



Comparative Study of AODV, DSDV and DSR Routing Protocols in MANET Using Network Simulator-2

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ABSTRACT: Mobile Ad hoc Network (MANET) is a collection of wireless mobile nodes that dynamically form a network temporarily without any support of central management. Moreover, Every node in MANET moves arbitrarily making the multi-hop network topology to change randomly at uncertain times. There are several familiar routing protocols like AODV, DSR, DSDV etc... which have been proposed for providing communication among all the nodes in the wireless network. This paper presents a performance comparison and study of reactive and proactive protocols AODV, DSR and DSDV based on metrics such as throughput, control overhead, packet delivery ratio and average end-to-end delay by using the NS-2 simulator.

Keywords: MANET, AODV, DSR, DSDV, NS-2 simulator

Introduction

The fast growth of mobile communication in recent years is especially observed in the field of mobile system, wireless local area network, and ubiquitous computing. The rapid growth in the mobile communication is mainly due to the mobility offered to end users, providing information access to anywhere, easy deployment, and user friendliness. The set of mobile terminals that are placed in a close location communicating with each other, sharing services, resources or computing time during a limited period of time and in a limited space forms Spontaneous ad hoc networks. Network management should be transparent to the user. These types of networks have independent centralized administration; user can enter the networks and leave the networks easily.

One of the important research areas in MANET is establishing and maintaining the ad hoc network through the use of routing protocols. However there are so many routing protocols present, this paper focus only considers AODV, DSR and DSDV for performance comparisons due to its familiarity among all other routing protocols. These routing protocols are analyzed based on the important metrics such as control overhead, throughput, packet delivery ratio and average end-to-end delay and is presented with the simulation results obtained by NS-2 simulator.

In particular, Section 2 briefly discusses the MANET routing protocols classification and the functionality of the three familiar routing protocols DSDV, AODV and DSR. In section 3 shows that the overview of routing protocols. The simulation results and performance comparison of the three above said routing protocols are discussed in Section 4. Section 5 simulation method and two cases involved while varying number of the nodes and varying speed of the nodes. Section 6 comparisons of the overall performance of the three protocols AODV, DSR and DSDV based on the throughput, control overhead, packet delivery ratio and average end-to-end delay metrics and showing concludes which protocols are better among these three routing protocols.

Mobile Ad Hoc Network Routing Protocols

Protocol Classifications

The classification of MANET routing protocols are shown below (Figure 1), depending on how the protocols are handle the packet to deliver from source to destination. Due to their functionality of Routing protocols are broadly classified into three types such as Reactive, Proactive and Hybrid protocols.

Proactive Protocols

These types of protocols are called table driven routing protocols in which, all the route information is maintained in routing table. The Packets are transferred over the network in the manner of specified and predefined route in the routing table. In this method, the packet forwarding is done faster but the routing overhead is greater because all the routes have to be defined before transmitting the data and control packets. Table-driven protocols have lower intermission because all the routes are maintained at all the times. Example protocols: DSDV, OLSR (Optimized Link State Routing)

Reactive Protocols

This network maintains only the routes that are currently in use, so reducing the burden on the network when only a few of all available routes is in use at any time. These types of protocols are also called as On Demand Routing Protocols where the routes are not before defined for routing. A Source node calls for the route discovery phase to determine a new route whenever a transmission is necessary. This route discovery mechanism 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 nearby nodes. This is a repetitive technique until it reaches the destination. On-demand techniques have smaller routing overheads but higher latency.

Example Protocols: DSR, AODV

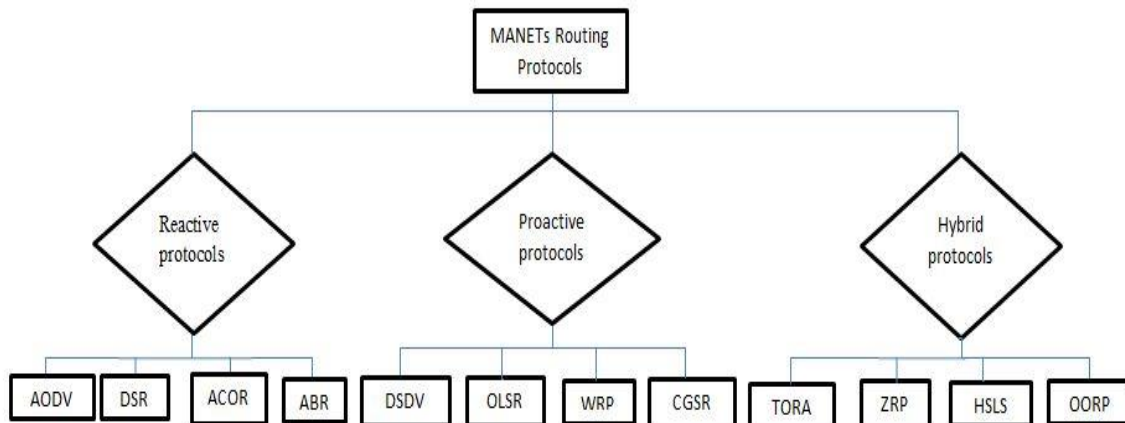


Figure 1. Manet Routing Protocols

Hybrid Protocols

The Hybrid protocols are the combinations of reactive and proactive protocols and takes advantages of these two protocols and as a result, routes are found quickly in the routing zone.

Example Protocol: ZRP (Zone Routing Protocol)

Overview of Routing Protocols

In this section, a short overview of the routing operations performed by the well-known protocols DSDV, AODV and DSR are discussed.

Destination-Sequenced Distance-Vector (DSDV) protocol

(DSDV) is a table driven routing scheme for ad-hoc mobile networks based on the Bellman-ford algorithm. The improvement made to the Bellman-Ford algorithm includes freedom from loops in routing table by using sequence numbers. Each node acts as a router where a routing table is maintained and periodic routing updates are transfer, even if the routes are not necessary. A sequence number is associated with each route or path to the destination to prevent routing loops. The Routing updates are exchanged even if the

network is idle which uses up battery and network bandwidth. So, it is not preferable for highly dynamic networks.

Ad hoc On-Demand Distance Vector Routing (AODV)

AODV is an On –Demand routing protocol which is confluence of DSDV and DSR. Route is calculated on demand, just as it is in DSR via route discovery process. On the other hand, AODV maintains a routing table where it maintains one entry per destination unlike the DSR that maintains multiple route cache entries for each target. AODV provides loop free routes while repairing link breakages but, DSDV doesn't require global periodic routing advertisements.

Dynamic Source Routing (DSR)

Dynamic Source Routing is a Pure On-Demand routing protocol, where the route is calculated only when it is necessary. It is designed for use in multi hop ad hoc networks of mobile nodes. DSR allows the network to be self-organized and self-configured without any central administration and network setup. It uses no periodic routing messages like AODV, thus reduces bandwidth overhead and conserved battery power and also huge routing updates. It needs only the effort from the MAC layer to identify link failure's uses source routing where the whole route is carried as an overhead.

In DSR, the whole route is carried with the message as an overhead, whereas in AODV, the routing table is maintained thus it is not required to send the whole route with the message during the Route Discovery process.

Simulation And Analysis Method

Network simulator-2 is popularly used for ad-hoc networking community. It is the open source software for evaluating the performance of the existing network protocols and evaluates new network protocols before use. Using ns2 simulator to simulate a variety of IP networks.

The Routing protocols were compared based on 4 parameter metrics given below.

Packet delivery Ratio

Packet Delivery Ratio (PDR) is the ratio between the number of packets transmitted by a traffic source and the number of packets received by a traffic destination. It measures the loss rate as seen by transport protocols and as specific to both the correctness and efficiency of ad hoc routing protocols. A great packet delivery ratio is desired in any network.

Average End-to-End delay:

The packet End-to-End delay is the average time that a packet takes to travel 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. Therefore includes all the delays in the network such as transmission times, buffer queues and delays induced by routing activities and MAC control exchanges.

Throughput

Throughput defined as the ratio of the total amount of data that reaches a receiver from a sender to the time it takes for the receiver to get the last packet.

Control overhead

Refers to the time it takes to transmit data on a packet-switched wireless network. Each packet requires extra bytes of format information that is stored in the packet header and combined with the assembly and disassembly of packets, decreases the overall transmission speed of the raw data.

Major assumption

Random waypoint mobility scenario creates random mobility scene every time it is executed by using setdest command in ns-2 tool. So that compares a protocol with themselves, we use the same mobility scenario for each modification. At same time using the random way point model we have the two cases for performance analyzes of wireless routing protocols. Finally, by varying the number of nodes (30,40 and 50) and also by

varying the speed(5ms,10ms,20ms) of the nodes then calculate the parameter values such as throughput, control overhead, average end to end delay and packet delivery ratio.

Simulation

Before we start the simulation, we can create 3 template TCL scripts to be used by our batch file to automatically simulate scenarios using the Mobility scene generated by using the setdest toolset. Four Batch files are used: Batch file to run the simulations based on the test scenarios varying speed and number of nodes, batch file to copy the test scenarios in the template TCL script, the batch file to run the awk script and the final batch file to move the network animator window, trace and mobility scenarios in specific folder for archiving and future use. The simulations parameters are shown in the table below .The same set of mobility scenarios for each variation of node speed and variation of the number of nodes while changing the routing protocol.

Case (1) By varying No. of nodes

By changing number of nodes then measure the parameter values such as control overhead, normalized routing overhead, delay, packet delivery ratio, throughput and jitter by keeping the speed of the node is constant.

Table 1.Simulation parameter

| | | | |
|---------------|-------------|-------------|--------|
| Topology area | 500 x 500 m | Max. Speed | 20ms |
| Pause time | 10s | UDP traffic | 3 conn |

Case (2) By varying speed of the nodes

In this circumstance by varying the speed(5ms,10ms,20ms) of the node then measure the parameter values such as packet delivery ratio, control overhead, normalized routing overhead, delay, throughput and jitter by keeping the number (40nodes) of the node is constant.

Table 2.Simulation parameter

| | | | |
|---------------|-------------|-------------|--------|
| Topology area | 500 x 500 m | No.of nodes | 40 |
| Pause time | 10s | UDP traffic | 3 conn |

Simulation Results

Simulations were done by varying the number of nodes and keeping speed of the node is constant (20ms) then varying the speed of the nodes keeping the number of the nodes is constant (40nodes).The deviation were done respectively varying the routing protocol from AODV to DSR and DSDV. The number of nodes for each comparison was also varied from 30 to 40 to 50 to identify the result. In all scenarios the Comparison were based on performance metric: Packet Delivery Ratio, Control Overhead, End to End Delay and Throughput.

Table.3. Simulation parameter values by varying number of nodes

| Parameter measured | 30 Nodes | | | 40 Nodes | | | 50 Nodes | | |
|-----------------------------|----------|---------|---------|----------|---------|---------|----------|--------|--------|
| | AODV | DSR | DSDV | AODV | DSR | DSDV | AODV | DSR | DSDV |
| No. of packets send | 557 | 560 | 578 | 573 | 572 | 555 | 568 | 558 | 562 |
| No. of packets received | 549 | 557 | 351 | 567 | 571 | 390 | 565 | 558 | 497 |
| Packet delivery ratio | 98.56 | 99.46 | 60.72 | 98.95 | 99.82 | 70.27 | 99.47 | 100 | 88.43 |
| Control Overhead | 399 | 88 | 444 | 285 | 107 | 585 | 253 | 46 | 780 |
| Normalized routing Overhead | 0.7263 | 0.1579 | 1.2649 | 0.5026 | 0.1873 | 1.5 | 0.4477 | 0.0082 | 1.5694 |
| Delay | 0.03299 | 0.01291 | 0.01044 | 0.01011 | 0.01204 | 0.00762 | 0.00929 | 0.0090 | 0.0074 |
| Throughput | 23984 | 23425 | 15377 | 24766 | 24034 | 17057 | 24691 | 23479 | 21741 |
| Jitter | 0.1742 | 0.1748 | 0.2465 | 0.1718 | 0.1705 | 0.2256 | 0.1726 | 0.1747 | 0.1961 |
| No. of packets dropped | 8 | 3 | 227 | 6 | 1 | 165 | 3 | 0 | 65 |

Table 4. Simulation parameter values by varying speed of the mobile nodes

| Parameter measured | 5ms | | | 10ms | | | 20ms | | |
|-----------------------------|----------|---------|---------|---------|--------|---------|---------|--------|---------|
| | AODV | DSR | DSDV | AODV | DSR | DSDV | AODV | DSR | DSDV |
| No. of packets send | 579 | 567 | 558 | 570 | 554 | 561 | 557 | 561 | 559 |
| No. of packets received | 576 | 568 | 494 | 566 | 553 | 347 | 550 | 556 | 367 |
| Packet delivery ratio | 99.4819 | 100.176 | 88.5305 | 99.298 | 99.81 | 61.85 | 98.74 | 99.10 | 65.65 |
| Control Overhead | 242 | 50 | 590 | 324 | 61 | 607 | 525 | 92 | 624 |
| Normalized routing Overhead | 0.42013 | 0.08802 | 1.19433 | 0.57243 | 0.1103 | 1.7492 | 0.9545 | 0.1634 | 1.7002 |
| Delay | 0.01163 | 0.01003 | 0.00885 | 0.01432 | 0.0142 | 0.00988 | 0.01969 | 0.0103 | 0.00658 |
| Throughput | 25170.1 | 23903.7 | 21607 | 24728 | 23247 | 15172 | 24067 | 23376 | 16038 |
| Jitter | 0.169339 | 0.17164 | 0.19737 | 0.17232 | 0.1764 | 0.2813 | 0.17710 | 0.1755 | 0.2657 |
| No. of packets dropped | 3 | -1 | 64 | 4 | 1 | 214 | 7 | 5 | 192 |

Comparison based on Packet Delivery Ratio

As it can be seen from the above results ,the pdr remains the same in all the scenario despite the increase the number of nodes and increase in the speed of nodes which could be due to the multihop characteristics of the Ad hoc Routing protocol.DSR has slight higher pdr than AODV and Table driven routing protocol(DSDV) lower pdr than reactive protocols(AODV,DSR).Among these three protocols DSR is better pdr than AODV and DSDV.

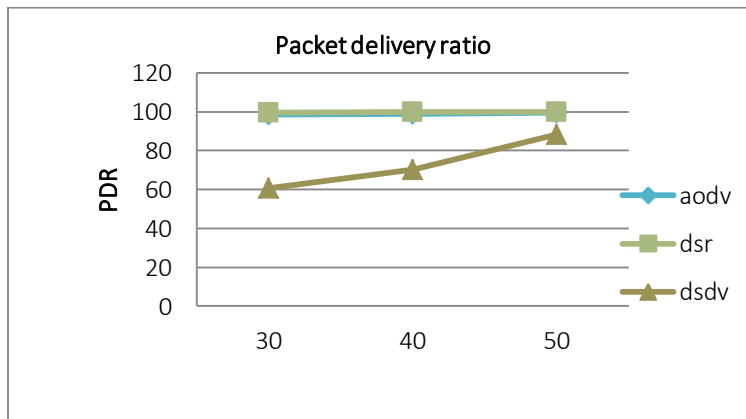


Figure 2.By varying number of nodes

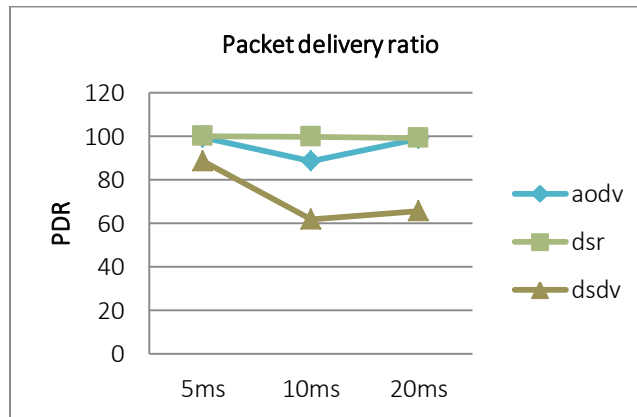


Figure 3.By varying speed of the nodes

Comparison based on Control overhead

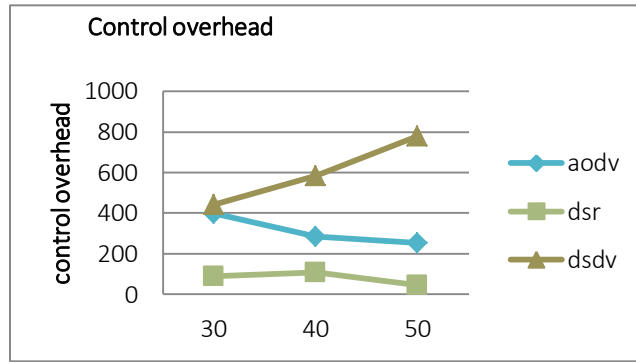


Figure 4. By varying number of nodes

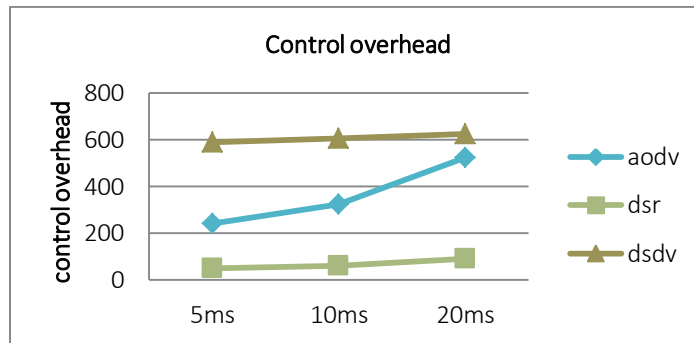


Figure 5. By varying speed of the nodes

As it can be seen from the above results, the control overhead is varied by varying the number of nodes and speed of the nodes. Fig.4 and 5 clear that DSDV is huge control overhead because its periodic routing table updates in the network. Then AODV is slightly lower than the DSDV and DSR have lower control overhead than two other routing protocols.

Comparison based on Throughput

The number of nodes was varied (30, 40, 50) each time in Fig. 6. and the throughput was calculated at destination node during entire AODV shows higher throughput than the DSR and DSDV. The AODV has much more routing packets than DSR because the AODV avoids loop and freshness of routes while DSR uses stale routes. Its throughput is higher than other two routing protocols at high mobility simulation period. As it can be clearly show that simulation and expected throughput can be obtained in AODV routing protocol. Among these three routing protocols AODV is better than other two routing protocols and DSR have slightly lower throughput than AODV. The DSDV have lower throughput than other routing protocols shown in Fig.6 and Fig.7.

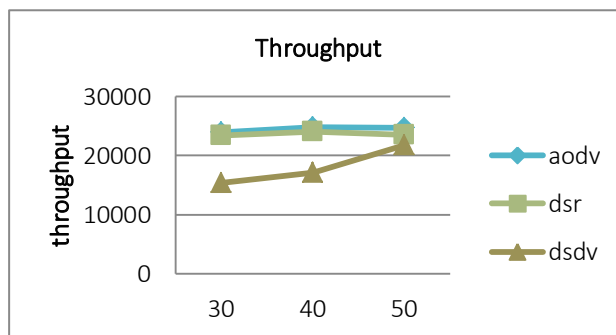


Figure6. By varying number of nodes

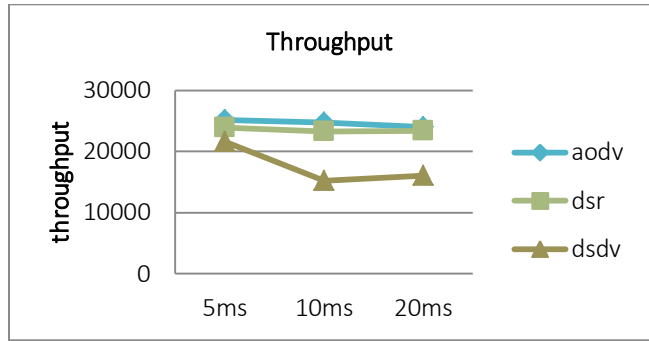


Figure7.By varying speed of the nodes

Comparison based on End to End delay

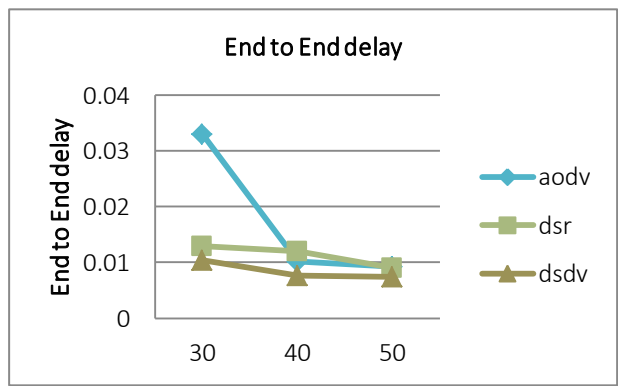


Figure 8. By varying number of nodes

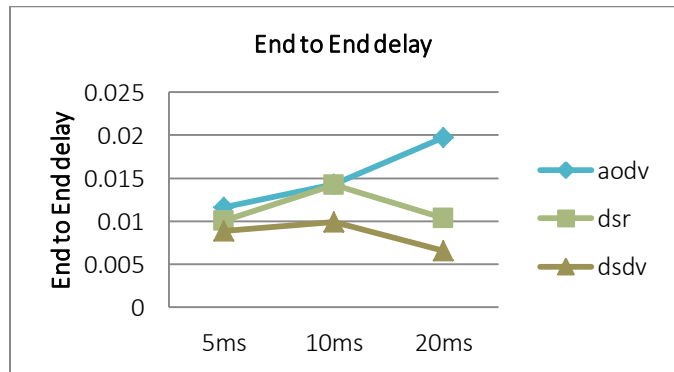


Figure 9. By varying speed of the nodes

As it can be seen from the above simulation, end to end delay is higher in AODV followed by DSR and DSDV having the lowest and most stable End to End Delay in mobility. By increasing number of nodes in small area then reduce the end to end delay in AODV and increasing speed of the node then increase the delay in AODV. In DSR and DSDV slightly lower delay compared to AODV.

Conclusion

Our simulation work illustrates the performance of three routing protocols AODV, DSR and DSDV. The paper presents a study of the performance of routing protocols, used in MANETs, in high mobility case under low, medium and high density scenario. We vary the number of nodes from 30 (low density) to 50 (high density) in a fixed topography of 500*500 meters. Moreover, since Random Waypoint Mobility Model has

been used in this study to generate node mobility. We find that the performance varies widely across different number of nodes and different types of speed in node mobility. AODV performance is the best considering its ability to maintain connection by periodic exchange of data's. As far as Throughput is concerned, AODV and DSR perform better than the DSDV even when the network has a large number of nodes. Overall, our simulation work shows that AODV performs better in a network with a larger number of nodes whereas DSR performs better when the number of nodes is slight. Average End-to-End Delay is the least for DSDV and does not change if the no of nodes are increased. Thus, we find that AODV is a viable choice for MANETs. In this paper, we have done complete analysis of the three MANET's routing protocols. Our future plan is to evaluate security issues in AODV.

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