Simulation Analysis of AODV and DSDV Routing Protocols for Improving Quality of Service in MANET

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Abstract

Background: In the past few years, Mobile Ad Hoc Networks have been a popular area of exploration. But, to design a reliable and an efficient routing strategy is still a challenge. A number of routing protocols have been designed to overcome the existing problems and the number is still increasing. Method: In this paper we have simulated and analyzed existing well known routing protocols Ad-Hoc On-demand Distance Vector (AODV) and Distance Sequenced Distance Vector (DSDV) over number of packets and nodes. Various performance criterion used for comparison are end-to-end delay, throughput, and packet loss ratio. Findings: The study shows that AODV protocol outperforms DSDV in terms of QoS parameters such as packet loss ratio, end-to-end delay, and throughput. Improvements: AODV protocol can be further improved by the use of optimization techniques for better path establishment and enhanced QoS.

Keywords: AODV, DSDV, Proactive, QoS, Reactive

1. Introduction

A collection of interconnected nodes forms a network. A Mobile Ad hoc NETwork MANET can be defined as a decentralized, infrastructure less network that uses multi-hop radio relaying and is able to operate without the any infrastructure that is they comprise of a cluster of mobile wireless nodes moving around freely, co-operating with each other in routing and forwarding of packets. Ad-hoc wireless network is adaptive and self-organizing, that is a designed network can be de-formed on the fly without the requirement of any administration. MANETs organize themselves to form a network over radio links. The network topology varies unpredictably and rapidly over time, due to movement of nodes. As, routing is a significant part of MANETs, a number of protocols have been proposed to enhance the performance and reliability. The routing protocols proposed are further categorized into Proactive, Reactive and Hybrid routing protocol. This study is to compare different taxonomies of these routing protocols.

2. Routings in MANETs

A routing protocol describes how the nodes communicate with each other in the network. Circulation of information facilitates them to choose a route between any two nodes in a network. The specific route to destination is calculated by routing algorithm. Each router has information of networks directly connected to it. A routing protocol shares this knowledge amongst first nearest neighbors, and then to the entire network. Classification of these protocols can be done into Reactive (on-demand), Proactive (table-driven) and Hybrid. The Reactive protocols are also known as on-demand as they do not have to maintain the routing table and rely on query-reply topology. In contrast to reactive protocols, proactive protocols maintain their routing tables for each node to all other nodes present in a network. Hybrid protocols combine best features of reactive and proactive protocols. Due to dynamic nature of MANETs the key issue in routing is the immediate response to the topological changes in the network. Routing protocols are classified in to three categories as presented in the Figure 1.

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2.1 Proactive Protocol
These protocols manage updated tables of the routes from one node to another in a network. These acquire the knowledge the topology of the connections by swapping topological knowledge among the nodes. Each node requires maintaining the route tables so as to store the routing information as well as to circulate updates over the entire network. Therefore, these protocols are termed to as table-driven routing protocols. DSDV, Optimized Link State Routing (OLSR) and Workforce Recruitment Program (WRP) are some examples of table driven ad hoc routing protocols.

2.2 Reactive Protocol
The reactive protocols rely on Query-Reply topology where protocols need not to manage the table. Whenever a path to the target node is required, a process is initiated so as to determine a suitable path to the target node. The main objective of reactive routing protocol is to reduce the network traffic overhead. Since these protocols rely on query-reply mechanism, these need not constantly maintain the updated topology of the connections. AODV and DSR are some examples of on-demand routing protocols.

2.3 Hybrid Protocols
These protocols have combined characteristics of proactive and reactive protocols and are mostly used for hierarchal routing. Arranging the connections according to the parameters is main challenge that is faced by hybrid routing protocols. The limitation of these protocols is that the nodes consume more memory and power as they have to maintain high level topological information. Some examples of these protocols are Zone Routing Protocol (ZRP) and Secure Remote Password (SRP).

3. Explanation of Different Routing Protocols used in Analysis

3.1 Destination-sequenced Distance Vector
The DSDV is one of the proactive protocols designed for MANETs. DSDV is an extension of Distance Vector Routing (DVR). The prime disadvantage of DVR is count to infinity problem as every node in the network is not aware of other nodes present in the connections. Thus, every node broadcasts their routing table to their neighbors. The routing table entry constitutes of destination, next hop and the distance (hop count). To solve the problem of distance vector routing, destination sequence number is added with every routing entry. The destination sequence number ensures loop free routing. In DSDV, every node maintains routing information for all known destination. To maintain the consistency of routing table, routing information is transmitted regularly. The routing table entry includes the destination, next hop, distance (hop count) and destination sequence number. The table uses two types of updates to reduce the traffic overhead; Incremental update and full dump update. An incremental update takes single Network Data Packet Unit (NDPU) while full dump update takes multiple NDPUs. If the route fails, the node immediately updates its routing table and broadcast it to the neighboring nodes. As availability of route to destination is present all the times, therefore less interruption is involved in route set up process. The main disadvantage of DSDV is that it experience excessive control overhead because of frequent updates of broken links. This may choke the bandwidth.

3.2 Ad-Hoc on-demand Distance Vector
AODV routing protocol is an example of reactive protocol since whenever a node desires to send information to other node at that time a procedure is invoked to determine a route to the destination. AODV is an extension of DSR protocol. DSR protocol does not use network bandwidth efficiently also for one destination multiple routes are possible. To overcome this problem AODV routing protocol is used which is on-demand acquisition system as the paths are created when required. AODV keep up a traditional routing table, that is, single entry per destination. AODV follows On-demand mechanism of Route Discovery and Maintenance. Whenever a connection to
the target node is required the source broadcasts a route request packet. Route REQuest (RREQ) carries address of the source identifier, the destination identifier and the broadcast identifier, also sequence number of the source and destination. The destination sequence number identifies the most recent path and also ensures loop free routing. The neighbors further broadcast the packet to their neighbors till it arrives at the destination\textsuperscript{14}. The Figure 2 shows the RREQ and Route REPLY (RREP). With the help of sequence numbers, RREQ guarantees that the path is loop free. Every node keeps the track of the path from which request packet was delivered in order to build up reverse path for RREP to source node. When the RREP is sent back to source, the nodes present on the route receiving route reply, update their route tables with latest destination sequence numbers\textsuperscript{15,16}.

The comparison between the two protocols over QoS parameters is represented in Table 1.

4. Performance Metrics

Various Quality of Service parameters used for analysis of routing protocols\textsuperscript{5} are defined as follows:

- **Throughput:** The amount of received data packets at the target node in a given period of time. It is generally measured in bits per second. We aim to increase this value;

- **End-to-End Delay:** It is time taken by the data packet which is transmitted across a network to reach the destination. We prefer to decrease this rate; and

- **Packet Loss:** The difference between the total number of packets sent by the source and the total number of packets received at the destination. We aim to decrease the packet loss.

5. Simulation Analysis and Results

The network simulator used for implementation is NS2. It runs under LINUX operating system. The various simulation parameters used are given in Table 2.

5.1 Simulation Results

We have used Tool Command Language (TCL) for implementation of routing protocols. In Figure 3 we can see that AODV has higher throughput than DSDV that is there is less packet drop in AODV as compared to DSDV.

In Figure 4 and 5, simulation results show that the end-to-end delay and packet loss is less in reactive routing protocol AODV than proactive routing protocol DSDV. We can also analyze that DSDV has more packet drops than AODV.

Table 2. Simulation parameters

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routing Protocols analyzed</td>
<td>AODV, DSDV</td>
</tr>
<tr>
<td>Number of nodes</td>
<td>10-100</td>
</tr>
<tr>
<td>Topology Size</td>
<td>800X800</td>
</tr>
<tr>
<td>Simulation time</td>
<td>500secs</td>
</tr>
<tr>
<td>Packet size</td>
<td>512 bytes</td>
</tr>
</tbody>
</table>

Figure 3. Throughput vs. Time
The Figure 6 demonstrates the simulation results of end-to-end delay vs. number of nodes. We can see that the end-to-end delay starts increasing with the increase in number of nodes. AODV routing protocol has higher delay than DSDV routing protocol. Also in Figure 7 we see the performance illustration of throughput vs. number of nodes. It is noticed that throughput starts increasing with increase in number of nodes. AODV has higher throughput than DSDV. The overall analysis and comparison of protocols based on performance parameters show that AODV shows better performance than DSDV except for end-to-end delay that increases with increase in number of nodes.

6. Conclusions

This paper discusses the taxonomies of routing protocols in MANETs. The routing protocols are classified into 3 different categories: 1. proactive, 2. reactive, and 3. hybrid protocols. Every protocol has different characteristics. We have presented the comparison between AODV and DSDV, analyzed and simulated using NS2 environment. The simulation results show that AODV outperforms DSDV in terms of QoS parameters such as end-to-end delay, packet loss ratio and throughput over number of transmitted packets. As the number of nodes increases, throughput for both proactive and reactive protocol increases as throughput is related to packet drop. Similarly, as the number of nodes in the network increases the delay also increases. DSDV shows less delay than AODV. Overall, AODV showcases better performance but the performance of AODV decreases as we start increasing the number of nodes. Hence size of the network determines the best routing protocol.

7. References


