Volume: 02, Issue: 04, Pages: 732-737 (2011)

Performance Evaluation of DSR and DSDV Routing Protocols for Wireless Ad Hoc Networks

Rajeshwar Singh
Department of Electronics and Communication Engineering,
Gateway Institute of Engineering and Technology, Sonipat, Haryana-131001 (India)
Email: rajeshwar.rajata@gmail.com
Dharmendra K Singh
Department of Electronics and Communication Engineering, BIT Sindri,
Dhanbad, Jharkhand (India)
Email:dksingh-bit@yahoo.com
Lalan Kumar
IT Centre, Central Institute of Mining and Fuel Research (CIMFR)
Dhanbad, Jharkhand (INDIA)
Email: lalan_lit@yahoo.co.in

ABSTRACT

A Wireless ad hoc network is a collection of autonomous mobile nodes that communicate with each other over wireless links without any fixed infrastructure. The nodes use the service of other nodes in the network to transmit packets to destinations that are out of their range. Such networks are expected to play increasingly important role in future organizations, University, Civilian and Military settings, being useful for providing communication support where no fixed infrastructure exists. Also, in case of disaster or natural calamities, the deployment of a fixed infrastructure is neither feasible nor economically profitable for establishing communication among the rescue members. In order to accomplish this, a number of ad-hoc routing protocols have been proposed and implemented, which include dynamic source routing (DSR) and Destination sequenced Distance Vector (DSDV) routing protocols. In this paper for experimental evaluation purposes, we have considered 500m x 500m, terrain area which illustrates the performance in terms of the packet delivery fraction and throughput for DSR and DSDV routing protocols. Our simulation results using NS-2 shows that DSR performs better in both the case of packet delivery fraction and throughput over DSDV routing protocol.

Keywords – **DSDV, DSR, Packet Delivery Fraction, Throughput.**

Date of Submission: August 06, 2010 Revised: September 17, 2010 Date of Acceptance: October 21, 2010

1. INTRODUCTION

A Wireless ad hoc network is a collection of self-organized wireless mobile nodes dynamically forming a temporary network without the aid of any established or fixed infrastructure and centralized administration control stations, unlike cellular wireless networks. The surrounding physical environment significantly attenuates and distorts the radio transmissions since signal quality degrades with distance. Because of limited transmission area of these nodes, the effective throughput may be less than that of node's maximum transmission capacity. Hence, it may be needed for one mobile node to take the assistance of other nodes in forwarding its packets to the desired destination. A node can move anytime in an ad hoc scenario and, as a result, such a network needs to have routing protocols which can adapt dynamically changing wireless topology. However, since there is no fixed infrastructure in a network, each mobile node operates not only as a node but also as a router, forwarding packets from one node for other mobile nodes in the network, that may not be within direct wireless transmission range of each other [1], [10].

As wireless ad hoc network does not have any fixed infrastructure and so also called as infrastructure-less network because nodes establish communication among themselves "on the fly" by adapting the dynamically changing network environment. Dynamic and infrastructure-less, wireless ad-hoc networks implies that any computation on the network needs to be carried out in a decentralized manner. Also, many important problems in ad-hoc networking needs to be formulated as problems in distributed computing system. For example a Mesh Networks offers a wireless broadband network system based on 802.11 ad hoc modes and a patented peer-to-peer routing technology [2]. Further, in a wireless ad hoc network, channel bandwidth and node energy, are two important constrain factors [11] and hence it is a good idea to use reactive routing, where routing is performed only on demand. This paper discusses in detail the functioning of DSR and DSDV and how well it adapts to the dynamically changing link conditions. More specifically, we compare the two routing protocols with real experimental results on Network Simulator NS-2.29[3]. NS-2 is a packet-level simulator and essentially a centric discrete event scheduler to schedule the events such as packet and timer expiration. Centric event scheduler cannot accurately emulate “events handled at the same time” in real world, that is, events are handled one by one. However, this is not a serious problem in most network simulations, because the events here are often transitory. Beyond the event scheduler, NS-2 implements a variety of network components and protocols. Notably, the wireless extension, derived from CMU Monarch Project [4], has two assumptions simplifying the physical world, the first is that the nodes do not move significantly over the length of time they transmit or receive a packet. Secondly, node velocity is insignificant compared to the speed of light. In particular, none of the propagation models have included Doppler effects, although they could.

The rest of this paper is organized as follows. Section 2 covers an overview of routing protocols by explaining a proactive protocol, DSDV (Destination Sequence Distance Vector), and a reactive protocol, DSR (Dynamic Source Routing). Section 3 describes our experimental setup for performance evaluation of DSR and DSDV routing protocols using NS-2. In Section 4, the performance metrics and result analysis is presented. Section 5 concludes this paper with discussions.

2. PROACTIVE AND REACTIVE ROUTING PROTOCOLS

In this section we briefly describe a proactive protocol, DSDV (Destination Sequence Distance Vector) [5], and reactive protocol DSR (Dynamic Source Routing) [6-9]. A proactive routing protocol exchanges topology information with other nodes of the network regularly whether the node has to forward a packet or not in order to update its routing table. A particular node in the network announces the nodes, which are reachable by it periodically in their control messages so as to build and update the topology. On the other hand a reactive protocol initiates to find a route to the destination whenever it needs to forward a packet to other nodes. In other words, we can say that in a proactive protocol routes are ready when needed, but the reactive protocol searches for routes only when needed. A network in which bandwidth is not a major constraint, proactive protocols would be preferred since the lead time to start a transmission is less as routes to a destination are available instantly. However, in a wireless ad hoc network, the channel bandwidth is a major concern because of many nodes and energy constraint. For a proactive routing protocol we can also say that it leads to a lot of routing overheads and becomes constraint for wireless ad hoc network.

2.1 DSDV (Destination Sequence Distance Vector)

Destination Sequence Distance Vector (DSDV) [5] is a proactive routing protocol and is based on the distance vector algorithm. In proactive or table-driven routing protocols, each node continuously maintains up-to-date routes to every other node in the network. Routing information is periodically transmitted throughout the network in order to maintain routing table consistency. The routing table is updated at each node by finding the change in routing information about all the available destinations with the number of nodes to that particular destination. Also, to provide loop freedom DSDV uses sequence numbers, which is provided, by the destination node. In case, if a route has already existed before traffic arrives, transmission occurs without delay. Otherwise, traffic packets should wait in queue until the node receives routing information corresponding to its destination. However, for highly dynamic network topology, the proactive schemes require a significant amount of resources to keep routing information up-to-date and reliable.

In case of failure of a route to the next node, the node immediately updates the sequence number and broadcasts the information to its neighbors. When a node receives routing information then it checks in its routing table. If it does not find such entry into the routing table then updates the routing table with routing information it has found. In case, if the node finds that it has already entry into its routing table then it compares the sequence number of the received information with the routing table entry and updates the information. If it has sequence number that is less than that of the received information then it discards the information with the least sequence number. If the both the sequence numbers are the same then the node keeps the information that has the shortest route or the least number of hops to that destination.

2.2 DSR (Dynamic Source Routing)

Dynamic Source Routing DSR [6-9] is a reactive protocol. This protocol is one of the example of an on-demand routing protocol that is based on the concept of source routing. It is designed for use in multi hop ad hoc networks of mobile nodes. It allows the network to be completely self-organizing and self-configuring and does not need any existing network infrastructure or administration. DSR uses no periodic routing messages like AODV, thereby reduces network bandwidth overhead, conserves battery power and avoids large routing updates. However, it needs support from the MAC layer to identify link failure. The DSR routing protocol discovers routes and maintains information regarding the routes from one node to other by using two main mechanisms: (i) Route discovery – Finds the route between a source and destination and (ii) Route maintenance –In case of route failure, it invokes another route to the destination. DSR has a unique advantage by virtue of source routing. As the route is part of the packet itself, routing loops, either short – lived or long – lived, cannot be formed as they can be immediately detected and eliminated. This property of DSR opens up the protocol to a variety of useful optimizations**.** If the destination alone can respond to route requests and the source node is always the initiator of the route request, the initial route may the shortest. This routing protocol apply the concept of source routing, which means that the source determines the complete path from the source node to the destination node, that the packets have to traverse, and hence ensures routing to be trivially loop-free in the network. The packet in DSR carries all information pertaining to route in its preamble (header) thus permitting the intermediate nodes to cache the routing information in their route tables for their future use.

In DSR Protocol, Route discovery is the process in which a source, in order to send data to a destination, obtains the route to the destination, even if it does not have a route to the destination. Route maintenance is the mechanism by which the node keeps the record of dynamic changes of the network topology. In other words, source node checks for any link failure between source and destination. If a link failure is found between source and destination, the source node tries to find another route to the destination or invokes Route Discovery; thereby communication between source and destination continues to be established.

3. EXPERIMENTAL SETUP

The experimental setup is used for performance evaluation of the DSR and DSDV routing protocols. It measures the ability of protocols to adapt to the dynamic network topology changes while continuing to successfully deliver data packets from source to their destinations. In order to measure this ability, different scenarios are generated by varying the number of nodes. We use following scenario generation commands for generating scenario file for 20, 50, 80 and 100 nodes:

./setdest –v 1 –n 20 –p 2.0 –M 10.0 -t 200 -x 500 -y 500;
./setdest –v 1 –n 50 –p 2.0 –M 10.0 -t 200 -x 500 -y 500;
./setdest –v 1 –n 80 –p 2.0 –M 10.0 -t 200 -x 500 -y 500;
./setdest –v 1 –n 100 –p 2.0 –M 10.0 -t 200 -x 500 -y 500.

Similarly, for connection pattern generation we use, cbrgen.tcl file. By using following commands the connection pattern is generated:

ns cbrgen.tcl -type cbr -nn 20 -seed 1.0 -mc 16 –rate 4.0; ns cbrgen.tcl -type cbr -nn 50 -seed 1.0 -mc 16 –rate 4.0; ns cbrgen.tcl -type cbr -nn 80 -seed 1.0 -mc 16 –rate 4.0; ns cbrgen.tcl -type cbr -nn 100 -seed 1.0 -mc 16 –rate 4.0;

The trace file is created by each run and is analyzed using a variety of scripts, particularly one called file *.tr that counts the number of successfully delivered packets and the length of the paths taken by the packets, as well as additional information about the internal functioning of each scripts executed. This trace file is further analyzed with AWK file and Microsoft Excel is used to produce the graphs [12].

Simulations are run by considering DSR and DSDV routing protocol. In order to get realistic performance, the results are averaged for a number of scenarios. We tried to measure the protocols performance on a particular terrain area of 500m x 500m from real life scenario at a speed of 10 m/s. The simulation time was taken to be of 200 seconds for Constant Bit Rate (CBR) traffic type with a packet size of 512 Byte. Also, we have considered nodes with Omni-Antenna and Two Ray Ground Radio Propagation method. Simulation parameters are appended in Table-1.

SIMULATION PARAMETERS

Parameter	Value
Simulator	NS-2.29
Protocols studied	DSDV and DSR
Simulation time	200 sec
Simulation area	500 x 500
Transmission range	250 m
Node movement model	Random waypoint
Traffic type	CBR (UDP)
Data payload	512 Bytes / packet

Table: 1. Simulation Parameters

4. PERFORMANCE METRICS AND RESULT ANALYSIS

In this paper we have considered Packet Delivery Fraction (PDF) and throughput in Kilo bits per second (Kbps) for evaluation of DSR and DSDV routing protocols. The simulation results obtained with the above mentioned simulation parameters are appended in Table-2. The graph showing comparison between DSDV and DSR is shown in Figure.1

4.1 Packet Delivery Fraction (PDF).

It is the ratio of the data packets delivered to the destinations to those generated by the sources.

Packet Delivery Fraction (PDF) = Total Packets Delivered to destination / Total Packets Generated.
Mathematically, it can be expressed as:

$$P = \frac{1}{c}\sum_{f=1}^{e}\frac{R_f}{N_f}$$

Where, P is the fraction of successfully delivered packets, C is the total number of flow or connections, f is the unique flow id serving as index, R_f is the count of packets received from flow f and N_f is the count of packets transmitted to f.

Node: 20, Pause Time: 2.0 Sec., Max Speed: 10 m/s.

Routing Protocol	Total Packets Sent	Total Packets Received	Packet Delivery Ratio
DSDV	8860	7602	0.858014
DSR	8915	8907	0.999103

Node: 50, Pause Time: 2.0 Sec., Max Speed: 10 m/s.

Routing Protocol	Total Packets Sent	Total Packets Received	Packet Delivery Ratio
DSDV	8827	7535	0.853631
DSR	8877	8865	0.998648

Node: 80, Pause Time: 2.0 Sec., Max Speed: 10 m/s.

Routing Protocol	Total Packets Sent	Total Packets Received	Packet Delivery Ratio
DSDV	8901	7685	0.863386
DSR	8854	8806	0.994579

Node: 100, Pause Time: 2.0 Sec., Max Speed: 10 m/s.

Routing Protocol	Total Packets Sent	Total Packets Received	Packet Delivery Ratio
DSDV	8838	8176	0.925096
DSR	8895	8874	0.997639

Table.2 Packet Delivery Fraction with varying number of Nodes.

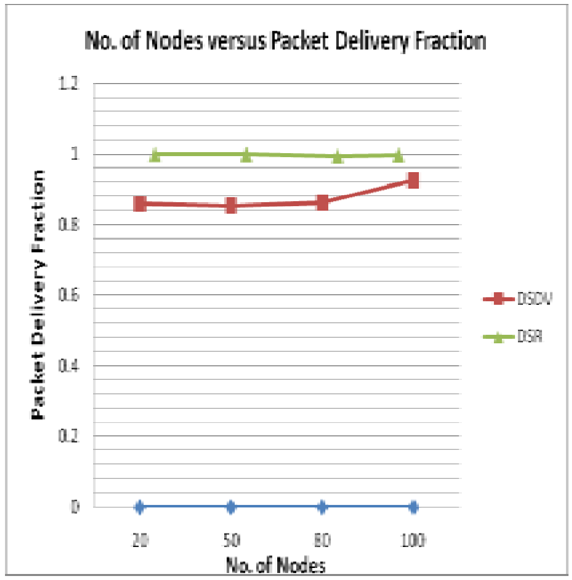


Figure: 1. No. of Nodes versus Packet Delivery Fraction.

4.2 Throughput

Throughput of the routing protocol means that in certain time the total size of useful packets that received at all the destination nodes. The unit of throughput is MB/s, however we have taken Kilo bits per second (Kb/s). The throughput values obtained for the simulation parameters of table-1 is tabulated in table-3. The graph shown in figure-2 indicates the throughput comparison of routing protocols, DSDV and DSR.

Throughput in Kbps with varying number of Nodes				
DSDV	1740.16	1733.69	1976.17	2052.04
DSR	6855.53	7935.53	8151.34	7316.86
No. of Nodes	20	50	80	100

Table.3 Throughput with varying number of Nodes.

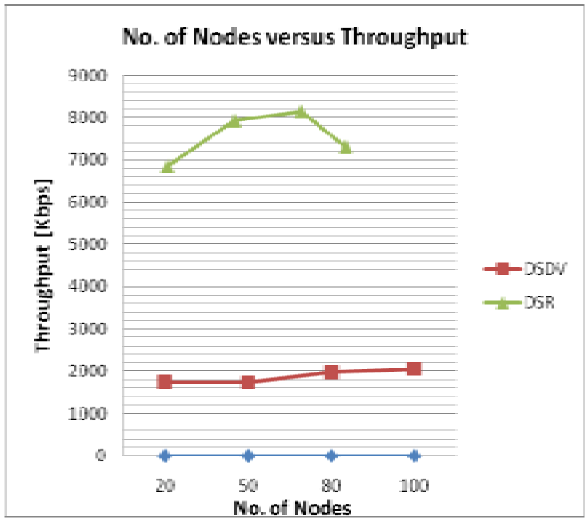


Figure: 2. No. of Nodes versus Throughput.

5. CONCLUSION

In this paper we have evaluated the performance of DSDV and DSR routing protocols for ad hoc networks using NS-2.29 event simulator keeping packet size of 512 Byte**.** DSDV uses the proactive table-driven routing strategy whereas DSR uses the reactive on demand routing strategy with different routing mechanisms. Experimental results showed that DSR perform better for Packet Delivery Fraction as well as Throughput. Also, DSDV apply the sequence numbers and contains one route per destination in its routing table whereas DSR uses source routing and route caches and maintains multiple routes per destination. The other observation from the experiments on DSDV and DSR protocols, with an increase in number of nodes for a fixed area of 500m x 500m illustrates that even if the terrain area of the network scenario is kept constant, the behavior of these routing protocols changes.

It has been found that the overall performance of DSR routing protocol for performance matrices, Packet Delivery Fraction as well as Throughput is better than that of DSDV routing protocols. In our experimental evaluation we have taken up comparison of DSR and DSDV protocols with varying number of nodes. We shall consider the comparison of DSR and DSDV by varying packet size and speed of nodes.

ACKNOWLEDGEMENT

We are thankful to referee's comments for their valuable and helpful suggestions. Also, we are thankful to CMU Monarch Project Group for providing Wireless and Mobility Extensions to NS-2 Simulator.

REFERENCES

[1] Azzedine Boukerche. Performance Evaluation of Routing Protocols for Ad Hoc Wireless Networks. *Kluwer Academic Publishers, Netherlands, Mobile Networks and Applications Vol.9,* No.4. pp 333-342, 2004,

[2] C. Cheng, R. Riley, Srikanta P. R. Kumar, J. J. Garcia-Luna Aceves. A Loop free Bellman-Ford reouting protocol without bouncing effect. *In ACM SIGCOMM'89,* September 1989, pp 224-237.

[3] The Network Simulator - ns-2, Website : *http://www.isi.edu/nsnam/ns/*

[4] Charles E. Perkins and Pravin Bhagwat. Highly dynamic Destination-Sequenced Distance-Vector routing (DSDV) for mobile computers. In *Proceedings of the SIGCOMM '94 Conference on Communications Architectures,* Protocols and Applications, pages 234–244, August 1994.

[5] The CMU Monarch Project's Wireless and Mobility Extensions to ns, Website: *http://www.monarch.cs.cmu.edu/*

[6] Charles E. Perkins, Pravin Bhagwat. Highly dynamic Destination-Sequenced Distance-Vector routing (DSDV) for mobile computers. In *Proceedings of the SIGCOMM '94 Conference on Communications Architectures, Protocols and Applications*, pages 234–244, August 1994. A revised version of the paper is available from *http://www.cs.umd.edu/projects /mcml/papers/Sigcomm94.ps Dynamic Source Routing Protocol Internet Draft http://www.ietf.org/html. charters/manet-charter.html*.

[7] D. Johnson, D. Maltz. Dynamic source routing in ad hoc wireless networks. In T. *Imielinski and H. Korth, editors*, *Mobile computing*, Chapter 5. Kluwer Academic, 1996.

[8] Josh Broch, David Johnson, and David Maltz. The dynamic source routing protocol for mobile ad hoc networks. *IETF Internet Draft http://www.ietf.org/internet-drafts/ draft-ietf-manet-dsr-01.txt*, Dec 1998.

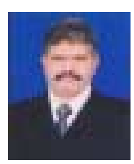
[9] D. Johnson, D. Maltz and J.Jetcheva, The Dynamic Source Routing Protocol for Mobile Ad hoc networks, *Internet Draft, draft-ietf-manet-dsr-07.txt,* 2002.

[10] Azzedine Boukerche, Athanasios Bamis, Ioannis Chatzigiannakis, Sotiris Nikoletseas. A mobility aware protocol synthesis for efficient routing in ad hoc mobile networks. *The International Journal of Computer and Telecommunications Networking, Vol. 52*, Issue 1, pp 130-154, Jan, 2008.

[11] Rajeshwar Singh, D K Singh, Lalan Kumar. Ants Pheromone for Quality of Service Provisioning In Mobile Adhoc Networks. *International Journal of Electronics Engineering Research, Vol. 2,* No 1 pp 101–109, Apr 2010.

[12] Nor Surayati Mohamad Usop, Azizol Abdullah, Ahmad Faisal Amri Abidin. Performance Evaluation of AODV, DSDV & DSR Routing Protocol in Grid Environment. *IJCSNS, VOL.9* No.7,pp 261-268, July 2009.

AUTHORS BIOGRAPHY



Rajeshwar Singh received his AMIE (India) degree from the Institution of Engineers, India, in year 1992, Master of Engineering (Digital Systems) from Motilal Nehru Regional Engineering College, Allahabad, U.P in year 2002. He has also received Master of Business Administration (MBA) in Information Technology from MD University, Rohtak, Haryana, in year 2009. He is presently working as Dean at Gateway Institute of Engineering and Technology, Sonipat, Haryana. He has rich experience of industry and teaching in UG and PG Courses. His more than 30 research papers are published in National and International Journals and conferences of repute. His area of interest is Swarm Intelligence Based Routing in Communication Systems and Embedded Systems Design.

Dr. Dharmendra K Singh is presently working as Head, Department of Electronics and Communication Engineering at BIT Sindri, Dhanbad, Jharkhand. He has more than 20 years of teaching experience at various levels. He has published more than 35 papers in national and international journals / conferences of repute. He has supervised a number of M.Tech. and Ph.D. research scholars, and presently there are five research scholars working under him. His current research interests include Swarm Intelligence based Optimization, intellectual information technology, Mobile Ad hoc Network Routing, Coding theory, cryptography, Photonic Crystal Fibers, e-Governance and Educational Planning. He is member and convener of various computerization programs of BIT Sindri, Vinoba Bhave University and Ranchi University, Jharkhand (India).

Dr. Lalan Kumar received his Ph.D. degree from the Indian School of Mines, (ISM) Dhanbad, Jharkhand. Joined National Informatics (NIC) Centre, under Planning Commission of Govt. of India in 1990 and worked till 25th Nov.'02. Joined Central Institute of Mining and Fuel Research (CIMFR) on 25th Nov.'02. Prior to joining CMRI as Scientist, he has studied, designed, developed and implemented many packages for the District, state and some of the packages are running in almost all the districts of the country. He has been appointed as a panel expert for local governance and community engagement for the various departments of state government. He has published more than 50 papers in National and International Journals / conferences of repute.