCRIPTIONS

2.1. Dynamic MANET on Demand Routing Protocol (DYMO)

The DYMO routing protocol has been proposed by Perkins &Chakeres as advancement to the existing AODV protocol. It is also defined as successor of AODV or ADOVv2 and keeps on updating till today. DYMO operates similar to its predecessor i.e. AODV and does not add any extra modifications to the existing functionality but simplifies some processes. DYMO is a purely reactive protocol in which routes are computed on demand i.e. as and when required. Unlike AODV, DYMO does not support unnecessary HELLO messages and operation is purely based on sequence numbers assigned to all the packets.It employs sequence numbers to ensure loop freedom. It enables on demand, multi-hop unicast routing among the nodes in a mobile adhoc network.basic operations are route discovery and maintenance. Route discovery is performed at source node to a destination for which it does not have a valid path. And route maintenance is performed to avoid the existing obliterated routes from the routing table and also to reduce the packet dropping in case of any route break or node failure [11], [12]. DYMO is able to set up and maintain unicast routes in IPv4 and IPv6 network scenarios by using the following mechanism [11]: 1. In order to discover a new route to a peer, a node transmits a route request message (RREQ) to all nodes in range. This can be achieved by sending the message to a dedicated linklocal multicast address that is associated with all MANET routers. When an intermediate node receives such an RREQ, it takes note of previously appended information, deducing routes to all nodes the message previously passed through. The node then appends information about itself and passes the message on to all nearby nodes. This way, the RREQ is effectively flooded through the MANET and eventually reaches its destination. 2. The destination responds to the received RREQ by sending a route reply message (RREP) via unicast back to the node it received the RREQ from. As with the propagation of a RREQ, this node again appends information about itself and takes note of all routing information contained in the RREP. With the help of the routing information previously obtained while forwarding the corresponding RREQ, the intermediate node is able to send the RREP further back to the start of the chain, until it eventually reaches the originating node. This node will now know a route to the requested destination, as well as routes to all intermediate nodes, and vice versa.

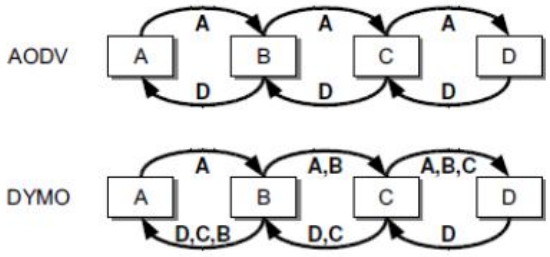


Fig.1. In DYMO, the originator of the RREQ will also receive the routing information of all intermediate nodes in the newly discovered path, unlike AODV were only information about the next hop is received. [11]

2.2. Greedy Perimeter Stateless Routing (GPSR)

Greedy Perimeter Stateless Routing, GPSR, is a responsive and efficient routing protocol for mobile, wireless networks. Unlike established routing algorithms before it, which use graph-theoretic notions of shortest paths and transitive reachability to find routes, GPSR exploits the correspondence between geographic position and connectivity in a wireless network, by using the positions of nodes to make packet forwarding decisions. GPSR uses greedy forwarding to forward packets to nodes that are always progressively closer to the destination.

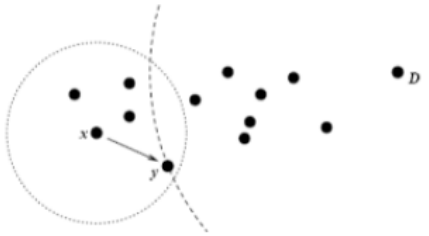


Fig.2. Greedy Forwarding: x wants to sent a packet to D and it forwards it greedily to y. The circle around x is its transmission radius. [13]

In regions of the network where such a greedypath does not exist (i.e., the only path requires that one move temporarily farther away from the destination), GPSR recovers by forwarding in perimeter mode, in which a packet traverses successively closer faces of a planar sub graph of the full radio network connectivity graph, until reaching a node closer to the destination, where greedy forwarding resumes [13], [14].

III. SIMULATION ENVIRONMENT

OMNeT++ is getting popularity in educational and industrial area. It has a well-designed simulation engine and powerful GUI, so these are better for simulation environment development [15]. Considering those, we used the OMNET++-Simulation-tool [16], [17]. It is a C++-based framework which allows us to simulate different kinds of networks.Our parameters are given in table1 . In our simulation we vary the number of hosts and the mobility speed to see how the performance will change in different scenarios. All other parameters will stay constant. We decided to simulate a Wlan-Network with UDP traffic. The transmission power is set to 2mW. All hosts use the same mobility model which is the RWP (Random-Way-Point) model. The node moves to a random destination position where it remains for a certain waitTime. Then it is moving to then next randomly chosen destination. For our conclusion we will analyze the ping loss rate.

Area	1000*1000
Traffic	UDP
Type of Network	IPV4-WLAN
Mobility Speed	(5,15,30)mps
Mobility Type	RandomWPMobility
Number of Nodes	(5,10,15,25,35,50)
Transmit Power	2mW
Simulation Time Limit	50s
Repeating number	10
Bit rate	2Mbps
Seed-Set	Takes different value in each Simulation
Mobility Wait Time	uniform(3s,8s)
Mobility Change Interval	truncnormal(2s, 0.5s)
Mobility Change Angle By	normal(0deg, 90deg)
Mobility Update Interval	100ms

Table 1:Parameters

IV. PERFORMANCE ANALYSIS OF STUDIED AD HOC ROUTING PROTOCOLS

The performance evaluation of ad hoc routing protocols requires more than just an implementation of the protocol in a given simulation environment. In the following subsections, we introduce the necessary steps for successfully evaluating a routing protocol. In network topology and mobility issues, number of the nodes considered as a density of the network and mobility patterns like speed of the nodes are taken into consideration. In parameter and traffic patterns, we configure our protocols with the given parameters in Table.I and generate traffic in our network. In performance metrics, we simulate different scenarios for both of the studied routing protocols in which we repeat the simulation ten times and set the simulation time on 100s to receive trustworthy results.

4.1. Network Topology and Mobility Issues

Network topology and mobility issues are given as follows.

1. Network topology: Evaluation of the routing protocols on an Ad hoc network are often only performed in a random topology using a varying number of nodes which are distributed in the studied area. Note that random topology for the Ad hoc routing protocols does not cover the worst case in most of the time. So, it is recommended to simulate the same scenarios in different topologies to analyze the weakness of the presented typologies. Random, Grid and Linear networks are the most used case for routing protocols. In random topology, the nodes are placed randomly in a rectangular area. Nodes are located in a regular grid area in grid topology and this may cause some problems for wireless communication. In linear network, nodes are placed on a straight line. This topologyproved a single path among nodes and it is used in studying the handling the long routing path.

2. Density: Another important factor in the routing performance is the density of the network. Therefore, both low and high networks need to be evaluated for analyzing the protocols. In a high density network, it is not important to assume the distance between nodes since in a dense network you can usually always find and generate a path from transmitter to receiver.

3. Settings for the case study: Considering these factors, we simulated a number of different setups to study the behavior of the DYMO and the GPSR protocols. In the simulations, we considered a varying number of nodes taking values between 5, 10, 15, 25, 35, 50 and different speeds like 5mps, 15mps, 30mps. Nodes were distributed randomly in a 1000× 1000m2 area. All the nodes move according to the RWP model. A screenshot for the 1000 × 1000m2 of a randomly distributed scenario is provided in Fig. 3 for 15 nodes. All hosts named host [x] where x = 1; 2; ; N − 1 and N is the number of the nodes participating in the generating data. In addition, we modeled a network where nodes are distributed in a 500 × 500m2 area and simulated it at the speed of 5mps for nodes taking values of 5,10,15,25,35,50.

4.2. Parameter Settings and Traffic Patterns

Besides of the network topology and density of the scenario, we use the parameters given in table 1 for both DYMO and GPSR routing protocol. Note that we apply the same parameters for both DYMO and GPSR. This table also includesthe values that have been used for the case study.We use a traffic generator from the OMNET++. Aside from varying the network topology as introduced in Section 4.1, we also ran simulations according to three different load models. We used a traffic generator module that is available for OMNET++.

V. SIMULATION RESULTS

In this section, we analyze the packet loss rate for both DYMO and GPSR routing protocols where nodes are mobile using different speeds and varying number of nodes. Based on the fact in the stationary scenario, we usually have between two and nine lost

packets in DYMO and GPSR, and most packets are received in the destination nodes due to the fact that no changes will be made on the nodes locations or the route between nodes. Moreover, it is important to consider that we should have a minimum number of nodes in the area to establish a route between source and destination. Briefly speaking, the low density scenario tends to show a higher number of route failures compared to the high density example. However, in the mobile scenario, the path loss rate is essentially related to the speed and number of the nodes as well as the considered topology area. We compare the ping loss rate of the DYMO protocol in an 1000×1000m2 area in Fig.8, Fig.9 and Fig.10 where speed takes values 5,15,30 mps for different nodes. As an example, it can be realized from the figures that by increasing the speed of the nodes the ping loss ratio will increase for a specific number of nodes. Moreover, the same result can be obtained by using the GPSR routing protocol from Fig.11, Fig.12 and Fig.13. However, the amount of change in a ping loss ratefor GPSR protocol is higher than the DYMO protocol. It is shown in Fig.8 and Fig.11 that GPSR protocol is better than the DYMO protocol in a low speed scenario. Nevertheless, by simulating the scenario in a 30mps speed for studied protocol in Fig.10 and Fig.13, DYMO protocol is a good choice for the routing protocol. In the simulation, we also changed the density of the network by decreasing the area to 500×500m2 for different number of nodes and a specific speed 5mps. In both scenarios shown in Fig.14 and Fig.15, ping loss ratio is reduced compared on the 1000×1000m2 area (Fig.8 and Fig.11). In our study, we also analyzed the same topology with a different mobility type since it is possible that a specific random mobility will not cover the worst case of the studied routing protocol. In this way, we could understand the different proposed routing protocols. Therefore, we run the program under the same parameters given in Table.I for Mass Mobility and Linear Mobility besides the RWP Mobility. In all of the comparison we assume that the nodes are distributed in a 1000×1000m2 and speed 5mps. For a DYMO protocol as shown in Fig. 8, Fig4 and Fig.5, we obtain better results for Mass Mobility than for the other two mobility types. For the GPSR protocol, RWP mobility has a lower ping loss rate comparing from Fig.11, Fig.6 and Fig.7.

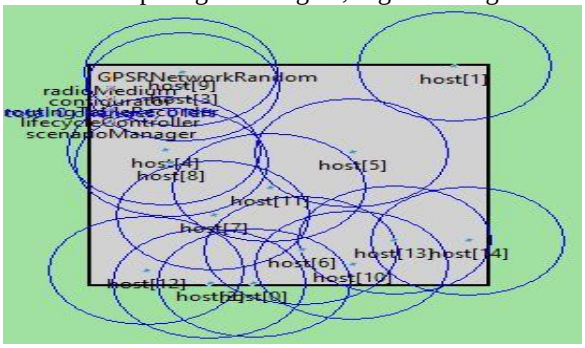


Fig.3. Screen shot of the 15 Nodes randomly distributed in a 1000×1000m^2 area.

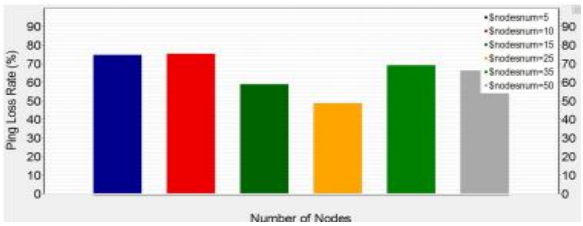


Fig.4. Ping Loss Rate (%) DYMO Routing Protocol for Different Nodes- (Speed =5mps- Area= 1000 × 1000m^2 - Mobility Type = Linear Mobility)

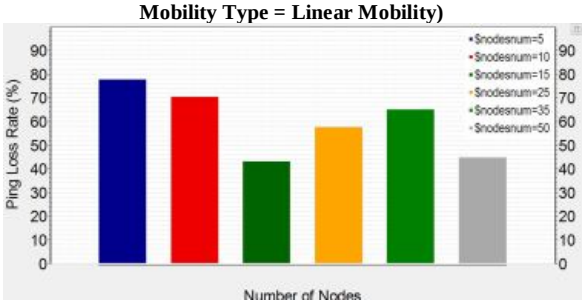


Fig.5. Ping Loss Rate (%) GPSR Routing Protocol for Different Nodes- (Speed =5mps- Area= 1000 × 1000m^2 - Mobility Type = Mass Mobility).

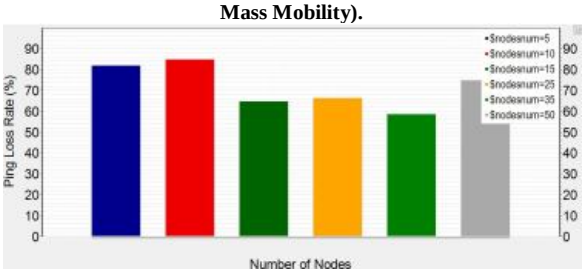


Fig.6. Ping Loss Rate (%) DYMO Routing Protocol for Different Nodes- (Speed =5mps- Area= 1000 × 1000m2 - Mobility Type = Linear Mobility).

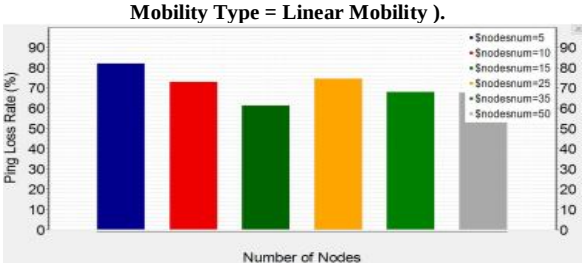


Fig.7. Ping Loss Rate (%) GPSR Routing Protocol for Different Nodes- (Speed =5mps- Area= 500 × 500m^2 - Mobility Type = Mass Mobility)

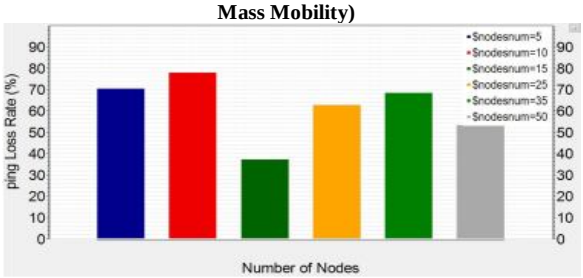


Fig.8. Ping Loss Rate (%) DYMO Routing Protocol for Different Nodes- (Speed =5mps- Area= 1000 × 1000m^2).

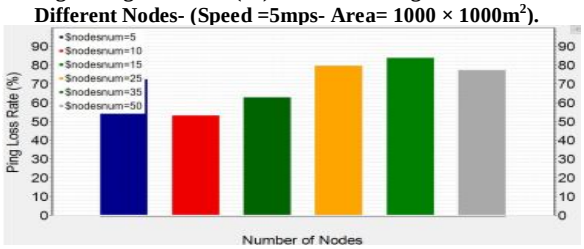


Fig.9. Ping Loss Rate (%) DYMO Routing Protocol for Different Nodes- (Speed =15mps- Area= 1000 × 1000m^2).

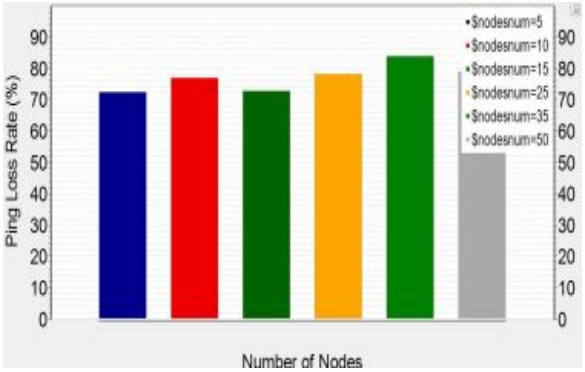


Fig.10. Ping Loss Rate (%) DYMO Routing Protocol for Different Nodes- (Speed =30mps- Area= 1000 × 1000m^2).

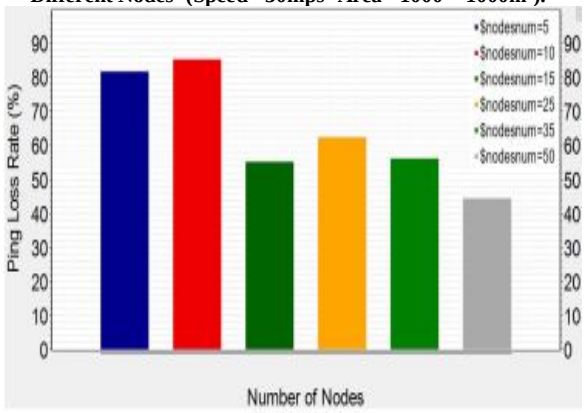


Fig.11. Ping Loss Rate (%) GPSR Routing Protocol for Different Nodes- (Speed =5mps- Area= 1000 × 1000m^2).

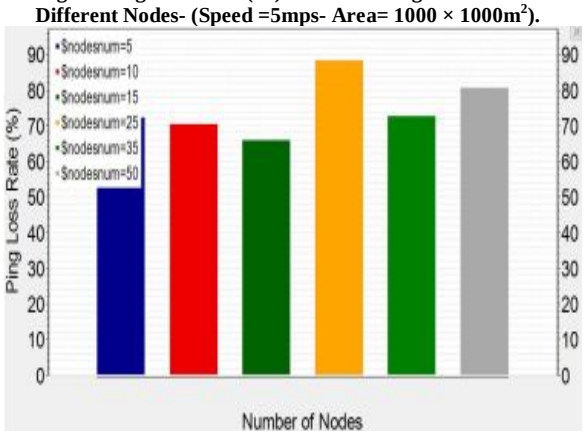


Fig.12. Ping Loss Rate (%) GPSR Routing Protocol for Different Nodes- (Speed =15mps- Area= 1000 × 1000m^2).

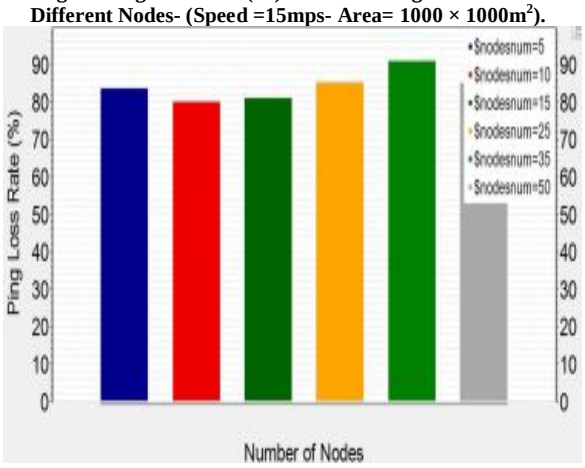


Fig.13. Ping Loss Rate (%) GPSR Routing Protocol for Different Nodes- (Speed =30mps- Area= 1000 × 1000m^2).

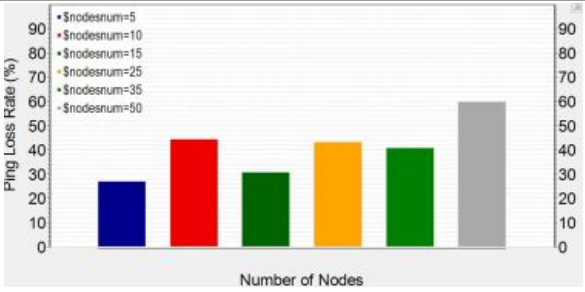


Fig.14. Ping Loss Rate (%) DYMO Routing Protocol for Different Nodes- (Speed =5mps- Area= 500 × 500m^2)

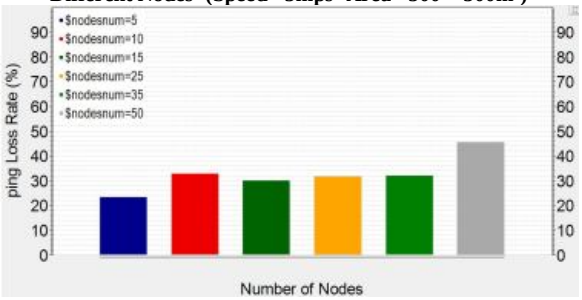


Fig.15. Ping Loss Rate (%) GPSR Routing Protocol for Different Nodes- (Speed =5mps- Area= 500 × 500m2).

CONCLUSIONS

MANETs will inevitably play a more significant role within the network industry as the ongoing widespread use of mobiledevices are expected to have a more dominant effect on both generic commercial and specific applications. It is obvious that either military or rescue scenarios will demand more from MANETs in near future. So that, the protocols to be used within MANETs should allow a completely reliable and fast communication between nodes. In the light of previous studies comparing the protocols, we have evaluated the performances of the protocols DYMO and GPSR with respect to their ping loss rate by changing the number of nodes and speed of the nodes respectively while keeping the total area where the nodes move, the power consumed by each node (so the coverage area of each node) and the direction and distances of the movements of the nodes constant in each experiment. It is observed that an increase of the number of nodes incurs initially a sharp decrease and then a smooth increase or a constant progress in ping loss rate for all speed values. On the other hand, an increase in the speed values of nodes has have a positive effect on DYMO while a dramatic decline in the performance of GPSR in parallel with an increase in the number of nodes. Taking few numbers of studies based on the comparisons of these two protocols, this study may be helpful for future enhancement.

REFERENCES

[1] K. Akkaya and M. Younis, “A survey on routing protocols for wireless sensor networks,” Ad hoc networks, vol. 3, no. 3, pp. 325-349, 2005.

[2] S. Giordano et al., "Mobile ad hoc networks," Handbook of wireless networks and mobile computing, pp. 325-346, 2002.

[3] D. B. Johnson, "Routing in ad hoc networks of mobile hosts," in Mobile Computing Systems and Applications, 1994. WMCSA 1994. First Workshop on. IEEE, 1994, pp. 158-163.

[4] M. Koksal, "A survey of network simulators supporting wireless networks," http://www.ceng.metu.edu.tr.

[5] C. E. Perkins, "Ad hoc networking," Addison-Wesley Professional, 2008.

[6] M. Ikeda, E. Kulla, L. Barolli, M. Takizawa, and R. Miho, "Performance evaluation of wireless mobile ad-hoc network via ns-3 simulator," in Network-Based Information Systems (NBiS), 2011 14th International Conference on, Sep 2011, pp. 135-141.

[7] P. Sakar and H. Paul, "Performance comparison of aodv, dsr, dymo and tora routing protocols in mobile ad hoc networks," Int. J. of Recent Trends in Engineering and Technology, vol. 11,2014.

[8] N. H. B. M. P. Johansson, Y. Larsson and M. Degermark, "Scenario based performance analysis of routing protocols for mobile ad-hoc networks," Proceedings of the 5th annual ACM/IEEE International Conference on Mobile Computing and Networking (Mobicom 99), pp. 195-206, 1999.

[9] F. B. N. B. D. Reina, S. Toral and E. Asimakopoulou, "Evaluation of ad hoc networks in disaster scenarios," Proceedings of the 3rd International Conference on Intelligent Networking and Collaborative Systems (INCoS 11), pp. 759-764, 2011.

[10] F. D. A. M. A. Wister, P. Pancardo and D. Arias-Torres, "Performance evaluation of aodv and dymo as a platform for rescue task applications in manets," Proceedings of the International Conference on Advanced Information Networking and Applications (WAINA 11), pp. 670-675, 2011.

[11] C. Sommer, I. Dietrich, and F. Dressler, "A simulation model of dymo for ad hoc routing in omnet++", in Proceedings of the 1st international conference on Simulation tools and techniques for communications, networks and systems and workshops. ICST (Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering), 2008, p.76.

[12] C. Sommer and F. Dressler, "The dymo routing protocol in vanet scenarios," in Vehicular Technology Conference, 2007. VTC-2007 Fall. 2007 IEEE 66th. IEEE, 2007, pp.16-20.

[13] M. del Mar Alvarez-Rohena and C. Eberz, "Implementation and analysis of gpsr: Greedy perimeter stateless routing for wireless networks," 2004.

[14] B. Karp and H. T. Kung, "Gpsr: Greedy perimeter stateless routing for wireless networks," in Proceedings of the 6th annual international conference on Mobile computing and networking. ACM, 2000, pp. 243-254.

[15] C. Sommer, I. Dietrich, and F. Dressler, "Simulation of ad hoc routing protocols using omnet++," Mobile Networks and Applications, vol. 15, no. 6, pp. 359-362, 2013.

[16] S. Baxla and R. Nema, "Performance analysis of aodv, olsr, dsr and grp routing protocol of mobile and ad hoc network-a review," International Journal of Computer Science and Mobile Computing (IJCSMC), vol. 2, no. 6, pp. 359-362, 2013.

[17] A. Kumar, S. K. Kaushik, R. Sharma, and P. Raj, "Simulators for wireless networks: A comparative study," in Computing Sciences (ICCS), 2012 International Conference on. IEEE, 2012, pp. 338-342.

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