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COMPARISION OF AODV, OLSR, TORA ROUTING PROTOCOLS IN MANET

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Abstract: MANET is a collection of wireless mobile nodes which forms a dynamic temporary network without using any existing infrastructure. Routing is an essential part in the success of communication among these mobile structures. Routing protocols play an important role for finding an efficient and reliable route from source to destination. In the literature, there are numerous MANET routing protocols aiming to find the most suitable path from source to destination. . In this paper, a comprehensive simulation based performance study and analysis is performed on various types of routing protocols over MANET. Ad Hoc On-Demand Distance Vector (AODV), Optimized Link State Routing (OLSR) and Temporally-Ordered Routing Algorithm (TORA).
Keywords : MANET ,AODV, LSR, TORA, Routing.

I. INTRODUCTION

MANET is called as wireless ad-hoc network in which nodes are free to move anywhere and be capable of transmit and receive traffic and communication link broken at any moment [1]. MANET has some attributes like simplicity of use, continually changing topology, wireless connection and distributed operations [2]. Mobile nodes use radio transmits medium for message sending. It is a self-organized network. Mobile nodes in wireless network can communicate with one other in specific range [1]. MANET has some feature like Mesh network, dynamic topology, highly adaptable and rapidly deploy-able network. Though there are so many routing protocols available, this paper considers AODV, OLSR and TORA for performance comparisons due to its familiarity among all other protocols.

II. ROUTING IN MANET

The process of sending and receiving data from one node to another is done with the help of routing protocols [4]. In MANET each node works as router. Sender and receiver be capable of communicate, if and only if they are inside the communicate range beside sender has sent the message through the nodes [5]. The chief goal in ad-hoc network is to create an accurate and capable route among couples of nodes and to make sure that the proper and timely release of packets [4]. The routing protocols for MANET can be categorized into three types according to procedure used for route discovery and route maintenance [2]:

- Reactive or on-demand,
- Proactive or table driven and
- Hybrid routing protocols

Proactive vs. Reactive Routing

Proactive methods determine the routes to various nodes in the network in advance, so that the route is already present whenever needed. Route Discovery overheads are larger in such schemes as one has to discover all routes. Examples of such schemes are the conventional routing schemes, Destination Sequenced Distance Vector (DSDV).Reactive methods determine the route when needed. Therefore

they have smaller Route Discovery overheads. Examples for such schemes are Ad Hoc On- Demand Distance Vector (AODV) routing protocol.

Single-Path vs. Multi-Path

There are several decisive factors for comparing single- path routing and multi-path routing in ad-hoc networks. First, the overhead of route discovery in multi-path routing is much more than that of single-path routing. On the other hand, the frequency of route discovery is much less in a network which uses multi-path routing, since the system can still operate even if one or a few of the multiple paths between a source and a destination fail. Second, it is commonly believed that using multi-path routing results in a higher throughput. Third, multi-path networks are fault tolerant when dynamic routing is used, and some routing protocols, such as OSPF (Open Shortest Path First), can balance the load of network traffic across multiple paths with the same metric value.

Proactive vs. Source Initiated

A proactive (Table-Driven) routing protocols are maintaining up-to-date information of both source and destination nodes. It is not only maintained a single node's information, it can maintain information of each and every nodes across the network. The changes in network topology are then propagated in the entire network by means of updates. Some protocols are used to discover routes when they have demands for data transmission between any source nodes to any destination nodes in network, such protocol as DSDV(.Destination Sequenced Distance Vector) routing protocol. These processes are called initiated on-demand routing. Examples include DSR (Dynamic Source Routing) and AODV (Ad-hoc On Demand Distance Vector) routing protocols [3].

III. REACTIVE ROUTING PROTOCOLS

Reactive Routing protocols are on demand routing protocols in which route is required, when its demand for the data packets [6]. At any time, if source wants to send message to receiver, then the protocol create a path as soon as when demand for the route. Ad hoc On-Demand Distance Vector Routing (AODV), Cluster based Routing Protocols (CBRP) and Dynamic Source Routing Protocol (DSRP) are On-Demand Routing protocols [2].

Ad-hoc On Demand Distance Vector (AODV)

AODV is reactive routing protocol which does not discover or maintain a route until or unless requested by nodes. AODV uses destination sequence number to ensure the loop freedom and freshness of route [4]. AODV is capable of both unicast and multicast routing. The Ad Hoc On-demand Distance Vector Routing (AODV) protocol is a reactive unicast routing protocol for mobile ad hoc networks [12]. As a reactive routing protocol, AODV only needs to maintain the routing information about the active paths. In AODV, the routing information is maintained in the routing tables at all the nodes. Every mobile node keeps a next-hop routing table, which contains the destinations to which it currently has a route. A routing table entry expires if it has not been used or reactivated for a pre-specified expiration time. In AODV, when a source node wants to send packets to the destination but no route is available, it initiates a route discovery operation. In the route discovery operation, the source node broadcasts route request (RREQ) packets which includes Destination Sequence Number. When the destination or a node that has a route to the destination receives the RREQ, it checks the destination sequence numbers it currently knows and the one specified in the RREQ. To guarantee the freshness of the routing

information, a route reply (RREP) packet is created and forwarded back to the source only if the destination sequence number is equal to or greater than the one specified in RREQ.

AODV uses only symmetric links and a RREP follows the reverse path of the respective RREQ. Upon receiving the RREP packet, each intermediate node along the route updates its next-hop table entries with respect to the destination node. The redundant RREP packets or RREP packets with lower destination sequence number will be dropped. The advantage of this protocol is low Connection setup delay and the disadvantage is more number of control overheads due to many route reply messages for single route request.

Advantages:

- Routes are established on demand and destination sequence numbers are used to find the latest route to the destination.
- Lower delay for connection setup.

Disadvantage:

- AODV doesn't allow handling unidirectional links.
- Multiple Route Reply packets in response to a single Route Request packet can lead to heavy control overhead.
- Periodic beaconing leads to unnecessary bandwidth consumption.

IV. PROACTIVE ROUTING PROTOCOLS

Proactive Routing protocols are table driven and there is require retaining regular up-to-date routing information about the every node inside the network and it stores the entire information within route table in the type of cache [6]. Destination Sequenced Distance Vector (DSDV) routing protocol, Global State Routing (GSR), Wireless Routing Protocol (WRP), Zone Based Hierarchical Link State Routing Protocol (ZHLS) and Clustered Gateway Switch Routing Protocol (CGSR) are table driven routing protocols [7].

Optimized Link State Routing (OLSR)

OLSR is a hop by hop proactive routing protocol. It is optimizations of clean connections state algorithm in ad hoc networks. The routes are always all the time at once presented when required suitable to its proactive nature [10]. OLSR used multipoint relay (MPR). MPR are responsible for generating and forwarding topology information. OLSR always need to maintain routing tables. OLSR is a proactive routing protocol, in which all routes have route table for maintaining information to every node in the network. The routes are immediately available whenever needed due to the route tables. OLSR is an optimized version of link state protocol. OLSR uses the concept of Multipoint Relays (MPR) to reduce the possible overhead in the network. OLSR has three types of control messages, Hello, Topology Control (TC), and Multiple Interface Declaration (MID) [11].

1. a. Hello: OLSR makes use of "Hello" messages to find it is one hop neighbours and it is two hop neighbours through their responses. This control message is transmitted for sense the neighbour and used for MPR calculation.

1. b. Topology Control: OLSR uses topology control (TC) messages along with MPR forwarding to disseminate neighbour information throughout the network.

1. c. Multiple Interface Declaration: MID message includes the record of every IP addresses use by every node in the network. Every single nodes running on OLSR broadcast messages on extra than single interface.

1. d. Multi Point Relaying: MPR are used nodes to transmit route message. The choice of MPR is base on HELLO communication send between the neighbour nodes.

Advantages:
- OLSR does not need central administrative system to handle its routing process.
- The link is reliable for the control messages, since the messages are sent periodically and the delivery does not have to be sequential.
- OLSR is suitable for high density networks.
- It does not allow long delays in the transmission of packets.

Disadvantages:
- OLSR protocol periodically sends the updated topology information throughout the entire network.
- It allows high protocol bandwidth usage.

V. HYBRID ROUTING PROTOCOLS

Hybrid routing protocol have both the combines feature of Reactive and Proactive Routing protocols [6]. It decreased the latency in reactive protocol and reduce the control overhead of proactive routing protocols. This protocol is based on hierarchical or layered system structure. Temporally ordered routing algorithm (TORA) and Zone routing protocol (ZRP) are Hybrid routing protocols [7].

Temporally Ordered Routing Algorithm (TORA)

TORA is an adaptive on demand routing protocol for multi hop networks. TORA is source initiated specially proposed routing protocol for highly dynamic mobile, multi-hop wireless networks [8]. TORA is based on link reversal algorithms. TORA establish the routes quickly and minimize the communication overhead by localizing algorithm reaction to topological changes when possible [10]. Instead of using the concept of shortest path for computing routes which take huge amount of bandwidth TORA algorithm maintains the "direction of the next destination" to forward the packets. Thus the source node maintains one or two "downstream paths" to the destination node through multiple intermediate neighboring nodes. The three steps involved in TORA are: a) route creation, b) route maintenance, and c) route erasure. TORA uses the concept of "directed acyclic graphs" to establish downstream paths to destination and such DAG is known as "Destination Oriented DAG" [12].

Advantages:
- TORA supports multiple routes between source and destination. Hence, failure or removal of any of the nodes quickly resolved without source intervention by switching to an alternate route to improve congestion.
- TORA does not require a periodic update, consequently communication overhead and bandwidth utilization is minimized.
- TORA provides the supports of link status sensing and neighbor delivery, reliable, in-order control packet delivery and security authentication.

Disadvantages:

- It depends on synchronized clocks among nodes in the ad hoc network.
- The dependence of this protocol on intermediate lower layers for certain functionality presumes that the link status sensing, neighbor discovery, in order packet delivery and address resolution are all readily available. This solution is to run the Internet MANET Encapsulation Protocol at the layer immediately below TORA.
- This will make the overhead for this protocol difficult to separate from that imposed by the lower layer.

VI. Comparative Study of Ad Hoc Routing Protocols

Metrics for Performance Comparison:MANET has number of qualitative and quantitative metrics that can be used to compare ad hoc routing protocols. The table-I illustrates the comparison of OLSR, AODV and TORA routing protocols. This paper has been considered the following metrics to evaluate the performance of ad hoc network routing protocols.

Packet delivery ratio: The ratio of the data packets delivered to the destinations to those generated by the CBR sources.

Optimal path length: It is the ratio of total forwarding times to the total number of received packets.
Average end to end delay: This is the difference between sending time of a packet and receiving time of a packet. This includes all possible delays caused by buffering during route discovery latency, queuing at the interface queue, retransmission delays at the MAC, and propagation and transfer tirnes.

Media Access Delay: The time a node takes to access media for starting the packet transmission is called as media access delay. The delay is recorded for each packet when it is sent to the physical layer for the first time.

Table 1. Comparison of ad-hoc routing protocols

SL. NO	Performance Constraints	OLSR	AODV	TORA
1.	Multi-cost Routes	No	No	Yes
2.	Distributed Environment	Yes	Yes	Yes
3.	Unidirectional Link	Yes	No	Yes
4.	Multicast	Yes	Yes	No
5.	Periodic Broadcast	Yes	Yes	Yes
6.	QoS Support	Yes	No	Yes
7.	Routes Information Maintained in	Route Table	Route Table	Route Table(Adjacent nodes on-hop knowledge
8.	Reactive	No	Yes	Yes
9.	Proactive	Yes	No	Yes
10.	Hybrid	No	No	Yes
11.	Provide Loop-Free Routers	Yes	Yes	Yes
12.	Scalability	Yes	Yes	Yes
13.	Route Reconfiguration	Control Messages sent in advance to increase the reactivenes	Erase Route notify source	Link reversed route repair
14	Routing Philosophy	Flat	Flat	Flat
15.	Route Optimization	Yes	Yes	Yes
16.	Protocol Type	Link State scheme	Distance Vector	Link Reversed
17.	Message Overhead	Minimum	Larger	Moderate
18.	Protocol Suite	Large and Dense networks	Dynamic Self-Starting networks	Large and Dense networks

Table. 2. Routing performance in low mobility

Low Mobility and Low traffic					
Sl. No	Protocol	End-to-End Delay	Packet Delivery Ratio	Route Over head	Path Optimality
1.	OLSR	Low	High	Low	Good
2.	AODV	Average	High	Low	Average
3.	TORA	Low	High	Average	Good

Table.3. Routing performance in high mobility

High Mobility and High traffic					
Sl. No	Protocol	End-to-End Delay	Packet Delivery Ratio	Route Over head	Path Optimality
1.	OLSR	Low	Average	Average	Good
2.	AODV	Average	Average	Average	Average
3.	TORA	High	Low	Average	Good

VII. Conclusion

In this paper, we presents the comparative study and performance analysis of three mobile ad hoc routing protocols (OLSR, AODV and TORA) on the basis of end-to-end delay, packet delivery ratio, media access delay, path optimality, routing overhead performance metrics. The quantitative study of these routing protocols shows that OLSR is more competent in high density networks with highly sporadic traffic. OLSR requires that it continuously have some bandwidth in order to receive the topology updates messages. AODV keeps on improving in packet delivery ratio with dense networks. The performance of all protocols was almost stable in sparse medium with low traffic. TORA performs much better in packet delivery owing to selection of better routes using acyclic graph. It has been concluded that performance of TORA is better for dense networks. The AODV is better for moderately dense networks where as the OLSR performs well in sparse networks. The future work suggested that the effort will be made to enhance ad hoc network routing protocol by tackling core issues.

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