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Brief Description of Routing Protocols in MANETS And Performance And Analysis (AODV, AOMDV, TORA)

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Abstract:A variety of routing protocols have been proposed and several of them have been extensively simulated or implemented as well. In this paper, we compare and evaluate the performance of three types of On demand routing protocols- Ad-hoc On-demand Distance Vector (AODV) routing protocol, which is unipath , Adhoc On-demand Multipath Distance Vector (AOMDV) routing protocol and Temporally Ordered Routing Algorithm (TORA) . In this paper we note that on comparing the performance of AODV and AOMDV, AOMDV incurs more routing overhead and packet delay than AODV but it had a better efficiency when it comes to number of packets dropped and packet delivery.

Keywords: Ad-hoc networks; routing protocols; Simulation; Performance evaluation.

1. Introduction

The history of wireless networks started in the 1970s and the interest has been growing ever since. At present, this sharing of information is difficult, as the users need to perform administrative tasks and set up static, bi-directional links between the computers. This motivates the construction of temporary networks with no wires, no communication infrastructure and no administrative intervention required. Such interconnection between mobile computers is called an Ad hoc Network. Ad hoc networks are emerging as the next generation of networks and defined as a collection of mobile nodes forming a temporary (spontaneous) network without the aid of any centralized administration or standard support services. In Latin, ad hoc literally means “for this,” further meaning “for this purpose only” and thus usually temporary. An ad hoc network is usually thought of as a network with nodes that are relatively mobile compared to a wired network. Hence the topology of the network is much more dynamic and the changes are often unpredictable oppose to the Internet which is a wired network. This fact creates many challenging research issues, since the objectives of how routing should take place is often unclear because of the different resources like bandwidth, battery power and demands like latency.

MANETs have several salient characteristics: 1) Dynamic topologies 2) Bandwidth constrained, variable capacity links 3) Energy-constrained operation 4) Limited physical security. Therefore the routing protocols used in ordinary wired networks are not well suited for this kind of dynamic environment. Routing algorithms are often difficult to be formalized into mathematics they are instead tested using extensive simulation. Recently more attention has been paid to use specific network parameters when specifying routing metrics. Examples might include delay of the network, link capacity, link stability or identifying low mobility nodes. These schemes are generally based on previous work, which is then enhanced with the new metrics. A mobile ad-hoc network or MANET is a collection of mobile nodes sharing a wireless channel without any centralized control or established communication backbone. They have no fixed routers with all nodes capable of movement and arbitrarily dynamic. These nodes can act as both end systems and routers at the same time. When acting as routers, they discover and maintain routes to other nodes in the network. The topology of the ad-hoc network depends on the transmission power of the nodes and the location of the mobile nodes, which may change from time to time . One of the main problems in ad-hoc networking is the efficient delivery of data packets to the mobile nodes where the topology is not pre-determined nor does the network have centralized control. Hence, due to the frequently changing topology, routing in ad-hoc networks can be viewed as a challenge.

2. Routing Protocols For Mobile AD HOC:

Routing protocols for Mobile ad hoc networks can be broadly classified into two main categories:

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

A). Table-Driven Routing Protocols

Table-driven routing protocols attempt to maintain consistent, up-to-date routing information from each node to every other node in the network. The routing information is kept in a number of different tables and they respond to changes in network topology by propagating updates throughout the network in order to maintain a consistent. The Proactive routing approaches designed for ad hoc networks are derived from the traditional routing protocols. These protocols are sometimes referred to as table-driven protocols since the routing information is maintained in tables. Proactive approaches have the advantage that routes are available the moment they are needed. However, the primary disadvantage of these protocols is that the control overhead can be significant in large networks or in networks with rapidly moving nodes. Proactive routing protocol includes Destination-Sequenced Distance-Vector (DSDV) protocol, Wireless Routing Protocol (WRP), Optimized Link State Routing Protocol (OLSR) etc.

B). Reactive or on-demand routing protocols

Reactive routing approaches take a departure from traditional Internet routing approaches by not continuously maintaining a route between all pairs of network nodes. Instead, routes are only discovered when they are actually needed. When a source node needs to send data packets to some destination, it checks its route table to determine whether it has a route. If no route exists, it performs a route discovery procedure to find a path to the destination. Hence, route discovery becomes on-demand. The drawback to reactive approaches is the introduction of route acquisition latency. That is, when a route is needed by a source node, there is some finite latency while the route is discovered. In contrast, with a proactive approach, routes are typically available the moment they are needed. Hence, there is no delay to begin the data session. Reactive routing protocol includes Dynamic Source Routing (DSR) protocol, Ad hoc On-demand Distance Vector (AODV) protocol, Ad hoc On-demand Multiple Distance Vector (AOMDV) protocol etc.

C). Hybrid Routing Protocol

Hybrid protocols seek to combine the Proactive and Reactive approaches. An example of such a protocol is the Zone Routing Protocol (ZRP).

Our discussion is limited to three On-demand ad-hoc routing protocols AODV, AOMDV and TORA as follows:

2.1) AODV

Ad–hoc on demand distance vector routing (AODV) is a stateless on-demand routing protocol . The Ad-hoc On Demand Distance Vector (AODV) classified under reactive protocols. The operation of the protocol is divided in two functions, route discovery and route maintenance. In Ad-hoc routing, when a route is needed to some destination, the protocol starts route discovery. Then the source node sends route request message to its neighbors. And if those nodes do not have any information about the destination node, they will send the message to all its neighbors and so on. And if any neighbor node has the information about the destination node, the node sends route reply message to the route request message initiator. On the basis of this process a path is recorded in the intermediate nodes. This path identifies the route and is called the reverse path. Since each node forwards route request message to all of its neighbors, more than one copy of the original route request message can arrive at a node. A unique id is assigned, when a route request message is created. When a node received, it will check this id and the address of the initiator and discarded the message if it had already processed that request. Node that has information about the path to the destination sends route reply message to the neighbor from which it has received route request message. This neighbor does the same. Due to the reverse path it can be possible. Then the route reply message travels back using reverse path. When a route reply message reaches the initiator the route is ready and the initiator can start sending data packets.

2.2) AOMDV

Ad-hoc On Demand Multipath Distance Vector Routing Algorithm (AOMDV) is proposed in . AOMDV employs the "Multip le Loop -Free and Link-Disjoint p ath" technique. In AOMDV only disjoint nodes are considered in all the paths, thereby achieving path disjointness. For route discovery route request packets are propagated throughout the network thereby establishing multiple paths at destination node and at the intermediate nodes. Multiples Loop-Free paths are achieved using the advertised hop count method at each node. This advertised hop count is required to be maintained at each node in the route table entry. The route entry table at each node also contains a list of next hop along with the corresponding hop counts. Every node maintains an advertised hop count for the destination. Advertised hop count can be defined as the "maximum hop count for all the p aths". Route advertisements of the destination are sent using this hop count. An alternate path to the destination is accepted by a node if the hop count is less than the advertised hop count for the destination .

2.3) TORA

Temporally Ordered Routing Algorithm TORA comes under a category of algorithms called “Link Reversal Algorithms”. TORA is an on demand routing protocol. Unlike other algorithms the TORA routing protocol does not uses the concept of shortest path for creating paths from source to destination as it may itself take huge amount of bandwidth in the network. Instead of using the shortest path for computing the routes the TORA algorithm maintains the “direction of the next destination” to forward the packets. Thus a source node maintains one or more “downstream paths” to the destination node through multiple intermediate neighboring nodes. TORA reduces the control messages in the network by having the nodes to query for a path only when it needs to send a packet to a destination. In TORA three steps are involved in establishing a network. A) Creating routes from source to destination, B) Maintaining the routes and C) Erasing invalid routes. TORA uses the concept of “directed acyclic graph (DAG) to establish downstream paths to the destination”. This DAG is called as “Destination Oriented DAG”. A node marked as destination oriented DAG is the last node or the destination node and no link originates from this node. It has the lowest height. Three different messages are used by TORA for establishing a path: the Query (QRY) message for creating a route, Update (UPD) message for creating and maintaining routes and Clear (CLR) message for erasing a route. Each of the nodes is associated with a height in the network. A link is established between the nodes based on the height. The establishment of the route from source to destination is based on the DAG mechanism thus ensuring that all the routes are loop free. Packets move from the source node having the highest height to the destination node with the lowest height. It’s the same top to down approach.

Parameter	AODV	AOMDV	TORA
Update information	Route error	Route error	Node’s height
Update destination	Source	Source	Neighbors
Method	Unicast	Broadcast	Broadcast
Topology	Full	Full	Reduced

TABLE 1.COMPARISON OF THE THREE ROUTING PROTOCOLS

3. METHODOLOGY

3.1) Simulation Environment

Simulation environment is as follows:

Parameter	Values
Traffic type	CBR
Simulation time	100 seconds
Number of nodes	100
Pause time	0, 25, 50, 75 and 100 second
Maximum connections	15, 30 and 45
Maximum speed of nodes	10 meter per second
Transmission rate	10 packets per second
Area of the network	800m X 800m

3.2)SIMULATION

The simulations were performed using Network Simulator 2 (Ns-2) , particularly popular in the ad hoc networking community. The traffic sources are CBR (continuous bit – rate). The source-destination pairs are spread randomly over the network. The mobility model uses ‘random waypoint model’ in a rectangular filed of 500m x 500m with 50 nodes. During the simulation, each node starts its journey from a random spot to a random chosen destination. Once the destination is reached, the node takes a rest period of time in second and another random destination is chosen after that pause time. This process repeats throughout the simulation, causing continuous changes in the topology of the underlying network. Different network scenario for different number of nodes and pause times are generated.

3.3) Performance Metrics

We report four performance metrics for the protocols:

Packet Delivery Fraction (PDF): The ratio between the number of data packets received and the number of packets sent.

Throughput: Throughput is total packets successfully delivered to individual destination over total time divided by total time.

End-to-End Delay: It is the ratio of time difference between every CBR packet sent and received to the total time difference over the total number of CBR packets received.

4. SIMULATION RESULTS AND ANALYSIS

We ran the simulation environments for 100 sec for five scenarios with pause times varying from 0 to 100 second and also maximum connections varying in between 15 to 45 connections. Packet delivery fraction, routing load, end to end delay and throughput are calculated for AODV, AOMDV and TORA. The results are analyzed below with their corresponding graphs.

4.1)Packet Delivery Fraction

4.1 Packet Delivery Fraction

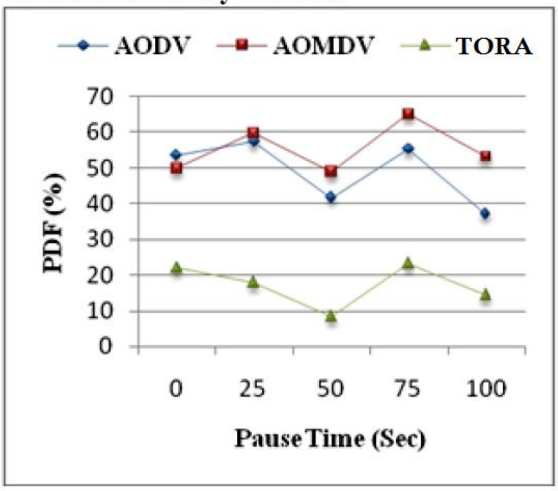

Fig. 4.1(a) Comparison of AODV, AOMDV and DSR on basis of PDF at maximum connection 15

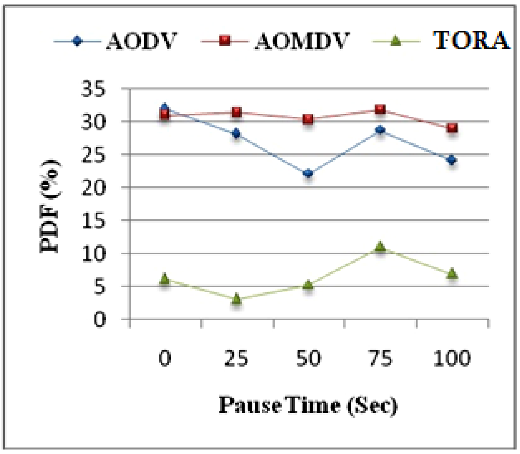

Fig. 4.1(b) Comparison of AODV, AOMDV and DSR on basis of PDF at maximum connection 30

Analysis of the result

We note that at pause time 0 sec, AODV has a better PDF value when compared to AOMDV and TORA for each set of connections. But AOMDV gives better performance with increasing pause time. At pause time 100 sec, AOMDV has best PDF value compared to AODV, TORA for each set of connections.

4.2) Throughput

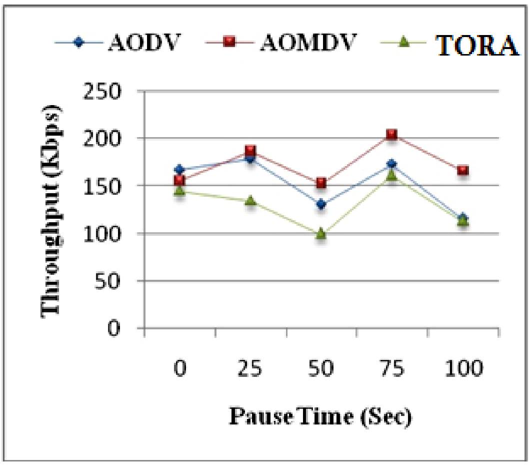

Fig. 4.2(a) Comparison of AODV, AOMDV and DSR on basis of Throughput at maximum connection 15

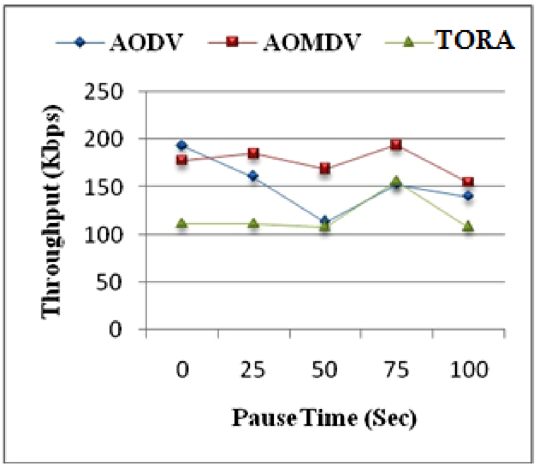

Fig. 4.2(b) Comparison of AODV, AOMDV and DSR on basis of Throughput at maximum connection 30

Analysis of the result

From studying the figures (Fig 4.2) for throughput, we note that at pause time 0 sec, AODV has a better throughput when compared to AOMDV and TORA for each set of connections. But with increasing pause time, AOMDV provides higher throughput compared to AODV, TORA for each set of connections.

4.3) End to End delay

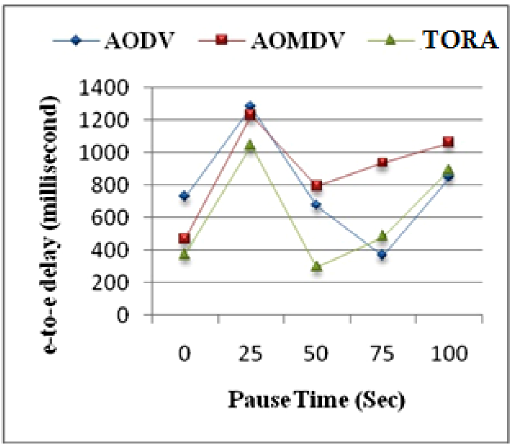

Fig. 4.3(a) Comparison of AODV, AOMDV and DSR on basis of end to end delay at maximum connection 15

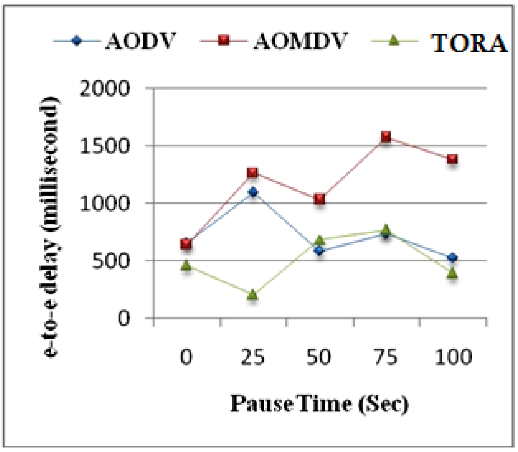

Fig. 4.3(b) Comparison of AODV, AOMDV and DSR on basis of end to end delay at maximum connection 30

Analysis of the result

We have seen that in maximum simulation scenarios,TORA has better end to end delay from AOMDV and AODV protocols. AOMDV incurs worse end to end delay when compared to AODV in all simulation scenarios.

5. CONCLUSION

This paper evaluated the performance of AODV, AOMDV and TORA using ns-2. Comparison was based on the packet delivery fraction, throughput, end-to-end delay and normalized routing overhead. We concluded that in the dynamic network (pause time 0 sec), the performance of AODV is better as compared to the AOMDV and TORA in terms of packet delivery fraction, throughput and normalized routing overhead. In the static network (pause time 100 sec), AOMDV gives better performance as compared to AODV and TORA in terms of packet delivery fraction and throughput but worst in terms of end-to end delay. We have also seen that TORA routing protocol is best in terms of end-to-delay in both Static and dynamic network for each set of maximum connections.

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