Performance Comparison Study of AODV, OLSR and TORA Routing Protocols for MANETS

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Abstract

Mobile Ad hoc Networks (MANETs) are the special type of wireless network, where mobile nodes are connected through wireless interfaces forming a temporary network. They don't need fixed infrastructure. Due to higher mobility in nodes and dynamic infrastructure of MANETS, Routing is important issue in ad hoc networks. There are many routing protocol in MANETS like AODV, TORA, DSDV, OLSR, DSR etc. MANETS is classified in three routing protocols. This research paper make a comparison of these routing protocol based on the performance metrics like packet delivery fraction, end–to–end delay and throughput. Simulation is used to compare the performance of AODV, OLSR and TORA. NS2 (Network Simulator version2) is used as simulator. With the help of ns-2, result shows that AODV's performance in PDF and throughput metrics is better than OLSR and TORA. For end-to-end delay metrics TORA perform better than OLSR and AODV.

Keywords: *. AODV, MANET, OLSR, Routing Protocols, , TORA.*

1. Introduction

Mobile Ad-Hoc Networks are autonomous and self-configuring wireless systems. MANETs consist of mobile nodes that are free to move in and out of the network. These node can be mobile phone, system etc. Mobility affects the power indulgence of the nodes in a MANET. This is because of the high overhead incurred in Route Discovery and Route Maintenance in mobile nodes. Due to higher mobility of nodes they form random topologies depending on their connectivity with each other in the network. The dynamic topology makes the routing protocol design complex.

APPLICATIONS OF MOBILE AD HOC NETWORKS

Table 1: Application of MANETs

Applications	**scenarios/services**
Educational Applications	• In Universities and campus. • To Setup virtual classrooms, conference rooms.
Tactical networks	• In military , battlefield • Rescue operations
Entertainment	• Outdoor Internet access. • Multi-user games. • Robotic pets. • Wireless P2P networking.
Enterprise Networking	• Personal Area Network . • Conferences, meeting rooms. • Networks at construction sites.

Emergency services	• Search and rescue operations • Disaster recovery • In hospitals • Policing and fire fighting
Sensor networks	• Home applications: smart sensor nodes. • Environmental applications

1.1 MANETs routing protocols

Ad-Hoc network is called as Mobile Ad-Hoc Network (MANET) because of mobility of nodes in network. They are IBSS (Independent Basic Service Set), because they does not need AP(Access Point) for communication in nodes. MANETs is a self-configuring network and form an uninformed topology. These nodes behave like routers in network to route the packet. MANETs are used in those areas where wire and wireless infrastructures are unreachable. Due to rapid change of topology in MANETs, MANETs routing protocols are required. The routing protocol is required whenever the source needs to communicates with destination. Routing protocols are classified as Proactive (Table Driven Routing Protocol), Reactive (On Demand Routing Protocol) and Hybrid (having the advantages of both proactive and Reactive routing protocols) routing protocols.

MANETs routing protocols are classified as:-

A. Reactive protocols
B. Proactive protocols
C. Hybrid protocols

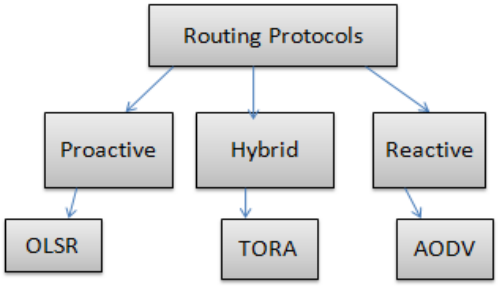

Fig. 1 MANETs Routing Protocols

A. Reactive Protocols:

Reactive protocols are also called as on demand driven reactive protocols. It is mainly used to find the route between source and destination as needed. As per the demand of source this routing protocol initiate route discovery, to find the route to the destination. Then this route is used for further communication [1, 2] e.g. AODV.

B. Proactive Protocols:

Proactive protocols also called as Table driven routing protocols. Each node maintains routing tables which are consistent and up-to-date containing routing information for every node in the network. Whenever new node is entered in the network or removes from the network, control messages are sends to neighboring nodes then they update their routing tables. This routing protocol uses link-state routing algorithms which frequently flood the link information about its neighbors. Proactive routing protocols are OSPF and OLSR [2].

C. Hybrid Routing Protocol:

Hybrid routing protocol have advantages of both proactive and reactive routing protocols. Firstly it behave like proactive routing protocol, because in starting nodes have tables. Then whenever nodes finds that they does not have route to destination, they start route discovery and behave like reactive routing protocols .Hybrid protocols are TORA and ZRP.

1.2 Overview of Protocols

A. Ad-Hoc on Demand Distance Vector Protocol (AODV):

AODV [3] is reactive protocol, when a source wants to initiate transmission with another node as destination in the network, AODV use control messages to find a route to the destination node in the network. AODV will provide topology information (like route) for the node. Fig.2 shows the message routing for AODV protocol. Node "A" wants to send messages to another node "F". It will generate a Route Request message (RREQ) and forwarded to the neighbors, and those node forward the control message to their neighbors' nodes. Whenever the route to destination node is located or an intermediate node have route to destination. They generate route reply message (RREP) and send to source node. When the route is established between "A" and "F", node then they communicate with each other.

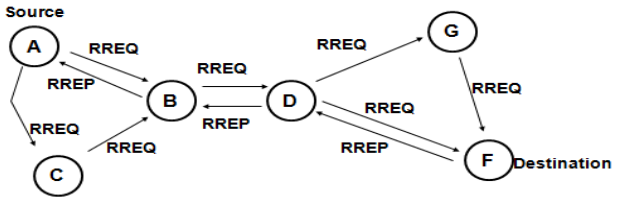

Fig 2 Message routing in AODV

B. Optimized Link State Routing Protocol (OLSR) :

OLSR is proactive routing protocol or table driven protocol. Initially nodes have routing tables and they update their routing tables time to time. It is based on the link-state algorithm. Each node maintains the topology information of network and sending this information from time to time to neighbors. The uniqueness of OLSR is that it minimizes the size of control messages and rebroadcasting by using the MRP (Multipoint Relaying). The basic concept of MPR is to reduce the loops of retransmissions of the packets. Only MPR nodes broadcast route packets. The nodes within the network maintain a list of MPR nodes. MPR nodes are selected within the environs of the source node. The selection of MPR is done by the neighbor nodes in the network, with the help of HELLO messages.

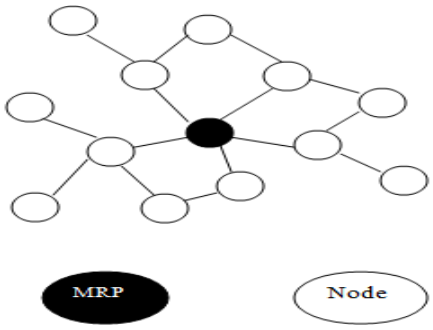

Fig. 3.3 Flooding Packets using MPR

C. Temporally Ordered Routing Algorithm (TORA):

TORA is a hybrid protocol, based on a "link reversal" algorithm. It discovers multiple routes to a destination, create routes quickly, and diminish communication overhead. Nodes have routing tables, so it helps the sending node to find the route to destination with the help of given tables. Routing tables also maintains the longer routes to avoid discovering newer routes. When a node finds that a route to a destination is no longer valid, it adjusts its height so that it is a local maximum with respect to its neighbors and transmits an UPDATE packet. If the node has no neighbors of finite height with respect to this destination, then the node discover a new route. When a node detects a network partition, it generates a CLEAR packet which resets routing tables and removes invalid routes which does not exist from the network.

1.3 Related Work

AODV, OLSR and TORA have lot of attention in recent times. B.M Sobral et. al. [5] compared the performance of AODV and OLSR using a self-configuration mechanism for Heterogeneous Wireless Mesh Networks. As relevant results they got some improvements related to the original OLSR and AODV protocols, by applying the self-configuration capacity, such as, the increased throughput of the overall network, improvement of the delay of discovery local neighboring routes by

reducing the HELLO traffic messages and the MPR Count metric and finally the improvement of the delivery of packets due to smaller dropped packets.

Dong-Won Kum,Jin-su-park et. al.[6] they propose an Mobility aware Hybrid Routing (MHR) approach for WMNs, which varies its routing between reactive and proactive to adapt to node mobility using ns-2. Applied MHR approach to AODV, called AODV-MHR and compared its performance with that of AODV and OLSR in terms of routing overhead, total throughput, and the average end-to-end delay by simulation. Simulation results showed that AODV-MHR's performance was enhanced by the advantages attained by using both reactive and proactive routing approaches.

Jing Xie,Yuming Jiang [7],they propose a threshold-based hybrid routing protocol that supports a mobile node to selectively run the routing protocol based on its velocity. They Theoretically analyzed THRP,OLSR , AOD and ZRP and found THRP can show better scalability than both OLSR and AODV since it partly shortens the AODV route discovery process and constrains the local control overhead of OLSR to flood in the whole network.

Julian Hsu, Sameer BhatiaMineo Takai [8], They compare the Performance of AODV,DSR, OLSR, OLSR v2 and ZRP in REALISTIC SCENARIOS. AODV protocol performed best in this type of scenario, with a slight edge in overall throughput.

2. Methodology

2.1 Simulation Environment:

Simulations are done to compare these routing protocols. Simulator ns-2 is used for performance comparison. The network simulator ns-2 developed by the VINT research group at University of California at Berkeley in 1995 . The network simulator NS2 is a discrete event network simulation. NS2 is used to simulate the proposed algorithm. It work on network layer and inform about link breakage. The implementation of the protocol has been done using C++ language in the backend and TCL language in the frontend. TCL(Tool Command Language) is compatible with C++ programming language.

During interpretation two files trace files and nam files are to be generated. Network Animator (.nam) file, records all the visual events that happened during the simulation. Trace files (.tr), records the entire network event that occur during the simulation. And file is post analyzed with the help of awk scripts.

Table 2 : Simulation Parameter

Parameter	***value***
Simulation Time	50 Sec
No. of Nodes	50
Traffic Type	CBR
Pause Time	10 Sec
Maximum X-Y coordinate value	1000 M
Packet Size	512 byte
MAC Protocol	802.11
Mobility Model	Random Waypoint
Routing Protocols	AODV,OLSR, TORA
Observation Parameters	EED, Throughput, PDF

2.2 Performance Metrics:

The estimation of performance of AODV, OLSR and TORA is done on the basis of following Performance metrics:

- **Packet Delivery Ratio:** It is the ratio of the packets received by destination to those generated by the sources. CBR traffic type is used by source. It specifies the packet loss rate, which limits the maximum throughput of the network. The routing protocol which have better PDR, the more complete and correct. This reflects the usefulness of the protocol. And provide good performance.

  Packet Delivery Ratio = (Received Packets/Sent Packets)
- **End to End Delay:** Average end-to-end delay is the average time it taken by the packet to reach to destination in seconds.
- **Throughput:** No. of packet passing through the network in a unit of time. It is measure in kbps.

3. Result and Discussion

3.1 Packet Delivery Ratio Graph:

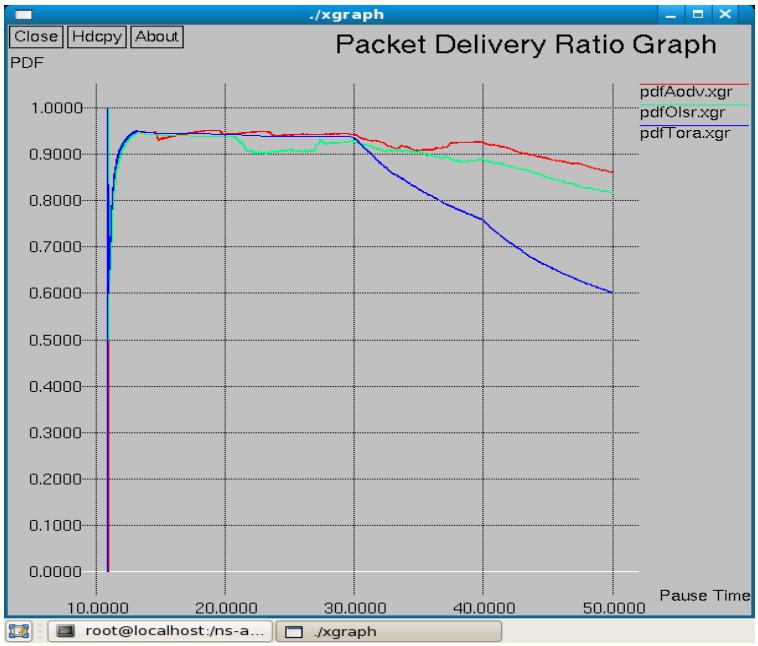

Figure 3: Packet Delivery Ratio vs. Pause Time

Figure 3 shows the PDR of the three protocols AODV, TORA and OLSR. The PDR of AODV is greater than OLSR and TORA. At the high mobility all three protocols behave same but with less mobility AODV has maximum PDR, OLSR lies in between AODV and TORA. TORA has minimum PDR. Routing protocol which has higher PDR, it performed better as good the routing protocol performed. Because it states that maximum packets are received by destination node.

3.2 End to End delay Graph

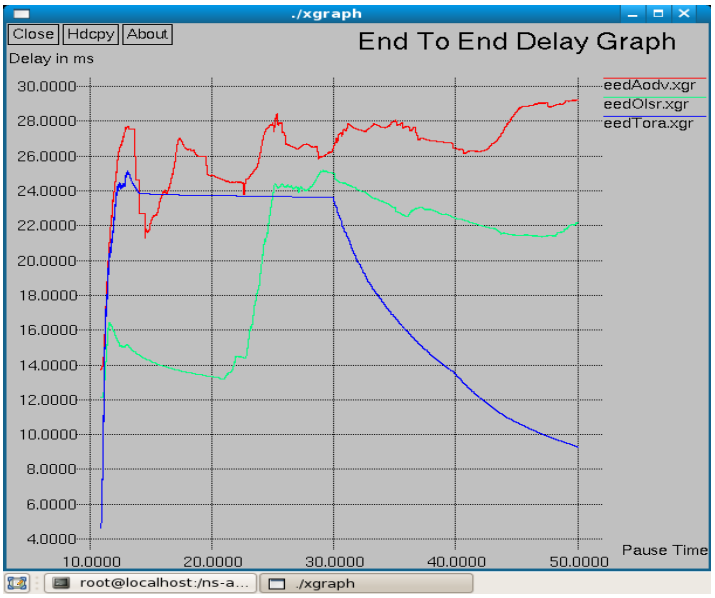

Figure 4: End to End delay vs. Pause Time

Figure 4 compares the average End-To-End packet delay between AODV, TORA and OLSR. In this figure, TORA exhibited the lowest average end-to-end delay, while AODV had the highest delay. The end-to-end delay of OLSR is lowest at a higher mobility, but with higher mobility it is increases and become greater than that of TORA. TORA had lowest average end-to-end delay because it has routing tables need not to rediscover the route for the same destination.

3.3 Throughput Graph:

Below Fig. 5 shows the total throughput of AODV, TORA and OLSR. Total throughput is the amount of packet transferred through the network per unit time. At a higher mobility, OLSR exhibit the lowest total throughput, while TORA had the highest throughput at a higher mobility. The average throughput of AODV is higher than OLSR, TORA. Higher the throughput, better the routing protocol performed.

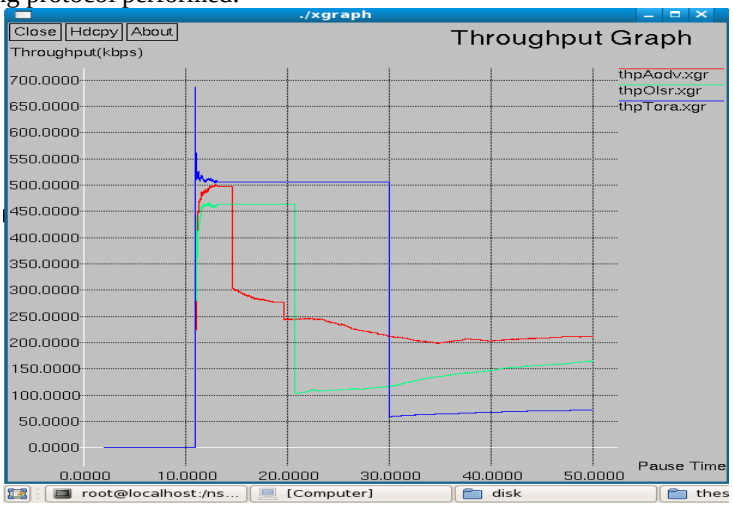

Figure 5: Throughput (kbps) vs. Pause Time

Table 3: Performance Summary of AODV, OLSR, AND TORA

Performance metrics	*Routing Schemes*	*High Mobility*	*Low Mobility*
Packet Delivery Ratio	AODV	High	High
	OLSR	High	Medium
	TORA	High	Low
Total throughput	AODV	Medium	High
	OLSR	Low	Medium
	TORA	High	Low
Average end-to-end delay	AODV	High	High
	OLSR	Low	Medium
	TORA	Medium	Low

Table 4: Performance Comparison of AODV, OLSR, AND TORA

Performance metrics		AODV	OLSR	TORA
Packet Delivery Function	CBR	s:3934 r:3383	s:2993 r:2445	s:1595 r:958
	r/s	.8599	.8169	.6006
	F	4465	4013	0
Total throughput(in kbps)	Avg. Thp.	211.26	164.71	72.07
	Start Time	10.91	10.95	10.90
	Stop Time	49.98	49.99	49.58
Average end-to-end Delay(in sec)		29.2420	22.175877	9.30079

4 Conclusion:

Mobile Ad-Hoc Networks has the ability to deploy a network where a traditional network infrastructure environment cannot possibly be deployed. With the importance of MANET comparative to its vast potential it has still many challenges left in order to overcome. Performance comparison of routing protocol in MANET is one of the important aspects. In this paper, I have analyzed the behavior and different performance matrices for MANETs using different protocols. (AODV, OLSR and TORA) and compared their performance matrices, like End to end delay, Packet delivery Fraction and Throughput . In Table 3 and 4 performance comparisons of routing protocols AODV, OLSR, TORA is shown using ns2 simulator. For Throughput and PDF, AODV behaving the best and for End to End delay is concern TORA is taking less delay.

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