# Comparison of AODV, OLSR, TORA and OSPFv3 at Terrestrial Level

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## Abstract

*Mobile Ad hoc networks represent complex distributed systems that comprise collection of mobile nodes. Routing protocols are developed to support user communication in networks. Ad hoc network nodes dynamically forming a temporary network without the use of any existing network infrastructure or centralized administration. These networks need efficient routing protocols; various ad hoc routing protocols have been proposed and compared based on some metrics. We present he analytical simulation results of routing protocols AODV, OLSR, TORA and OSPFv3 using the network simulator OPNET Modeler 14.0 Educational Version.*

## 1. Introduction

Ad Hoc network is the kind of infrastructure less network, where nodes are the moving devices and even the number of nodes in the network can vary at any specific time. Nodes may change their network and can enter into another network in their range. Ad Hoc network architectures are that which can self deploy, reconfigure in the presence of link failures due to node mobility and can potentially have a large number of nodes. A mobile Ad Hoc network can be constructed with few nodes as 2 nodes and it may extend with hundreds or thousands of wireless mobile nodes. Mobile Ad Hoc network is the network of wireless devices where each device is free to move independently in any direction. These mobile devices can change their links frequently. Routing protocols of Mobile Ad Hoc network are used to discover various routes from source to destination. Mobile Ad Hoc network routing protocols must be capable for handling large number of nodes with minimum energy resources. These routing protocols must be capable of handling host mobility as nodes in the Ad Hoc networks appear and disappear from one place to another very frequently [1].



## 2. Routing

Routing is the name given to choose a path. Routing in Mobile Ad Hoc Network means to pick out a suitable and right path from source to destination. Routing terminology is used in different types of networks. Here we are more concern about routing in Mobile Ad Hoc Networks. Routing protocols in Mobile Ad Hoc Networks means that the mobile nodes will search for a path or route to connect to each other and share the data packets. Protocols are the set of rules through which two or more devices can communicate with each other. Mobile Ad Hoc Networks mostly did the routing with the help of routing tables. These routing tables are kept in the cache memory of the mobile nodes. When routing process is going on, it route the data packets in different mechanisms.

## 3. Routing protocols

Routing protocols are used to discover various routes to send data over the network from source to destination. Routing protocols i n Mobile Ad Hoc Network are divided into two categories, one is proactive category where the nodes always maintain current up to date routing information. It is achieved by connecting to nodes all the time by sending periodic updates to each other, and second is reactive category where protocols act as distance vector routing algorithm and find nodes on demand when required but no periodic updates is there.

### 3.1 Ad Hoc on Demand Distance Vector Routing (AODV)

AODV provides on demand route discovery in mobile Ad hoc networks. Like most reactive routing protocols, route finding is based on a route discovery cycle involving a unicast reply while searching a broadcast network. When a source node has data packets to send to some destination, it first checks its route table to determine whether it already has a route to the destination. If such a route exists, it can use that route for data packet transmissions. Otherwise, it must initiate a route discovery procedure to find a route. In AODV there is no broadcasts to every change in the network to every node if a link breakage does not affect ongoing transmission, No global broadcast occurs. Only affected nodes are informed. Local movements of nodes have local effects. AODV reduces the network wide broadcasts to the extent possible significant reduction in control overhead as compared. AODV nodes maintain a route table in which next hop routing information for destination nodes is stored. Each routing table entry has an associated lifetime value. If a route is not utilized within the lifetime period then the route expires. Otherwise, each time the route is used. The lifetime period is updated so that the route is not prematurely deleted. AODV relies on node sequence numbers for loop freedom and for ensuring selection of the most recent routing path.

### 3.2 Optimized Link State Routing (OLSR)

OLSR is a proactive routing protocol and is also called a table driven protocol because it permanently stores and updates its routing table. OLSR keeps track of its routing table in order to provide a route if needed. OLSR protocol performs hop by hop routing, i.e. each node uses its most recent information to route a packet. Therefore, when a node is moving, its packet can be successfully delivered to it, if its speed is such that its movement could be followed in its neighborhood at least. The protocols thus support a node mobility that can be traced through its local control messages, which depends upon the frequency of these messages [24], [30].

### 3.3 Temporally Ordered Routing Algorithm (TORA)

TORA is source-initiated on-demand routing protocol. It is designed to operate in a highly dynamic mobile networking environment. It is source initiated and provides multiple routes for any desired source destination pair. The key design concept of TORA is the localization of control messages to a very small set of nodes near the occurrence of a topological change. To accomplish this, nodes need to maintain routing information about adjacent nodes. TORA is built on the concept of link reversal of Directed Acyclic Graph. The protocol performs three basic functions: Route creation, Route maintenance and Route erasure [6].In addition to being loop-free and bandwidth-efficient, TORA has the property of being highly adaptive and quick in route repair during link failure, while providing multiple routes for any desired source/destination pair. These features make it especially suitable for large highly dynamic Mobile Ad Hoc environments with dense populations of nodes [22]. The main objective of TORA is to limit control message propagation in the highly dynamic mobile computing environment. Each node has to explicitly initiate a query when it needs to send data to a particular destination [6], [23].TORA can operate in either On-Demand or Proactive mode. TORA broadcasts a Query message when traffic needs to be transmitted and there is no known route to the destination. Update packets are returned to the source by an intermediate node with a route to the destination. TORA can provide multiple routes to a destination and minimizes protocol overhead by localizing reaction to topological changes [23], [26].

### 3.4 Open Shortest Path First version 3 (OSPFv3)

OSPFv3 enhancements for Mobile Ad Hoc Networks (MANETs) help optimize the performance and scalability of OSPFv3 in highly dynamic, wireless mobile environments. OSPFv3 has more efficient flooding of routing updates when the network topology changes. OSPFv3 MANET enhancements improve routing efficiency and reduce overhead traffic in mobile ad hoc environments, so that network clusters can scale to support more users. It reduces overhead traffic associated with periodic Hello packets. The implementation of a new MANET interface type designed specifically for wireless networks. OSPFv3 enables to be extended into Ad hoc an environment which reduces complexity by eliminating the need to implement another protocol.

## 4. Experimental Design

The goal of this study is together the knowledge about various networking parameters, how to measure the performance of the network, what are the possible solutions for enhancement in performance. The simulator used in study is OPNET Modeler 14.0 - Educational Version.

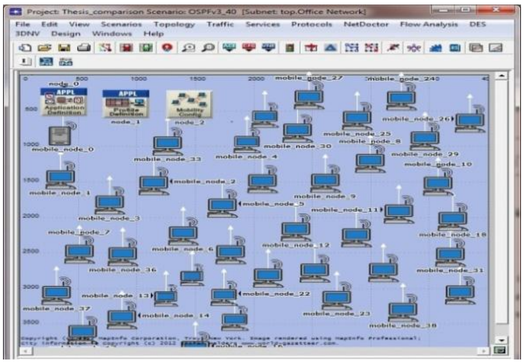

**Figure 1: Scenario layout**

The various simulation parameters are as per following Table 1.

**Table 1: Simulation parameters and their values**

| S. No. | Parameters | Values |
|---|---|---|
| 1. | Simulator | OPNET Modeler 14.0 Educational Version |
| 2. | Protocol Studied | AODV,OLSR, TORA,OSPFv3 |
| 3. | Buffer Size (bits) | 256000 |
| 4. | Simulation Time | 10 minutes |
| 5. | Speed | 128 |
| 6. | Number of Nodes | 40 nodes |
| 7. | Bandwidth | 2 Mbps |
| 8. | Data Payload | Bits per second |



## 5. Results

The performance of above four Ad Hoc routing protocols AODV, OLSR, TORA, and OSPFv3 are compared on the basis of various metrics. The metrics used to compare the performance are Data Dropped, Delay, Load, Media Access Delay, Network Load, Retransmission Attempts, and Throughput.

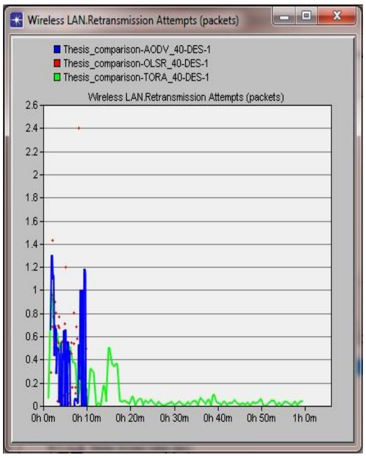


**Figure 2: Retransmission attempts**

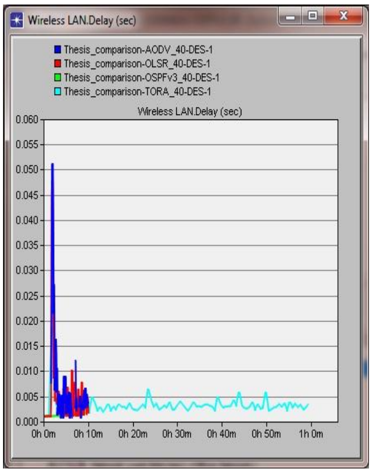


**Figure 3: Ethernet delay**

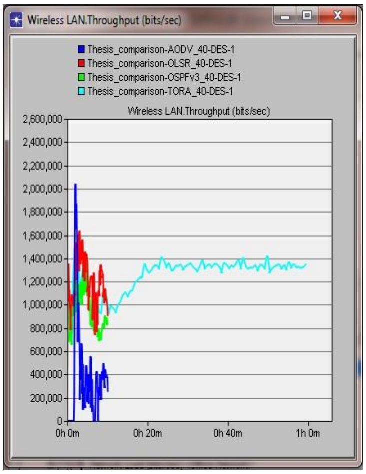


**Figure 4: Throughput**

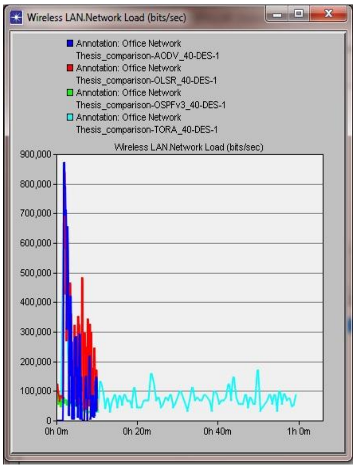


**Figure 5: Network load**

Results are concluded for all four routing protocols for performance metrics Retransmission, Ethernet Delay, Throughput, and Load.

**Table 2: Simulation results**

| Parameters | AODV | OLSR | TORA | OSPFv3 |
|---|---|---|---|---|
| **Retransmission** | 1.31 packets/sec | 2.4 packets/sec | 3 packets/sec | 3 packets/sec |
| **Ethernet Delay** | 0.052 seconds | 0.047 seconds | 0.046 seconds | 0.0018 seconds |
| **Throughput** | 2003000 bits/sec | 1600000 bits/sec | 1790000 bits/sec | 1370000 bits/sec |
| **Load** | 870000 bits/sec | 845000 bits/sec | 850000 bits/sec | 80000 bits/sec |

## 6. Conclusions

It is evident from Table 2 that the performance of OSPFv3 for all the parameters under consideration is fine as compared to other protocols. On the other hand TORA is performing worst in almost all parameters. The study of these Mobile Ad Hoc routing protocols shows that the OSPFv3 is better according to our simulation results because it shows almost low or tolerable load even other parameters are also showing reliable results such as throughput and retransmission attempts but it is not necessary that OSPFv3 perform always better in all the networks. Performance may vary due to the variation in network type.



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