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The Impact of Mobility Models on the Performance of AODV, DSR and LAR Routing Protocols

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Abstract: MANETs are the collection of wireless nodes that can dynamically form a network anytime and anywhere to exchange information without using any pre-existing infrastructure. There are some challenges that make the design of mobile ad hoc network routing protocols a tough task. Firstly, in mobile ad hoc networks, node mobility causes frequent topology changes and network partitions. Secondly, because of the variable and unpredictable capacity of wireless links, packet losses may happen frequently. Moreover, the broadcast nature of wireless medium introduces the hidden terminal and exposed terminal problems. Additionally, mobile nodes have restricted power, computing and bandwidth resources and require effective routing schemes. The highly dynamic nature of MANET coupled with limited bandwidth and battery power imposes severe restrictions on routing protocols especially on achieving the routing stability. Due to all these constraints, designing of a routing protocol is still a challenging task for researchers. In this paper an attempt has been made to evaluate and compare the impact of different mobility models on the performance of three most commonly used on-demands routing protocols named as AODV, DSR and LAR. The performance of these routing protocols has been simulated using QualNet 5.0 simulator.

Keywords: MANET, Ad hoc networks, Routing Protocols, Network simulation, Mobility models

1. INTRODUCTION

A Mobile ad hoc network [1][2] is a group of wireless mobile computers (or nodes); in which nodes collaborate by forwarding packets for each other to allow them to communicate outside range of direct wireless transmission. Ad hoc networks require no centralized administration or fixed network infrastructure such as base stations or access points.

Traditional table-driven routing approach was used in which tables are created at each node and when a node wishes to communicate with a distant node that is not within its vicinity the node consults its routing table and routes the packet accordingly. The protocols based on the above mechanism such as DSDV and CGSR consumes large memory and significant control overhead is consumed in maintaining tables which can be bearable in wired network but in case of wireless networks like MANETs this approach is not feasible due to above mentioned constraints.

The second method of routing is on demand. These protocols start to set up routes on-demand. The routing protocol will try to establish such a route, whenever any node wants to initiate communication with another node to which it has no route. This kind of protocols is usually based on flooding the network with Route Request (RREQ) and Route reply (RREP) messages. By the help of Route request message the route is discovered from source to target node; and as the target node gets a RREQ message it send RREP message for the confirmation that the route has been established. The three prominent on-demand routing protocols are AODV [5] [6] and DSR [7] [8] and LAR.

In order to thoroughly simulate a protocol for an ad hoc network, it is imperative to use a mobility model that accurately represents the mobile nodes (MNs) that will eventually utilize the given protocol. Currently, there are two types of mobility models used in the simulation of networks: traces and synthetic models. Traces provide accurate information, especially when they involve a large number of participants and an appropriately long observation period. New network environments are not easily modeled if traces have not yet been created. In this situation it is necessary to use synthetic models. Synthetic model attempt to realistically represent the behavior of mobile nodes without traces. Synthetic models can be: group mobility model or entity mobility models. This paper considers three routing protocols and compares them using QualNet 5.0 simulator [14] on different parameters. The rest of the paper is organized as follows: Section 2 describes literature survey of AODV, DSR and LAR routing protocols. Section 3 discusses the results, comparisons and simulation. Finally, we present the conclusion.

2. LITERATURE SURVEY

Ad Hoc On-Demand Distance-Vector Routing Protocol (AODV) is a reactive unicast routing protocol for mobile ad hoc networks. As a reactive routing protocol, AODV only needs to maintain the routing information about the active paths. In AODV, routing information is maintained in routing tables at nodes. Every mobile node keeps a next-hop routing table, which contains the destinations to which it currently has a route. A routing table entry expires if it has not been used or reactivated for a pre-specified expiration time. Moreover, AODV adopts the destination sequence number technique used by DSDV in an on-demand way.

In AODV, when a source node wants to send packets to the destination but no route is available, it initiates a route discovery operation. In the route discovery operation, the source broadcasts route request (RREQ) packets. A RREQ includes addresses of the source and the destination, the broadcast ID, which is used as its identifier, the last seen sequence number of the destination as well as the source node’s sequence number. Sequence numbers are important to ensure loop-free and up-to-date routes. To reduce the flooding overhead, a node discards RREQs that it has seen before and the expanding ring search algorithm is used in route discovery operation. The RREQ starts with a small TTL (Time-To-Live) value. If the destination is not found, the TTL is increased in following RREQs. In AODV, each node maintains a cache to keep track of RREQs it has received. The cache also stores the path back to each RREQ originator. When the destination or a node that has a route to the destination receives the RREQ, it checks the destination sequence numbers it currently knows and the one specified in the RREQ. To guarantee the freshness of the routing information, a route reply (RREP) packet is created and forwarded back to the source only if the destination sequence number is equal to or greater than the one specified in RREQ. AODV uses only symmetric links and a RREP follows the reverse path of the respective RREP. Upon receiving the RREP packet, each intermediate node along the route updates its next-hop table entries with respect to the destination node. The redundant RREP packets or RREP packets with lower destination sequence number will be dropped.

In AODV, a node uses hello messages to notify its existence to its neighbors. Therefore, the link status to the next hop in an active route can be monitored. When a node discovers a link disconnection, it broadcasts a route error (RERR) packet to its neighbors, which in turn propagates the RERR packet towards nodes whose routes may be affected by the disconnected link. Then, the affected source can re-initiate a route discovery operation if the route is still needed.

Dynamic Source Routing Protocol (DSR) was proposed for routing in MANET by Broch, Johnson and Maltz [7]. In DSR, each mobile node is required to maintain a route cache that contains the source routes of which the mobile node is aware. The node updates entries in the route cache as and when it learns about new routes. The protocol consists of two phases:

The Route Discovery process initiates whenever the source node wants to send a packet to some destination. Firstly, the node consults its route cache to determine whether it already has a route to the destination or not. If it finds that an unexpired route to the destination exists, it makes use of this route to send the packet. On the other hand, if the node does not have such a route, it initiates route discovery by broadcasting a Route Request (RREQ) packet. The Route Request (RREQ) packet contains the address of the source and the destination, and a unique identification number as well. Each intermediate node that receives the packet checks whether it knows of a route to the destination. If it does not, it appends its own address to the route record of the packet and forwards the packet along to its neighbors. However, in case it finds a route, a Route Reply (RREP) packet containing the optimal path is transmitted back to the source node through the shortest route. To limit the number of route requests propagated, a node processes the Route Request (RREQ) packet only if it has not already seen the packet and its address is not present in the route record of the packet. A Route Reply (RREP) is generated when either the destination or an intermediate node with current information about the destination receives the Route Request (RREQ) packet. As the Route Request (RREQ) packet propagates through the network, the route record is formed. If the Route Reply (RREP) is generated by the destination then it places the route record from Route Request (RREQ) packet into the Route Reply (RREP) packet. The Route Reply (RREP) packet is sent by the destination itself.

In Route maintenance Phase, when a node encounters a fatal transmission problem at its data link layer, it generates a Route Error (RERR) packet. When a node receives a route error packet, it removes the hop in error from its route cache. All routes that contain the hop in error are truncated at that point. Acknowledgement (ACK) packets are used to verify the correct operation of the route links. This also includes passive acknowledgements in which a node hears the next hop forwarding the packet along the route.

The Location Aided Routing (LAR) is a reactive unicast routing scheme. LAR exploits position information and is proposed to improve the efficiency of the route discovery procedure by limiting the scope of route request flooding.

In LAR, a source node estimates the current location range of the destination based on information of the last reported location and mobility pattern of the destination. In LAR, an expected zone is defined as a region that is expected to hold the current location of the destination node. During route discovery procedure, the route request flooding is limited to a request zone, which contains the expected zone and location of the sender node. The source node calculates the expected zone and defines a request zone in request packets, and then initiates a route discovery. Receiving the route request, a node forwards the request if it falls inside the request zone; otherwise it discards the request. When the destination receives the request, it replies with a route reply that contains its current location, time and average speed. The size of a request zone can be adjusted according to the mobility pattern of the destination. When speed of the destination is low, the request zone is small; and when it moves fast, the request zone is large.

3. RESULTS AND SIMULATION

Various researchers have evaluated the performance of on demand routing protocols [10][11][12][13] on different simulators such as NS2,MATLAB but in our case we used QualNet 5.0 simulator[14] as it is a network modelling software that predicts performance of networks through simulation and emulation.For the purpose of simulation different scenarios were created for different number of nodes (15, 20, 25 and 30). The following parameters were configured as shown in Table 1.

Table 1. Configured Parameters

Parameter	Description
Size of Region	1500*1500
Shape of Region	Square
Mobility Model Used	File, RWP, Group Mobility
No. of Nodes Deployed	40
Battery Model	Linear model
Placement of Nodes	Random
No. Of Iterations	25
Energy model	Mica Motes
Antenna	Omni Direction
Total Bytes Sent	12288
Total Packet Sent	24
Throughput	4274

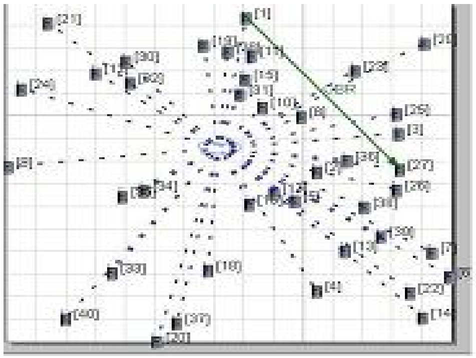

Figure 1. A Scenario for AODV, DSR and LAR routing protocols (on 40 Nodes)

In Figure 1, a scenario with 40 nodes is shown. The nodes were randomly distributed in 1500 X 1500 unit area. The node1 (Source) and the nodes 3,4,5,7,8,9,11,13,15,16,17,19, 21,22,23,25,27,29,31,32,33,35,37,38,39 (Destination) were connected and 1kb data was transmitted. The simulation was run for 30 seconds. The routing protocols taken were AODV, DSR, LAR and a comparison of the following parameters have been done.

3.1 Average Jitter

In case of AODV, avg. jitter is more when RWP mobility model is used, but it works well in group and file mobility model in compare with LAR, but DSR works best as shown in Figure 2.

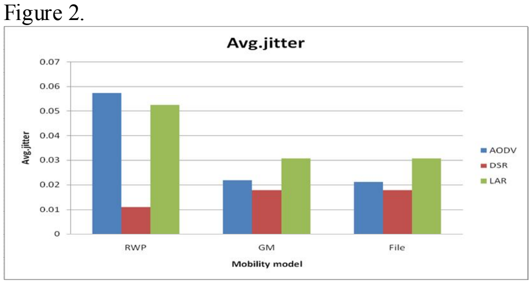

Figure 2. Average Jitter in AODV, DSR and LAR

3.2 First packet received

In case of DSR, result is same and best in all 3 mobility model in comparison to AODV, LAR as shown in Figure 3.

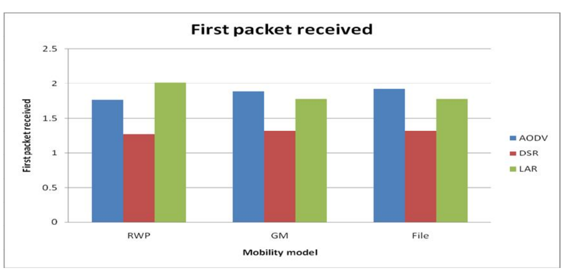

Figure 3. First packet received in AODV, DSR and LAR

3.3 Total packet received

In case of DSR, total packets received are more in comparison to AODV and LAR, as shown in Figure 4.

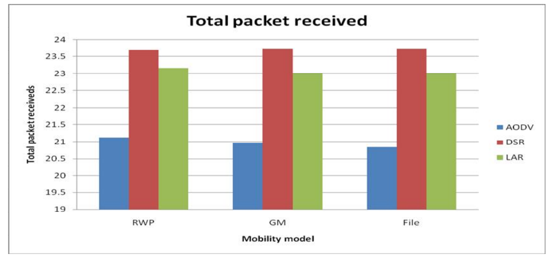

Figure 4. Total Packets received in AODV, DSR and LAR

3.4 Last packet received

In case of LAR, last packet receives faster in comparison to AODV and DSR, as shown in Figure 5.

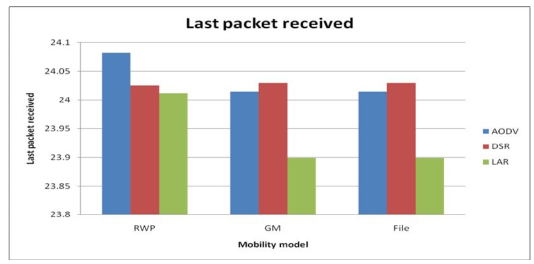

Figure 5. Last Packet received in AODV, DSR and LAR

3.5 Throughput

In case of DSR, numbers of hop counts are very high which indicates that congestion will be quite more in DSR in comparison to AODV, as shown in Figure 6.

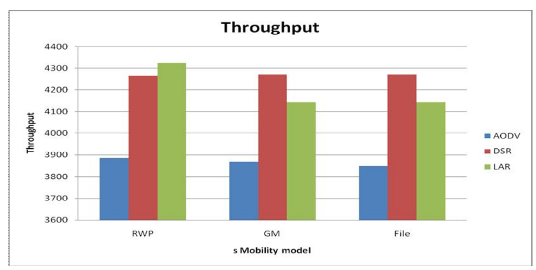

Figure 6. Throughput in AODV, DSR and LAR

From the above graphs which are generated on different parameters, we can see the comparison of AODV, DSR and LAR routing protocols (Table 2).

Table 2. Comparison of AODV, DSR and LAR Routing Protocols (On 40-Nodes Placement)

Parameter	AODV RWP N	DSR RWP	LAR RWP	AODV GM	DSR GM	LAR GM	AODV File	DSR File	LAR File
Average jitter	Very High	Low	High	Low	Very Low	High	Low	Very Low	High
First packet received	High	Low	Very High	Very High	Low	High	Very High	Low	High
Total packet received	Less	Very High	High	Less	Very High	High	Less	Very High	High
Last packet received	More	Less	Very Less	Less	More	Very Less	Less	More	Very Less
Throughput	Low	High	Very high	Low	Very High	High	Very Less	Very High	High

4. CONCLUSION

In this paper, the comparison of routing protocols AODV, DSR and LAR has been presented after their simulation on the QualNet 5.0 simulator. The following conclusions were drawn:

- The average jitter (uneven delay) will be more in case of LAR, but it is very less in DSR.AODV shows higher jitter in case of random waypoint mobility model in comparison to LAR.
- The first packet received earliest in DSR in comparison to AODV and LAR.
- The total packet received is highest in DSR in comparison to AODV and LAR.LAR results better than AODV.
- The last packet received earlier in LAR in comparison to AODV and DSR.
- The throughput is more in DSR in comparison to AODV and LAR.LAR results better than AODV.

5. REFERENCES

[1] Joseph Macker and Scott Corson, "Mobile Ad Hoc networks(MANET)",http://www.ietf.org/proceedings/01 dec/183.htm, December 2001.

[2] M. Abolhasan, T. Wysocki and E. Dutkiewicz, "A review of Routing Protocols for Mobile Ad Hoc Networks", Ad Hoc Networks, vol.2, issue1, pp.122, Jan.2004.

[3] Amit Goel and A. K. Sharma, "A Comparative Study of Unicast Routing Protocols for Mobile Ad Hoc Network", Proc. of National Conference on Communication, Information and Telemetric- An Indian Scenario (CITEL-2005), KCT, Coimbatore, Mar. 2005.

[4] C. Sivaram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks", Architecture and Protocols, Pearson Education, Fourth Impression, 2009.

[5] C. Perkins and E. M. Royer, "Ad Hoc on Demand Distance Vector (AODV) routing", In Proceeding of 2nd IEEE workshop on Mobile computing systems and Applications, pp. 90-100, February 1999.

[6] C. E. Perkins, E. M. Royer, S. R. Das, "Ad Hoc On demand Distance Vector (AODV) Routing", IETF MANET Internetdraft (2003).

[7] Josh Broch, D. B. Johnson, D. A. Maltz, "The Dynamic Source Routing Protocol for Mobile Ad Hoc Networks", Internet Draft, IETF MANET Working Group, March 2nd 2001.

[8] Johnson, D. A. Maltz, and Y.-C. Hu, "The Dynamic Source Routing Protocol for Mobile Ad Hoc Networks (DSR)", IETF Draft, April 2003, work in progress. [Online]. Available: http://www.ietf.org/internet-drafts/draft-ietf-manet-dsr-09.txt .

[9] Z. Alexander, "Performance Evaluation of AODV Routing Protocol: Real-Life Measurements", SCC, June 2003.

[10] J. Macker and S. Corson, RFC2501, "Mobile Ad Hoc Networking (MANET): Routing Protocol Performance Issues and Evaluation Considerations", IETF 1999.

[11] M. A. Bhagyaveni and S. Shanmugavel, "Performance of Ad Hoc Network Routing Protocols with Environment Awareness", Information Technology Journal 4 (1): 1-5, 2005.

[12] Qian Feng, Zhongmin Cai, Jin Yang, Xunchao Hu, "A Performance Comparison of Ad Hoc Network Protocols", Second International Workshop on Computer Science and Engineering, 2009 IEEE.

[13] Nor Surayati Mohamad Usop, Azizol Abdullah and Ahmad Faisa Amri Abidin, "Performance Evaluation of AODV, DSDV and DSR Routing Protocol in Grid Environment", IJCSNS International Journal of Computer Science and Network Security, Vol.9 No.7, July 2009.

[14] The Network Simulator QualNet 5.0, [Online], Available http://www.scalable-network.com/products/qualnet/