INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

IJARIIT

ISSN: 2454-132X
Impact factor: 6.078
(Volume 6, Issue 3)
Available online at: www.ijariit.com

Analyzing the QoS metrics of DSR

Diamond Celestine Aluri
diamondcelestinealuri@gmail.com
Andhra University College of Engineering for Women, Visakhapatnam, Andhra Pradesh

Challa Tejaswini
tejuchalla99@gmail.com
Andhra University College of Engineering for Women, Visakhapatnam, Andhra Pradesh

Chandaka Leela Sai Jyothirmai
jyothich12340@gmail.com
Andhra University College of Engineering for Women, Visakhapatnam, Andhra Pradesh

Chappidi Sravani
sravanich256@gmail.com
Andhra University College of Engineering for Women, Visakhapatnam, Andhra Pradesh

Dr. K. Soumya
soumyaindian@gmail.com
Andhra University College of Engineering for Women, Visakhapatnam, Andhra Pradesh

ABSTRACT

Mobile ad hoc networks have gained light in recent years and provide significant scope for research. Its various aspects considered for research include routing, bandwidth limitations, packet delivery ratio, etc. Researchers have proposed numerous routing algorithms for ad hoc networks among which, the DSR protocol is one effective protocol designed for MANETs. This protocol is highly adaptive to the topological changes in a network during data transmission, which enables the network to be self-configuring and self-organizing irrespective of the existent infrastructure. This paper explores the underlying concepts of the DSR protocol and analyzes its performance, along with a brief introduction to the wireless networks and routing protocols.

Keywords— *Routing, Network, Ad-hoc, Wireless networks, Throughput, Nodes, Communication, DSR, MANETs*

1. INTRODUCTION TO WIRELESS NETWORKS

A computer network is a collection of computers or other communicating devices (also called nodes) that are either connected through cables or a wireless medium. A wireless network enables the network nodes to be connected through high-frequency radio waves or microwaves for the exchange of data. The wireless networks are categorized into Infrastructure networks and Ad-Hoc networks. Infrastructure based networks allow the devices to be connected via an access point or a base station that acts as a central hub that coordinates the communication among all the nodes associated with it. An Ad-Hoc network is a decentralized type of network that does not depend on its pre-existing infrastructure or access from a central base station [4]. It is termed as Ad-Hoc because the nodes transmit data packets in a dynamically chosen route based on the active nodes in the network [1].

The Mobile Ad-Hoc networks (MANET) are self-configuring infrastructure-less networks where the nodes act as routers as well as nodes to forward the data packets through intermediate nodes dynamically. These networks are thus referred to as multi-hop networks.

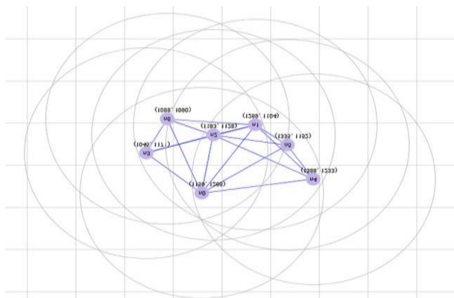

Fig. 1: Mobile ad-hoc network

The most challenging task for MANET is implementing a relevant and highly accurate routing protocol that can manage the underlying ad-hoc topologies in a network to maintain and configure stable, reliable routes for the packet delivery to its destination node. In this paper, we emphasize topology-based routing protocols that determine and maintain the routes based on the information of the nodes and their links in the network. The topology-based protocols are classified into proactive (table-driven), reactive (on-demand), and hybrid approaches [4].

The proactive routing protocol follows a predetermined approach where it identifies routes using a routing table which contains information about all the nodes (such as hop number, list of destination nodes, next hop, and the like) and any topological alterations are periodically updated and broadcasts the same to all nodes in the network. Examples: Destination Sequenced Distance Vector (DSDV), Wireless Routing Protocol (WRP), Hierarchical State Routing (HSR), Source Tree Adaptive Routing (STAR), Optimized Link State Routing (OLSR), and Global State Routing (GSR). [4]

The reactive routing protocol adapts a cooperative approach among the nodes to deliver the packets at the destination node. Unlike the proactive routing protocols, this procedure avoids the constant updating of the routing tables. Reactive routing is implemented with two phases: Route discovery and Route maintenance. These topics will be discussed in detail further in the paper. Examples: Ad-Hoc On-demand Distance Vector (AODV), Dynamic Source Routing Protocol (DSR), Temporally Ordered Routing Algorithm (TORA), Ad-hoc On-demand Multipath Distance Vector Routing (AOMDV). Hybrid routing protocol implements a combined approach of both proactive and reactive routing Examples: Zone Routing Protocol (ZRP). In this paper, we emphasize the Dynamic Source Routing protocol which is one of the reactive routing protocols.

2. REACTIVE ROUTING PROTOCOLS

The reactive routing protocol is also called an On-Demand protocol. This protocol employs a route determination procedure whenever a route request is initiated. This protocol has less overhead as it discovers the route only when required which makes it highly suitable for Mobile ad-hoc networks. It implements two phases to establish the route from the source node to the destination node: Route Discovery and Route Maintenance.

2.1 Route Discovery

The route discovery phase is initiated by the source node which is based on request and reply recycles. While implementing these protocols, each node maintains a local cache to save the route path from that node to the destination [1]. So, initially, the source node consults the cache of each node for any possible route to the destination and sends the data packet through the most reliable valid route. In absence of any, it initiates the route discovery process which is executed by broadcasting a Route Request (RR) message. The intermediate nodes on receiving this request refer to the cache and if no route exists, append their address to the message and send it to their neighbors until the destination node is reached. The destination node responds by unicasting the Route Reply message to the source node containing the hop sequence through which it received the packet. [7]

2.2 Route Maintenance

The major issue during the packet transmission from the source to destination is the link/route breakage as it undergoes dynamic topological changes in the process [6]. To avoid this, route maintenance is implemented. A route breakage might occur due to the host mobility in the network or if an alternate better route has been determined [10]. Whenever an erroneous node or a transmission flaw to the route is detected, the route is removed from the hop sequence and a route error message is broadcasted. Every node that receives this message, deletes the particular hop from its cache [7]. In this paper, we study the Dynamic Source Routing protocol (DSR) which implements the above approach for packet transmission.

3. DYNAMIC SOURCE ROUTING (DSR) PROTOCOL

The DSR protocol is an on-demand routing protocol that is based on Source routing. Source routing is a concept where the sender node initiates packet transmission by identifying the entire sequence of nodes to the destination node and, it appends the same in the packet's header to identify each forwarding "hop" by the address of the next node to transmit the packet on its way to the destination host [2]. The DSR protocol is considered efficient to implement it in multi-hop wireless ad-hoc networks with mobile hosts. As nodes in the network move about or join or leave the network, and as wireless transmission conditions such as sources of interference change, all routing is automatically determined and maintained by the DSR routing protocol [3].

The DSR protocol functions to avoid updating and maintaining the routing table as in the table-driven approach and unlike other reactive routing protocols, it does not require interrupting HELLO packet transmissions to inform their existence to the neighboring nodes in the network [7]. The protocol procedure involves a route construction phase where the source node requires to establish a route to the destination node via route request and reply messages [7]. The entire packet transmission involves a cooperative execution of route discovery and route maintenance phases. DSR protocol requires that every node maintains a route cache where the route information is stored. Every time a route is to be discovered, the node refers to its cache for any route information related to the destination node. The DSR protocol maintains a route cache that every cache entry functions as a full path and, it also maintains a link cache that stores route information [1]. When a route is found, the route is inserted in the packet header and then the packet is forwarded to its destination through this route [4]. In the absence of such information, the route discovery process is initiated by broadcasting RR (Route Request) messages from the source. The source node appends source ID, destination ID, and a unique request ID to it [4]. The packet also contains a route record listing the address of each intermediate node it passes through. The destination node on successful transmission, responds by a RR (Route Reply) message to the source node which contains the exact hop sequence of the intermediate nodes through which it received the request. The source node then transmits the original packet through this route which initially stores in a local buffer before flooding the requests. The route selection procedure considers the route with the minimal number of hops among the available active intermediate nodes. DSR protocol follows the shortest path algorithm to find the most feasible route [4].

Route Maintenance in DSR is designed to allow unidirectional links and asymmetric routes to be easily supported [5]. The route maintenance uses the data link layer and detects any lost links and topological changes. It involves generating route error messages and acknowledgements. When the source node detects a topological change, the route maintenance mechanism deletes the route that is no longer functional due to a lost link from the route cache and initiates the route discovery to identify an alternate route to the destination. On detecting a transmission error in the network, it generates an error message called the ROUTE ERROR message to the original sender of the packet, identifying the link over which the packet could not be forwarded and all routes containing the hop are truncated at that point [3]. To track the hop sequence, messages acknowledgements are used which verify the correct operation of the route links. Route maintenance can also be performed using end-to-end acknowledgements when a communication channel exists between the two end hosts rather than the hop-by-hop acknowledgement [2].

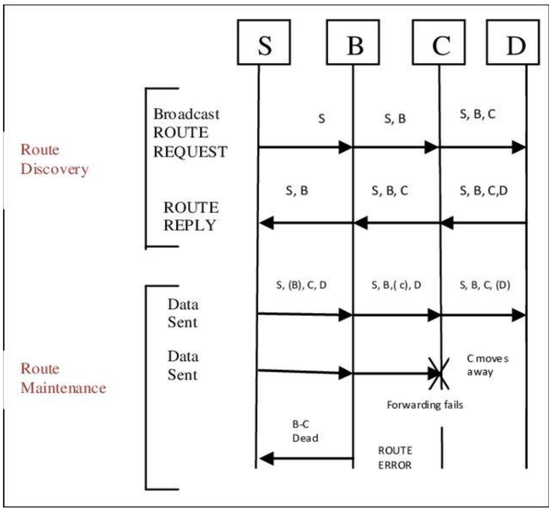

Fig. 2: Route Discovery and Route Maintenance in DSR [9]

For any network, two important parameters that define its stability are throughput and delay. The throughput for a network is the amount of actual data received at the destination node from the source node divided by the total time taken by the destination node to receive the last packet. Delay is referred to as the time taken for the data packet to travel across the network from source to destination node. These metrics define the Quality of Service (QoS) for a network. For any network with better QoS, it is required to have a high throughput and less delay. The DSR protocol satisfies these specifications to provide a better QoS for packet transmission across a limited number of nodes. As per a simulation project of the DSR protocol carried over by Ali El-Desoky et al, DSR end-to-end delay decreased with increasing the number of nodes to 80 nodes. So they concluded that DSR protocol holds good for nodes less than 80. With an increase in the number of nodes, it increases the number of hops in routes and results in an increase in the time for the packet to reach the destination.

4. IMPLEMENTATION OF THE DSR PROTOCOL USING NS-2.35

4.1. Brief description of Network Simulator

A network simulator (NS-2.35) is used to set up a virtual network among nodes in a device which uses TCL language for creating a simulation scenario file (for example, sample.tcl). This file contains information such as network topology transmission time, the protocol being used, etc. On successful execution of the scenario file, the simulated result is output to the out.tr and out.nam files respectively. The different files that help with the simulation task are as follows:

The **testDSR.tr** file contains all the information about communication among nodes and indicates how the packet was forwarded. This file is called a trace file.

The **testDSR.nam** includes data required for the animation of the experiment result. This file can be executed by Nam, an animation software.

The **out.tcp** records the changes in TCP parameters with time.

Xgraph is a program in ns2 that plots the network parameter characteristics like throughput, delay, latency, etc. It draws an X display from the data it reads from data files or any external specified files.

4.2. Simulation of DSR protocol

The simulation parameters used for this project are:

Table 1: Simulation Parameters

Routing Protocol	DSR
Number of Nodes	10, 20, 30, 40, 50, 60, 70, 80, 90, 100
Simulation time	2 Minutes
Simulation area	1200 x 1500 m
Propagation Model	Two ray ground reflection model
Traffic model	TCP
Application Protocol	FTP
MAC protocol	802.11
Antenna direction	Omni

The simulation area considered for the analysis is 2100 x 1500 where all the nodes are equipped with Omni directional antennas. The simulation is carried out for 2 minutes for 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100 nodes consecutively.

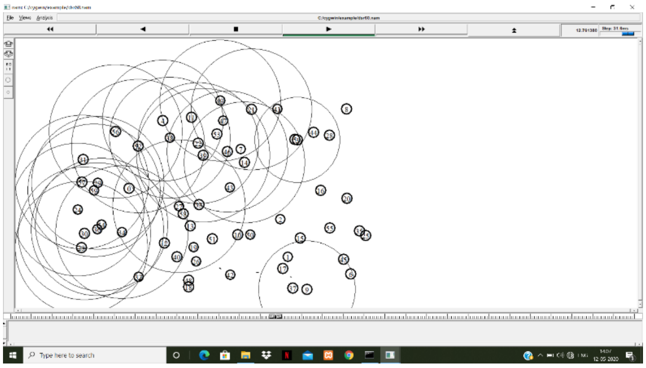

Fig. 3: Simulation of 60 nodes using NS-2.35

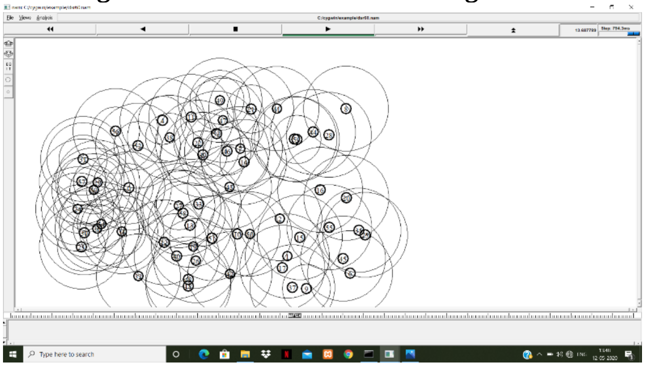

Fig. 4: Simulation of 60 nodes using NS-2.35

In this project, two simulation metrics were used to estimate the QoS of the DSR protocol: Throughput and Delay.

Throughput (bits/sec): The variations in throughput for different numbers of nodes is shown in figure 5. From the graph, it is observed that the throughput is maximum for 10 nodes and decreases to a minimum value for 50 nodes. The overall results obtained for throughput as per our system configuration are tabulated in table 2.

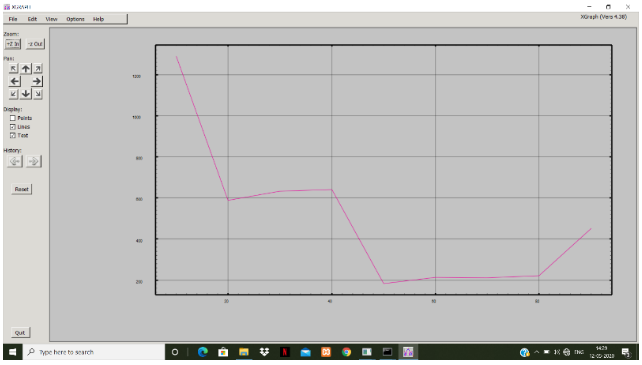

Fig. 5: Variations in Throughput for different numbers of nodes using XGraph

Table 2: Variation in throughput for different numbers of nodes

Number of nodes	10	20	30	40	50	60	70	80	90	100
Throughput	1290	588	632	640	183	212	210	221	452	233

Delay: The variations in delay with different numbers of nodes is shown in figure 6. From the graph, it is observed that the delay is minimum for 10 nodes and increases to a maximum for 10 nodes. The overall results obtained for the delay as per our system configuration are tabulated in table 3.

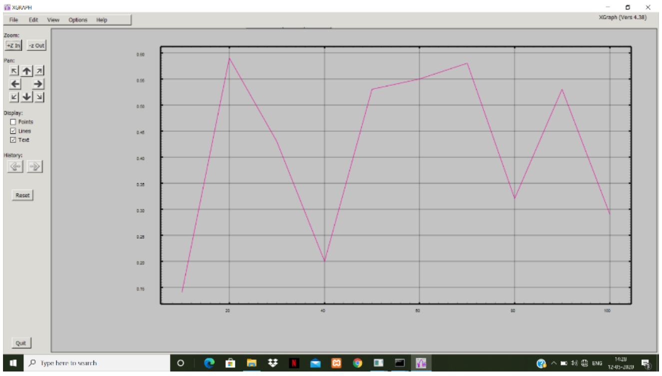

Fig. 5: Variations in Delay for different numbers of nodes using XGraph

Table 3: Variation of delay with different number of nodes

Network Size	10	20	30	40	50	60	70	80	90	100
Delay	0.14	0.59	0.43	0.20	0.53	0.55	0.58	0.32	0.53	0.29

The system configurations used for this project are mentioned in table 4.

Table 4: System Configuration

Device Name	HP LAPTOP – 15-bs1xx
Processor	Intel ® Core™ i5-8250U, CPU @ 1.60GHz 1.80 GHz
Installed RAM	4.00 GB
System Type	A 64-bit operating system, x64-based processor

4.3 Advantages of the DSR protocol

The DSR protocol is highly efficient than the other reactive routing protocols. It has a lower bandwidth consumption as a result of control packets used in transmission [8]. It eradicates the use of hello packets, unlike other on-demand protocols. Unlike the table-driven approaches, this protocol does not require to update the topological changes regularly. The intermediate nodes also utilize the stored route information efficiently to reduce the control overhead [8]. The DSR protocol has a better Packet delivery ratio as it allows packets to stay in the send buffer until a valid route is found [4]. The DSR protocol is thus considered to show excellent performance for multi-hop wireless ad hoc networks of mobile nodes.

4.4 Disadvantages of the DSR protocol

The DSR protocol does not allow a successful packet transmission in case of a route/link breakage and, the process to find a new route consumes time. It is not suitable for larger networks where the number of nodes involved in packet transmission increase [4]. A major disadvantage of this protocol is its route maintenance mechanism, which does not locally restore a broken link. A substantial routing overhead which is directly proportional to the path length is involved as this protocol applies source routing.

5. CONCLUSION

In this paper, we gave an overview of wireless networks and various types of routing mechanisms. We highlighted the concepts underlying the functioning of the DSR protocol. In this paper, we explained the principle mechanisms of Route Discovery and Route Maintenance employed by DSR, and have briefly described how the wireless mobile nodes automatically develop a completely self-organizing and self-configuring network among themselves. We evaluated the performance of the DSR protocol's QoS metrics in terms of throughput and delay. As per our system configuration, the QoS metrics obtained showed that, as we increase nodes in a network, the DSR protocol lacks scalability. This work may be further extended to provide scalability by minimizing delay and maximizing throughput.

6. REFERENCES

[1] Salem, A. O. A., Samara, G., & Alhmiedat, T. (2017). Performance analysis of dynamic source routing protocol. arXiv preprint arXiv:1712.04622.
[2] Johnson, D. B., & Maltz, D. A. (1996). Dynamic source routing in ad hoc wireless networks. In Mobile computing (pp. 153-181). Springer, Boston, MA.
[3] Johnson, D. B., Maltz, D. A., & Broch, J. (2001). DSR: The dynamic source routing protocol for multi-hop wireless ad hoc networks. Ad hoc networking, 5(1), 139-172.
[4] Ali El-Desoky, Amany Sarhan., & Reham Arnous. (2014). A Simulated Behavioral Study of DSR Routing Protocol Using NS-2. Int. J. Eng. Res. Appl., Vol. 4, Issue 12(Part 2), pp.64-71.
[5] Sneha, V. G. Trust-Based Routing in DSR over Mobile Ad-hoc Network. International Journal For Advance Research In Engineering And Technology, Volume 3, Issue VI, June 2015, pp. 65-69.
[6] Kohila, N., and R. Gowthami. "Routing Protocols in Mobile Ad-Hoc Network." International Journal of Computer Science and Mobile Computing 4, no. 1 (2015): 159-167.
[7] Kumar, Anjesh & Himral, Lalit. (2015). Enhanced Dynamic Source Routing (DSR) in MANET. International Journal of Advanced Research in Computer Science and Software Engineering, 5(4), May 2015 pp. 1495-1501.
[8] Ghuman, S. S. (2016). Dynamic source routing (DSR) protocol in wireless networks. International Journal of Computer Science and Mobile Computing, 5(6), 251-254.
[9] Kaur, D., & Kumar, N. (2013). Comparative analysis of AODV, OLSR, TORA, DSR and DSDV routing protocols in mobile ad-hoc networks. International Journal of Computer Network and Information Security, 5(3), 39.
[10] Wu, S., Ni, S., Sheu, J. et al. Route Maintenance in a Wireless Mobile Ad Hoc Network. Telecommunication Systems 18, 61–84 (2001) (https://doi.org/10.1023/A:1016787318571).

