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# Comparative Analysis of Ad Hoc Routing Protocols

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**Abstract:** MANET has become the most popular network nowadays for communication. Communication is being done without any need of establishing heavy centralized fixed node architecture. Nodes are mobile, so nodes need cooperation of other nodes to maintain route in the network. The topology keeps on changing in MANETS effecting different aspects of network. There are many aspects on which routing depend in a MANET. Many evaluations of comparisonshave been done using different scenarios resulting in different results. A variation of result may be found in different scenarios. We have briefly evaluated a comparison of AODV, OLSR, DSR and GRP protocols. A different scenario was created to evaluate their performances. This paper focuses on the performance of these protocols by four matrices namely throughput, delay, load and retransmission attempts. The overall goal was to determine the more suitable protocol for routing in ad-hoc MANET in a mobile network. Different protocols performed better in different metrics. We have carried out simulations in OPNET tool.

**Key words:** MANET · Routing Protocols · AODV · OLSR · DSR · GRP

## INTRODUCTION

MANET is collection of multiple nodes which communicate with each other through wireless medium. World has changed into a global village through MANETS, as communication is more simplified in areas where establishing a centralized station based structure is difficult. For example in a war soldiers need to communicate with each other [1]. Establishing a wired fixed infrastructure in such situations is very difficult. Through MANET this is done really simply and efficiently. There is no fixed architecture so nodes keeps updating its route through control signals to keep track of the neighboring nodes in order to maintain the route. Each node can send and receive packets i.e. acts as a host and a router that are not in same radio range [2]. There are many parameters of MANET applications such as throughput, hop count, quality of service, packet loss ratio e.tc. Many ad-hoc protocols are developed in order to compensate the drawbacks of older routing protocols. The organization of paper is as follows. Section 2 explains the mechanism of routing protocols. Section 3 explains the experimental parameters which are used for simulations. Section 4 concludes the results and related discussion. At the end in section 5 conclusions is given.

**Routing Protocols in Ad-hoc Manet:** A routing protocol is a mechanism by which user traffic is focused and transported through the network from source node to destination node. A protocol is a set of rules that must be obeyed by the user in order to send a packet to destination. Ad-hoc routing protocols are placed into different categories depending upon their nature and working mechanism. The main goal is to use an efficient protocol according to the scenario with reduce reduced cost. OLSR is a proactive protocol which keeps updating its information even when no route or connection is required. AODV is reactive protocol which establishes a route only when it's needed [1]. GRP is a hybrid protocol which combines the features of both proactive and reactive protocols [2]. Following is a brief overview of these protocols.

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**OLSR (Optimized Link State Routing):** OLSR is a proactive link state protocol used in Ad-hoc network [1]. In Link state protocols, every node in the network knows which node is connected to which one on these bases each node constructs its own best path to that point to the destination. This protocolis basically an optimization of traditional link state protocol developed for mobile ad-hoc network [3]. As being proactive it keeps the information about all the routes in the network and keeps updating it all the time. OLSR uses the concept of MPR's. MPR's broadcasts hello messages for link detection in the network [1]. Every node can get information of its two hop-neighbor nodes in the network. Each node selects its set of MPR's in the network. Through MPR'S nodes keep the neighbor detection and route maintenance mechanism working. Through MPR'S the overhead in flooding mechanism is quietly reduced. OLSR is preferably used in large network and denser networks. The more the denser is the network, the more OLSR will be perform better. Entire information is not passed between the nodes only control messages are passed between the MPR's. Each node keeps it own route table.

**DSR (Dynamic Source Routing):** DSR is a reactive protocol that discovers and establishes routes between nodes [4]. It is a very simple protocol used on ad-hoc network.DSR uses source routing in which the originator node adds all the information of the intermediate nodes through which the packet will travel in its header. The packet knows which path it has to follow therefore the intermediate node does not need to update its routing information. Sender node sends the data over the route if there is a route in the route cache. If there is no route to the destination a Route discovery is initiated. DSR always used the shortest path to the destination.

**AODV (ad-hoc on Demand Distance Vector):** AODV is a multi-hop on-demand routing protocol [5]. The AODV algorithm allows the nodes to obtain routes quickly to the destination and can easily adapt to the varying and sudden changes in link situations. Link failure notifications are sent to the affected nodes in the network instead of broadcasting to entire network and wasting resources. When link failure notification is received all routes through these affected nodes are cancelled to avoid further delay in communication. AODV uses only a single best path for communication so network usage in communication is minimum as all routes for communication are build on demand also reducing

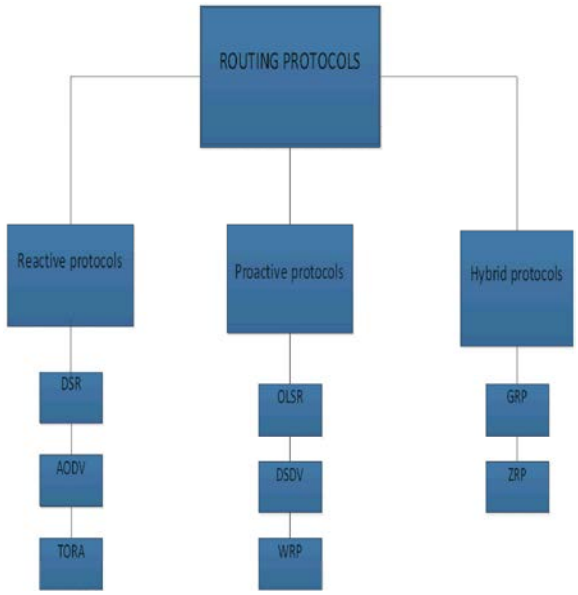


Fig. 1: Routing protocols category

the network traffic. Extra routing information is not kept in AODV. AODV algorithm establishes routes when we need communication between two nodes. AODV has a distinguishing feature known as the destination sequence number which is helpful in avoiding loops which was a big problem in legacy routing protocols in the past [5]. Another approach used by a protocol is a learning automata agent which keeps on running at every node so that the packets would be routed choosing the best path leading to optimized used of energy [6].

**GRP (Geographic Routing Protocol):** GRP is mostly categorized as a hybrid protocol. It possesses both the qualities of a reactive and proactive protocol. It implies regional and hierarchal regional method to reduce flooding in the network [5]. A GRP minimizes the overhead in the network. Source node gathers all the information about the network. Sender node sends a query packet to destination. When this packet arrives at the destination, the destination then sends NIG (network gathering information) packet to neighboring nodes which contains all the information [4]. It also saves network resources. For fast and secure transmission, a mechanism to reduce waiting time for efficient processing and minimum time transmission by enhanced security using central agent and process algorithm has been introduced in [7]. Improved security is also an essential need to prevent intrusions by updating peer node information in signaling phase [8].

Table 1: Simulation parameters

| Environment statistics | Value |
|---|---|
| Network Simulator | OPNET 14.5 |
| Simulated protocols | AODV,DSR,OLSR,GRP |
| Medium Access Control Protocol | IEEE 802.11 a |
| Area Size of Environment | 10km X10 km |
| Number of nodes (N) | 30 |
| Bandwidth | 1 Mb/sec |
| Node Transmission Range | 1500 meters |
| MANET Trajectory | Vector |
| Transport Layer Protocol | TCP |
| Mobility Model | Random Waypoint |
| Simulation Time | 1800 seconds |

**Simulation Enviroment and Parameters:** In Table 1, network model is designed with 30 modes and has observed its performance.

Results are observed on basis of four parameters delay, load, retransmission attempts and throughput respectively. The network consists of mobile nodes. The simulation setup time is 30 minutes in the office setup with area of 10 x 10 km.

## RESULT ANAYLISIS AND DISCUSSION

**Delay:** A delay is a parameter which is measured by the time taken by a bit to travel from source to node in a network. Mostly it is measured in seconds.

The network delay for 30 nodes is shown in fig. 2. As we can see initially DSR has the highest delay mostly because all the information in DSR is included in the packet's header before the transmission of the packet, but later as the network is small and nodes does not have to keep information about neighboring nodes as all the information is already in the packet, the delay later becomes very low. After that AODV has the second highest delay. GRP has a medium delay.OLSR has the lowest delay in the network because of its proactive nature.

**Load:** The load is basically the congestion in the network. Due to high traffic and mobility the route becomes congested. With increase of overhead the data over a path becomes highly dense which creates bottlenecks in the network and the load becomes very high.

The network load is basically the measure of networks overall traffic. A load is increased if there is too much traffic in the route which has caused congestion or the bandwidth is small and the traffic is large. As simulations shows in fig. 3 AODV has highest network

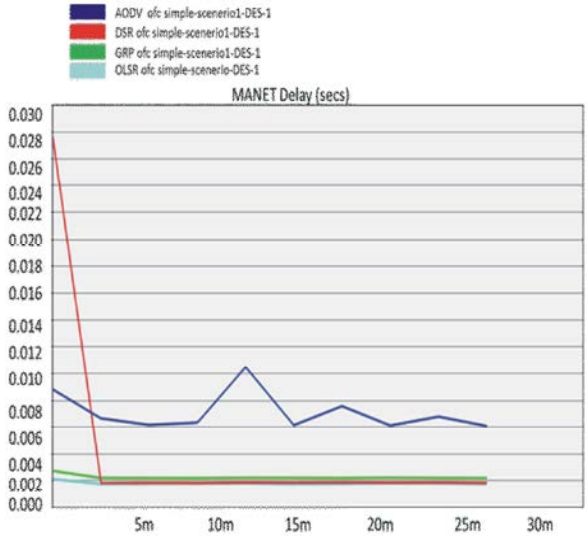


Fig. 2: Comparison of network delay in 30 nodes

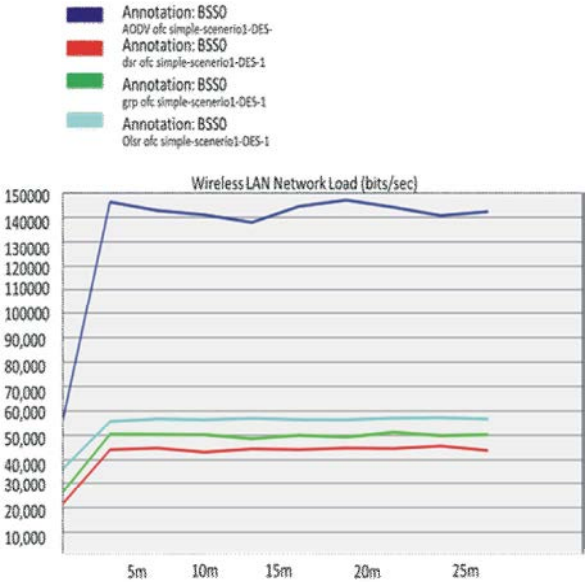


Fig. 3: Comparison of network load in 30 nodes

load in the network. OLSR has the second highest traffic load in the network followed by GRP which has medium load in the network.GRP is based on the mechanism to minimize flooding in the network. Due to which the overhead in the network is decreased rapidly and load is rapidly minimized. However DSR has lesser load then other protocols the reason behind is that DSR performs so much better in small networks.

**Retranmission Attempts:** The number of attempts that a protocol does inorder to retransmit the packet if the link is being broken. The more the number of retransmission attempts the more load will be on the network.

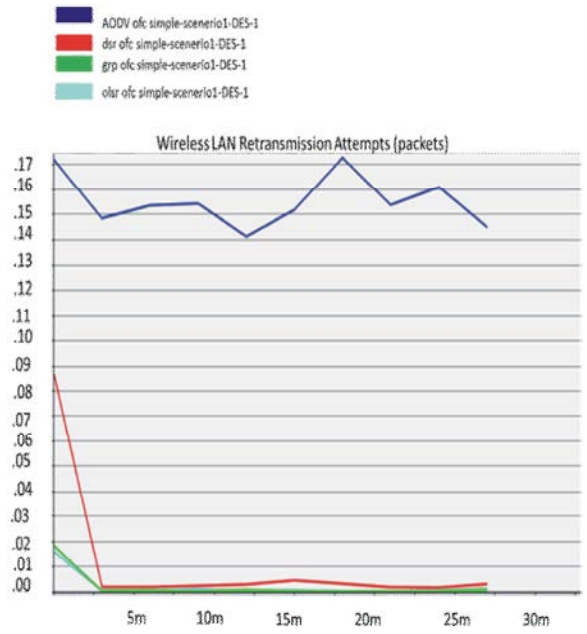


Fig. 4: Comparison of retransmission attempts in 30 nodes

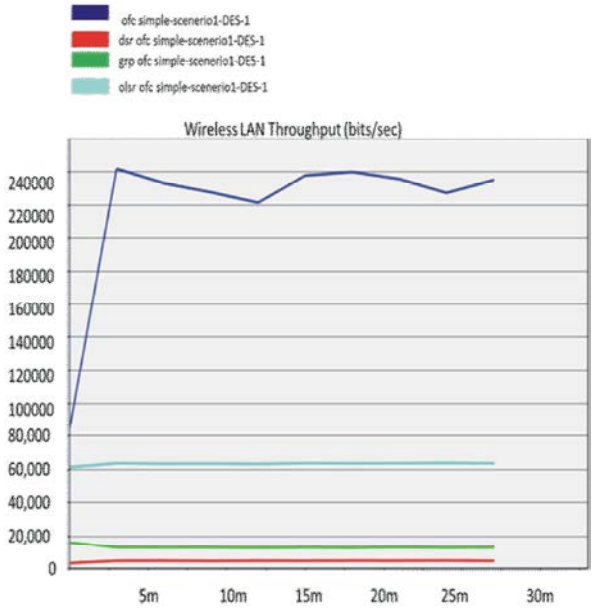


Fig. 5: Comparison of throughput in 30 nodes

The number of retransmission attempts by each node is shown in fig. 4. AODV has the highest number of retransmission attempts in the network due to which AODV will have more load in its network which is moreevident in fig. 3. DSR has the second highest number of retransmission attempts. OLSR and GRP have almost the same number of retransmission attempts in the network but GRP has slight more number of retransmission then OLSR.

**Throughput:** It's a ratio of packets that are delivered from source to destination successfully. It is measured in bits per second. The performance of protocol is mainly measured by the performance that it shows in the network. Throughput is the basically the measure of how much data can be sent successfully. If a protocol can send more data compared to other in the same network scenario then obviously that has better performance than the rest.

As shown in fig. 5 AODV shows by far and large more throughput than any other protocol. OLSR has second highest throughput. GRP and DSR have lower throughput.

## CONCLUSIONS

In this paper we discussed different aspects of DSR AODV OLSR and GRP through simulations on a network of mobile nodes. The objective was to find which protocol is more efficient in such scenario. AODV as being reactive protocol outperformed all other protocols. Its throughput was far much better than other protocols. However OLSR had less delay and less retransmission attempts comparatively others due to the proactive nature of the protocol. DSR has the lowest load in the network mainly due to small overhead and the network is also small aiding in lesser load as DSR performs better in small network. Summarizing this simulation we can say that AODV is best suited for network consisting of mobile nodes. However different simulation results will be obtained in a changed scenario. The performance varies significantly by varying the scenario.

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