Performance Evaluation of Diverse MANET Routing Protocols – A Review

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ABSTRACT
MANET is infrastructure less, decentralized multi-hop network where the mobile nodes are free to move randomly, these mean the network topology dynamic, the performance evaluation is major challenges in ad hoc network. Performance evaluation refers to evaluate the performance of MANET routing protocols, there are various performance metrics are used to improve the performance of MANET routing protocols. Performance are evaluated in case of change in traffic, number of nodes, mobility and pause time etc. performance is measured in term of packet delivery ratio, routing load, average jittering and throughput. In

this paper, we review on the various research papers related to the performance evaluation of various routing protocols and performance comparison of routing protocols in MANET, we also provide the overview of MANET routing protocols such as: AODV, DSDV, DSR and ZRP.

Keyword:
MANET, Performance Evaluation, AODV, DSR, ZRP.

1. INTRODUCTION
A mobile ad hoc network (MANET) consists of a set of mobile hosts that know how to communicate with each other without the help of base stations. As shown in Fig. 1, the topology of a MANET can be extremely dynamic due to the mobility of mobile nodes. The formation of mobile computing and communication devices (e.g., cell phones, laptops, personal digital assistants) is driving a new change in our information culture. Wireless networks consist of a number of nodes which communicate by each other over a wireless

Channel [1]. There are now two variations of mobile wireless networks: infrastructure networks and infrastructure less networks. The infrastructure networks are the one, in which mobile devices communicate with base stations that are connected to fixed network infrastructure. Each node in the infrastructure networks is within the range of a fixed access point like base station. Infrastructure less wireless networks is a major class of wireless networks that is greatest appropriate for scenarios where there is demand of temporary and localized telecommunication demand. Such networks consist of wireless devices that can form a network alone without the need for pre-deployed telecommunication infrastructures such as base-stations and access points.

Fig 1: MANET Network [1]

2. ROUTING PROTOCOLS
There are many routing protocols has been using in MANET. Each routing protocols has its own pros and cons in different scenario. In MANET, routing protocols has been classified into three categories that are proactive (DSDV, OLDR and WRP), reactive (DSR and AODV) and highbred routing protocols (ZRP and TORA)

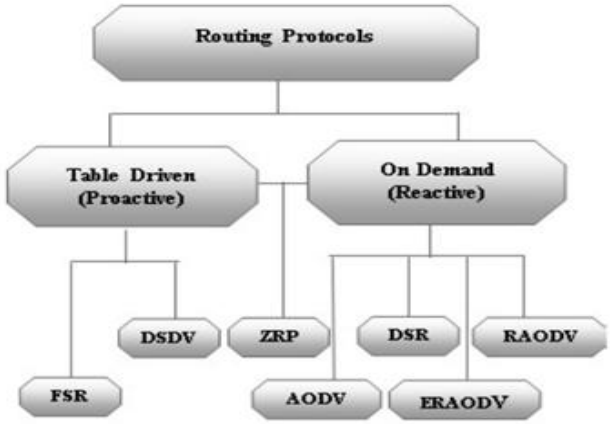

Fig 2: Classification of Routing Protocols [2]

2.1 Proactive Protocols
Proactive protocols are also known as table driven protocols because route to each node which are in network maintained in routing table [3] .Packet are transmitted to node as predefined route as in a routing table, the packet forwarding is done faster but routing overhead is greater because all the route have to be defined before sending packet. DSDV are example of proactive protocols.

2.1.1 Destination sequenced distance vector (DSDV)
DSDV is table driven routing protocol based on the classical Bellman-Ford routing algorithm. In this routing protocol, each mobile node in the system maintains a routing table in which all the possible destinations and the number of hops to thin in the network are recoded. A sequence number is also associated with each route to the destination. The route labeled with the highest sequence number is always used. The data broadcast by each mobile node well contain new sequence number, the destination address, the number of hopes to reach the destination and the sequence number of the information received regarding that destination.

2.2 Reactive Protocols
Reactive protocols are also known as on demand routing protocols. This routing Protocol does not keep record of route and routing table so there is no overhead for maintaining the route to nodes. When a path establish in network, the date packet sent immediately to the connected router that will send the request for the new route. The route searching is done using the flooding algorithm which says "just forward the

packet to their neighbor". This process repeat until it reaches the destination node. These protocol have low overhead of routing information but higher latency. DSR and AODV are example of reactive protocols.

2.2.1 Dynamic source routing protocol

DSR is on-demand routing protocol. This protocol has to mechanisms – route discovery and route maintenance. The source route is needed when some node originates a new packet destined for some node by searching its route cache all initiate route discovery using ROUTE REQUEST AND ROUTE REPLY messages. On detecting link break, DSR sends ROUTE ERROR message to source node for new route.

2.3 Hybrid Protocols

These types of protocols have combine feature of reactive and proactive protocols and take advantage of both type so hybrid protocol have less time for route discovery and no overhead of routing information. ZRP and TORA are the example of hybrid protocol.

2.3.1 Zone Routing protocol (ZRP)

The Zone Routing Protocols approaches by maintaining an up- to-date topological map of a zone centered on each node. ZRP uses proactive approach for routing inside the zone i.e. intra-zone routing protocol (IARP) and reactive approach for routing outside the zone i.e. inter zone.

Table 1: Parametric Comparison of Routing Protocol Strategies [11]

Parameters	Reactive	Proactive	Hybrid
Routing Philosophy	Flat	Flat / Hierarchical	Flat /Hierarchical
Routing Scheme	On-Demand	Table-Driven	Combination of both
Topology Dissemination	Periodical	On-Demand	Both
Route Latency	Always available	Available when needed	Both
Communication Overhead	High	Low	Medium
Scalability	Suitable for small network	Low	Designed for large network
Storage Capacity	Low	High	Depend upon zone, as capacity inside zone is high
Types	AODV,DSR,TORA	DSDV,WRP,FSR	ZRP,WARP

3. PERFORMANCE METRICS

For calculating the performance of different MANET routing protocols, we require both the qualitative as well as quantitative metrics are:

3.1 Throughput

Throughput is the number of packet that is passing through the channel in a particular unit of time. This performance metric shows the total number of packets that have been successfully delivered from source node to destination node [12]. Factors that affect throughput include frequent topology changes, unreliable communication, limited bandwidth and limited energy.

$$\text{Throughput} = \frac{Received\ Packet\ Size}{Time\ to\ send}$$

3.2 Packet Delivery Ratio (PDR)

Packet delivery ratio is calculated by dividing the number of packet received at the destination by the number of packet originated at the source [9]. For the best performance packet delivery ratio of routing protocol should be as high as possible. If the ratio is 1, it will be the best delivery ratio of routing protocol.

$$\text{PDR} = \frac{\text{Packets Received by the Destination Node}}{(\text{Packets Received} + \text{Packets dropped})}$$

3.3 End to end delay

This metric includes all possible delay that may be caused by buffering during route discovery, queuing at the interface queue, retransmission delay at the MAC layer, propagation and transfer time [13]. It is defined as the time taken for a data packet to be transmitted across a MANET from source to destination. The E2E metric is given by:

E2E = Tr –Ts

Where, Tr is the time that a packet is received and Ts the time that this packet was injected into the network.

3.4 Packet Dropped

Packet dropped is the ratio of all same packets at the destination to all transmitted packets from CBR source.

Packet dropped = number of packet send – number of packet received

3.5 Routing load (RL)

Routing load is the number of routing packets transmitted for each data packet delivered at the destination. Routing load is determined as [13].

RL = Pc/ Pd

Where Pc is total control packet sent and Pd is total packet sent.

3.6 Normalized Routing Load (NRL)

It is number of routing packets transmitted by each node in a network divided by the number of packets received from the receiver node.

$$\text{NRL} = \frac{Routing\ Packets}{Total\ Received\ Packets}$$

Table 2: Performance Metrics

Performance Metrics	Better When
Throughput	High
Packet Delivery Ratio	High
End-to-End Delay	Low
Packet Loss	Low
Routing Load	Low
Normalized Routing Load	Low

4. RELATED WORK

There are various type of comparison has been performed with the routing protocols. Most researchers shown comparison and performance evaluation of routing protocols by mean of performance metrics. Some researchers study on the performance evaluation of routing protocols by using the various performance metrics and some on the performance comparison of routing protocols in MANET. While most of the work relate to the performance evaluation of MANET routing protocol include reactive, proactive and hybrid protocols. The performance evaluation of diverse MANET routing protocols has been demonstrated in Table 2

Table 3: Performance Evaluation of Various Routing Protocols.

Authors name	Protocols Evaluated	Area Size	Variable Parameters	Performance Metrics	Conclusion
Reena et al. [3]	DSR,TORA, LEACH	500*500	No. of nodes	Throughput, end-to-end delay, jitter, PDR	DSR is much better because of higher PDR and Throughput. TORA and LEACH best in case of end-to –end delay.
Divangna et al.[4]	DSDV,DSR, AODV,ZRP	1200*1200	No. of nodes	PDR, Average Throughput, Routing Overhead, Average Delay	AODV best in case of average throughput and PDR.ZRP best in case of average delay and routing overhead.
ZaibaIshrat et al.[5]	DSDV,DSR, ZRP	500*500	No. of nodes, Pause time	Packet delivery fraction and Throughput	DSR performance is better for both PDF and Throughput. When pause time less throughput low for all DSDV, DSR and ZRP. DSR is better.
AshishK.Murya et al.[6]	AODV,FSR, ZRP	1500*1500	No. of nodes , Pause time	Average end-to-end delay, PDR, Throughput, Average jitter	AODV show best performance in case of PDR and throughput FSR and ZRP show lowest end-to-end delay.
PreetiGaharwar et al.[7]	DSDV,AODV, DSR	2000*500	No. of nodes	Average end-to-end delay, PDR, Packet dropped	AODV show best performance than DSR and DSDV in term of average end-to-end delay, no. of packet dropped and PDR.so AODV is better.
GinniTonk et al. [8]	AODV,DSR, DSDV	800*800	No. of nodes, Pause time, Maximum speed	PDR, NRL, Average end-to-end delay	In all case AODV has highest PDF and NRL. While DSR has highest average end-to-end delay.
Deepak Kumar et al.[9]	DSDV,AODV	500*500	Maximum speed	PDR, Average end-to-end delay	AODV suffer in term of PDF but give better performance in term of end-to-end delay. DSDV perform better in case of PDF and suffer in term of end-to-end delay.
A Rama Rao et al.[10]	AOMDV,DSR ZRP	1600*2550	No. of nodes	End-to-end delay, PDR, Throughput	When no. of nodes less, ZRP has less delay but when increase high delay than DSR and AOMDV. AOMDV has high PDR. AOMDV performance is better.

5. CONCLUSION

In this paper an effort has been made on the performance evaluation of various routing protocols such as proactive, reactive and hybrid protocols. There are different kind of parameters are available for performance evaluation of various routing protocols. We analyzed that each protocol has different behavior in the network and we conclude that the AODV (Ad-Hoc on–demand distance vector) and DSR (Dynamic Source Routing) protocol is best and efficient which has high throughput, less packet dropped, low NRL and higher PDR. The protocol which offer low routing load is efficient routing protocol. These parameters have great role to select the efficient routing protocols in any communication network.

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