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Performance Analysis with Proactive and Reactive Protocols for Mobile Ad-hoc Networks

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ABSTRACT

The protocol selection is important approach to design any mobile ad-hoc network. The selected mobile ad-hoc network protocols are used to give better results in terms of key factors like energy consumption and average delay. Hence before selecting a particular protocol for an ad-hoc network, it is highly necessary to do the performance analysis of the protocols in varying scenarios so as to have a better understanding about mobile ad-hoc protocols. In this paper, a comparative performance analysis is done on various protocols like the Dynamic Source Routing, Ad-hoc On-demand Distance Vector, Destination Sequenced Distance Vector and Optimized Link State Routing protocols using NS2 simulator. This analysis is attempted on key factors to know the performance of mobile Ad-hoc protocols.

Key words: Ad-hoc, Routing, Protocols, AODV, DSDV, DSR, OLSR, Energy consumption, Average Delay.

1. INTRODUCTION

During recent years there has been a fast growth in the use of mobile networks mainly due to an explosion of wireless devices. This has also led to an increase in the research studies being conducted in wireless domain, specially the mobile ad-hoc networks. A mobile ad-hoc network is a network without permanent infrastructure. The nodes belonging to a mobile ad-hoc networks can either be data interchange end-points or can act as routers when the two end-points are not in a straight line within their radio range. This kind of self-organizing and self-reconfiguring network is very useful when it is not economically or physically feasible to provide a wired networking infrastructure for example scenarios like natural disasters and battlefield [1].

Quite a few a mobile ad- hoc networks protocols have been proposed with the goal of achieving efficient routing. These algorithms differ in the technique used for searching a new route or modifying a known route, when there is mobility in hosts. These routing protocols may be generally categorized as table-driven and source initiated on-demand driven [2]. These are also referred as to being proactive or reactive respectively.

Proactive Protocols use a table driven approach where each node maintains a routing table and any modifications to the network topology should be updated in each of these routing tables. Different type of mobile ad-hoc protocols as shown in Figure.1.

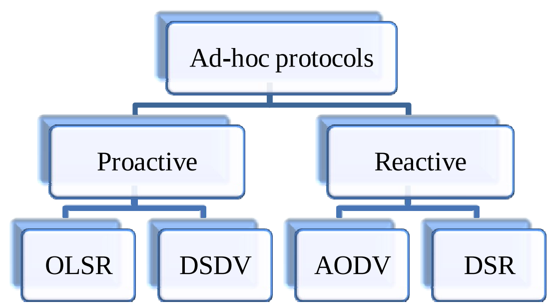


Figure 1: Ad-hoc protocols

During transmission, each and every node maintains a routing information table that communicates all the other nodes in the network to update the changes in network topology and this information should be reflected to all other nodes within the network. Though it establishes the routes quickly with a small delay, it requires larger resources and the major disadvantage is that, there is a tendency of creating loops within the network. Some examples of the proactive protocols are Destination Sequenced Distance Vector, Optimized Link State Routing.

Whereas a reactive protocol is an on-demand technique in which the routes are being established only when there is a request from the sender node. When there is an in availability of a route from one node to another, it helps in establishing a connection between them by creating a route. A route is obtained through the route discovery function which is initiated from the source node. The route is being maintained through the route maintenance function. On a comparison against the Proactive Protocol, this consumes more power with large delay. The flexible operations are done through reduced routing loads as it has no loop formation within the network. Some examples of Reactive Protocols are Ad-hoc On-demand Distance Vector routing, Modified Associatively Based Routing [6].

2. LITERATURE REVIEW

Researchers have analysed and compared the performance of the mobile ad-hoc networks routing protocols. The literature survey is highly focused on energy consumption.
Rango et al. have compared reactive and proactive protocols in wireless ad-hoc network. Using the ns-2 simulator, an evaluation was made of how the Dynamic Source Routing and the Optimized Link State Routing affect the energy use of mobile devices. In simulations using 50 nodes with a speed range [0,20] m/s moving in a 870 m x 870 m area and no pause time. Simulations show that a reactive protocol takes advantage of its routing policy, but a proactive routing protocol can perform well with high traffic load and a variable traffic pattern [1]. Jun-Hu Zhang et al. have analysed the energy cost of route discovery and multi-hop data transmission in Ad-hoc On-demand Distance Vector, Dynamic Source Routing, Destination Sequenced Distance Vector and Temporally-Ordered Routing Algorithm for comparing protocols, Network size, node speed, pause time are parameters using to compare energy consumption in mobile ad-hoc network protocols. The simulation shows on large-sized network, Temporally-Ordered Routing Algorithm can cause too much energy consumption and is more fit with low node mobility. Ad-hoc On-demand Distance Vector, Dynamic Source Routing an Destination Sequenced Distance Vector perform well on energy consumption for the mobile ad hoc network with high node mobility [4].

Qutaiba et al. have used several performance metrics, Average energy consumption, packet delivery fraction, Normalized routing load, Average throughput and total dropped packets to analyze and compare performance of Destination Sequenced Distance vector, Dynamic Source Routing and Ad hoc On demand Distance Vector routing protocols using constant bit rate, variable bit rate then combining both class. Results declared that Dynamic Source Routing and Ad-hoc On demand Distance Vector routing protocols becomes a good choice for combined traffic file for the performance metrics examined. Ad-hoc On demand Distance Vector better performance when the examined metrics are simulated versus nodes mobility and Destination Sequenced Distance Vector contend Dynamic Source Routing in terms of minimum energy consumption when either CBR or VBR traffic class are applied [5].

Gouda et al. have studied the density nodes effect on the energy metrics of Reverse Ad-hoc On demand Distance Vector, Ad-hoc On demand Distance Vector and Destination Sequenced Distance Vector. In simulations using (5,15,25,35,45,55,65,75,85,95) nodes moving on 800m x 800m with speed 10m/s. It is concluded that Destination Sequenced Distance Vector performs low in energy consumption compared with Ad hoc On demand Distance Vector and Reverse Ad-hoc On demand Distance Vector [7].
Gupta et al. have analyzed performance Ad-hoc On demand Distance Vector, Dynamic Source Routing and Temporally-Ordered Routing Algorithm using parameters like Packet Delivery and Average end to end Delay with variations in Pause Time of network [8].

3. SIMULATION SETUP

In order to understand the effect of varying pause time on the various efficiency parameters, especially energy consumption and average delay, of the ad hoc routing protocols, simulations were conducted on the NS-2 simulator. NS-2 is a specially designed simulator that helps in simulating the behaviour of transport and network layer protocols under varying complex network topologies.
For the purpose of this analysis, separate simulations were performed on NS2 for Ad-hoc On-demand Distance Vector, Optimized Link State Routing, Destination Sequenced Distance Vector and Dynamic Source Routing protocols for 25, 50 nodes each with a varying pause time scenario of 0, 10, 20, 30, 40, 50 seconds. The following metrics were employed for the purpose of evaluation and analysis of protocols:

Average end-to-end data packet delay (E2E delay): It expresses the value of delay encountered in transmission of data packet from source to destination. It includes delay during actual propagation of the packet and also the queuing delay.

Energy consumption: This metric is expresses the total energy consumed by the protocol. It accounts the energy consumption involved in transmitting, receiving packets and also includes power consumed during idle moments.
The Table1 shows the values of the various parameters used during simulation of these protocols.

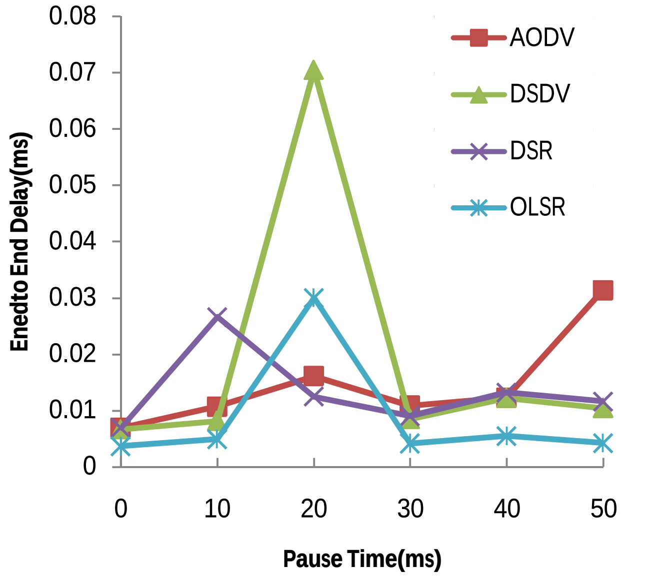
Table1: Values for Simulation Parameters.

Parameter	Values
Routing protocols	AODV,DSDV,DSR, OLSR
No. of Mobile Nodes	25,50
Simulation Period (s)	150
MAC type	802.11
Max speed (m/s)	10
Pause Time (s)	0, 10, 20, 30 , 40 , 50
Initial node energy (J)	1000
Max Connections	10
Connection Type	CBR
Simulation area	500 x 500

4. SIMULATION RESULTS

For the different values of pause time, it is evident from Figure 2 that with increase in pause time the end to end delay in case of Ad-hoc On-demand Distance Vector protocol gradually increases and finishes at a highest value among the other three protocols. The results of Destination Sequenced Distance Vector and Dynamic Source Routing exhibit a similar declining trend with increase in pause time value. Out of the four protocols under consideration Optimized Link State Routing protocol maintains the lowest end to end delay for most of the pause time scenarios hence, achieving the best delay results for the 25 nodes case. However when the number of nodes are increased to 50, the behaviour for Ad-hoc On-demand Distance Vector, Destination Sequenced

Distance Vector and Dynamic Source Routing show an initial drastically difference then its 25 nodes counterpart as shown



in Figure 3.

Figure 2: End to End Delay for 25 Nodes

The mean end to end delay achieved over all the scenarios of pause time in Ad-hoc On-demand Distance Vector for 50 nodes case is the highest among all the four protocols. A sharp rise in the delay values is observed for Destination Sequenced Distance Vector and Dynamic Source Routing as the pause time is changed from 0 to 10. But these values get normalised for other scenarios of pause time. For Optimized Link State Routing, the change in number of nodes proves a boon as its mean delay reduces even further. Its mean delay value for 50 nodes case is even lower than its 25 nodes simulation.

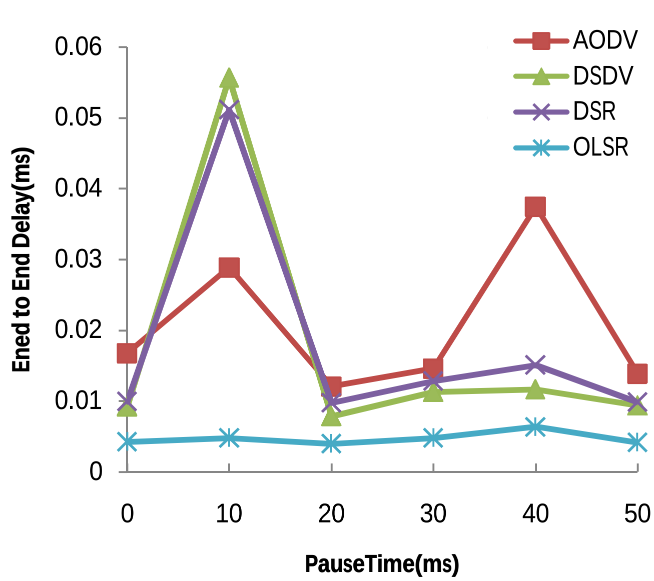


Figure 3: End to End Delay for 50 Nodes

Optimized Link State Routing maintains is a low end to end delay which gets even better by an increase of number of mobile nodes from 25 to 50.

Figure 4 and Figure 5 clearly signifies the higher energy consumption of Optimized Link State Routing as compared to the other protocols. This energy consumption of Optimized Link State Routing is minimum at pause time 0, after which it gradually increases and almost stays constant for other pause time scenarios. For Ad-hoc On-demand Distance Vector we observe a significant decline in energy consumption with increase in pause time. But for Destination Sequenced Distance Vector we observe major variations over the various pause time scenarios due to which we observed the lowest energy consumption for this protocol under 25 nodes case.

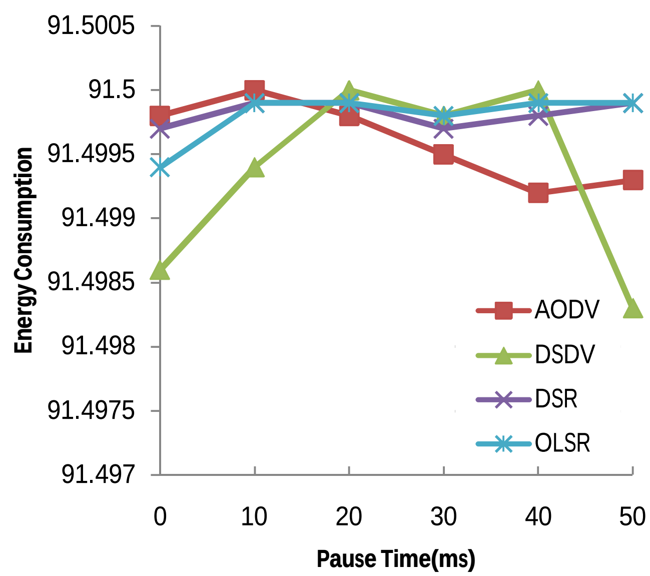


Figure 4: Energy Consumption for 25 Nodes

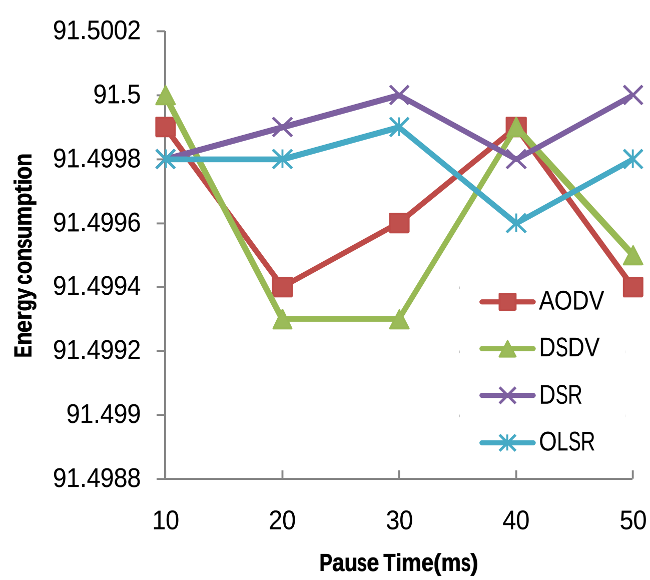


Figure 5: Energy Consumption for 50 Nodes

Similar trend of energy consumption is again observed for most of the protocols when the number of nodes is changed to 50 as show in Figure 5. Here again we can observe that the energy consumption of Optimized Link State Routing protocol is higher than the other protocols. However it was also observed that the energy consumption of Dynamic Source Routing also showed an ascending sign for higher pause time scenarios. Due to which we also registered high energy consumption for Dynamic Source Routing as well.

But even for the 50 nodes case, both Ad-hoc On-demand Distance Vector and Destination Sequenced Distance Vector showed lower energy consumption values. In fact Destination Sequenced Distance Vector showed the least energy consumption results for 50 nodes case as well.

5. CONCLUSION

In this paper, four ad-hoc routing protocols viz. Ad-hoc On-demand Distance Vector, Destination Sequenced Distance Vector, Dynamic Source Routing & Optimized Link State Routing were analysed and simulated using NS2 simulator. These protocols were analysed on the basis metrics like of end to end delay and energy consumption. These analyses were made while varying the value of pause time parameter.

It is observed that the proactive protocols like Optimized Link State Routing and Destination Sequenced Distance Vector have shown better delay results. However these high results come at a price of high energy consumptions due to the proactive nature of Optimized Link State Routing. Over all the scenarios of pause time and number nodes, Optimized Link State Routing had the highest energy consumption results consistently. The reactive protocol, namely Ad-hoc On-demand Distance Vector showed lesser energy consumptions and even delay in some cases. These made Ad-hoc On-demand Distance Vector suitable for scenarios where the energy consumption is an important constraint.

Another observation that can be made on the basis of these simulation data is that the maximum effect of change in pause time was seen on Destination Sequenced Distance Vector. The value for its metrics like energy consumption showed deep variations as compared to other protocols.

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