ISBN: 978-93-83758-09-8

Comparative Study of Adhoc Routing Protocols AODV & DSR in Mobile Adhoc Network

[1]Divya Malhotra, [2] Meetu Galhotra
[1,2]M.Tech Student, Geeta Engineering College Panipat (Haryana)
[1]divya.malhotra19@gmail.com, [2]meetu023@gmail.com

***Abstract*— A Mobile Ad hoc Network (MANET) is a kind of wireless ad-hoc network, and is a self configuring network of mobile routers connected by wireless links. It consists of mobile platforms which are free to move arbitrarily. Efficient routing protocols will make MANETs reliable. Various research communities are working in field of MANET and trying to adopt the protocols and technology in other applications as well. In this paper, an attempt has been made to compare two well known protocols AODV and DSR by using two performance metrics, End to end delay and Throughput. The comparison has been done by using simulation tool NS2 which is the main simulator, NAM (Network Animator) and excel graph which is used for preparing the graphs from the trace files.**

***Index Terms*— MANET, NS-2, AODV, DSR.**

I. INTRODUCTION

Mobile Ad Hoc Network - A MANET consists of mobile nodes, a router with multiple hosts and wireless communication devices. The wireless communication devices are transmitters, receivers and smart antennas. The term node referred to as, which are free to move arbitrarily in every direction. These nodes can be a mobile phone, laptop and personal computer, which can be located in cars, ships, airplanes or with people having small electronic devices. Nodes can connect with each other randomly forming arbitrary topologies as shown in figure 1.1. Nodes communicate to each other and also forward packets to neighbor nodes as a router. The ability of self configuration of these nodes makes them more suitable for urgently required network connection.

II. APPLICATIONS OF MANETS

There are various applications of MANETs such as:

- Military or police exercises.
- Disaster relief operations.

- Mine site operations.
- Urgent Business meetings
- Personal area network

Such networks can be used to enable next generation of battlefield applications envisioned by the military including situation awareness systems for maneuvering war fighters. Many examples of MANETs can be found in real life such as, Emergency situations due to fire, earthquake, or bombs. In such a case, it is important to set up a quick network. MANETs are ideal for such situations. For example, in emergency operation, police and fire fighters can communicate through a MANET and perform their operations without adequate wireless coverage.

III. CHARACTERISTICS OF MANET

MANETs are autonomous systems of mobile nodes which may operate in isolation, or may have gateways too and interface with a fixed network. In the latter operational mode, it is typically envisioned to operate as a "stub" network connecting to a fixed internet work.

Stub networks carry traffic originating at and/or destined for internal nodes, but do not permit exogenous traffic to "transit" through the stub network. MANET nodes are equipped with wireless transmitters and receivers using antennas which may be omni directional (broadcast) or highly-directional (point-to-point). At a given point in time, depending on the nodes' positions and their transmitter and receiver coverage patterns, transmission power levels and co-channel interference levels, a wireless connectivity in the form of a random, multihop graph or "ad hoc" network exists between the nodes. This ad hoc topology may change with time as the nodes move or adjust their transmission and reception parameters.

IV. MANET ROUTING PROTOCOLS

Mobile Ad-Hoc Network is managed through the routing protocols. Routing is the process of selecting paths in a network along which to send data or physical traffic. Routing directs forwarding of logically addressed packets from their source toward their ultimate destination through intermediate nodes; typically hardware devices called routers, bridges, gateways, firewalls, or switches.The routing process usually directs forwarding on the basis of routing tables which maintain a record of the routes to various network

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destinations. Thus constructing routing tables, which are held in the routers' memory becomes very important for efficient routing. Routing protocol is routing of packets based on the defined rules and regulations. Every routing protocol has its own algorithm on the basis of which it discovers and maintains the route. In every routing protocol, there is data structure which stores the information of route and modify the table as route maintenance is required. The routing table stores only the best possible routes while link-state or topological databases may store all other information as well. Ad-Hoc Routing Protocols are divided in three categories as shown below:

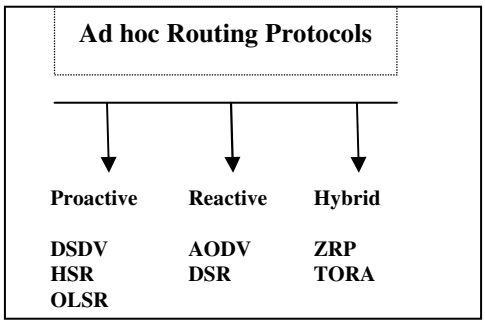

Fig. 1.2 Ad hoc Routing Protocols

A. *Proactive Protocols*

Proactive routing algorithms aim to keep consistent and upto-date routing information between every pair of nodes in the network by proactively propagating route updates at fixed time intervals. Usually, each node maintains this information in tables; thus, protocols of this class are also called table-driven algorithms. Examples of proactive protocols are:

1. Destination-Sequenced Distance Vector (DSDV)
2. Optimized Link-State Routing (OLSR)
3. HSR (Hierarchical State Routing Protocol) etc.

B. *Reactive Protocols*

Proactive routing algorithms aim to keep consistent and upto-date routing information between every pair of nodes in the network by proactively propagating route updates at fixed time intervals. Usually, each node maintains this information in tables; thus, protocols of this class are also called table-driven algorithms. Examples of proactive protocols are:

1. Dynamic Source Routing (DSR)
2. Ad Hoc On-Demand Distance Vector (AODV)

C. *Hybrid Routing Protocols*

This type of protocols combines the features of proactive and reactive routing protocols. Routing is established proactively by prospected routes and then serves the demands from additionally activated nodes through reactive flooding. Examples of hybrid protocols are:

1. ZRP (Zone Routing Protocol)
2. TORA (Temporally Ordered Routing Algorithm).

V. DETAILS OF MANET ROUTING PROTOCOLS USED IN SIMULATION

A. *Ad hoc On-Demand Distance Vector (AODV) Routing Protocol*

Ad hoc On-Demand Distance Vector (AODV) Routing is a routing protocol for MANETs and other wireless ad-hoc networks. It is jointly developed in Nokia Research Center, University of California, Santa Barbara and University of Cincinnati. AODV Routing protocol uses an on-demand approach for finding routes, that is, a route is established only when it is required by a source node for transmitting data packets as shown in figure 1.3 below. It employs destination sequence numbers to identify the most recent path.

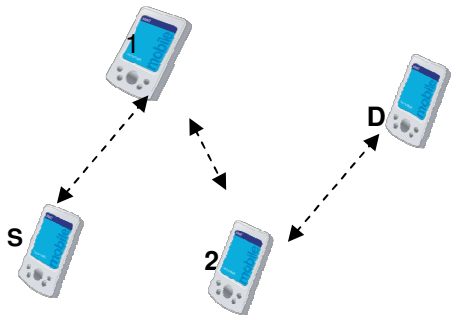

Fig. 1.3 AODV route discovery

AODV performs the following operations:

- Rou eeds a "next hop" to forward a packet to a destination
- Route maintenance: when link breaks, rendering next hop unusable

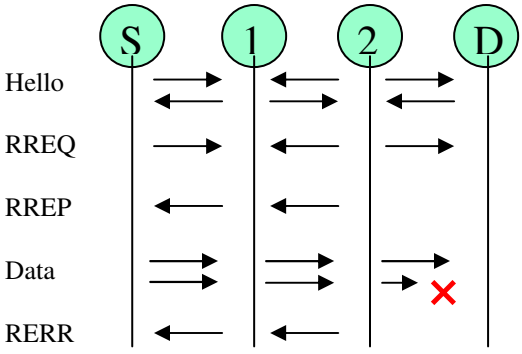

Fig. 1.4 AODV protocol's Events

B. *Dynamic Source Routing (DSR)*

DSR is a reactive routing protocol which is able to manage a

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MANET without using periodic table-update messages like table-driven routing protocols do. DSR was specifically designed for use in multi-hop wireless ad hoc networks. Ad-hoc protocol allows the network to be completely self-organizing and self-configuring which means that there is no need for an existing network infrastructure or administration. For restricting the bandwidth, the process to find a path is only executed when a path is required by a node (On-Demand Routing). In DSR the sender (source, initiator) determines the whole path from the source to the destination node (Source-Routing) and deposits the addresses of the intermediate nodes of the route in the packets. Compared to other reactive routing protocols DSR is beacon-less which means that there are no hello-messages used between the nodes to notify their neighbors about the presence. DSR was developed for MANETs with a small diameter between 5 and 10 hops and the nodes should only move around at a moderate speed.

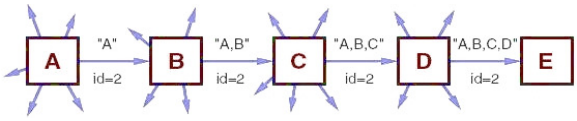

Fig. 1.5 Route Discovery by DSR

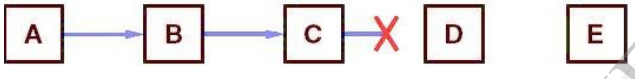

Fig. 1.6 DSR Route Error

As shown in Figure:1.6 above, If retransmission results in a failure, a Route Error message is sent to the initiator, that can remove that Source Route from its Route Cache. So the initiator can check his Route Cache for another route to the target. If there is no route in the cache, a Route Request packet is broadcasted.

VI. Experiment Modeling & Design

The Performance of AODV and DSR is determined on the basis of the following two metrics:

- End-to-end delay: The average time between a packet transmission at source node until packet delivery to a destination.
- Throughput: The total amount of data a receiver receives from the sender divided by the time it takes for the receiver to get the last packet.

Following two experiments were performed using simulator ns-2 with control parameters Node Density and Mobility.

Experiment #1 (Node Density Test): Study the effect of change in node density with the following three levels:

i. Low Density Network: 10 nodes in the network.
ii. Medium Density Network: 30 nodes in the network
iii. High Density Network: 50 nodes in the network

Experiment #2 (Mobility Test): Study the effect of node mobility.

i. Perpetual Mobility (Pause time 5 ms)
ii. High Mobility (Pause time 10 ms)
iii. Medium Mobility (Pause time 20 ms)
iv. Low Mobility (Pause time 30 ms)

VII. What is the NS-2?

NS-2: Network Simulator version 2, is a discrete event simulator for networking research.

NS-2 Architecture

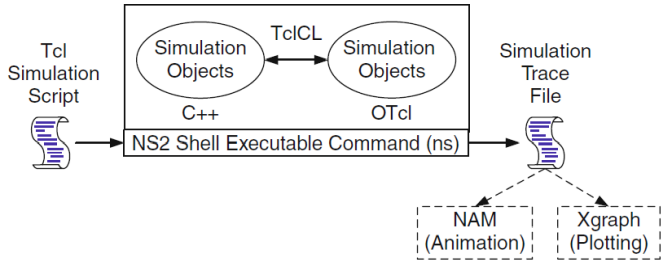

Fig. 1.7

VIII. Node Density Test Results

A. *Effect on End-to-End Delay*

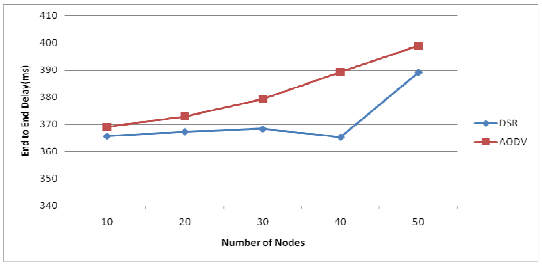

Fig. 1.8

B. *Effect on Throughput*

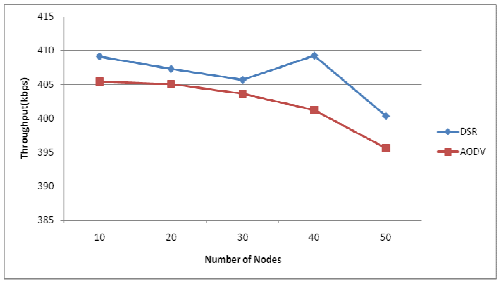

Fig. 1.9

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IX. MOBILITY TEST RESULTS

A. *Effect on End-to-End Delay*

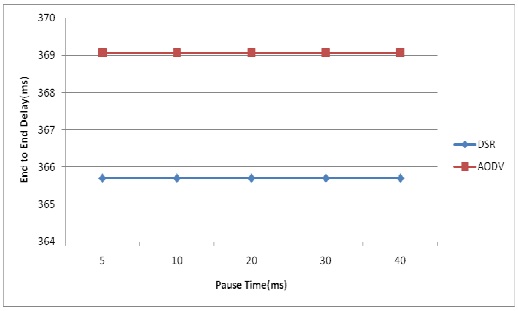

Fig. 1.10

B. *Effect on Throughput*

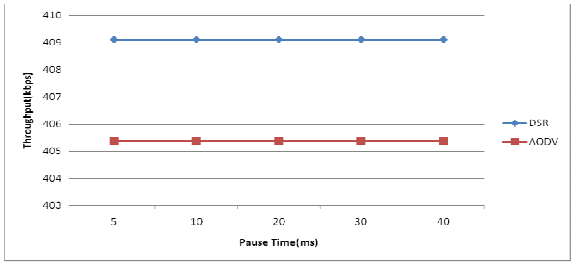

Fig. 1.11

X. CONCLUSION

We have compared two On-demand routing protocols i.e. AODV and DSR. On the basis of performance of protocols with varying number of nodes, the throughput of DSR is high as compared to AODV protocol. AODV protocol has minimum throughput and maximum end to end delay. As per performance analysis of both routing protocols on the basis of various parameters (Throughput and End to End Delay), we can conclude that DSR protocol is best performer as compared to AODV.

On the basis of performance of protocols with varying pause time, again the throughput of DSR is high as compared to AODV protocol. So From different analysis of graphs and simulations it can be concluded that DSR performs well than AODV under different situations with variation in pause time.

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