Performance Investigation of AODV, DSR and DSDV MANET Routing Protocols using CBR and FTP Traffic

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ABSTRACT
A wireless MANET is a collection of communication nodes that wants to communicate with each other, but has no fixed infrastructure and no re-determined topology of links. Mobile ad hoc network is a collection of wireless mobile nodes dynamically forming a network topology without the use of any existing network infrastructure. The purpose of the present work is to compare the performance of AODV, DSR and DSDV MANET protocols for different number of nodes and mobility with different traffic channels CBR and FTP. The AODV and DSR are reactive or On demand routing protocol and DSDV is a proactive or table driven routing protocol. The performance metrics considered in this work includes packet delivery ratio, throughput and average end-to-end delay. Results were obtained after simulations performed using NS2.

Keywords
MANET AODV, DSR, DSDV, CBR, FTP.

1. INTRODUCTION
A wireless MANET (Mobile Ad hoc NETwork) is a collection of communication nodes that wish to communicate with each other, but has no fixed infrastructure and no re-determined topology of links. Individual nodes are responsible for dynamically discovering other nodes that they can directly communicate with. Due to the limitation of signal transmission range in every node, all nodes cannot directly communicate with each other. Therefore, nodes are required to relay packets on behalf of other nodes in order to deliver data in the network. An important feature of Ad hoc networks is that changes in connectivity and link characteristics are introduced due to node mobility and power control practices. The absence of fixed infrastructure in a MANET poses several types of challenges. The biggest challenge in MANET is routing. Energy consumption issue is an important research topic in wireless MANET, because wireless nodes in such networks operate on limited battery power [1].

Routing protocols are mainly used to find the shortest, most efficient and correct path(s) while providing the data transmissions between different wireless devices in ad hoc network. The use of wireless technology has become a ubiquitous method to access the Internet or making connection to the local network due to its easier and inexpensive deployment with a possibility of adding new devices to the network at no or lower cost.

Although, the reliance upon an existing infrastructure and its potential limitations on mobility can be a major drawback, due to which wireless-capable devices may operate as autonomous entities, communicating via multiple wireless hops without a pre-established fixed infrastructure. The discussion that supports, such wireless-equipped devices are referred to as nodes and function as both clients and servers in the network to forward the data packets. Such a network is called a MANET, where the nodes employed in the network can change their location from time to time [2]. The various challenges in MANET are routing, security, QoS, limited bandwidth, dynamic topology etc.

This paper is organized into seven sections, with Section 1, presents MANET introduction. Section 2, presents a brief of related work and identify problem. Section 3, presents classification of MANET routing protocols. Section 4, presents overview of routing protocols. Section 5, presents simulation model and performance parameters. Section 6, presents result and discussion. Finally Section 7, concludes our work and propose future direction.

2. RELATED WORK
A number of routing protocols have been proposed and implemented for MANETs in order to enhance the bandwidth usage, more throughputs, less overheads per packet, least consumption of energy and others. All these protocols have advantages and disadvantages under certain circumstances [3]. In a proposal by Ajay Kumar et al. [4] discuss the various MANET routing protocols and various studies done on the performance evaluation of MANET. They study the performance of MANET routing protocols based on TCP traffic patterns and also analyzed the performance of AODV, DSR and DSDV protocols for TCP traffic pattern on the basis of Packet Delivery Ratio, Throughput and Jitter**.** It is concluded that DSDV protocol performs better as compared to AODV and DSR protocols for TCP traffic pattern. It is also concluded that performance of these protocols is more affected while subject to change in pause time as compared to change in number of connections. In a proposal by Youssef Saadi et al. [5] describes the simulation of AODV, DSDV and DSR routing protocols using Manhattan Grid Mobility Model. The reactive AODV, DSR and proactive DSDV protocol's internal mechanism leads to considerable performance difference. It has been observed that, AODV and DSR perform better than DSDV in terms of Packet Delivery Fraction and Throughput under Manhattan Grid mobility model. Although in term of Average end-to-end Delay, DSDV appears to be the best one. In a proposal by Ginni Tonk et al. [6**]** evaluate the performance of MANET Routing Protocols DSR, AODV and DSDV under different performance metrics like Packet Delivery Fraction, Average End-to-End delay, NRL, Throughput, Routing Overhead and Packet Loss. The performance evaluation is done in different network sizes using network simulator NS-2. The comparison result shows that AODV gives highest Packet Delivery Fraction and Throughput, DSR gives lowest packet loss and DSDV gives the lowest NRL, End-to-End Delay and Routing Overhead.

3. MOBILE AD-HOC NETWORK ROUTING PROTOCOLS

Routing protocols are ordered into three categories such as Proactive, Reactive and Hybrid Protocols [3].

3.1 Proactive Protocols

These types of protocols are called table driven protocols in which, the route towards all the nodes is maintained in routing table. Packets are shifted over the prebuilt route specified in the routing table. In this strategy, the packet shifting is done faster but the routing overhead is greater because all the routes have to be defined before shifting the packets. Proactive or table driven protocols have lower latency because all the routes are maintained at all the times. Example protocols: DSDV, OLSR.

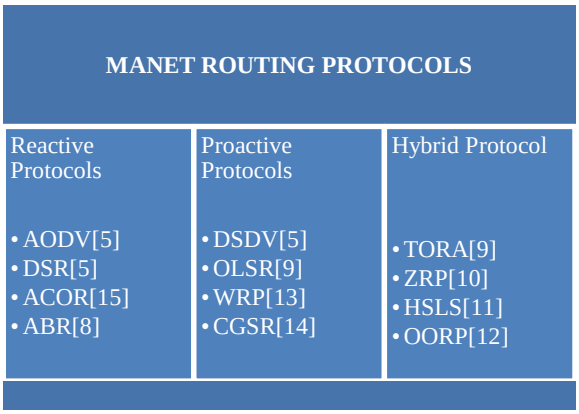

Fig 1: MANET Routing Protocols [3]

3.2 Reactive Protocols

These types of protocols are also called as On Demand Routing Protocols where the routes are not prebuilt for routing. Whenever a transmission is needed source node calls for the route discovery phase to determine a new route. This route discovery process is based on flooding algorithm which employs on the technique that a node just broadcasts the packet to all of its neighbors and intermediate nodes just forward that packet to their neighbor nodes. This process is repeated until it reaches the destination. Reactive approach has lesser routing overheads but more latency. Example Protocols: DSR, AODV.

3.3 Hybrid Protocols

Hybrid protocols are the combinations of reactive and proactive protocols. They take advantages of these two protocols due to which routes are found quickly in the routing zone. Example Protocol: ZRP.

4. OVERVIEW OF ROUTING PROTOCOLS

In this section we present an overview of routing protocols which we have considered for analysis in this work. We present a brief specification of AODV, DSR and DSDV MANET routing protocols.

4.1 Ad Hoc On-Demand Distance Vector Routing (AODV)

The AODV is a routing protocol for MANETs and other wireless ad-hoc networks provides On-demand route discovery. AODV is a reactive routing protocol, in which route is established to a destination only on demand. A node requests a route to a destination by broadcasting an RREQ message to all its neighbors. This RREP is unicast along the reverse-routes of the intermediate nodes until it reaches the original requesting node. The process repeats until the RREQ reaches a node that has a valid route to the destination. At each node, AODV maintains a routing table. Each node has its own sequence number. When a node wants to start route discovery process, it incorporates its sequence number and the most recent sequence number it has for destination. When a node loses connectivity to its neighbor, the node negates its route by sending an RERR to all nodes that received its RREP.

4.2 Dynamic Source Routing (DSR)

The DSR is a reactive routing protocol designed specifically for use in multi-hop wireless ad hoc networks of mobile nodes. In this protocol each source determines the route to be used in transmitting its packets to selected destinations. There are two main mechanisms, called Route Discovery and Route Maintenance. Route Discovery is the procedure by which a node wishing to send a packet to a destination obtains a path to the destination. Route Maintenance is the procedure by which a node finds a break in its source route and obtains a corrected route. The sender has the complete hop by hop route information to the destination. These routes are stored in a route cache. The protocol allows multiple routes to any destination and allows each sender to select and control the routes used in subjecting its packets, for example for use in load balancing or for increased robustness. The DSR protocol is mainly designed for MANETs of up to about two hundred nodes, and is also designed to work well with even very high rates of mobility.

4.3 Destination Sequenced Distance Vector (DSDV)

The DSDV routing protocol is a proactive routing protocol based on the Bellman-Ford routing algorithm. It was developed by C. Perkins and P. Bhagwat in 1994. At each node this protocol adds a new attribute, sequence number, to each route table entry. Each node in the mobile network maintains a routing table in which all of the possible destinations within the non-partitioned network and the number of routing hops to each destination are recorded. In DSDV, routing tables stored at each node are used for routing packets between nodes of an ad hoc network. At each node, routing table contains a list of the addresses of every other node in the network. With each node's address, the table contains the address of the next hop for a packet to take in order to reach the node. This protocol was motivated for the use of data exchange along changing and arbitrary paths of interconnection which may not be close to any base station.

5. SIMULATION ENVIRONMENT AND PERFORMANCE PARAMETERS

In this section, The Simulation environment used for analysis is shown in table 1. Fig 2 and fig 3 depict the scenario of 30 nodes for AODV and DSDV protocol.

5.1 Simulation Environment

A simulation study was carried out to evaluate the performance of MANET routing protocols such as DSDV, AODV and DSR based on the metrics throughput, Packet Delivery Ratio and average end-to-end delay with the following parameters:

Table 1: Parameter and Symbols

Parameter	Value
Number of nodes	30, 75, 100
Network size	1200M X 1200M
Path loss model	Two-Ray Propagation Model
Antenna type	Omni directional
Physical layer protocol	PHY802.11b
Data link layer protocol	MAC802.11
Traffic flow	CBR and FTP
Routing protocols	AODV, DSDV, DSR

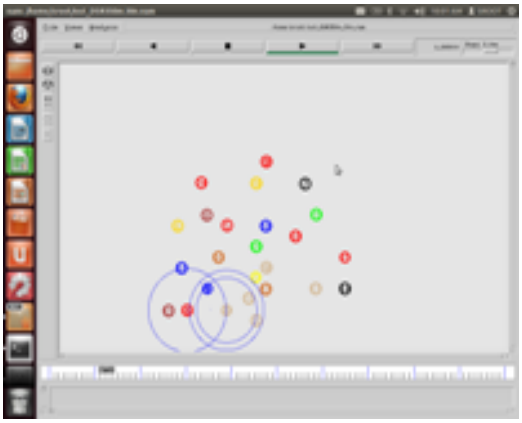

Fig 2: Scenario of 30 Mobile nodes for AODV

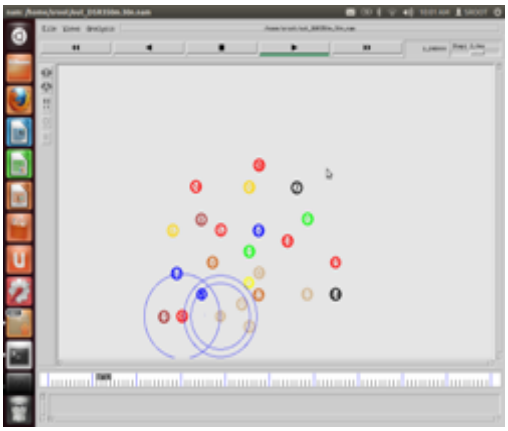

Fig 3: Scenario of 30 Mobile nodes for DSR

5.2 Performance Parameters

MANET protocols AODV, DSDV and DSR have been analyzed on the basis of three parameters using CBR and FTP traffic [3] [4] [7]. These are:

5.2.1 Packet Delivery Ratio

Packet delivery ratio is calculated by dividing the number of packets received by the destination through the number of packets originated by the application layer of the source. It measures the loss rate as seen by transport protocols and as such, it characterizes both the correctness and efficiency of ad hoc routing protocols. A high packet delivery ratio is desired in any network.

5.2.2 Throughput

The throughput of the protocols can be defined as percentage of the packets received by the destination among the packets sent by the source. It is the amount of data per time unit that is delivered from one node to another via a communication link. The throughput is measured in bits per second.

5.2.3 Average End-to-End Delay

The packet End-to-End delay is the average time that a packet takes to traverse the network. This is the time from the generation of the packet in the sender up to its reception at the destination's application layer and it is measured in seconds. It therefore includes all the delays in the network such as buffer queues, transmission time and delays induced by routing activities and MAC control exchanges.

6. RESULTS & DISCUSSIONS

We evaluated the performance of AODV, DSR and DSDV protocols for different nodes 30, 75and 100 and mobility 1000, 2000 and 3000 with CBR and FTP traffic. The performance metrics to be compared are Packet Delivery Ratio, average throughput and average delay.

6.1 Average Delay

Fig 4 shows average delay versus number of nodes for AODV, DSR and DSDV at different mobility using CBR traffic. It is concluded that average delay is more in AODV as compared to DSR and DSDV. AODV is worst and DSDV is best among all protocols in average delay which makes DSDV more preferable.

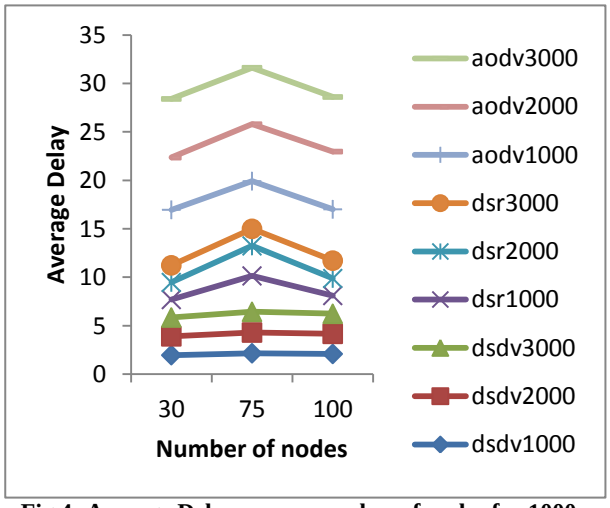

Fig 4: Average Delay versus number of nodes for 1000, 2000 and 3000 mobility with CBR traffic in AODV, DSR and DSDV

Fig 5 shows average delay versus number of nodes for AODV, DSR and DSDV at different mobility using FTP traffic. It is conclude that average delay is more in DSR as compared to AODV and DSDV. DSR is worst and DSDV is best among all the protocols in average delay which makes DSDV more preferable.

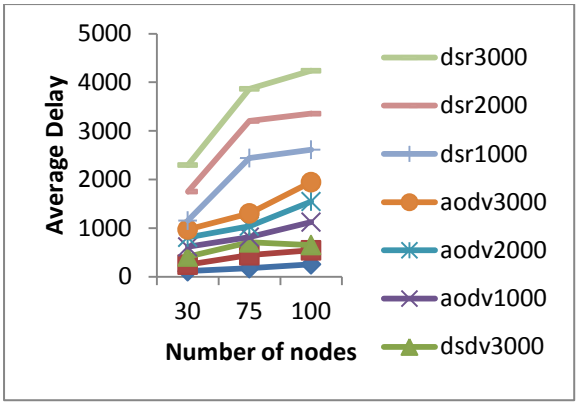

Fig 5: Average Delay versus number of nodes for 1000, 2000 and 3000 mobility with FTP traffic in AODV, DSR and DSDV

6.2 Packet Delivery Ratio

Fig 6 shows packet delivery ratio versus number of nodes for AODV, DSR and DSDV at different mobility using CBR traffic. It is conclude that packet delivery ratio is more in AODV as compared to DSR and DSDV. AODV is best and DSDV is worst among all the protocols in packet delivery ratio which makes AODV more preferable.

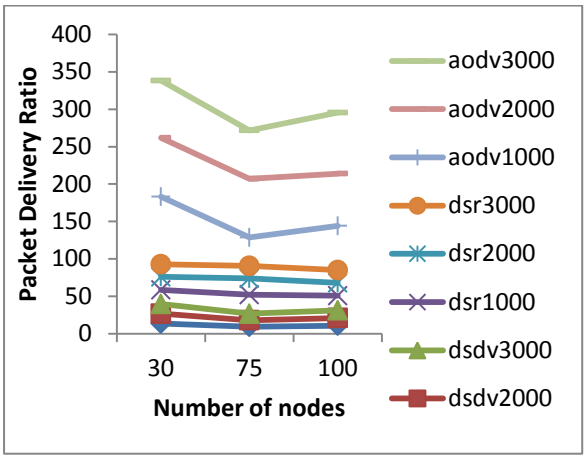

Fig 6: Packet Delivery Ratio versus number of nodes for 1000, 2000 and 3000 mobility with CBR traffic in AODV, DSDV and DSR

Fig 7 shows packet delivery ratio versus number of nodes for AODV, DSR and DSDV at different mobility using FTP traffic. It is conclude that packet delivery ratio is more in AODV as compared to DSR and DSDV. AODV is best and DSDV is worst among all the protocols in packet delivery ratio which makes AODV more preferable.

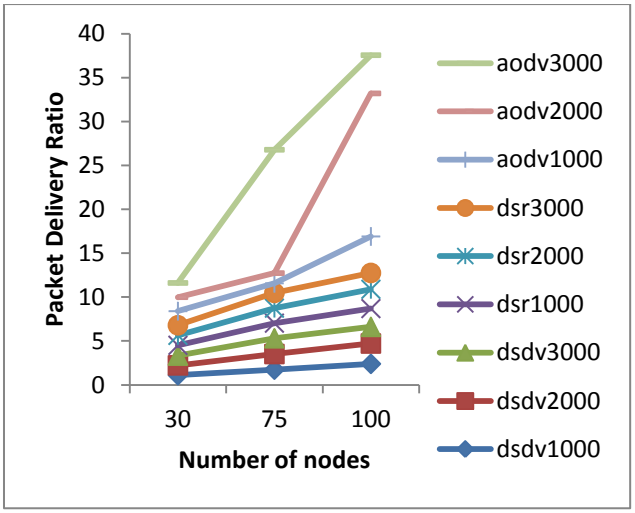

Fig 7: Packet Delivery Ratio versus number of nodes for 1000, 2000 and 3000 mobility with FTP traffic in AODV, DSDV and DSR

6.3 Throughput

Fig 8 shows average throughput versus number of nodes for AODV, DSR and DSDV at different mobility using CBR traffic. It is concluded that throughput is more in AODV as compared to DSR and DSDV. AODV is best and DSDV is worst among all the protocols in packet delivery ratio which makes AODV more preferable.

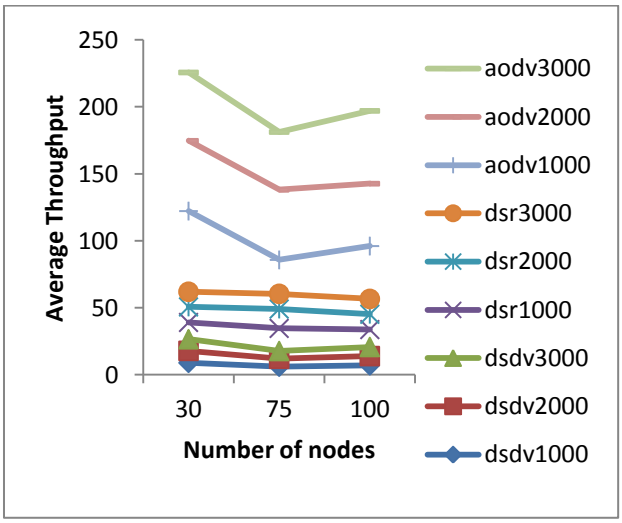

Fig 8: shows the Average Throughput versus number of nodes for 1000, 2000 and 3000 mobility with CBR traffic in AODV, DSDV and DSR

Fig 9 shows average throughput number of nodes for AODV, DSR and DSDV at different mobility using CBR traffic. It is concluded that average throughput is more in AODV as compared to DSR and DSDV.AODV is best and DSDV is worst among all the protocols in packet delivery ratio which makes AODV more preferable.

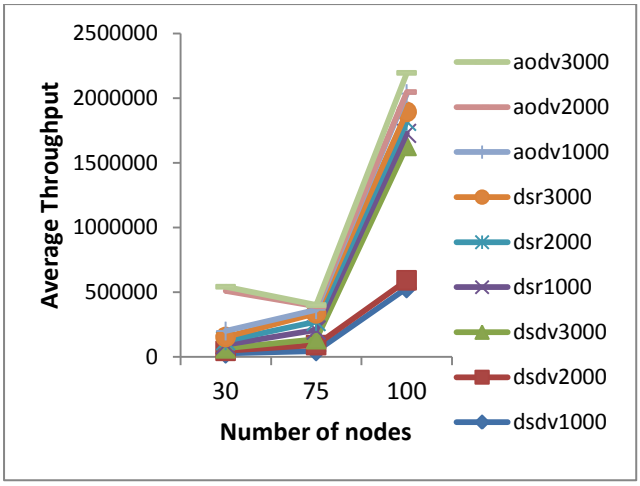

Fig 9: shows the Average Throughput versus number of nodes for 1000, 2000 and 3000 mobility with FTP traffic in AODV, DSDV and DSR

7. CONCLUSION

We compare the routing protocols for different nodes and mobility over CBR and FTP traffic. We compare the reactive and proactive MANET routing protocols. Our simulation result is dictated below as:

- In CBR traffic the value of average delay is small for DSR and DSDV for all network size and mobility as compared to AODV which makes DSDV and DSR more favorable while in FTP traffic the value of average delay is small for AODV and DSDV as compared to DSR which makes AODV and DSDV more favorable.
- In CBR and FTP traffic the value of PDR is small as for DSR and DSDV for all network size and mobility as compared to AODV which makes AODV more favorable.
- In CBR and FTP traffic the value of average throughput is small for DSR and DSDV for all network size and mobility as compared to AODV which makes AODV more favorable.

On the basis of these results it can be concluded that if delay is not an important issue then AODV is superior over DSR and DSDV as the value of other two parameters packet delivery ratio and average throughput is very good for AODV for all network size and mobility. And if only delay is a matter of concern during transmission then DSR and DSDV are good choices.

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