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Performance Comparison of AODV, DSR, DSDV, OLSR and DYMO Routing Protocols in MANETS

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Abstract

Recently Mobile Ad Hoc Network (MANET) has become very popular. A MANET is a collection of mobile nodes sharing a wireless channel without any fixed infrastructure or centralized administration. MANET has dynamic topology and each node has limited resources such as battery, processing power and on-board memory. In MANET, mobile nodes communicate with each other in a multi-hop manner. That means a node sends a packet to a destination through intermediate mobile nodes and each node can act as an end system and also can act as a router. Routing protocols have an important role in any Mobile Ad Hoc Network. There are many routing protocols that exhibit different performance levels in different scenarios. In this article we compare AODV, DSR, DSDV, OLSR and DYMO routing protocols in Mobile Ad Hoc Networks (MANETS) to specify the best operational conditions for each protocol. We study these five routing protocols by extensive simulations in NS-2 simulator and show that how the Number of Nodes affects their performance. In this study, performance is calculated in terms of Packet Delivery Ratio, Average End to End Delay, Normalised Routing Load and Average Throughput.

Keywords Mobile Ad Hoc Networks, Comparison, AODV, DSR, DSDV, OLSR, DYMO.

Introduction

Huge work has been done in the development of routing protocols in different types of ad hoc networks like MANETs (Mobile Ad Hoc Networks), WMNs (Wireless Mesh Networks), WSNs (Wireless Sensor Networks), and VANETS (Vehicular Ad-Hoc Networks) etc [1]. Designing the routing functionality at each of the mobile node is the main aim of the MANETs. For such designing aspects of ad hoc networks routing-based approach, information-theoretic approach, dynamic control approach or game-theoretic approach has been applied [2].

The routing protocols in MANETs are organised into three different categories: Proactive (Table-driven) routing protocols, Reactive (On-demand) routing protocols and Hybrid routing protocols [3].

The routing information in proactive routing protocolsis stored in the organization of tables maintained by each node. DSDV [4] and OLSR [5] are the examples.Reactive routing protocolsinvolve discovering routes to other nodes only when they are desirable.AODV [6, 7], DSR [8] and DYMO [9] are the examples.Hybrid routing protocolscombine intrinsic worth of both the proactive and reactive approaches.

The remainder of the article is organized as follows. After presenting the related works in section 2, section 3 presents simulation environment. The results of our simulation are analysed in section 4. Finally, section 5 concludes the paper.

Related Works

Many works have been elaborated related to the performance comparison of different routing protocols in Mobile Ad Hoc Network (MANET). We focus on those works performed by network simulator NS-2[10] and by considering the variation of Number of Nodes.Table 1 shows the comparative performance evaluation.

Table 1: Performance analysis of MANET routing protocols.

Ref. no	**Protocols used**	**Performance metrics**	**Variable Parameters**
[11]	AODV, DSR, DSDV	End to End Delay, Packet Delivery Ratio, Throughput	Number of nodes
[12]	AODV, DSR, DSDV	Average End to End Delay, Normalized Routing Load, Packet Delivery Ratio,	Number of Nodes, Speed, Pause time, Transmission Power
[13]	AODV, DSR, DSDV	Packet Delivery Ratio, Average End to End Delay, Normalized Routing Load	Pause time, Number of nodes and mobility
[14]	DSDV, AODV	Packet Delivery Fraction, Average End to End Delay, Throughput	Number on nodes, Speed, Time

In our article, we will compare five MANET protocols (AODV, DSR, DSDV, OLSR, and DYMO). In our knowledge, there is no work in the literature which compares in the same article these five protocols by considering the variation of Number of nodes.

Simulation Environment

Simulation parameters

We elaborate the experiments for the evaluation of the performance of AODV, DSR, DSDV, OLSR and DYMO with varying Number of Nodes. We have 30 simulations run in total out of which 30 trace files has been generated for Random Waypoint Mobility each [15]. We tested all performance metrics in our experiment under varying Number of Nodesand while other parameters are constant. Table 2 shows the simulation parameters used in this evaluation. The NS-allinone-2.34 [10] supports simulation for AODV, DSR and DSDV. The simulation of protocols OLSR and DYMO are based on the work presented in [16].

Table 2: Simulations parameters

Parameters	**Value**
Simulator	NS-2.34
Data packet size	512 byte
Simulation duration	50 sec
Environment size	500m × 500m
Number of Nodes	20, 30, 40, 50, 60, 70
Pause Time	5 sec
MAC Layer Protocol	IEEE 802.11
Traffic Type	CBR
Number of connections	15
Maximum Mobility	20 m/s
Mobility Model	Random Waypoint
Protocols	AODV, DSR, DSDV, OLSR, DYMO

Performance Metrics

RFC2501 [17] illustrates a number of quantitative metrics that can be used for evaluating the performance of MANET routing protocols. To analyze routing protocols, we have focused on four performance metrics:

*Packet Delivery Fraction*is the ratio of number of received data packets successfully at the destinations nodes over the number of data packets sent by the sources nodes.

*Average End to End Delay*is the average time from the transmission of a data packet at a source node until packet delivery to a destination.

Normalized Routing Load is the ratio of all routing control packets send by all sources nodes to number of received data packets at the destination nodes.

*Average Throughput*is the average number of messages successfully delivered per unit time. It is measured as the number of bits delivered per second.

Simulation Results and Analysis

Packet Delivery Fraction

From Figure 1, we note that DSDV protocol has the lowest Packet Delivery Ratio compared to other protocol (AODV, DSR, OLSR and DYMO). DSR and AODV demonstrate good performance (height Packet Delivery Ratio), but DSR is better than AODV. In comparing on-demand protocols, DSR shows the highest and DYMO the lowest Packet Delivery Ratio. As table-driven protocols, OLSR outperforms DSDV in terms of Packet Delivery Ratio.

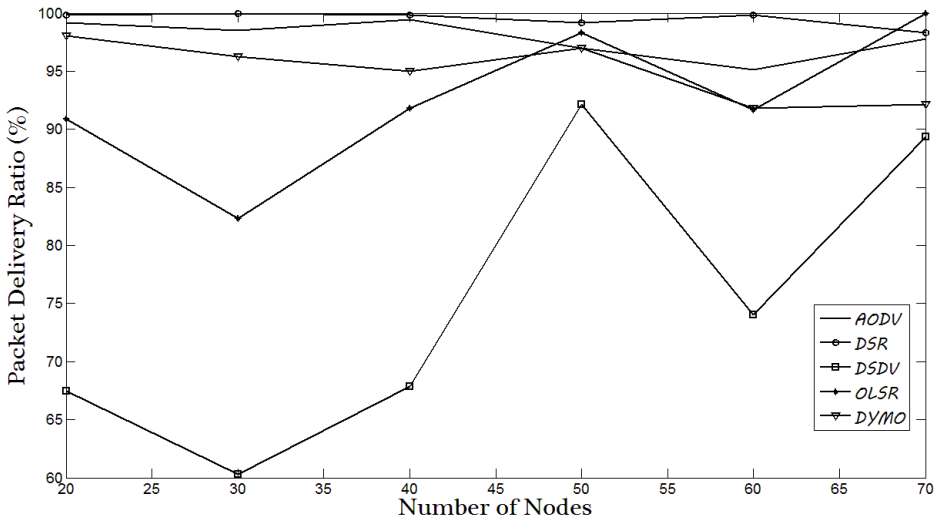

Figure 1: Packet Delivery Ratio versus Number of Nodes.

Average End to End Delay

Figure 2 shows that AODV protocol has the highest value of Average End to End Delay (low performance) compared to other protocols. This figure does not precise the behavior of the protocols: DSR, DSDV, OLSR and DYMO. For this reason we elaborate the Figure 3. From this figure, the performance of DSR and DYMO as on-demand protocol are approximately the same. It seems as table-driven protocols have the lowest Average End to End Delay than on-demand protocols when we vary the Number of Nodes. OLSR and DSDV as table-driven protocols have routing tables and they do not need to discover the route for the same destination.

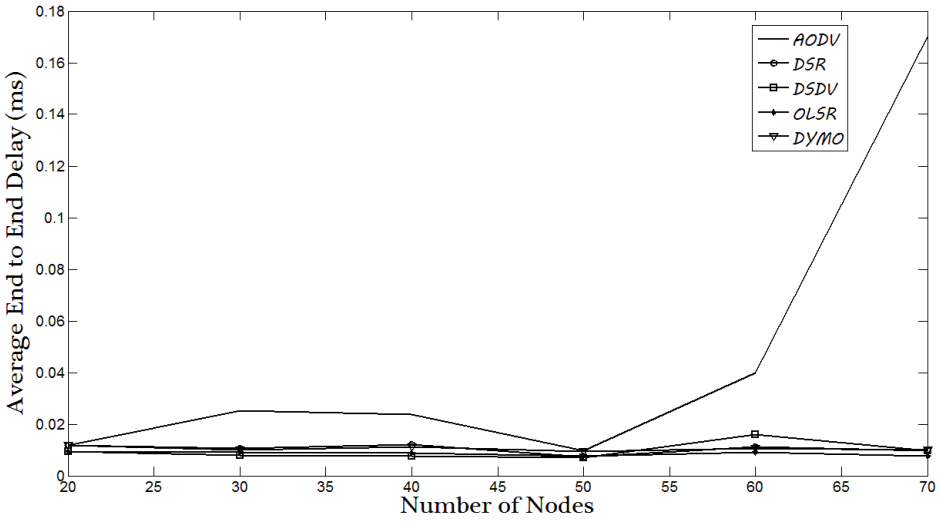

Figure 2: Average End of End Delay versus Number of Nodes

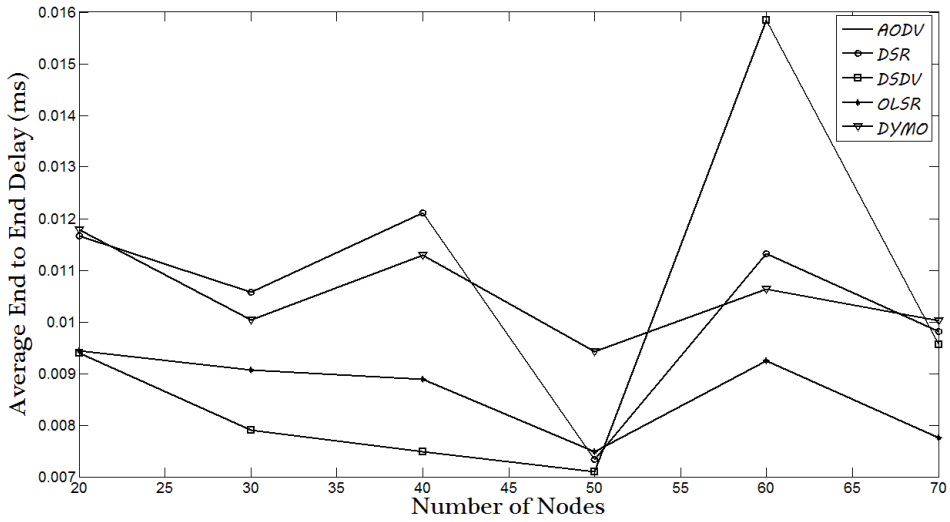

Figure 3: Average End of End Delay versus Number of Nodes

Normalized Routing Load

We remark from Figure 4 that when the Number of Nodes increases, the Normalized Routing Load increases. DSR has the lowest value of Normalized Routing Load (good performance) while the OLSR has the highest value (low performance). As driven-protocols, DSDV has better performance than OLSR in terms of Normalized Routing Load. By considering only on-demand protocols and the value of Normalized Routing Load observed, DSR outperforms other protocols (AODV and DYMO) and

DYMO demonstrates the lowest performance.

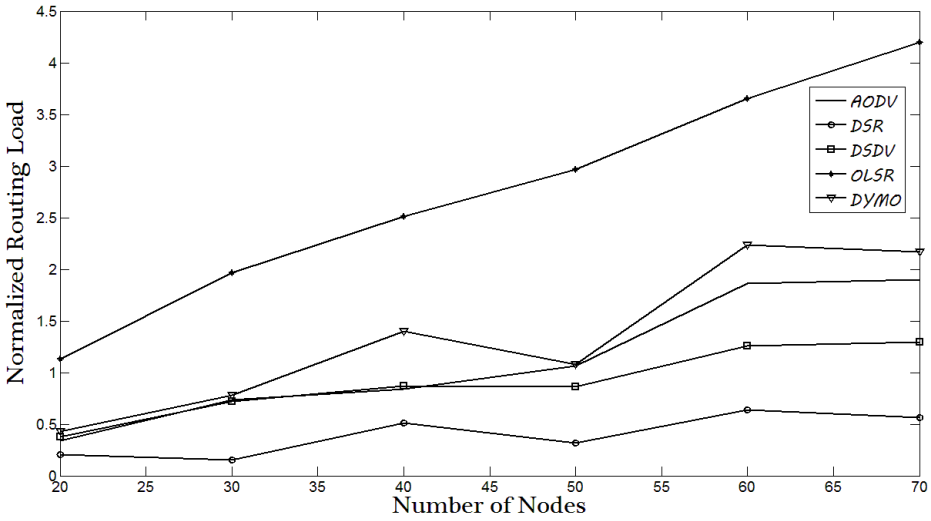

Figure 4: Normalized Routing Load versus Number of Nodes

Average Throughput

Figure 5 shows that DSDV demonstrates the lowest Average Throughput compared to other protocols (low performance). DSR and AODV give a good performance (highest value of Average Throughput). OLSR outperforms the other table-driven protocol DSDV in terms of Average Throughput. DYMO compared to the other on-demand protocols (AODV and DSR) has the lowest value of Average Throughput.

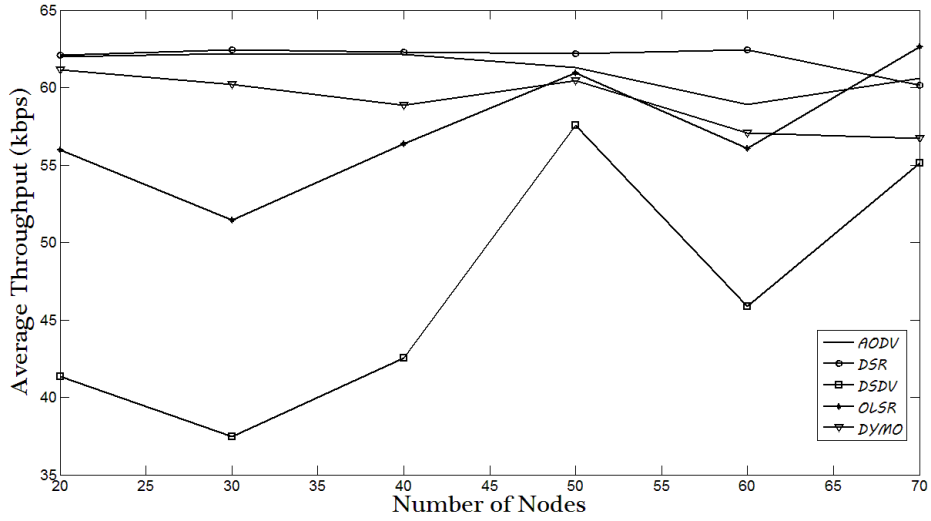

Figure 5: Average Throughput VS Number of Nodes

Conclusion

We have analysed in this paper different MANET routing protocols such as AODV, DSR, DSDV, OLSR and DYMO. In terms of Packet Delivery Ratio, AODV, DSR have higher value than other protocols (DSDV, OLSR and DYMO). As table-driven protocols, DSDV and OLSR show the lowest Average End to End Delay (good performance) compared to on-demand protocols (AODV, DSR and DYMO). DSR demonstrates the lowest Normalised Routing Load than other protocols. In almost all scenarios, AODV and DSR outperform other protocols (DSDV, OLSR and DYMO) in terms of Average Throughput.

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