

Step by Step Procedural Comparison of DSR, AODV and DSDV Routing protocol

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Abstract. Mobile Ad hoc network is network where nodes communicate without any central administration or network infrastructure. They are connected via wireless channels and can use multiple hops to exchange data. Routing protocols are needed for communication in such Ad hoc networks, where it targets for efficient and timely delivery of message. There are various performance metrics to compare Ad hoc routing protocols. In this paper, a step by step procedure is stated to compare 3 popular routing protocols, DSR, AODV and DSDV based on performance metrics Packet Delivery Fraction (Pdf), End to end delay and Normalized Routing load while varying the number of nodes, speed and Pause time. It also provides a step by step approach based on assumption on how to carry out such a comparative study, which could be used for future research.

Keywords: AODV, DSDV, DSR, Pdf, MANET

1. Introduction

Mobile adhoc network are networks where nodes communicate with each other without any existing infrastructure and wirelessly. They can multihop to the destination. They have the advantage of rapid deployment, robustness, flexibility and inherent support for mobility. This flexibility of self configuring and self administration makes it lucrative for various applications in military operations, wireless mesh networks; wireless sensor networks etc. Due to the wireless nature of Mobile Ad hoc network, the routing protocol is a very important issue to make it more efficient and reliable. Routing protocols for Mobile ad hoc networks can be classified into two main categories: Proactive or table Driven routing protocols and on-demand routing protocols.

Many paper present comparison between the routing protocols DSR, AODV and DSDV based on Pdf, Average End to End Delay and Routing Load [1,2]. This paper aims to provide a step by step comparative analysis of 3 popular routing protocols: AODV, DSR and DSDV.

The rest of the paper is organized as follows: Section 2 presents an overview of the Wireless routing protocol that is analyzed and compared. Section 3 gives a brief description of the Simulation parameters, assumptions hold and description of the step by step comparing methodology used in the paper. Section 4 provides the simulation results and discusses it. Finally the conclusion is provided in section 5.

2. Wireless Routing Protocols

Mobile Ad Hoc Networks can be divided into Table-Driven and On-Demand Routing protocol where Table Driven protocols are proactive and maintain a routing table and On-Demand are active and do not maintain a routing table. The following routing protocols are analyzed in the research:

2.1. 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. However, AODV maintains a routing table where it maintains one entry per destination unlike the DSR that maintains multiple route cache entries for

each destination. AODV provides loop free routes while repairing link breakages but unlike DSDV, it doesn't require global periodic routing advertisements. [3, 4]

2.2. Dynamic Source Routing (DSR)

Dynamic Source Routing is a Pure On-Demand routing protocol [6], where the route is calculated only when it is required. It is designed for use in multihop ad hoc networks of mobile nodes. DSR allows the network to be self organized and self configured without any central administration and network infrastructure. It uses no periodic routing messages like AODV, thus reduces bandwidth overhead and conserved battery power and also large routing updates. It only needs the effort from the MAC layer to identify link failure. DSR uses source routing where the whole route is carried as an overhead. [2]

2.3. Destination-Sequenced Distance Vector routing (DSDV)

(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 [3]. Each node acts as a router where a routing table is maintained and periodic routing updates are exchange, even if the routes are not needed. A sequence number is associated with each route or path to the destination to prevent routing loops. Routing updates are exchanged even if the network is idle which uses up battery and network bandwidth. Thus, it is not preferable for highly dynamic networks.

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.

3. Simulation and Analysis method

The simulations were performed using Network Simulator (Ns-2), which is popularly used for ad hoc networking community. The routing protocols were compared based on the following 3 performance metrics:

Packet Delivery Fraction (PDF): The ratio of Data packets delivered to those generated by the sources.

End to End delay: the delay in delivering a packet to the destination which is inclusive of all kinds of delay.

Routing Load: This is the routing packets sent per delivered packet at the destination.

3.1. Major assumption:

Random waypoint mobility scenario creates random mobility scene every time it is executed (using setdest command in ns2). Thus in order to compare a protocol with itself, we have to use the same mobility scenario for each variation. But using Random waypoint model, it is not possible. Thus, in order to minimize the randomness for each variation, 50 such mobility scenario is generated and the average of it is taken. This process is undertaken for each variation making it less random. In other words, for each simulation, the results are averaged over 50 randomly generated mobile scenarios with the same pause time interval or same speed. The same strategy has been used in [6].

3.2. Simulation Method

Before we start the simulation, we 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. 4 Batch files are used: Batch file to run the simulations based on the test scenarios varying speed and pause time, batch file to copy the test scenarios in the template tell script, the batch file to run the awk script and the final batch

Simulator	Ns-2
Studied protocols	DSDV, AODV and DSR
Simulation time	100 seconds
Simulation area	500 m X 500 m
Node Movement model	Random Waypoint
Speed	0-25 in steps of 5 m/s
Traffic type	CBR(UDP)
Node Pause time	0-100s in steps of 20s
Data payload	1000 bytes/Package
Packet Rate	250 k
No. of Nodes	15, 30 and 45
No. of source destination	4 and they are fixed and not randomly selected using ns2 tools.

Table 1: Simulation Parameters

file to move the nam, trace and mobility scenarios in specific folder for archiving and future use. The simulations parameters are shown in the table above. The same set of mobility scenarios for each variation of speed and pause time is used while changing the routing protocol.

4. Simulation results

Simulations were done varying the speed keeping the pause time constant (0 sec) and then varying the pause time keeping the speed constant (5 m/s). The variation were done respectively varying the routing protocol from DSR to AODV and then to DSDV. The number of nodes for each comparison were also varied from 15 to 30 to 45 to identify the effect. In all scenarios the Comparison were based on performance metric: Packet Delivery Fraction, End to End Delay and Routing Load.

4.1. Comparison based on Packet Delivery Fraction (Pdf), End to End Delay and Routing Load keeping the Pause time constant and varying Speed.

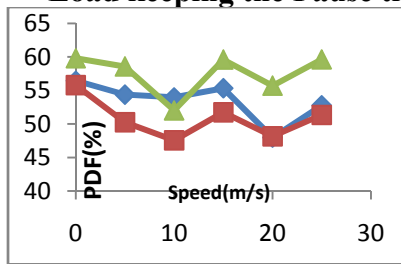


Figure 1. Number of nodes =15

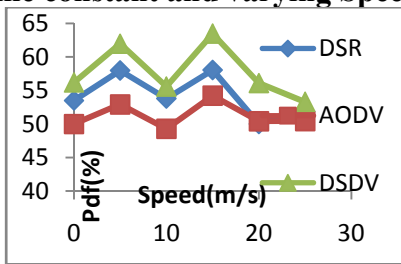


Figure 2. Number of nodes=30¹

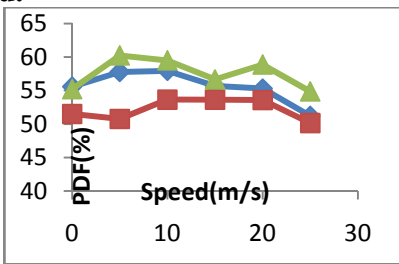


Figure 3. Number of nodes 45

As it can be seen from the above results, the pdf remains the same in all the scenario despite the increase of speed and increase in the number of nodes which could be due to the multihop characteristics of the Ad hoc Routing protocol. DSDV has a slight higher pdf than AODV and DSR in all the scenarios, which could be due to it being a Table-Driven Routing protocol and is slightly more reliable. DSR has slightly more Pdf than AODV as it always looks for the most fresh and reliable route when needed and does not look for it from the routing table like AODV.

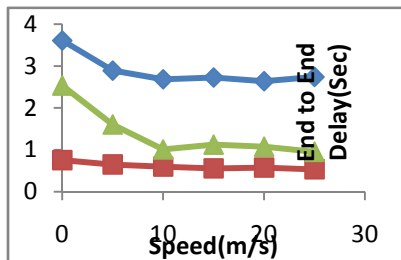


Figure 4. Number of nodes 15

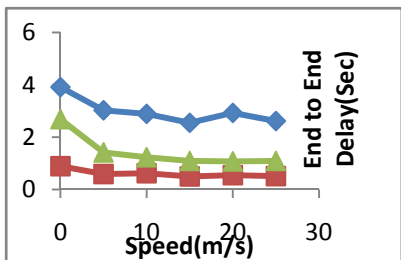


Figure 5. Number of nodes 30

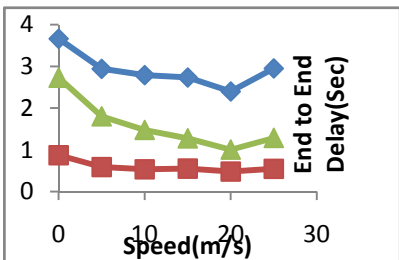


Figure 6. Number of nodes 45

As it can be seen from the above results, end to end delay is higher in DSR followed by DSDV and AODV having the lowest and most stable End to End Delay in mobility. DSR is a On-Demand source routing protocol, and this is the major reason for it having a higher End-to-End Delay, where route is looked only when needed and there is a route Discovery mechanism happening every time and it also has to carry a large overhead each time, thus the higher delay. AODV on the other hand has only one route per destination in the routing table, which is constantly updated based on sequence number and DSDV has to continuously update the whole routing table periodically and when needed, which leads to a slight delay in delivery. The end to end delay does not change with increase in the number of nodes as the source and destination are in the same place moving with same speed, the increased number of nodes only might increase number of hops. The End to End delay decreases with increase with speed, as when it moves more frequently the routing updates are exchanged more frequently and faster it reaches the destination.

¹ The same legend is used in all the graphs. Please refer the same legend provided here

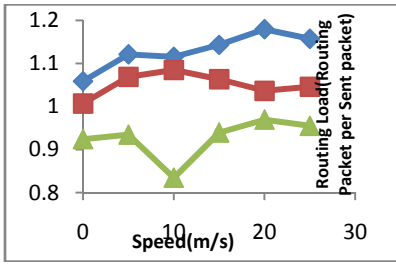


Figure 7. Number of nodes 15

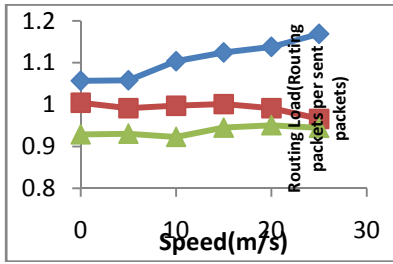


Figure 8. Number of nodes 30

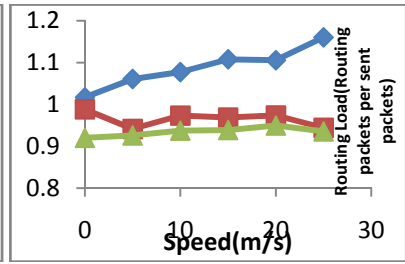


Figure 9. Number of nodes 45

As it can be seen and expected the Routing load is higher in DSR than in DSDV and AODV, as DSR is a source routing protocol and the whole route is sent with each message as an overhead, which increases the routing load. It increases with speed as well, as more frequently the destination changes the more route is carried as an overhead. It is stable in the case of AODV and DSDV as they maintain a routing table and have fewer routes overhead.

4.2. Comparison based on Packet Delivery Fraction (Pdf), End to End Delay and Routing Load keeping the Speed constant and varying Pause time

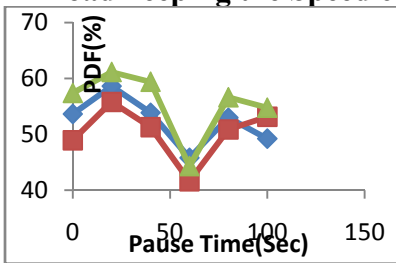


Figure 10. Number of nodes 15

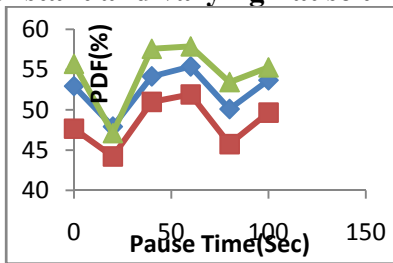


Figure 11. Number of nodes 30

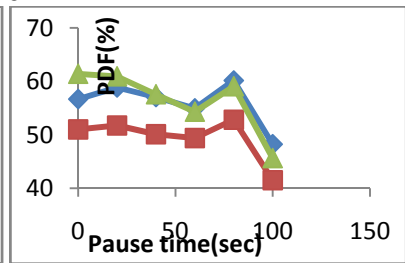


Figure 12. Number of nodes 45

As it can be seen from the above results, the pdf remains the same in all the scenario despite the increase of pause time (decrease in speed) and increase in the number of nodes which could be due to the multihop characteristics of the Ad hoc Routing protocol. DSDV has a slight higher pdf than AODV and DSR in all the scenarios, which could be due to it being a Table-Driven Routing protocol and is slightly more reliable. DSR has slightly more Pdf than AODV as it always looks for the most fresh and reliable route when needed and does not look for it from the routing table like AODV.

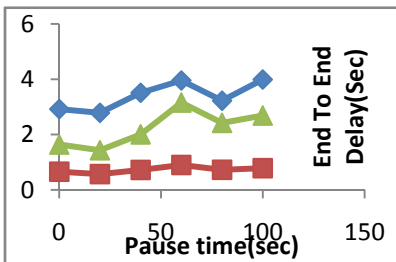


Figure 13 Number of nodes 15

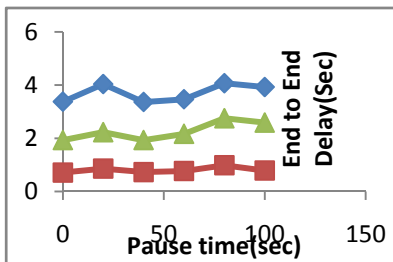


Figure 14 Number of nodes 30

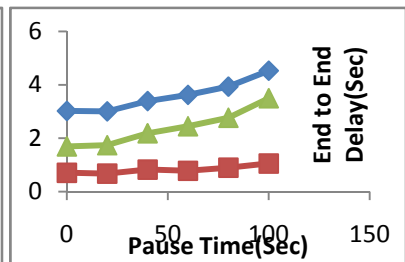


Figure 15 Number of nodes 45

As it can be seen from the above results, end to end delay is higher in DSR followed by DSDV and AODV having the lowest and most stable End to End Delay in mobility. DSR is a On-Demand source routing protocol, and this is the major reason for it having a higher End-to-End Delay, where route is looked only when needed and there is a route Discovery mechanism happening every time and it also has to carry a large overhead each time, thus the higher delay. AODV on the other hand has only one route per destination in the routing table, which is constantly updated based on sequence number and DSDV has to continuously update the whole routing table periodically and when needed, which leads to a slight delay in delivery. The End to end delay is almost constant in the scenarios with nodes 15 and 30 (the variation could be due to our

assumption of reducing the randomness and comparing). It is evident that the End to End Delay increases with increase in pause time with nodes of 45 as the number of nodes increases, so does the number of hops and thus the delay (which is inclusive of all sorts of delay).

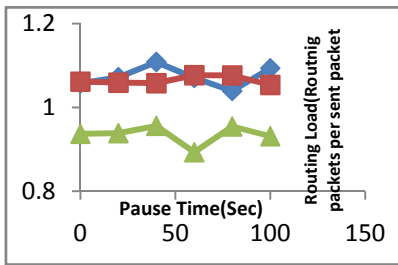


Figure 16 Number of nodes 15

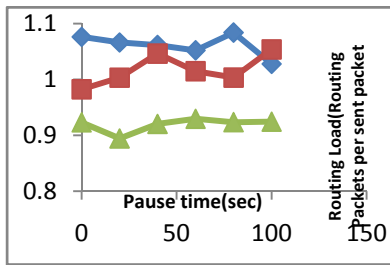


Figure 17 Number of nodes 30

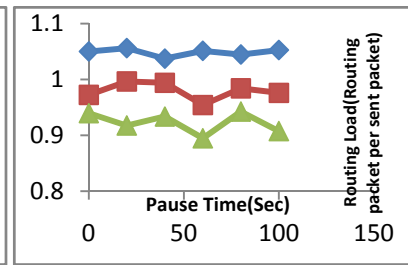


Figure 18 Number of nodes 45

As it can be seen and expected the Routing load is higher in DSR than in DSDV and AODV, and the reasoning could be the same as given above for the scenario of varying pause time with constant speed. DSDV is the most stable as it is Table Driven Routing protocol and has the same routing update despite change in speed or pause time. The variations do not change with the change in the number of nodes.

5. Conclusion

This paper compared the 3 popular ad hoc routing protocols AODV, DSR and DSDV. Simulation results show that amongst all the protocols, AODV has a stable End to End Delay despite mobility as it has the feature of On-Demand Routing protocol and also maintains a Routing table. DSDV has a higher Pdf than the other two routing protocols in mobility as it is a Table Driven protocol and is more reliable. DSR has the highest End to End Delay and Routing load increases the bandwidth and consuming the battery life. Based on the above simulation scenario, parameter, assumption and results AODV could be considered as an efficient faster routing protocol than DSR and DSDV but has a higher Routing load comparatively than DSDV.

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7. References

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