Performance Evaluation of DSDV, AODV and DSR Routing Protocol in MANET

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Abstract- A mobile Ad-Hoc network is a collection of wireless nodes that can dynamically be set up anywhere and anytime without using any pre-existing network infrastructure. It is an autonomous system in which mobile hosts connected by wireless links are free to move randomly and often act as routers at the same time. Mobile ad-hoc network have the attributes such as wireless connection, continuously changing topology, distributed operation and ease of deployment. The most important feature of a routing protocol, in order to be efficient for WSNs, is the energy consumption and the extension of the network's lifetime The distributed nature and dynamic topology of Wireless Sensor Networks (WSNs) introduces very special requirements in routing protocols that should be met. An analytical survey on energy efficient routing protocols for WSNs is provided. Energy efficient routing protocols are classified into four main schemes: *Network Structure*, *Communication Model*, *Topology Based* and *Reliable Routing*. In this paper, the classification is expanded, in order to enhance all the proposed papers earlier and to better describe which issues/operations in each protocol illustrate/enhance the energy efficiency issues. In this paper we have compared the performance of three MANET routing protocol DSDV, AODV and DSR by using NS-2. DSDV is proactive (Table driven routing Protocol) whereas AODV and DSR share similar On Demand behavior, but the protocol's internal mechanism leads to significant performance difference. A detailed simulation has been carried out in NS-2. The metrics used for performance analysis are Routing Overload, Delivery Ratio, And Average Delay.

Index Terms- MANET, UDP, Burst Time, Pause Time, Routing Overload, Delivery ratio, Avg. Delay

I. Introduction

The Ad-Hoc network is set up with multiple wireless devices without any infrastructure. Its employment is favored in many environments. Thus, many efforts are put on Ad-Hoc networks at both the MAC and routing layers. Meanwhile, QoS aware issues are considered in both MAC and routing layers for Ad-Hoc networks. In Ad-Hoc networks, communications are done over wireless media between stations directly in a peer to peer fashion without the help of wired base station or access points. Lots of efforts have been done on Ad-Hoc networks. One of the important and famous groups developing Ad-Hoc networks is Mobile Ad-hoc network Group (MANET) [2]. With the popularity of Ad-hoc networks, many routing protocols have been designed for route discovery and route maintenance. They are mostly designed for best effort transmission without any guarantee of quality of transmissions. Some of the most famous routing protocols are DSDV, Dynamic Source Routing (DSR) and Ad-Hoc on Demand Vector (AODV).

A number of protocols have been developed to accomplish this task. Several performance evaluation of MANET routing protocols using UDP traffic have been done by considering various parameters such as mobility, network load and pause time. In this paper we have investigated the performance of DSDV (Proactive), AODV (Reactive) and DSR On-Demand (reactive) routing protocol for performance comparison in the scenario. The purpose of this work is to understand there working mechanism and investigate that which routing protocol gives better Performance in which situation. The rest of the paper is organized as follows. In section 2, we have given the brief introduction of DSDV, AODV and DSR routing protocol. Section 3 and 4 deals with the simulation parameters and results obtained on the execution of simulation. Finally, conclusion is drawn in section 5.

II. DESCRIPTION OF ROUTING PROTOCOL

A. Destination-Sequenced Distance-Vector Routing Protocol

The Destination-Sequenced Distance-Vector (DSDV) Routing Algorithm [3] based on the idea of the classical Bellman-Ford Routing Algorithm with certain improvements. Every mobile station maintains a routing table that lists all available destinations, the number of hops to reach the destination and the sequence number assigned by the destination node. The sequence number is used to distinguish stale routes from new ones and thus avoid the formation of loops. The stations periodically transmit their routing tables to their immediate neighbors. A station also transmits its routing table if a significant change has occurred in its table from the last update sent. So, the update is both time-driven and event-driven. The routing table updates can be sent in two ways: - a "full dump" or an incremental update. A full dump sends the full routing table to the neighbors and could span many packets whereas in an incremental update only those entries from the routing table are sent that has a metric change since the last update and it must fit in a packet. If there is space in the incremental update packet then those entries may be included whose sequence number has changed. When the network is relatively stable, incremental updates are sent to avoid extra traffic and full dump are relatively infrequent. In a fast- changing network, incremental packets can grow big so full dumps will be more frequent. Each route update packet, in addition to the routing table information, also contains a unique sequence number assigned by the transmitter. The route labeled with the highest (i.e. most recent) sequence number is used. If two routes have the same sequence number then the route with the best metric (i.e. shortest route) is used. Based on the past history, the stations estimate the settling time of routes. The stations delay the transmission of a routing update by settling time so as to eliminate those updates that would occur if a better route were found very soon.

B. Ad-Hoc on Demand Distance Vector (AODV)

Ad-Hoc On-demand Distance Vector Routing (AODV) [6] is an improvement on the DSDV algorithm discussed in section 2.1. AODV minimizes the number of broadcasts by creating routes on-demand as opposed to DSDV that maintains the list of all the routes. To find a path to the destination, the source broadcasts a route request packet. The neighbors in turn broadcast the packet to their neighbors till it reaches an intermediate node that has recent route information about the destination or till it reaches the destination. A node discards a route request packet that it has already seen. The route request packet uses sequence numbers to ensure that the routes are loop free and to make sure that if the intermediate nodes reply to route requests, they reply with the latest information only. When a node forwards a route request packet to its neighbors, it also records in its tables the node from which the first copy of the request came. This information is used to construct the reverse path for the route reply packet. AODV uses only symmetric links because the route reply packet follows the reverse path of route request packet. As the route reply packet traverses back to the source, the nodes along the path enter the forward route into their tables. If the source moves then it can reinitiate route discovery to the destination. If one of the intermediate nodes move then the moved nodes neighbor realizes the link failure and sends a link failure notification to its upstream neighbors and so on till it reaches the source upon which the source can reinitiate route discovery if needed.

C. Dynamic Source Routing Protocol (DSR)

The Dynamic Source Routing Protocol [5] is a source-routed on-demand routing protocol. Anode maintains route caches containing the source routes that it is aware of. The node updates entries in the route cache as and when it learns about new routes.

The two major phases of the protocol are: route discovery and route maintenance. When the source node wants to send a packet to a destination, it looks up its route cache to determine if it already contains a route to the destination. If it finds that an unexpired route to the destination exists, then it uses this route to send the packet. But if the node does not have such a route, then it initiates the route discovery process by broadcasting a route request packet. The route request packet contains the address of the source and the destination, and a unique gentrification number. Each intermediate node checks whether it knows of a route to the destination. If it does not, it appends its address to the route record of the packet and forwards the packet to its neighbors. To limit the number of route requests propagated, a node processes the route request packet only if it has not already seen the packet and it's address is not present in the route record of the packet. A route reply is generated when either the destination or an intermediate node with current information about the destination receives the route request packet. A route request packet reaching such a node already contains, in its route record, the sequence of hops taken from the source to this node.. Creation of record route in DSRP As the route request packet propagates through the network, the route record is formed. If the route reply is generated by the destination then it places the route record from route request packet into the route reply packet. On the other hand, if the node generating the route reply is an intermediate node then it appends its cached route to destination to the route record of route request packet and puts that into the route reply packet. To send the route reply packet, the responding node must have a route to the source. If it has a route to the source in its route cache, it can use that route. The reverse of route record can be used if symmetric links are supported. In case symmetric links are not supported, the node can initiate route discovery to source and piggyback the route reply on this new route request. DSRP uses two types of packets for route maintenance: - Route Error packet and Acknowledgements. When a node encounters a fatal transmission problem at its data link layer, it generates a Route Error packet. When a node receives a route error packet, it removes the hop in error from it's route cache. All routes that contain the hop in error are truncated at that point. Acknowledgment packets are used to verify the correct operation of the route links. This also includes passive acknowledgments in which a node hears the next hop forwarding the packet along the route .

D. Efficient Ad-Hoc on Demand Distance Vector (E-AODV)

As in AODV each Mobile Host acts as a router and routes are obtained on demand with little or no periodic advertisements. It uses destination sequence numbers to ensure loop freedom at all times. EAODV reduces hop count, Latency time and enhances throughput, packet delivery ratio of packets in ad hoc networks. It maintains more than one route to the required destination. Also, the shortest route is selected to send the data packets to the destination.

III. PROBLEMS WITH CURRENT MOBILE NETWORKS

As users are increasingly mobile it is more and more common for users to meet and communicate without prior planning and in environments where there is little or no networking infrastructure. For example, business meetings often require documents to be exchanged and it could happen in a cafe or at the airport. In such situations it is difficult and inconvenient to set up a local area network (LAN) as the network will need to be created on the fly. Such a network is known as an ad hoc network where the network is of a dynamic nature without centralized administration.

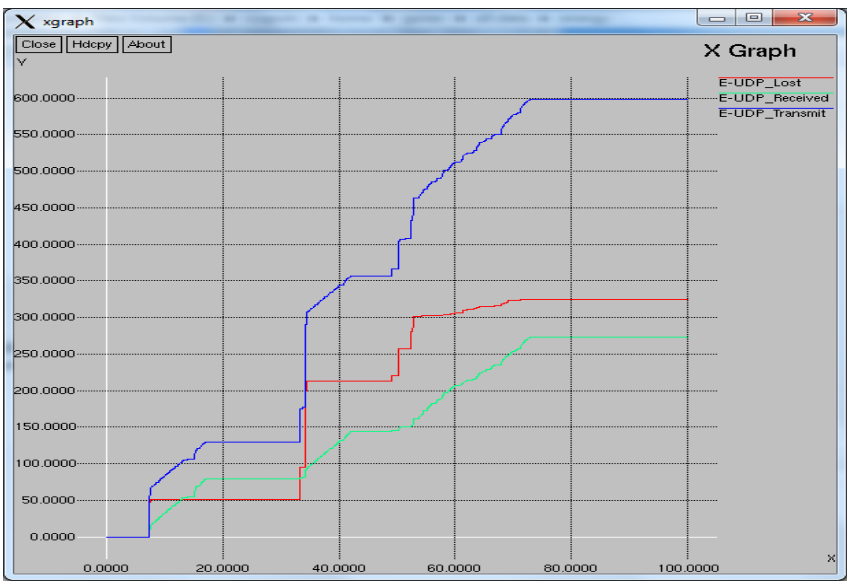
Current technologies can form ad hoc networks but is limited in that only single hop networks can be formed. This means that each node can only act as a host sending directly to the destination. In a multi-hop ad hoc network, all nodes act as routers and neighboring nodes will forward packets to the final destination.

A fundamental problem in ad hoc networking is how to deliver data packets among nodes efficiently without predetermined topology or centralized control, which is the main objective of ad hoc routing protocols. Because of the dynamic nature of the network, ad hoc routing faces many unique problems not present in wired networks. In addition, ad hoc networking is inherently a multi-layer problem. For example, to vertically optimize protocol layers, ad hoc routing is often jointly considered with power control in the physical layer, multiple access control in the link layer, and quality of service support for applications. Therefore, issues in multiple layers should be addressed with a cross-layer approach. Most existing ad hoc routing protocols build and utilize only one single route for each pair of source and destination nodes. Due to node mobility, node failures, and the dynamic characteristics of the radio channel, links in a route may become temporarily unavailable, making the route invalid. The overhead of finding alternative routes may be high and extra delay in packet delivery may be introduced. Multipath routing addresses this problem by providing more than one route to a destination node. Source and intermediate nodes can use these routes as primary and backup routes. Alternatively, they can distribute traffic among multiple routes to enhance transmission reliability, provide load balancing, and secure data transmission.

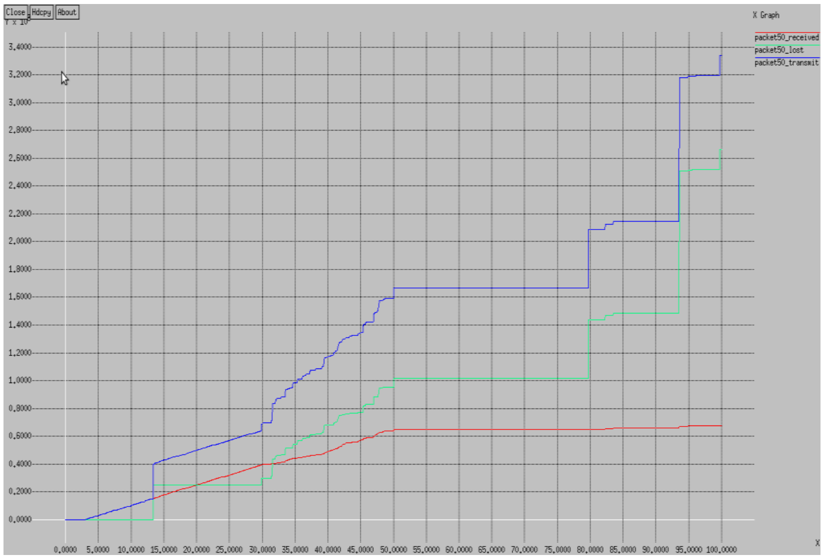
IV. SIMULATION ENVIROMENT & PERFORMANCE ANALYSIS

Network simulator 2 is the result of an on-going effort of re- search and development that is administrated by Researchers at Berkeley. It is a discrete event simulator targeted at net- working research. It provides substantial support for simula- tion of TCP, routing, and multicast protocols. The simulator is written in C++ and a script language called OTcl. NS uses an Otcl interpreter towards the user. This means that the user writes an OTcl script that defines the network (number of nodes, links), the traffic in the network (sources, destinations, type of traffic) and which protocols it will use. This script is then used by ns during the simulations. The result of the simu- lations is an output trace file that can be used to do data processing (calculate delay, throughput etc) and to visualize the simulation with a program called Network Animator (NAM). NAM is a very good visualization tool that visualizes the packets as they propagate through the network.

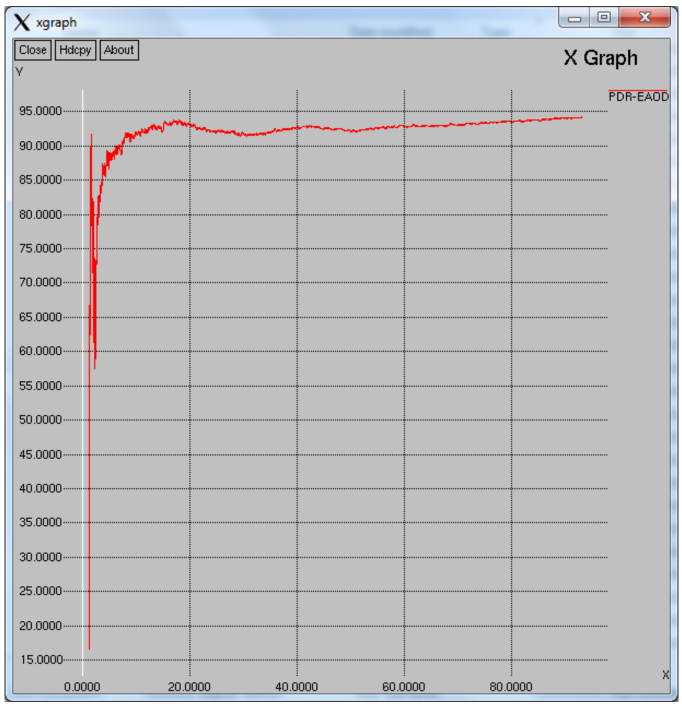
A. Following graphs shows performance of AODV and DSDV protocols:



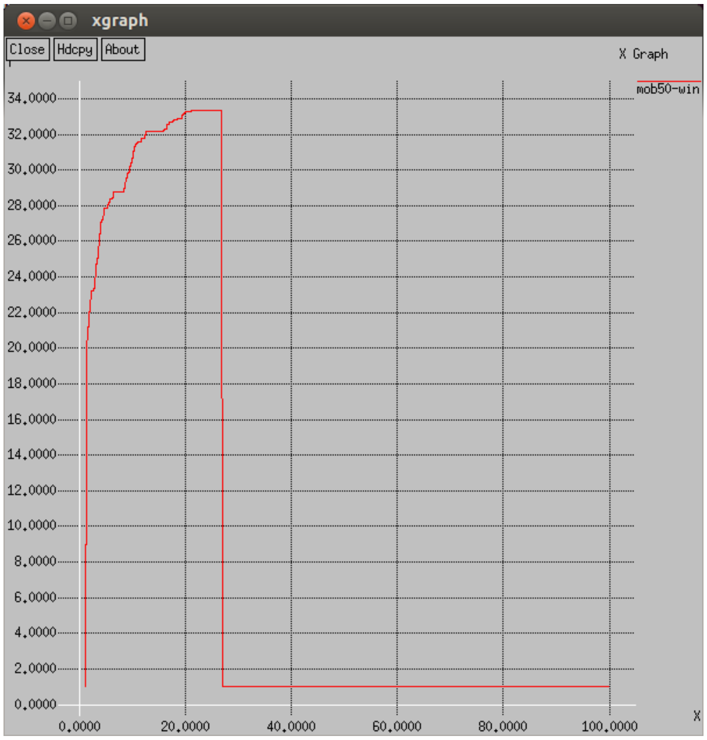
Graph 1. Udp Analysis of E-AODV



Graph 2. Udp Analysis of DSDV



Graph 3. Packet Delivery Ratio of E-AODV



Graph 4. Packet Delivery Ratio of DSDV

The packet delivery ratio of EAODV gives much better performance than conventional AODV, 94 Percent packet received here the graph plots between percentage of received packets and the simulation time.

B. Following table shows performance analysis of AODV and DSDV protocols:

SEND	9703
RECV	7299
ROUTING PACKTS	1148
PDF	75.22
NRL	0.16
Avg. End to End Delay(ms)	531.73
No. of Dropped Packets	2395

Table1. Performance parameters results of DSDV protocol for 50 nodes

SEND	7819.00
RECV	7362.00
ROUTING PACKTS	893.00
PDF	94.16
NRL	0.14
No. of Dropped Packets	440

Table2. Performance parameters results of AODV protocol for 50 nodes

V. CONCLUSION

This paper compared the performance of DSDV, AODV, and DSR routing protocols for Ad-hoc networks using ns-2 simulation. We have presented a detailed performance comparison of important routing protocols for mobile Ad-Hoc wireless networks. AODV and DSR are reactive protocol while DSDV proactive protocols. Both AODV and DSR use reactive approach to route discovery, but with different mechanism. DSR uses source routing and route cache and does not depend on their timer base activity. On other hand AODV uses routing tables, one route per destination, sequence number to maintain route. The general observation from simulation is that DSDV has performed well compared to all other protocols in terms of Delivery ratio

REFERENCES

[1] Mobile ad hoc networks (MANET). http: //www.ietf.org/html.charters/manet-charter.html, 1997 IETF Working Group Charter

[2] "Highly Dynamic Destination Sequenced Distance-Vector Routing (DSDV) for mobile Computer".C .F. Perkins and P.Bhagwat, Comp. Common. Rev., Oct. 1994, pp234-244.

[3] E.M. Royer, C.K. Toh, "A Review of Current Routing Protocols for Ad-Hoc Mobile Wireless Networks", IEEE Personal Comm., April 1999.

[4] "Dynamic Source Routing Protocol for MANET (DSR)", Internet Draft, www.ietf.org

[5] "Survey on Ad-Hoc Routing Protocols and Cross Layer Design", Liang Qin and Thomas Kunz, Technical Report SCE-04-14, August 2004.

[6] "NS_DOC.PDF", www.isi.edu/nsnam/ns

[7] "Tutorial-NS by Example", http://nile.wpi.edu/ns/

[8] "NsTutorial", http://www.isi.edu/nsnam/nam

[9] C. E. Perkins and E. M. Royer, "Ad Hoc On-demand Distance Vector Routing," I n Proceedings of the 2nd IEEE Workshop on Mobile Computing Systems and Applications, New Orleans, LA, February 1999, pp. 90-100.

[10] C. E. Perkins and P. Bhagwat, "Highly Dynamic Destination- Sequenced Distance- Vector Routing(DSDV)forMobile Computers," SIGCOMM, London, UK, August 1994, pp. 234-244.

D. B. Johnson and D. A. Maltz, "Dynamic Source Routing in Ad-Hoc Ad h o c Networks," Mobile Computing, ed. T. Imielinski and H. Korth, Kluwer Academic Publishers, 1996, pp. 153-181.

[11] Charles E. Perkins, Ad Hoc Networking, Addison-Wesley, March 2005.

[12] N. Nikaein, H. Labiod, and C. Bonnet. DDR-Distributed Dynamic Routing Algorithm for M o b i l e A d h o c Networks. First

[13] A n n u a l Workshop o n M o b i l e a n d A d H o c Networking and C o m p u t i n g (MobiHOC), 2000.

[14] S. R. Das, R. Castaneda, J. Yan, and R. Sengupta, "Comparative performance evaluation of routing protocols for mobile, ad hoc networks," in Proceedings of 7th International Conference o n Computer Communications and Networks (IC3N '98) pp. 153 161, Lafayette, La, USA, October 1998.

[15] M. Särelä. Measuring the Effects of Mobility on Reactive Ad Hoc Routing Protocols. Helsinki University of Technology Laboratory for Theoretical Computer Science, Research Reports 91, 2004.

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