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Performance Evaluation of AODV & DSR with Reference to Varying Terrain Range

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Abstract — This paper studies impact of varying Terrain Range on the performance of two reactive routing protocols AODV and DSR. For experimental purposes, initially we observed the performance of AODV with increasing Network Area from 1020m x 1020m to 2040m x 2040m. In another scenario we observed the performance of DSR with increasing Network Area from 1020m x 1020m to 2040m x 2040m. The performance of AODV and DSR are observed across Packet Delivery Ratio, Loss Packet Ratio and Routing overhead parameters. Our simulation results show that AODV and DSR perform equally for lower network size, while DSR is a better selection when network area is 2040m x 2040m.

Index Terms— AODV, MANET, Terrain Range, Routing, Overhead, Random Waypoint

INTRODUCTION

AN ad hoc network is a dynamic network. It allows wireless mobile nodes dynamically forming a temporary network without the use of any existing network infrastructure or centralized administration. A number of routing protocols like Dynamic Source Routing (DSR), Ad Hoc On-Demand Distance Vector Routing (AODV) and Destination-Sequenced Distance-Vector (DSDV) have been proposed. In this work an attempt has been made to compare the performance of two reactive routing protocols for mobile ad hoc networks AODV and DSR on the basis of varying network area. These simulations are carried out using the ns-2 network simulator, which is used to run ad hoc simulations. The results presented in this paper illustrate the importance in carefully evaluating and implementing routing protocols when evaluating an ad hoc network protocol.

1. AD HOC ROUTING PROTOCOLS

Routing in Mobile Ad-hoc Network is a subject of extensive research, Because of the fact that it may be necessary to pass several hops (multi-hop) before a packet reaches the destination, a routing protocol is needed. Routing protocol has two functions, first is selection of routes for various source-destination pairs and second, Delivery of messages to their correct destination.

The second function is conceptually straightforward using a variety of protocols and data structures (routing tables). Ad-hoc routing protocols can be classified based on different criteria. Depending upon the routing mechanism employed by a given protocol, they fall in two classes.

Table Driven Routing Protocols (Proactive): Each node in table-driven routing protocols, continuously maintains up-to-date routes to every other node in the network. Periodic routing information is transmitted throughout the network in order to maintain consistency of the routing table. Transmission occurs without delay if the route already exists, otherwise, node needs to receive routing information corresponding to its destination while traffic packets are waiting in the queue. Certain proactive routing protocols are Destination- Sequenced Distance Vector (DSDV), Wireless Routing Protocol (WRP), Global State Routing (GSR) and Cluster head Gateway Switch Routing (CGSR) [6].

On-Demand Routing Protocols (Reactive): In on demand protocols, only when a node wants to send packets to its destination it initiates a route discovery process through the network. After a route is determined or all possible permutations have been examined, the process of route discovery is completed. The discovered route has to be maintained by a route maintenance process until either the destination becomes inaccessible along every path from the source or until the route is no longer desired [6]. Some reactive protocols are Cluster Based Routing Protocol (CBRP), Ad hoc On-Demand Distance Vector (AODV), Dynamic Source Routing (DSR), Temporally Ordered Routing Algorithm (TORA), Associativity-Based Routing (ABR), Signal Stability Routing (SSR) and Location Aided Routing (LAR) [6].

1.1 Dynamic Source Routing Protocol (DSR)

The Dynamic Source Routing (DSR) protocol is an on demand routing protocol based on source routing. DSR protocol is composed by two “on-demand” mechanisms, which are requested only when two nodes want to

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communicate with each other. This Protocol is composed of two essential parts of route discovery and route maintenance. Every node maintains a cache to store recently discovered paths [5]. Route Discovery and Route Maintenance are built to behave according to changes in the routes in use, adjusting them-selves when needed. Along with those mechanisms, DSR allows multiple routes to any destination, thus can lead easily to load balancing or increase robustness .In the source routing technique, a sender determines the exact sequence of nodes through which to propagate a packet. The list of intermediate nodes for routing is explicitly contained in the packet's header. In DSR [5], every mobile node in the network needs to maintain a route cache where it caches source routes that it has learned. When a host wants to send a packet to some other host, it first checks its route cache for a source route to the destination. In the case a route is found, the sender uses this route to propagate the packet. Otherwise the source node initiates the route discovery process.

1.2 Ad hoc On-Demand Distance Vector (AODV)

Ad hoc on demand distance vector (AODV) routing protocol creates routes on-demand. In AODV, a route is created only when requested by a network connection and information regarding this route is stored only in the routing tables of those nodes that are present in the path of the route [1]. AODV is a reactive protocol based upon the distance vector algorithm. The algorithm uses different types of messages to discover and maintain links. Whenever a node wants to try and find a route to another node it broadcasts a Route Request (RREQ) to all its neighbors [2]. In this protocol, each terminal does not need to keep a view of the whole network or a route to every other terminal. Nor does it need to periodically exchange route information with the neighbor terminals. Furthermore, only when a mobile terminal has packets to send to a destination does it need to discover and maintain a route to that destination terminal. In AODV, each terminal contains a route table for a destination [5]. A route table stores the following information: destination address and its sequence number, active neighbors for the route, hop count to the destination, and expiration time for the table. The expiration time is updated each time the route is used. If this route has not been used for a specified period of time, it is discarded [7].

1.3 Destination Sequenced Distance-Vector Routing (DSDV)

The Destination Sequenced Distance Vector Protocol (DSDV) is a proactive, distance vector protocol which uses the Bellmann - Ford algorithm [4]. DSDV is a hop by hop distance vector routing protocol, wherein each node maintains a routing table listing the "next hop" and "number of hops" for each reachable destination. This protocol requires each mobile station to advertise, to each of its current neighbors, its own routing table (for instance, by broadcasting its entries). The entries in this list may change fairly dynamically over time, so the advertisement must be made often enough to ensure that every mobile computer can almost always locate every other mobile computer of the collection. In addition, each mobile computer agrees to relay data packets to other computers upon request. This agreement places a premium on the ability to determine the shortest number of hops for a route to a destination we would like to avoid unnecessarily disturbing mobile hosts if they are in sleep mode. In this way a mobile computer may exchange data with any other mobile computer in the group even if the target of the data is not within range for direct communication. DSDV requires a regular update of its routing tables, which uses up battery power and a small amount of bandwidth even when the network is idle [4].

2. Mobility Model

2.1 Random Waypoint Mobility Model

The Random waypoint model is a random-based mobility model used in mobility management schemes for mobile communication systems. Random Waypoint (RW) model assumes that each host is initially placed at a random position within the simulation area [3]. The mobility model is designed to describe the movement pattern of mobile users, and how their location, velocity and acceleration change over time [3]. Mobility models are used for simulation purposes when new network protocols are evaluated. In random based mobility simulation models, the mobile nodes move randomly and freely without restrictions. To be more specific, the destination, speed and direction are all chosen randomly and independently of other nodes. This kind of model has been used in many simulation studies. Two variants, the Random walk model and the Random direction model are variants of the Random waypoint model.

In this model, a mobile node moves from its current location to a randomly chosen new location within the simulation area, using a random speed uniformly distributed between [vmin, vmax] [3]. vmin refers to the minimum speed of the simulation, vmax to the maximum speed [3]. The Random Waypoint Mobility Model includes pause times when a new direction and speed is selected. As soon as a mobile node arrives at the new destination, it pauses for a selected time period (pause time) before starting traveling again. A Mobile node begins by staying in one location for a certain period of time (i.e. pause). Once this time expires, the

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mobile node chooses a random destination in the simulation area and a speed that is uniformly distributed between [vmin, vmax]. The mobile node then travels toward the newly chosen destination at the selected speed. Upon arrival, the mobile node pauses for a specified period of time starting the process again. The random waypoint model is the most commonly used mobility model in the simulation of ad hoc networks. It is known that the spatial distribution of network nodes moving according to this model is non-uniform. However, a closed-form expression of this distribution and an in depth investigation is still missing. This fact impairs the accuracy of the current simulation methodology of ad hoc networks and makes it impossible to relate simulation based performance results to corresponding analytical results. To overcome these problems, it is presented a detailed analytical study of the spatial node distribution generated by random waypoint mobility. It is considered that a generalization of the model in which the pause time of the mobile nodes is chosen arbitrarily in each waypoint and a fraction of nodes may remain static for the entire simulation time [3].

3. The Traffic and Scenario generator

Continuous bit rate (CBR) traffic sources are used. The source-destination pairs are spread randomly over the network. The simulation uses Random Waypoint mobility model in varying network areas 1020 m x 1020 m, 1530m x 1530m, and 2040m x 2040m with constant network load of 4 packets. Mobility speed is kept constant at 10 m/s. Here, each packet starts its journey from a random location to a random destination with a randomly chosen speed. Once the destination is reached, another random destination is targeted after a pause. The pause time, which affects the relative speeds of the mobile hosts, is kept at 10s. Simulations are run for 100 simulated seconds.

4. Performance Metrics

Following important metrics are evaluated-

1. Packet Delivery ratio (PDR) - Packet delivery ratio is calculated by dividing the number of packets received by the destination through the number of packets originated by the CBR source.
2. Loss Packet Ratio (LPR) - Loss Packet Ratio is calculated by dividing the number of packets that never reached the destination through the number of packets originated by the CBR source.
3. Routing Overhead – Routing overhead, which measures the ratio of total routing packets sent and the total number of packets sent.

5. Simulation Setup

In this simulation we wanted to investigate how varying network area affects on the behavior AODV and DSR.

TABLE 1

Parameter	Value
Protocols	AODV, DSR
Simulation Time	100 s
Number of Nodes	100
Network Load	4 Packets
Pause Time	10 s
Environment Size	1020 m x 1020 m, 1530m x 1530m, 2040m x 2040m
Traffic Type	Constant Bit Rate
Maximum Speed	10 m / s
Mobility Model	Random Waypoint
Network Simulator	NS 2.33

6. Results and Discussions

During the simulation we have increased the network size with maximum mobility maximum speed of 10 m/s and recorded the performance of AODV and DSR. We did this simulation for 100 simulated seconds with maximum 8 cbr connections. Readings were taken for different network sizes (1020m x 1020m, 1530m x 1530m, 2040m x 2040m). From the results it is evident that AODV and DSR perform equally with 1020m x 1020m, 1530m x 1530m. At higher network size i.e. 2040m x 2040m, the Packet Delivery ratio of AODV drops drastically as compared to DSR.

7. Performance Evaluation

In terms of packet delivery ratio, we observed that AODV and DSR are performing equally well when the terrain area is 1020m x 1020m and 1530m x 1530m. For terrain area of 2040m x 2040m, DSR is performing way better than AODV. Even though the percentage drop of packet delivery ration in AODV is not that low, still comparatively we can say that DSR is a suitable choice when having 2040m x 2040m scenario. In terms of loss packet ratio, again AODV and DSR are performing well for terrain area 1020m x 1020m and 1530m x 1530m. DSR is performing much better than AODV when terrain area is 2040m x 2040m. Routing overhead in AODV is much more than DSR when terrain area is

2040m x 2040m. Till then both protocols are performing equally well.

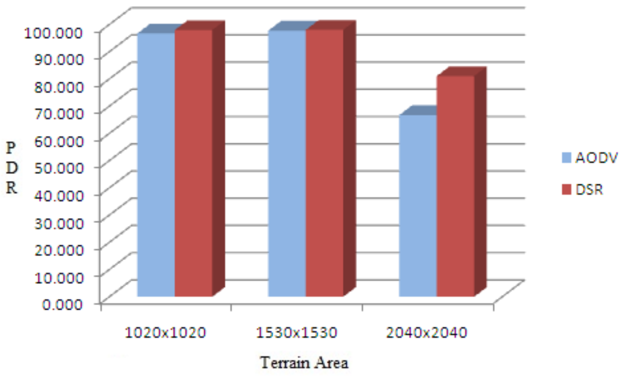

Fig 1. Terrain Area Vs Packet Delivery Ratio

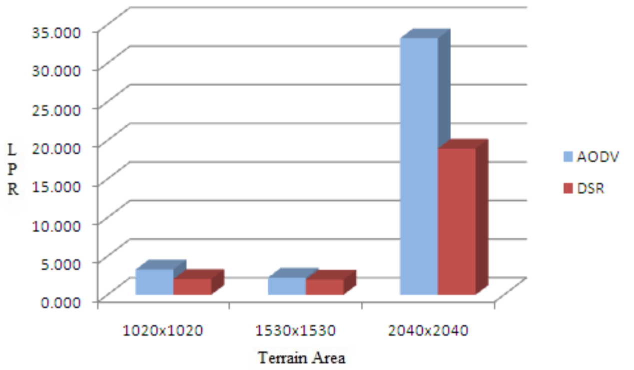

Fig 2. Terrain Area Vs Loss Packet Ratio

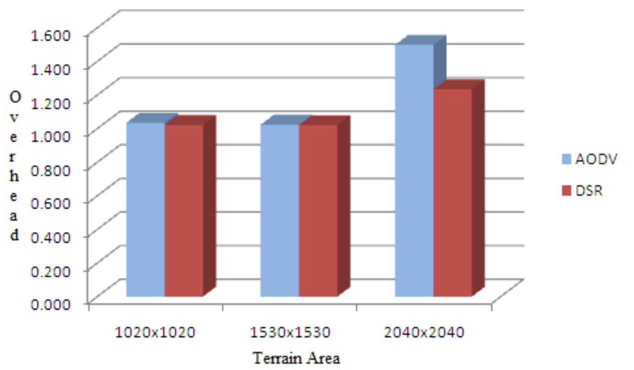

Fig 3. Terrain Area Vs Routing Overhead

8. Conclusion and Future Work

Empirical results illustrate that the performance of AODV and DSR varies widely across different network area, and study results from given scenario shows that increasing the network area does degrade the performance of AODV Hence. we have to consider the network area of an application while selecting the routing protocol to be used.

The future scope is to find out what factors can bring more improvements in performance of AODV not only while the network area is further increased but also on various other factors where AODV has not performed well in simulations presented here. Further simulation needs to be carried out for the performance evaluation by varying other related parameters like Pause Time, Mobility models, Mobility Speed etc.

References

[1] Charles E. Perkins, Elizabeth M. Royer, Samir R. Das, Mahesh K, "Performance Comparison of Two On-Demand Routing Protocols for Ad Hoc Networks", IEEE Personal Communications • February 2001

[2] Charles E_ Perkins, Elizabeth M_ Royer, "Ad hoc On Demand Distance Vector Routing"

[3] Valentina Timcenko, Mirjana Stojanovic, Slavica Bostjancic Rakas, "MANET Routing Protocols vs. Mobility Models: Performance Analysis and Comparison", Proceedings of the 9th WSEAS International Conference on Applied Informatics and Communications (AIC '09, http://www.wseas.us/e-library/conferences/2009/moscow/AIC/AIC47.pdf

[4] Abdul Hadi Abd Rahman, Zuriati Ahmad Zukarnain, " Performance Comparison of AODV, DSDV and I-DSDV Routing Protocols in Mobile Ad Hoc Networks", European Journal of Scientific Research, ISSN 1450-216X Vol.31 No.4 (2009), pp.566-576, http://www.eurojournals.com/ejsr_31_4_07.pdf

[5] Sunil Taneja, Ashwani Kush, Amandeep Makkar, "Experimental Analysis of DSR, AODV using Speed and Pause time", International Journal of Innovation, Management and Technology, Vol. 1, No. 5, December 2010, ISSN: 2010-0248, http://www.ijimt.org/papers/79-M466.pdf

[6] Anuj K. Gupta, Dr. Harsh Sadawarti, Dr. Anil K. Verma, "Performance analysis of AODV, DSR & TORA Routing Protocol", IACSIT International Journal of Engineering and Technology, Vol.2, No.2, April 2010, ISSN: 1793-8236, http://www.ijetch.org/papers/125--T203.pdf

[7] Thomas Staub, "Ad-hoc and Hybrid Networks Performance Comparison of MANET Routing", Computer Science Project, Institute of Computer Science and Applied Mathematics (IAM), University of Berne, Switzerland

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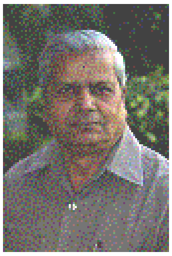

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