Performance Evaluation of AODV,DSDV and DSR Routing Protocols

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Abstract— **In this paper we are considering the performance evaluation of three routing protocols in Mobile Ad-hoc Networks (MANETs). We have tested the effect of speed, no. of packets transmitted, lost and packet delay for Destination Sequence Distance Vector (DSDV) protocol, Dynamic Source Routing (DSR), Ad-hoc On Demand Distance Vector (AODV) . By results we can say that DSR shows the better performances as compared to AODV and DSDV routing protocols.**

KEYWORDS: MANETS-MOBILE ADHOC NETWORKS, AODV-ADHOC ON DEMAND DISTANCE VECTOR, DSR-DYNAMIC SOURCE ROUTING, DSDV-DESTINATION SEQUENCE DISTANCE VECTOR ROUTING

I. INTRODUCTION

The demand for speed in wireless networks is continuously increasing. Recently, cooperative wireless communication has received tremendous interests as an untapped means for improving the performance of information transmission operating over the ever-challenging wireless medium. However, recent advances in cooperative communications will offer a number of advantages in flexibility over traditional techniques. Cooperation alleviates certain networking problems, such as collision resolution and routing, and allows for simpler networks of more complex links, rather than complicated networks of simple links.

Therefore, many upper layer aspects of cooperative communications merit further research, e.g., the impacts on topology control and network capacity, especially in mobile ad hoc networks (MANETs), which can establish a dynamic network without a fixed infrastructure. A node in MANETs can function both as a network router for routing packets from the other nodes and as a network host for transmitting and receiving data. MANETs are particularly useful when a reliable fixed or mobile infrastructure is not available. Instant conferences between notebook PC users, military applications, emergency operations, and other secure-sensitive operations are important applications of MANETs due to their quick and easy deployment. Due to the lack of centralized control, MANET nodes achieve a common goal. The major activities involved in self-organization are neighbor discovery, topology organization, and topology reorganization. Network topology describes the connectivity information of the entire network, including the nodes in the network and the connections between them. Topology control is important for the overall performance of a MANET. To maintain reliable network connectivity, nodes in MANETs may work at the maximum radio power, which results in high nodal degree and long link distance, but more interference is introduced into the network and much less throughput per node can be obtained. Using topology control, a node carefully selects a set of its neighbors to establish logical data links and dynamically adjust its transmit power accordingly, so as to achieve high throughput in the network by keeping the energy consumption low.

II. MOBILE ADHOC NETWORKS

Mobile Ad hoc Networks (MANETs) are future wireless networks consisting entirely of mobile nodes that communicate in the absence of any centralized support. Nodes in these networks will both generate user and application traffic and carry out network control and routing duties. Routing protocols in ad hoc networks has received wide interest in the past years due to the fact that existing internet routing protocols were designed to support fixed infrastructure and their properties are unsuitable for mobile ad hoc networks. The up to date standardized protocols are classified into reactive and proactive protocols. Reactive protocols, such as AODV and DSR , find the route only when there is data to be transmitted and as a result, generate low control traffic and routing overhead. Proactive protocols like OLSR and DSDV , on the other hand, find paths in advance for all source and destination pairs and periodically exchange topology information to maintain them.

Destination Sequence Distance Vector (DSDV), Dynamic Source Routing (DSR), and Ad- hoc On Demand Distance Vector (AODV) are classified under flat ad-hoc routing protocols where all nodes play an equal role in routing and the addressing scheme is flat.

DSDV is a flat proactive (or table-driven) protocol. It sets up tables required for routing regardless of any traffic that would require routing functionality. An advantage of a proactive protocol is that it can give QoS guarantees related connection set-up, latency or other real- time requirements. A disadvantage of a proactive protocol is its overhead in lightly loaded networks. Periodic updates for the routing tables consume the batteries of mobile devices and generate a lot of unnecessary traffic (bandwidth).

Both DSR and AODV are flat reactive (or on-demand) protocols. They set up a path between the sender and the receiver only if a communication is waiting. An advantage of a reactive protocol is its scalability as long as there is only light traffic and low mobility. The disadvantages of these protocols are: (a) the initial search latency may degrade the performance of the interactive applications, (b) the quality of the path is unknown in advance, and (c) route caching mechanism is useless in high mobility networks as routes change frequently.

III. ADHOC ON-DEMAND DISTANCE VECTOR ROUTING

Ad hoc On-Demand Distance Vector (AODV) Routing is a routing protocol for mobile ad hoc networks (MANETs) and other wireless ad-hoc networks. It is a reactive routing protocol, meaning that it establishes a route to a destination only on demand. In contrast, the most common routing protocols of the Internet are proactive, meaning they find routing paths independently of the usage of the paths.

In AODV, the network is silent until a connection is needed. At that point the network node that needs a connection broadcasts a request for connection. Other AODV nodes forward this message, and record the node that they heard it from, creating an explosion of temporary routes back to the needy node. When a node receives such a message and already has a route to the desired node, it sends a message backwards through a temporary route to the requesting node.

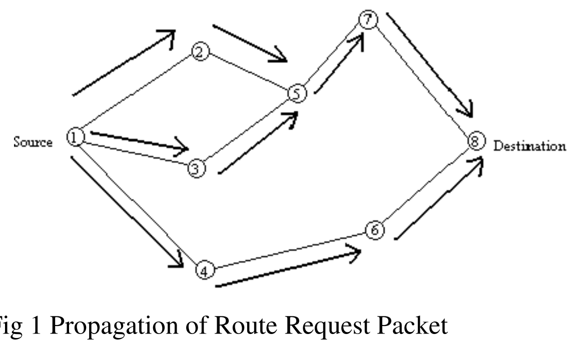


Fig 1 Propagation of Route Request Packet

The needy node then begins using the route that has the least number of hops through other nodes. Unused entries in the routing tables are recycled after a time. When a link fails, a routing error is passed back to a transmitting node, and the process repeats. Much of the complexity of the protocol is to lower the number of messages to conserve the capacity of the network.

Also, multiple Route Reply packets in response to a single Route Request packet can lead to heavy control overhead. Another disadvantage of AODV is unnecessary bandwidth consumption due to periodic beaconing.

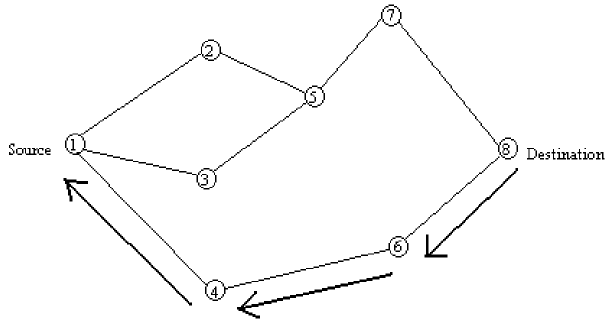


Fig 2 Path taken by the Route Reply Packet

Each AODV router is essentially a state machine that processes incoming requests from the SWANS network entity. When the network entity needs to send a message to another node, it calls upon AODV to determine the next-hop. Whenever an AODV router receives a request to send a message, it checks its routing table to see if a route exists. Each routing table entry consists of the following fields:

· Destination address
· Next hop address
· Destination sequence number
· Hop count

If a route exists, the router simply forwards the message to the next hop. Otherwise, it saves the message in a *message queue*, and then it initiates a route request to determine a route. The following flow chart illustrates this process:

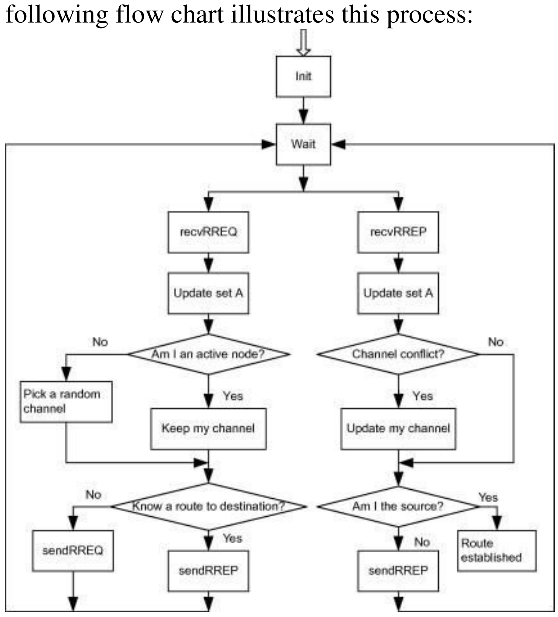


Fig 3 Flow Chart for AODV Protocol Design

ADVANTAGE AND DISADVANTAGE OF AODV

The advantage of AODV is that it creates no extra traffic for communication along existing links. Also, distance vector routing is simple, and doesn't require much memory or calculation. However AODV requires more time to establish a connection, and the initial communication to establish a route is heavier than some other approaches. The main advantage of this protocol is having routes established on demand and that destination sequence numbers are applied for find the latest route to the destination. The connection setup delay is lower.

One disadvantage of this protocol is that intermediate nodes can lead to inconsistent routes if the source sequence number is very old and the intermediate nodes have a higher but not the latest destination sequence number, thereby having stale entries.

IV. DESTINATION SEQUENCED DISTANCE VECTOR ROUTING

Destination-Sequenced Distance-Vector Routing (DSDV) is a table-driven routing scheme for ad hoc mobile networks based on the Bellman-Ford algorithm. The main contribution of the algorithm was 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. Packets are transmitted between the stations of the network by using routing tables which are stored at each station of the network. Each routing table, at each of the stations, lists all available destinations, and the number of hops to each. Each route table entry is tagged with a sequence number which is originated by the destination station. To maintain the consistency of routing tables in a dynamically varying topology, each station periodically transmits updates, and transmits updates immediately when significant new information is available.

Our proposed routing method allows a collection of mobile computers, which may not be close to any base station and can exchange data along changing and arbitrary paths of interconnection, to afford all computers among their number a (possibly multi-hop) path along which data can be exchanged. In addition, our solution must remain compatible with operation in cases where a base station is available. By the methods outlined in this paper not only will routing be seen to solve the problems associated with ad-hoc networks, but in addition we will describe ways to perform such routing functions at Layer 2, which traditionally has not been utilized as a protocol level for routing. Since we do not assume that the mobile hosts are maintaining any sort of time synchronization, we also make no assumption about the phase relationship of the update periods between the mobile hosts. These packets indicate which stations are accessible from each station and the number of hops necessary to reach these accessible stations, as is often done in distance-vector routing algorithms. It is not the purpose of this paper to propose any new metrics for route selection other than the freshness of the sequence numbers associated with the route; cost or other metrics might easily replace the number of hops in other implementations. The packets may be transmitted containing either layer 2 (MAC) addresses or layer 3 (network) addresses. Routing information is advertised by broadcasting or multicasting the packets which are transmitted periodically and incrementally as topological changes are detected - for instance, when stations move within the network. Data is also kept about the length of time between arrival of the first and the arrival of the best route for each particular destination. Based on this data, a decision may be made to delay advertising routes which are about to change soon, thus damping fluctuations of the route tables. The advertisement of routes which may not have stabilized yet is delayed in order to reduce the number of rebroadcasts of possible route entries that normally arrive with the same sequence number.

The DSDV protocol requires each mobile station to advertise, to each of its current neighbors, its own routing table (for instance, by broadcasting its entries). The entries in this list may change fairly dynamically over time, so the advertisement must be made often enough to ensure that every mobile computer can almost always locate every other mobile computer of the collection. In addition_ each mobile computer agrees to relay data packets to other computers upon request. This agreement places a premium on the ability to determine the shortest number of hops for a route to a destination we would like to avoid unnecessarily disturbing mobile hosts if they are in sleep mode. In this way a mobile computer may exchange data with any other mobile computer in the group even if the target of the data is not within range for direct communication. If the notification of which other mobile computers are accessible from any particular computer in the collection is done at layer 2, then DSDV will work with whatever higher layer (e.g., Network Layer) protocol might be in use.

The data broadcast by each mobile computer will contain its new sequence number and the following information for each new route:

- The destination's address
- The number of hops required to reach the destination and
- The sequence number of the information received regarding that destination, as originally stamped by the destination

This total paper is practically applied using the specifications that are defined through Highly Dynamic Destination Sequenced Distance Vector Routing Algorithm.

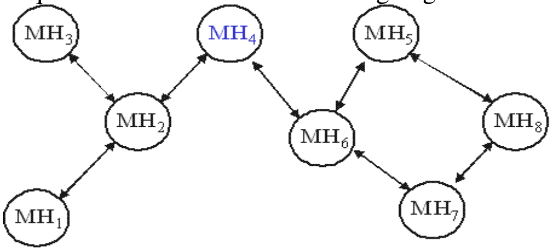


Fig 4 Example of DSDV Operation

SELECTION OF ROUTE:

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.

V.DYNAMIC SOURCE ROUTING

'Dynamic Source Routing' (**DSR**) is a routing protocol for wireless mesh networks. It is similar to AODV in that it forms a route on-demand when a transmitting computer requests one. However, it uses source routing instead of relying on the routing table at each intermediate device.

ROUTING IN DSR

Determining source routes requires accumulating the address of each device between the source and destination during route discovery. The accumulated path information is cached by nodes processing the route discovery packets. The learned paths are used to route packets. To accomplish source routing, the routed packets contain the address of each device the packet will traverse. This may result in high overhead for long paths or large addresses, like IPv6. To avoid using source routing, DSR optionally defines a flow id option that allows packets to be forwarded on a hop-by-hop basis.

This protocol is truly based on source routing whereby all the routing information is maintained (continually updated) at mobile nodes. It has only two major phases, which are Route Discovery and Route Maintenance. Route Reply would only be generated if the message has reached the intended destination node (route record which is initially contained in Route Request would be inserted into the Route Reply). To return the Route Reply, the destination node must have a route to the source node. If the route is in the Destination Node's route cache, the route would be used. Otherwise, the node will reverse the route based on the route record in the Route Request message header (this requires that all links are symmetric). In the event of fatal transmission, the Route Maintenance Phase is initiated whereby the Route Error packets are generated at a node. The erroneous hop will be removed from the node's route cache; all routes containing the hop are truncated at that point. Again, the Route Discovery Phase is initiated to determine the most viable route.

FLOW OF DSR ALGORITHM:

There are two basic parts of DSR protocol: route discovery and route maintenance. Every node maintains a cache to store recently discovered paths. When a node wants to send a packet to a particular node, it first checks the cache whether there is an entry for that. If yes then it uses that path to transmit the packet. Also it attaches its source address on the packet. If there is no entry in the cache or the entry is expired (due to long time unused), the sender broadcasts a route request packet to all its neighbors asking for a path to the destination. Until the route is discovered, the sender host will be waiting and during this time it can do other things like sending other packets or forwarding other packets. When the route request packet arrives to any other nodes, they check whether they know the destination asked (may be from neighbor or from their caches).

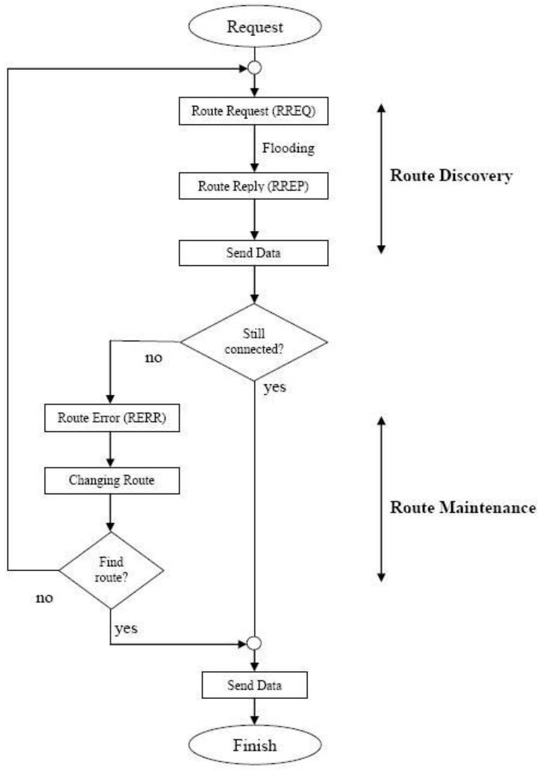


Fig 5 Flow Chart for DSR

If they have route information, they send back a route reply packet to the destination. Otherwise they broadcast the same route request packet. Once the route is discovered, the sender will send its required packets using the discovered route as well as insert an entry in the cache for future use. Also the node keeps the age information of the entry to recognize whether the cache is fresh or not.

When any intermediate node receives a data packet, it first sees whether the packet is sent to itself or not. If it is the destination, it receives that. Or it forwards the packet using the path attached on the packet. As ad-hoc network is very promiscuous, anytime any link might fail. So route maintenance process monitors and notifies the nodes if there is any failure in the path. And accordingly the nodes change the entries of their route cache.

ADVANTAGE AND DISADVANTAGE

This protocol uses a reactive approach which eliminates the need to periodically flood the network with table update messages which are required in a table-driven approach. In a reactive (on-demand) approach such as this, a route is established only when it is required and hence the need to find routes to all other nodes in the network as required by the table-driven approach is eliminated. The intermediate nodes also utilize the route cache information efficiently to reduce the control overhead.

The disadvantage of this protocol is that the route maintenance mechanism does not locally repair a broken link.

Stale route cache information could also result in inconsistencies during the route reconstruction phase. The connection setup delay is higher than in table-driven protocols. Even though the protocol performs well in static and low-mobility environments, the performance degrades rapidly with increasing mobility. Also, considerable routing overhead is involved due to the source-routing mechanism employed in DSR.

VI.NETWORK SIMULATOR

NS - Network Simulator is a name for series of discrete event network simulators, specifically ns-1, ns-2 and ns-3. All of them are discrete-event network simulator, primarily used in research and teaching. ns-3 is free software, publically available under the GNU GPLv2 license for research, development, and use.

PURPOSE OF USING NS-2:

The goal of the ns-2 project is to create an open simulation environment for networking research that will be preferred inside the research community; this mainly means two things:

- It should be aligned with the simulation needs of modern networking research and
- It should encourage community contribution, peer review, and validation of the software.

Since the process of creation of a network simulator that contains a sufficient number of high-quality validated, tested and actively maintained models requires a lot of work, ns-2 project spreads this workload over a large community of users and developers. The core of ns-2 is also written in C++, but the C++ simulation objects are linked to shadow objects in OTcl and variables can be linked between both language realms. Simulation scripts are written in the OTcl language, an extension of the Tcl scripting language. This structure permits simulations to be written and modified in an interpreted environment without having to resort to recompiling the simulator each time a structural change is made. In the timeframe in which ns-2 was introduced , this provided both a significant convenience in avoiding many time-consuming recompilations, and also allowing potentially easier scripting syntax for describing simulations. ns-2 has a companion animation object known as the Network Animator, nam-1, originally written by Mark Handley, used for visualization of the simulation output and for (limited) graphical configuration of simulation scenarios. Presently, ns-2 consists of over 300,000 lines of source code, and there is probably a comparable amount of contributed code that is not integrated directly into the main distribution (many forks of ns-2 exist, both maintained and unmaintained). It runs on Linux, FreeBSD, Solaris and Mac OS X. It is licensed for use under version 2 of the GNU General Public License.

VII. SIMULATION RESULTS

TABLE 1 PERFORMANCE OF AODV:

NO OF NODES	PACKET DELIVERY RATIO	END TO END DELAY
20	99.7953	0.00897853
30	99.5906	0.0139414
40	99.8976	0.011977
50	99.2835	0.0120311

Fig 6 NODES VERSUS PDR IN AODV

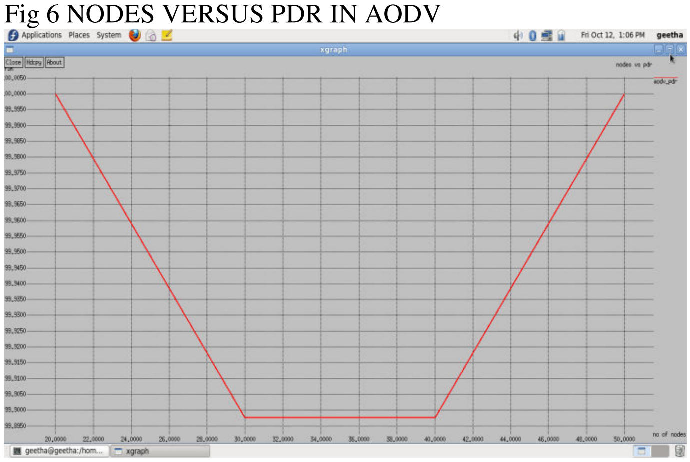


TABLE 2 PERFORMANCE OF DSDV:

NO OF NODES	PACKET DELIVERY RATIO	END TO END DELAY
20	98.9949	0.00592228
30	97.9734	0.0119412
40	99.4186	0.0120424
50	99.3265	0.0059386

Fig 7 NODES VERSUS PDR IN DSDV

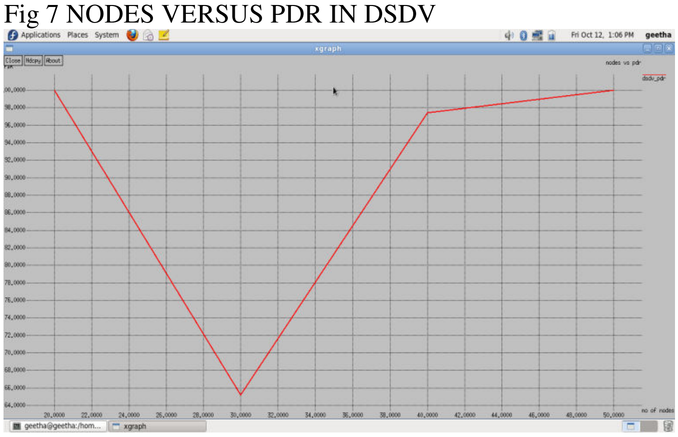


TABLE 3 PERFORMANCE OF DSR:

NO OF NODES	PACKET DELIVERY RATIO	END TO END DELAY
20	99.6257	0.012412
30	99.4358	0.0139956
40	98.3383	0.106257
50	99.8084	0.00583561

Fig 8 NODES VERSUS PDR IN DSR

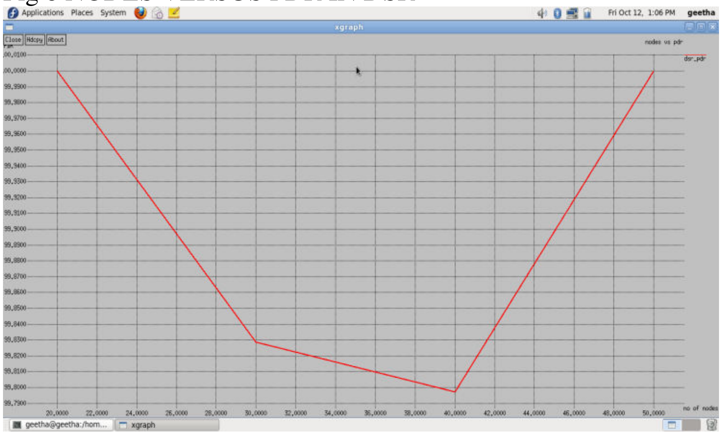
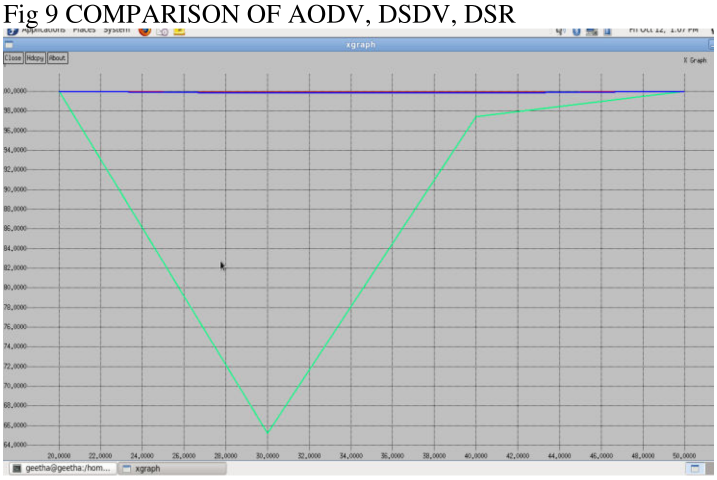


Fig 9 COMPARISON OF AODV, DSDV, DSR



Here, we have analyzed various existing routing protocols by measuring the packet delivery ratio, end to end delay with respect to varying number of nodes.

Thus, from the above simulation results we conclude that DSR has better performance when compared to the other protocols .In DSR, a route is established only when it is required and hence the need to find routes to all other nodes in the network as required by the table-driven approach is eliminated. The intermediate nodes also utilize the route cache information efficiently to reduce the control overhead.

VII.CONCLUSION

In this project, we have introduced physical layer cooperative communications, topology control, and network capacity in MANETs. To improve the network capacity of MANETs with cooperative communications, we have proposed a Capacity- Optimized Cooperative (COCO) topology control scheme that considers both upper layer network capacity and physical layer relay selection in cooperative communications. Simulation results have shown that physical layer cooperative communications techniques have significant impacts on the network capacity, and the proposed topology control scheme can substantially improve the network capacity in MANETs with cooperative communications. we have analyzed various existing routing protocols by measuring the packet delivery ratio, end to end delay with respect to varying number of nodes.

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