Comparative analysis of OLSR and Tora under IPv6 environment

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Abstract

A Mobile Ad Hoc Network (MANET) is an autonomous network that can be formed without any established infrastructure. It consists of mobile nodes equipped with a wireless interface that are free to move and establish communication on the fly. The mobile nodes act as hosts and routers, having routing capabilities for multi-hop paths connecting nodes which cannot directly communicate. Wireless Communication technology is exploring at very fast rate which lead to the increase in demand of infrastructure with such demand it is very difficult to have that much of fixed infrastructure. Routing is the prime concerns in Manet network as there are many dependency while choosing appropriate protocol for routing. OLSR and TORA are two most popular and hugely used protocols in Manet network. These two are different in their behavior as OLSR is a proactive protocol and TORA is a Reactive protocol. These two widely used protocols are compatable with new version of internet known as Ipv6. In our research we have done comparative analysis for these two protocols under Interenet Protocol version 6 so that the issues and analysis for both can be analyzed.

Keywords: Adhoc network, optimized link sate routing protocol, Temporally Ordered Routing Algorithm, Adhoc network routing protocols. Internet protocol version 6, interenet protocol version 4

1. INTRODUCTION

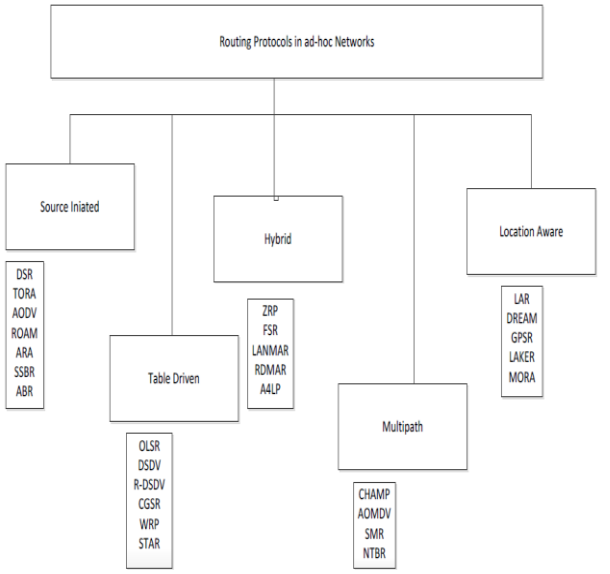
Recent advances in wireless communications and electronics have enabled the development of low-cost, low power, multifunctional sensor nodes that are small in size and communicate unmetered in short distances. Wireless communication technology is increasing daily, with such growth sooner or later it would not be practical or simply physically possible to have a fixed architecture for this kind of network. Ad hoc wireless network must be capable to self-organise and self-configure due to the fact that the mobile structure is changing all the time. Mobile hosts have a limited range and sending the message to another host, which is not in the sender's host transmission range, must be forwarded through the network using other hosts which will be operated as routers for delivering the message throughout the network. The mobile host must use broadcast for sending messages and should be in promiscuous mode for accepting any messages that it receives. In the ad hoc network there can be unidirectional hosts, that can transmit only to the one direction, so that the communication is not bi-directional as in the usual communication systems. [1,2,3].

Routing protocols are divided into two categories based on how and when routes are discovered, but both find the shortest path to the destination. Proactive routing protocols are table-driven protocols, they always maintain current up-to-date routing information by sending control messages periodically between the hosts which update their routing tables. When there are changes in the structure then the updates are propagated throughout the network. The proactive routing protocols use link-state routing algorithms which frequently flood the link information about its neighbours. Other routing protocols are on-demand routing protocols, in other words reactive, ones which create routes when they are needed by the source host and these routes are maintained while they are needed. Such protocols use distance-vector routing algorithms, they have vectors containing information about the cost and the path to the destination. When nodes exchange vectors of information, each host modify own routing information when needed. The ad hoc routing rotocols are usually classified as a pure proactive or a pure reactive protocol, but there are also hybrid protocols. This only concern flat routing protocols, but there are also hierarchical and graphic position assisted routing protocols. [4]

2. Routing Protocols in MANETs

The function of ad hoc routing protocol is to control the node decisions when routing packets between devices in MANET. When a node joins or tries to join the network it does not know about the network topology. By announcing its presence or by listening from the neighbor nodes it discover the topology. In a network route discovery process depends on the routing protocol implementation.

For wireless ad hoc networks, several routing protocols have been designed and all these protocols are classified under two major fields of protocols called reactive or proactive. An ad hoc routing protocol with combination of these two is called a hybrid protocol [8].



Proactive Routing Protocols

maintain and build routing information for all nodes and it works independently of the router [20]. This is achieved by periodically transmitting the control messages. These protocols continuously broadcast control messages even if there is no data flow, due to this reason these protocols are not bandwidth efficient. The proactive routing protocols have its advantages and disadvantages. One of the main advantages is that nodes can easily establish a session and can get routing information. When there is link failure its restructure process is slow, the nodes handles too much data for the route maintenance, which is the drawback of proactive routing protocols.

Optimized Link State Routing

OLSR is proactive routing protocol for wireless ad-hoc networks that is used in mobile ad-hoc networks. WIMAX Mesh (Backhaul) also uses this protocol. OLSR has its name because of its proactive nature. In order to discover their neighbors, the nodes get information of topology being used in the network by topology control (TC) and hello packets. Packets are not broadcasted by all nodes. Packets are only 19
routed by multipoint relay (MPR) nodes. Source to destination routes are established well before their use.
There is a routing table kept by each node. These routing tables create higher routing overhead for OLSR compared to other reactive routing protocols. It decreases the delay for route discovery.

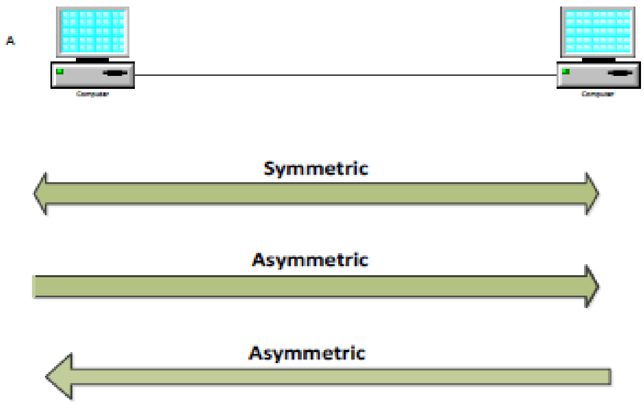


Figure 3.2: HELLO Message in MANET using OLSR

In OLSR, during the predetermined interval Hello messages are periodically sent to the neighbor nodes in order to determine the link status. For instance, if node A and B are neighbors, Hello message is sent to node B by node A and if the message is successfully received by node B then the link is called asymmetric. This is also true for node B if it sends a Hello message to node A. For two way communication the link is called symmetric as shown in figure 3.2. The information of neighboring nodes is contained by Hello messages. A node is built in network with a routing table, which contains the information of multiple hope neighbors. After the symmetric connections are established, a minimal number of MPR nodes are selected to broadcast TC messages at a predetermined interval [20]. The information of selected MPR nodes is contained by TC message. Routing calculations are also handled by TC messages.

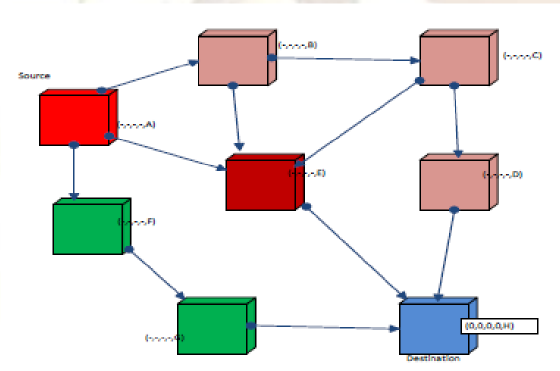
Reactive Routing Protocols

These protocols are bandwidth efficient. The routes are built on demand, which is accomplished by sending requests for routes in the network. The disadvantage of reactive routing protocols is that it offers high latency while finding the routes [21]. In our thesis we have considered DSR, AODV, and TORA.

Temporally-Ordered Routing Algorithm (TORA)

Temporally-Ordered Routing Algorithm is based on algorithm "link reversal" and is a distributed protocol. TORA guarantees the loop-free routes, and provides the multiple routes for the packets to alleviate the congestion. It is "source initiated" protocol that creates different routes from source to destination. Every node maintains the information about his adjacent nodes. There are three basic functions of TORA: route creation, route maintenance and route erasure. Three control packets are used to complete these functions: query (QRY) for route creation, update (UPD) for creating and maintaining of routes and clear (CLR) for route erasure [24]. The route creation algorithm in TORA starts with "height" (propagation ordering parameter in quintuple) that sets the height of all nodes to NULL (undefined) and 0 for the destination. A node having high height is considered upstream and downstream in case of lower height [38]. The "height" metric is used to establish the directed acyclic graph (DAG) at destination during the creation and maintenance of route. In TORA every node maintains a vector table stored in its memory that save the impression of its height as well as the status of interrelated links to all connection backed up by the network. For bandwidth, the node has to broadcast its availability to other nodes in order to update and manage topology variations [9].This routing algorithm is used to increase the scalability in MANET. This algorithm does not use the shortest path but it uses the optimized route [5].

The node that wants to communicate with the destination sends query message to the destination, which contains the node id of destination. When this query message reaches the destination the update message is sent to the sender. This update message contains the destination field [5]. The process is shown below.



the source node is represented by A and the destination node is labeled by H. A query messages is broadcasted across the network by the source node A. This message is responded by only one-hop neighbors. When query message is received, the node updates the sender. In this figure the distance of the node D and G from the destination is one hop. The main disadvantage of this network is that it depends on the activated nodes which are selected while initiating the setup at the beginning [10]. The other disadvantage is that the response to demand for traffic is dependent on the number of nodes (or rate of change of traffic) in the networks. In a network where the traffic volume has steep positive gradient, this protocol would not work efficiently.

3. Internet Protocol

Internet Protocol Version 4

IPv4 uses 32-bit (four-byte) addresses, which limits the address space to 4294967296 (232) addresses. Addresses were assigned to users, and the number of unassigned addresses decreased. IPv4 address exhaustion occurred on February 3, 2011. It had been significantly delayed by address changes such as classful network design, Classless Inter-Domain Routing, and network address translation (NAT).

Internet Protocol Version 6

IPv6, like the most-commonly-used IPv4, is an Internet-layer protocol for packet-switched internetworking and provides end-to-end datagram transmission across multiple IP networks. It is described in Internet standard document RFC 2460, published in December 1998. In addition to offering more addresses, IPv6 also implements features not present in IPv4. It simplifies aspects of address assignment (stateless address autoconfiguration), network renumbering and router announcements when changing network connectivity providers. The IPv6 subnet size has been independent network. Exchanging traffic between the two networks requires special translator gateways, but this is not generally required, since most computer operating systems and software implement both protocols for transparent access to both networks, either natively or using a tunneling protocol like 6to4, 6in4, or Teredo.standardized by fixing the size of the host identifier portion of an address to 64 bits to facilitate an automatic mechanism for forming the host identifier from link-layer media addressing information (MAC address). Network security is also integrated into the design of the IPv6 architecture, including the option of IPsec.

IPv6 does not implement interoperability features with IPv4, but essentially creates a parallel, independent network. Exchanging traffic between the two networks requires special translator gateways, but this is not generally required, since most computer operating systems and software implement both protocols for transparent access to both networks, either natively or using a tunneling protocol like 6to4, 6in4, or Teredo.

4. Parameters and Simulation

In the evaluation of routing protocols different performance metrics are used. They show different characteristics of the whole network performance. In this performance comparison we evaluate the Network Load, throughput and End-to-End delay of selected protocols in order to study the effects on the whole network.

Network Load

"In networking load refers to the amount of data traffic being carried by the network". Network load is a framework used in high-latency tolerant mobile networks. It utilizes most effective network protocols to overcome congestion. A network faces acute congestion when all its resources are over-utilized and over-burdened. So Load refers to a weight distribution system throughout network infrastructure [6].

In [7] Sushant et al. calculates network load by computing the ratio of volume of data received and the maximum data fluctuates during net simulation time.

Throughput

Throughput is the ratio of total amounts of data that reaches the receiver from the source to the time taken by the receiver to receive the last packet [11]. It is represented in packets per second or bits per second. In the MANET unreliable communication, limited energy, limited bandwidth and frequent topology change affect throughput [12].

End-to End Delay

The average time taken by the packets to pass through the network is called end-to-end delay. This is the time when a sender generates the packet and it is received by the application layer of destination, it is represented in seconds. This is the whole time that includes all delay of network such as transmission time, buffer queues, MAC control exchanges and delay produced by routing activities. Different applications require different packet delay levels. Low average delay is required in the network of delay sensitive applications like voice. MANET has the characteristics of packet transmissions due to weak signal strengths of nodes, connection make and break, and the node mobility. These are several reasons that increase the delay in the network. Therefore the end-to-end delay is the measure of how a routing protocol accepts the various constraints of network and shows reliability.

Simulator

We used Opnet Modeler 14.0 for simulating the behavior of routing protocols.

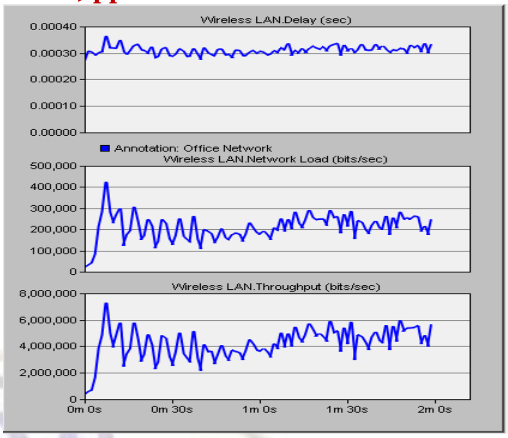
5. SIMULATION AND RESULTS

For evaluation the performance and analysis of our research protocosl, in this section, we use a simulation tool OPNET to conduct several experiments

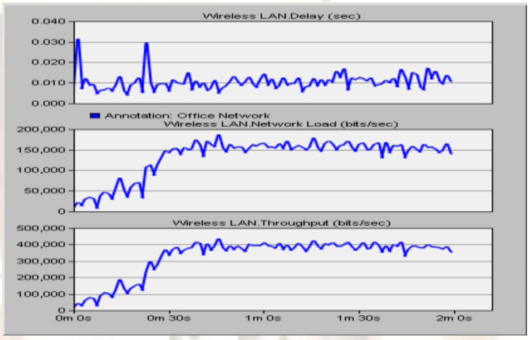
A. Simulation environment and parameters

In our simulations, we consider campus area network as a dense network: 4000 m * 4000m, with 70 randomly deployed manet nodes. Every node is initially equipped with 10 m/s speed and 60 sec of pause. We define the mobilty profile as default Random waypoint algorithm for mobilty. We have implemented heavy load FTP traffic with 50000 bystes of file size. We also define the simulation time which is 10 minutes for each scernarios. For each simulation scenario, the results are drawn by the average value of 10 mins.

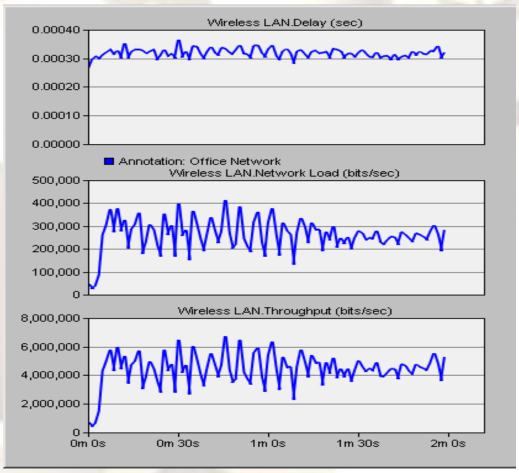
B. Simulation results



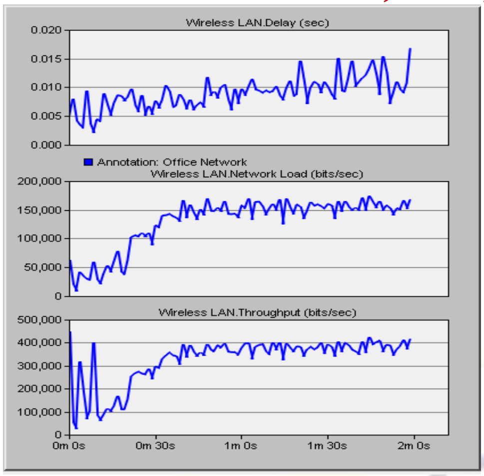
Scenario of TORA in Ipv4



Scenario of OLSR in IPv4

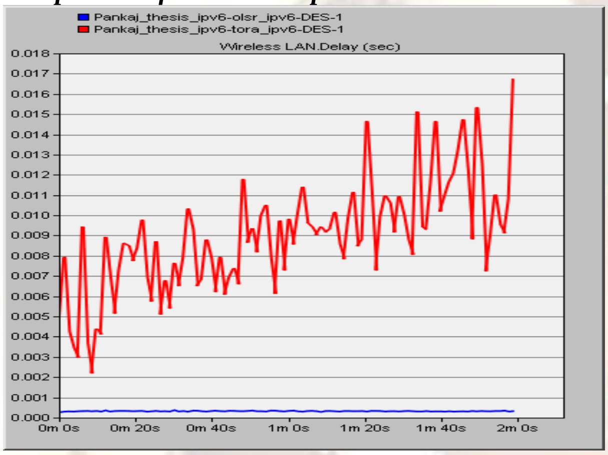


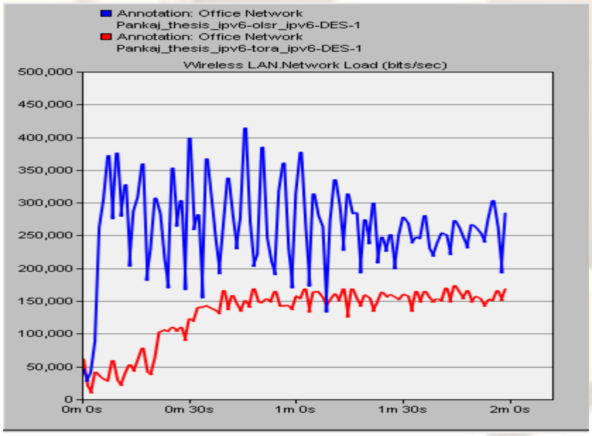
Scenario of TORA in Ipv6

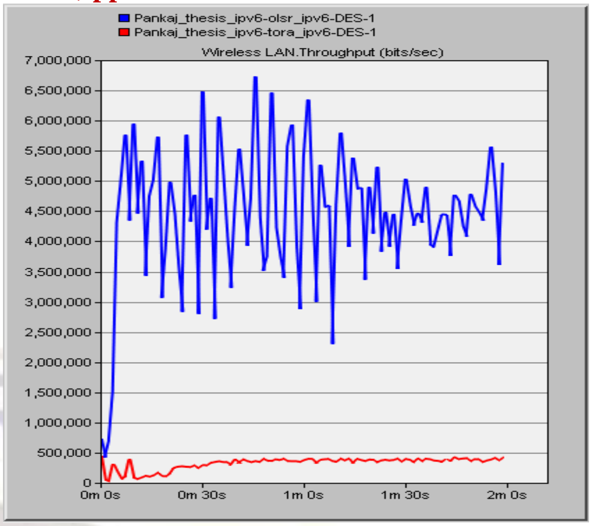


Scenario of OLSR in Ipv6

Comparison of both under Ipv6







Scenario of camparision for OLSR and TORA under Ipv6

7. CONCLUSION

In this paper, we discuss the routing protocols for manet. Two protocols have been judged under Ipv6 environmenet as it shows good results in Ipv6 environment then Ipv4. Both protocols show great compatability with Interenet protocol version6 under different scenario. In overall scenario OLSR outperform TORA in every term under Ipv6 which shows great support for OLSR under different Environmenets.

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