# Comparison of Performance Metrics for Source on Demand Routing Protocol

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## ABSTRACT

Mobile nodes available on ad-hoc network environments are unstable because of frequent mobility, and it is probable that the performance and quality of service (QoS) would be reduced or limited. To eliminate these limitations, many routing protocols were introduced over the years. However, this paper presents a Source on Demand Routing Protocol and then illustrates on its performance metrics by comparing Associativity Based Routing protocol (ABR), Ad-hoc On-Demand Distance Vector (AODV), and Dynamic Source Routing protocol (DSR). Network simulation 2 (NS-2) tool was used in simulating and analyzing these three protocols. Diverse performance metrics such as the Throughput, along with Packet delivery ratio and End-to-End delay, were simulated and their result indicates the best Source on Demand Driven Routing Protocol which gives the highest performance and quality of service (QoS) in MANET.

## Introduction

An independent structure in which mobile nodes are connected without any pre-existing network infrastructure, move freely at random and it often behaves like a router is called a Mobile Ad-hoc Network (MANET). The mobile nodes' topology is highly dynamic because nodes can move in any direction within a very limited amount of time. For nodes in motion to achieve their goals, a protocol for routing is

needed. This protocol would basically specify how the mobile nodes or hosts link with one another and distributing information that enables them to select routes between multiple nodes on the ad-hoc network. These protocols contain algorithms that establish specific choice of routes, and moreover, each node has prior knowledge of nodes within its visibility. There are three categories of protocols for routing that exist in an ad-hoc network namely, Table Driven (Proactive), Source on Demand Routing (Reactive) and Hybrid routing protocol [1].

The Proactive routing protocol is known as a Table-Driven Protocol, where each node keeps a routing table that includes the latest information of the routes to its neighbor node within the network. According to Hemant Rai et. al. [2], two types of table update is present in this protocol i.e. periodic update and triggered update. In the periodic update, the node broadcast the information on its able periodically to its neighbor and to any new node joining the network. The triggered update occurs whenever a node's neighbor makes changes to its table and then broadcast it on the network. The most widely used proactive protocols used are Distance-Sequence Distance Vector (DSDV), where the availability of path to all destination reveal that less delay is needed in setting up path process on the network and the Optimized Link State Routing (OLSR), where [3], stated that the topological changes causes flooding of the topological information to all the nodes available hosts in the network.

The Reactive Protocol which is known as source on-demand driven routing protocol, mobile nodes do not retain any routing information or routing activities if there are no communication [4]. Mobile nodes using this protocol only sends message to another node whereby the protocol then seek out for a route by demanding and establishing a link to transmit and receive data packets. A route is usually discovered by flooding route request packets on the network. There are dissimilar types of protocols available in an on-demand routing protocols namely; Ad-hoc on-demand distance vector (AODV), Destination Sequence Routing (DSR), and Associativity Based Routing protocol (ABR).

The Hybrid Protocol is the mixture of both proactive and reactive protocols [2]. Whenever the number of nodes scales up, this type of protocol is then applied to achieve an elevated performance. The type of protocol available here is called Zone Routing Protocol (ZRP), which

utilizes the feature of the combined protocols. This paper shows the comparison between the types of Source on Demand routing protocols. NS-2 simulation tool is used for performing analysis on different parameters to demonstrate which protocol among the three displays higher performance and QoS in real time.

## Literature Review

In [1], a simulation base analysis of DSDV and AODV was conducted using different parameters of QoS metrics. According to their research, the AODV protocol delivers about 70% to 90% of the packets in all cases, while DSDV delivers 50% to 75%. The final conclusion stated that the AODV performance is far better than that of DSDV protocol for real time application.

According to [2], a comparison of performance metrics for DSDV, AODV, ZRP protocol for routing in MANET was introduced. A simulation tool was used to analyze the different protocols for routing with respect to energy consumption, ratio of packet delivery and average delay between sources to destination using 50 nodes.

A realistic comparison between two MANET protocols namely OLSR and DSDV protocols was done by [3]. Their comparison shows that in a less tense environment, DSDV gives better throughput and PDF value compared to OLSR. But at high traffic load the DSDV performance degraded with the increases in pause time.

To control the congestion in MANET, [4] presented an Enhanced AODV (EAODV) protocol. The EAODV algorithm proposed was compare with the existing AODV algorithm using different parameters. In their conclusion, it was stated that the proposed system increased in performance and in controlling congestion than the existing system.

In [5], simulations with several different parameters was used in comparing the performances of OLSR and AODV. Their result shows that OLSR is more efficient than AODV, with respect to the performance in PDR, Average Delay, and Average overhead.

The performance of routing protocols such as EPRDSR, MTPR and DSR in Manet were analyzed using NS-2 Simulator in [6]. Their

findings reveal that EPRDSR outperforms DSR and MTPR due to less routing overhead whenever there is high node mobility.

## Classification of Source On-Demand (Reactive) Routing Protocol

Demand (Reactive) routing Protocols classified into the following sub-categories:

1. Ad-hoc On-Demand Distance Vector (AODV)
2. Dynamic Source Routing protocol (DSR),
3. Associativity Based Routing protocol (ABR).

## Ad-hoc On-Demand Distance Vector (AODV)

AODV is a Source on Demand routing protocol (Reactive) where mobile nodes are allowed to acquire routes quickly for new end point and also respond to broken links in the network topology within a reasonable amount of time. The different types of messages are used are Route Error (RERR), Route Request (RREQ), and Route Reply (RREP) when communicating with other participating nodes on the network. The source node usually requests for a route by initiating RREQ to inquire for route to a destination node by broadcasting it to its immediate neighbor. Any receiving node which receive the packet then checks to find out if its intended for it. If not, it attaches its ID to the message and rebroadcasting until the message reached the intended node. When the intended node gets the message, it creates a RREP message and send it back by unicasting through the route the packet came through. When an error occurs (i.e. link breakages) during message or packet transmission, a REER message is created, which in turn informs all other nodes about the link breakages that happened [5].

## Dynamic Source Routing Protocols (DSR)

DSR is a type of protocol used for routing which comprises of two separate mechanisms namely, Route Discovery (RD) and Route Maintenance (RM). These mechanisms are used for routing packets, and

to reduce routing overhead within the network. In the event of discovering new route, a RREQ message is generated by the initiating node and broadcasted to the intended node. Any neighbor node which receives RREQ packet and knows the route or path to the intended node then creates a RREP message, include its own ID then sends the packet which contains the complete route of source and destination node back to the source node. If a reply is not received with the time limit, then the RREQ message will continue to be broadcasted until a path to the destination is found. The Route Maintenance (RM) serves as a mechanism by which the initiating node is able to detect whether network topology has changed, such that the old route to the receiving node becomes outdated due to broken link. If the route maintenance confirms a broken route, then the source node can use another route that might have been sent by other neighboring node to get to the end point node [6].

## Associativity Based Routing Protocol (ABR)

Associative Based Routing (ABR) is an efficient routing protocol used in Ad hoc networks [7]. This On-Demand Protocol for routing is source initiated and uses broadcast as well as point-to-point routing. This protocol includes, Route Discovery phase, Route re- construction phase and Route deletion Phase. The discovery of new route is generated only when the source node needs to send a message to a node at another end point but has no information about the actual route to the intended node. The Re-Construction phase which can also be called route maintenance phase is responsible for the performing the partial route discovery, invalid route erasure, valid route update, and new route discovery. All these processes are executed depending on the mobility of the source, end point or transitional nodes. In the Route Deletion phase, the source is responsible for sending the Route Deletion message if the RREQ is not needed any more. When all transitional or intermediate node receive the message, the route is then purging out of each node's routing table.

## Simulation Environment

In determining the best Source on Demand Protocol for routing, which

gives the best quality of service (QoS), and higher performance in a real time MANET, network simulation 2 (NS-2) tool was used to simulate and analyze these three protocols namely: AODV, DSR, and ABR.

**Table 1 Simulation Parameters**

| Scenario Setup | Value |
|---|---|
| Routing Protocol | AODV, DSR, ABR |
| Channel | Wireless Channel |
| Propagation Model | Two Way Ground |
| Network Area | 1000 x 1000 |
| No. of nodes | 50 |
| Simulation Time | 200 secs |
| Packet Size | 512 bytes |
| Zone Radius | 1 |

**Performance Metrics**

Throughput: It is the sum of data sent successfully from one end point to another within a given period of time, and it's in bits per second (bps).

Packet Delivery Ratio: It is the relation between the message received and packets generated either by the source or destination node.

End to End Delay: It is the total time taken to transmit a packet within a network from one node to another.

**Simulation Results**

The scenario for MANET was implementation on NS-2.35, and the comparison was done using the following metrics, Packet Delivery Ratio (PDR), End to End Delay and Throughput for the different protocols mentioned in this paper.

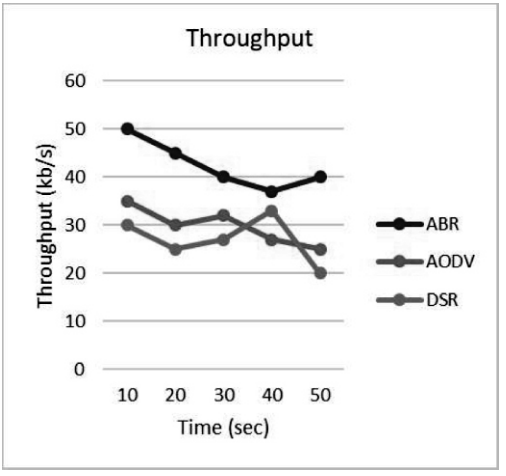


Fig. 1.Throughput vs Time (50 nodes)

The Fig. 1 graph indicates the comparison for throughput with respect to the quantity of packets that were delivered and at a certain time interval, the result shows that ABR protocol achieves better performance than both AODV and DSR protocols.

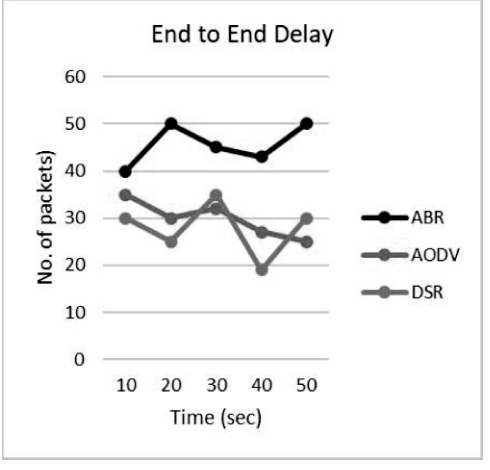


Fig. 2. End to End Delay vs Time (50 nodes)

The result for the end to end delay for 50 nodes in Fig. 2 shows that the ABR has less time to deliver more packets compare to the DSR and

AODV protocol. It also reveals that ABR performs better that the other two protocols.

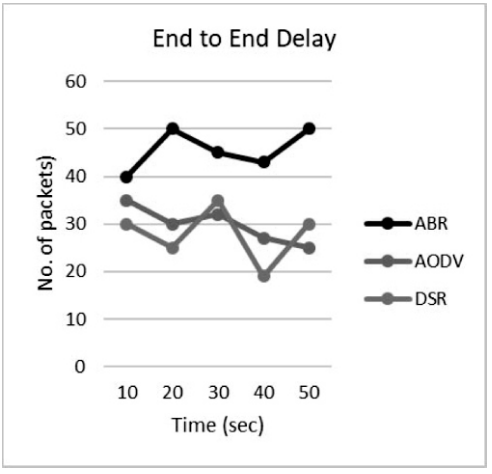


**Fig. 1.Packet Delivery Ratio vs Time (50 nodes)**

The PDR graph in Fig. 3 shows that ABR protocol performs better in terms of the amount of packet delivered within a limited time. It is more efficient compare to DSR and AODV protocols.

## Conclusion

In this paper, a realistic comparison between the Source-on-Demand Protocol for routing in MANET was proposed. The comparison was done using parameters like PDR, Throughput, and End-to End Delay. The simulation shows that the ABR routing protocol compared to its other counterparts, is the best Source-on- Demand Routing Protocol. It produces the best performance and possesses good QoS in MANET

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