Performance Evaluation of Routing Protocols (DSR, DSDV, ZRP) Mobile Adhoc Networks (MANET) by using Network Simulator-2

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Abstract: **A Mobile Ad-hoc Network (MANET) consists of a number of mobile wireless nodes, among which the communication is carried out without having any centralized control. MANET is a self organized, self configurable network having no infrastructure, and in which the mobile nodes move arbitrarily [1]. A routing protocol is used to find routes between mobile nodes to facilitate communication within the network. The main goal of such an ad hoc network routing protocol is to establish correct and efficient route between a pair of mobile nodes so that messages delivered within the active route timeout interval. Route should be discovered and maintained with a minimum of overhead and bandwidth consumption. A recent trend in ad hoc network routing is the reactive on-demand philosophy where routes are established only when required. The protocols are Dynamic Source Routing (DSR), Destination sequenced distance vector routing (DSDV) routing protocol, Zonel routing protocol (ZRP). The performance of these routing protocols is analyzed in terms of their average through-put, average end to end delay, packet delivery ratio and their results are shown in graphical forms.**

Keywords: MANET, Network Simulator-2, Routing protocols, DSR, DSDV, ZRP

1. INTRODUCTION

A MANET consists of a number of mobile devices that come together to form a network as needed, without any support from any existing Internet infrastructure or any other kind of fixed stations. Each device in a MANET is free to direction, and will be change its links to other devices frequently. Depending upon the nature of application, appropriate routing protocol is implemented. Proactive and reactive protocols are the two classes of MANET routing protocols and each constitute a set of protocols. Depending upon the nature of application, appropriate routing protocol is implemented. Some of the routing protocols are proactive, reactive, hybrid protocols.

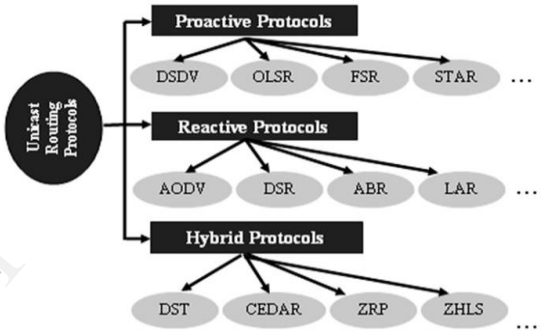


Figure: 1 Classification of routing protocols

Mobile ad hoc network is a group of wireless mobile computers (or nodes) in which nodes collaborate by forwarding packets for each other to allow them to communicate outside range of direct wireless transmission. Ad hoc networks require no centralized administration or fixed network infrastructure such as base stations or access points, and can be quickly and inexpensively set up as needed. A MANET is an autonomous group of mobile users that communicate over reasonably slow wireless links. The network topology may vary rapidly and unpredictably over time, because the nodes are mobile. The network is decentralized, where all network activity, including discovering the topology and delivering messages must be executed by the nodes themselves.

2. SIMULATION NETWORKS:

Ns-2 is a discrete event simulator targeted at networking research. It provides substantial support for simulation of TCP, routing and multicast protocols over wired and wireless networks. It consists of two simulation tools. The network simulator (ns) contains all commonly used IP protocols. The network animator (nam) is use to visualize the simulations. Ns-2 fully simulates a layered network from the physical radio transmission channel to high-level applications. Version 2 is the most recent version of ns (ns-2). The ns-2 simulator has several features that make it suitable for our simulations [2]. Ns-2 is an object-oriented simulator written in C++ and Tcl. The simulator supports class hierarchy in C++ and a similar class hierarchy within

the Tcl interpreter. There is a correspondence between a class in the interpreted hierarchy and one in the compile hierarchy. The reason to use two different programming languages is that Tcl is suitable for the programs and configurations that demand frequent and fast change while C++ is suitable for the programs that have It not only supports most commonly used IP protocols but also allows the users to extend or implement their own protocols. It also provides powerful trace functionalities, which are very important in our project and since various information need to be logged for analysis. The full source code of ns-2 can be downloaded and compiled for multiple platforms such as UNIX, Windows and Cygwin.

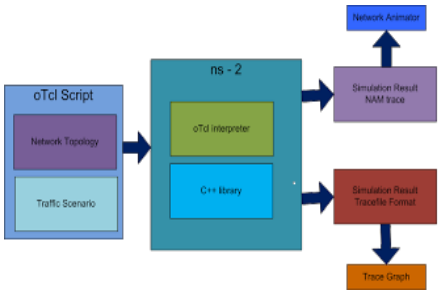


Figure: 2 Flow Diagram of NS-2

3. ROUTING PROTOCOLS:

Among various routing protocols available for MANETs, we worked with three protocols DSR, DSDV, &ZRP which come under reactive and hybrid routing protocols.

Reactive Routing protocol:

Reactive routing protocol is also known as on demand routing protocol. In this protocol route is discovered whenever it is needed Nodes initiate route discovery on demand basis. Source node sees its route cache for the available route from source to destination if the route is not available then it initiates route discovery process. The on-demand routing protocols have two major components are route discovery and route maintance. Reactive Protocol has lower overhead since routes are determined on demand. It employs flooding (global search) concept. Constantly updating of route tables with the latest route topology is not required in on demand concept. Reactive protocol searches for the route in an on-demand manner and set the link in order to send out and accept the packet from a source node to destination node. Route discovery process is used in on demand routing by flooding the route request (RREQ) packets throughout the network [3]. Examples of reactive routing protocols are the dynamic source Routing (DSR), ad hoc on-demand distance vector routing (AODV).

Proactive (Table Driven) Routing Protocol:

Each node in the network has routing table for the broadcast of the data packets and want to establish connection to other nodes in the network. These nodes record for all the presented destinations, number of hops required to arrive at each destination in the routing table. The routing entry is tagged with a sequence number which is created by the destination node [4]. To retain the stability, each station broadcasts and modifies its routing table from time to time. How many hops are required to arrive that particular node and which stations are accessible is result of broadcasting of packets between nodes. Each node that broadcasts data will contain its new sequence number and for each new route, node contains the following information:

– How many hops are required to arrive that a particular destination node

– Generation of new sequence number marked by the destination

– The destination address

The proactive protocols are appropriate for less number of nodes in networks, as they need to update node entries for each and every node in the routing table of every node. It results more Routing overhead problem. There is consumption of more bandwidth in routing table. Example of Proactive Routing Protocol is Destination Sequenced Distance Vector (DSDV).

Hybrid routing protocol:

Hybrid routing protocols are a new generation of protocol, which are both proactive and reactive in nature. These protocols are designed to increase scalability by allowing nodes with close proximity to work together to form some sort of a backbone to reduce the route discovery overheads. This is mostly achieved by proactively maintaining routes To nearby nodes and determining routes to far away nodes using a route discovery strategy. Most hybrid protocols proposed to date are zone-based, which means that the network is partitioned or seen as a number of zones by each node. This section describes a number of different hybrids routing protocol proposed for MANETs.

3.1 DSR (Dynamic Source Routing):

The Dynamic Source Routing (DSR) is one of the purest examples of an on-demand routing protocol that is based on the concept of source routing. It is designed especially 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. Instead DSR needs support from the MAC layer to identify link failure. DSR is composed of the two mechanisms of Route Discovery and Route Maintenance, which work together to allow nodes to discover and maintain source routes to arbitrary destinations in the network. 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 opens up the protocol to a variety of useful optimizations [5]. Neither AODV nor DSR guarantees shortest path. 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.

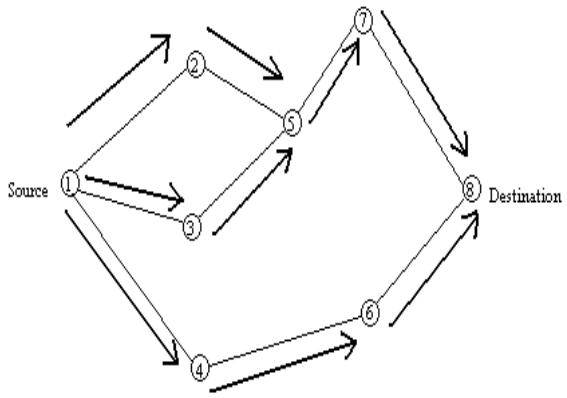


Figure: 3.1.1 Propagation of request (RREQ) packet

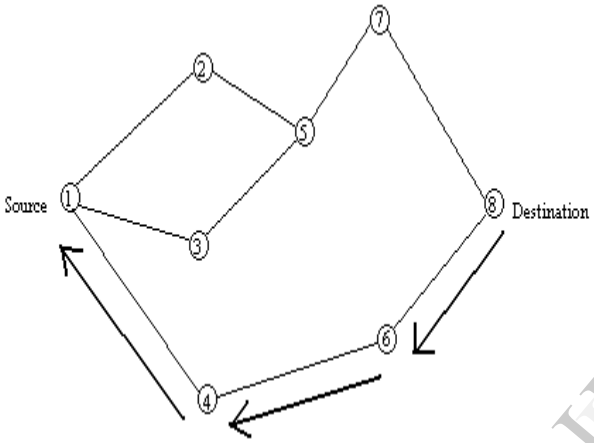


Figure 3.1.2 Path taken by the Route Reply (RREP) packet

3.2 DSDV (Destination sequenced distance vector routing):

Destination sequenced distance vector routing (DSDV) is adapted from the conventional Routing Information Protocol (RIP) to ad hoc networks routing. It adds a new attribute, sequence number, to each route table entry of the conventional RIP. Using the newly added sequence number, the mobile nodes can distinguish stale route information from the new and thus prevent the formation of routing loops. It is developed to solve the routing loop problem. Each entry in the routing table contains a sequence number, the sequence numbers are generally even if a link is present; else, an odd number is used. The number is generated by the destination, and the emitter needs to send out the next update with this number. Routing information is distributed between nodes by sending full dumps infrequently and smaller incremental updates more frequently [6]. If a router receives new information, then it uses the latest sequence number. If the sequence number is the same as the one already in the table, the route with the better metric is used. Stale entries are those entries that have not been updated for a while. Such entries as well as the routes using those nodes as next hops are deleted.

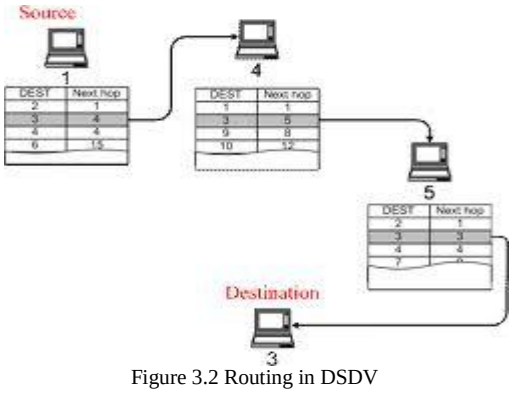
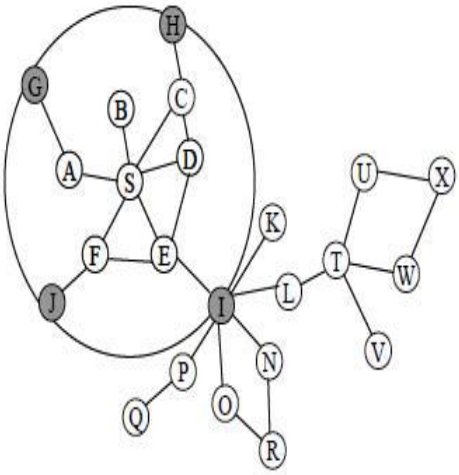


Figure 3.2 Routing in DSDV

3.3 ZRP (Zone Routing Protocol):

Zone Routing Protocol or ZRP was the first hybrid routing protocol with both a proactive and a reactive routing component. ZRP was first introduced by Haas in 1997. ZRP is proposed to reduce the control overhead of proactive routing protocols and decrease the latency caused by routing discover in reactive routing protocols. ZRP defines a zone around each node consisting of its k-neighbourhood (e. g. k=3). In ZRP, the distance and a node, all nodes within hop distance from node belong to the routing zone of node. ZRP is formed by two sub-protocols, a proactive routing protocol: Intra-zone Routing Protocol (IARP) is used n side routing zones and a reactive routing protocol: Inter-zone Routing Protocol (IERP), is used between routing zones, respectively. A route to a destination within the local zone can be established from the proactively cached routing table of the source by IARP therefore, if the source and destination is in the same zone, the packet can be delivered immediately [7]. Most of the existing proactive routing algorithms can be used as the IARP for ZRP. For routes beyond the local zone, route discovery happens reactively. The source node sends a route requests to its border nodes, containing its own address, the destination address and a unique sequence number. Border nodes are nodes which are exactly the maximum number of hops to the defined local zone away from the source. The border nodes check their local zone for the destination. If the requested node is not a member of this local zone, the node adds its own address to the route request packet and Forwards the packet to its border nodes. If the destination is a member of the local zone of the node, it sends a route reply on the reverse path back to the source. The source node uses the path saved in the route reply packet to send data packets to the destination. Consider the network in Fig. 3 The node S has a packet to send to node X. The zone radius is r=2. The node uses the routing table provided by IARP to check whether the destination is within its zone. Since it is not found, a route request is issued using IERP. The request is broadcast to the peripheral nodes (gray in the picture). Each of these searches their routing table for the destination.



Routing node of S

4. PERFORMANCE METRICS:

For MANET simulation, there are many performance metrics which are used to analysis the various proposals. In this we have used 3 performance metrics that evaluate routing protocols in all important aspects.

1. Throughput:

One can use them to measure the portion of the available bandwidth that is used by the protocol for route discovery and maintenance.

Throughput = (No of delivered packets*Packet size*8)/Simulation time

2. Average end-to-end delay:

This is the average time delay for data packets from the source node to the destination node.

AED = Σ (time received-time sent) /Total data packets received

3. Packet delivery ratio:

Packet Delivery Ratio is the ratio of number of packets received at the destination nodes to the number of packets sent from the source nodes. The performance is better when packet delivery ratio is high.

PDR = Number of received packets /Number of sent packets

5. PERFORMANCE ANALYSIS BASED ON SIMULATION RESULTS:

5.1Average Throughput:

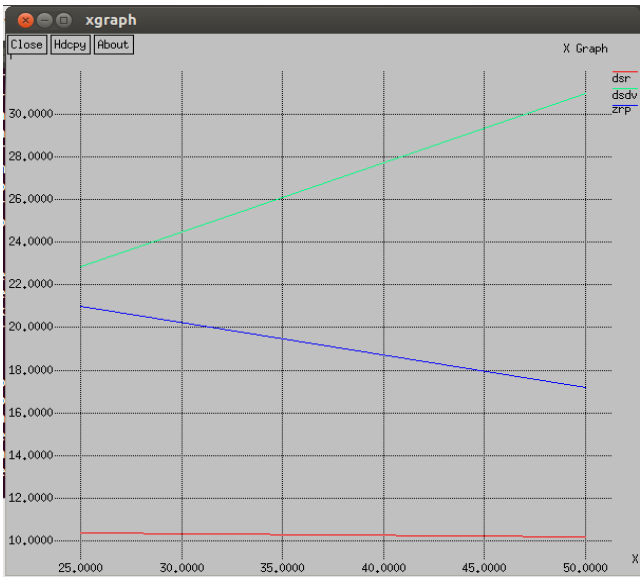


Figure 5.1 Average Throughput with varying number of nodes.

The above figure shows the clear result of average throughput. The performance of DSR is better than DSDV and ZRP for less number of nodes and large number of nodes in terms of average throughput. DSDV is better than ZRP for less number of nodes, and good for large number of nodes.ZPR performance is poor than the DSR, DSDV in terms of average throughput.

5.2 Average End-to-End Delay:

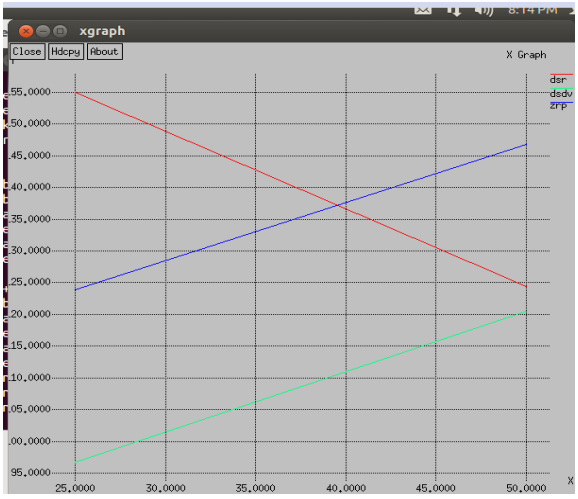


Figure 5.2 Average End-to-End Delay with varying number of nodes.

The above graph shows the clear result of Average end-to-end delay. The performance of DSR is decreases with respect to number of nodes increases. DSDV is better for large number of nodes. ZRP performance is increases with respect to number of nodes.

5.3Packet Delivery Ratio:

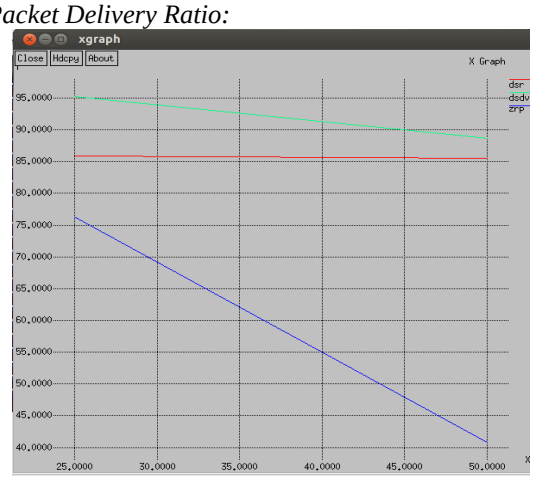


Figure 5.3 Packet Delivery Ratio with varying number of nodes.

The above graph shows the clear result of packet delivery ratio. The performance of DSDV is better for less number of nodes than the large number of nodes in terms of packet delivery ratio. The performance of ZRP is better for large number of nodes and good for large number of nodes.DSR performance shows slight difference for less and large number of nodes.

Table: Performance Evaluation of Three Protocols using Different Metrics in Various Scenarios:

METRICS	DSR		DSDV		ZRP	
	NUMBER OF NODES					
	25	50	25	50	25	50
Through put	10.35	10.20	22.85	30.95	21.01	17.21
Packet delivery ratio	85.8696%	85.567%	95.2107%	88.75%	76.2312%	40.8359%
End to end delay	154.934ms	124.421ms	96.7315ms	120.476ms	123.889ms	146.79ms

Conclusion and Future Work:

The goal of this paper was performance evaluation of MANET routing protocols such as reactive routing protocol, proactive routing protocol, hybrid routing protocol. The protocols are DSR, DSDV, ZRP..In this paper, the performance of MANET routing protocols have been analyzed under the three quantitative performance metrics (Throughput, Packet-delivery ratio and End to End Delay).The simulation result shown in the below table. The performance of DSDV is high for small number of nodes and large number of nodes than DSR and ZRP in terms of average throughput and packet delivery ratio. The performance of end to end delay is high for large number of nodes in terms of ZRP and end to end delay performance is high for less number of nodes in DSR. This work can be extended to the real time network which consists of more number of nodes. In this paper we choose only quantitative performance metrics, in future we will choose qualitative metrics such as security, scalability, multicasting loops.

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REFERENCES:

1. Tutorial for Simulation-based Performance Analysis of MANET Routing Protocols in ns-2By Karthik sadasivam.
2. Senthil Kumar, M. Venkatesh, C. Natarajan, A.M. ,"Performance comparison of multicast protocol for physically hierarchical ad hoc networks using neural concepts", in Proceedings of IEEE Seventh International Conference on Signal Processing ,2004.
3. Boukerche A, 2004. Performance Evaluation of Routing Protocols for Ad Hoc Wireless Networks. Journal on Mobile Networks and Applications: 333–342.
4. D. B. Johnson and D. A. Maltz, "Dynamic Source Routing in Ad hoc Networks, "Mobile Computing".
5. D. B. Johnson, D. A. Maltz, and J. Brooch, "DSR: the dynamic source routing protocol for multi-hop wireless ad hoc networks," in Ad Hoc Networking, Addison-Wesley, 2001, pp. 139-172.
6. Abolhasan M, Winsock T, Dutkiewicz E, 2004. A review of routing protocols for mobile ad hoc networks. Ad Hoc Networks 2: 1-22.
7. Zone Routing Protocol by Nicklaus Beiger, Networking laboratory, Helsinki University Of technology, Finland. Icentiate course on Telecommunications Technology, 2002.