COMPARATIVE PERFORMANCE ANALYSIS OF ROUTING PROTOCOLS USING NS2 SIMULATOR

Prinima 1  
Research Scholar, Singhania University, Jhunjhunu (Raj.), India.  
prinimamail@gmail.com

Dr.R.K.Tuteja 2  
Director, N.C. Institute of Computer Sciences, Israna (Panipat), India.  
rk_tuteja2006@yahoo.co.in

ABSTRACT

Mobile ad hoc network (MANET) is an autonomous system of mobile nodes connected by wireless links. Each node operates not only as an end system, but also as a router to forward packets. Routing in MANET is a critical task due to highly dynamic environment. In recent years several routing protocols targeted at mobile ad hoc networks are being proposed and prominent among them are Dynamic Source Routing (DSR), Ad Hoc On-Demand Distance Vector Routing (AODV) and Destination-Sequenced Distance-Vector (DSDV). In wireless network technology, simulative analysis is a significant method to understand the performance of routing protocols. This paper is based on performance comparison of the routing protocols carried out using the ns-2 network simulator. As per our findings the differences in the protocol mechanics lead to significant performance differentials for these protocols. The performance differentials are analyzed using varying simulation time, varying network load, network topology, and network size.

Keywords - MANET, Simulation, AODV, DSR, DSDV, NS2.

I. INTRODUCTION

The mobile ad hoc network (MANET) allows a more flexible communication model than traditional wire line networks since the user is not limited to a fixed physical location [2]. It is a new special network that does not have any fixed wired communication infrastructure or other network equipments. With no pre-existing fixed infrastructure, MANETs are gaining increasing popularity because of their ease
of deployment and usability anytime and anywhere. Several routing protocols have been developed under the authority of Mobile Ad hoc Networking (MANET) working group. Routing protocols are challenging to design as performance degrades with the growth of number of nodes in the environment and a large ad hoc network is difficult to manage. Proactive protocol DSDV [11] is considered to be traditional protocols which find routes between all source – destination pairs regardless of the use or need for such routes. The key motivation behind the development of reactive routing protocols like DSR [10] and AODV [8, 9] is the reduction of routing load. There will be impact on performance for low bandwidth wireless link if high routing load is there.

Lots of research has also been done about the performance of ad hoc networks under varying scenarios. Different kind of metrics or characteristics may be used to analyze the performance of an ad hoc network. Simulations are commonly utilized especially when analyzing the performance of a specific routing protocol. Analytical models have also been developed to be used especially in analysis considering a specific performance issue of ad hoc networks in general of existing or proposed protocols. In this paper we described the performance metrics on the basis of which we compared the DSDV, DSR and AODV. A simulation model has been explained on which basis results are obtained and graphs are generated to compare and analyze the results with the help of performance metrics. Software used for the performance analysis of taken protocols is based on NS-2 version 2.28 [1, 3, and 4]. We have presented the simulation based comparative performance analysis of routing protocols and finally concluded which protocol is better under certain traffic conditions and scenarios.

II. Simulation Model

In this we compare & test the ability of DSDV, AODV and DSR to react on network topology changes; furthermore the focus is on different network sizes, varying number of nodes, different area sizes and also to study these protocols under different traffic. For simulation study of routing protocols, we firstly have to set the simulation environment parameters under which we are going to study our protocols.

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simulator</td>
<td>NS-2.28</td>
</tr>
<tr>
<td>Protocol studied</td>
<td>DSR, AODV, DSDV</td>
</tr>
<tr>
<td>X and Y Boundary</td>
<td>800 × 700 m</td>
</tr>
<tr>
<td>Number of nodes</td>
<td>5</td>
</tr>
<tr>
<td>Dynamic nodes</td>
<td>0,1,3,4</td>
</tr>
<tr>
<td>Static nodes</td>
<td>2</td>
</tr>
<tr>
<td>Node mobility (m/s)</td>
<td>5m/s,10m/s</td>
</tr>
<tr>
<td>Traffic type</td>
<td>CBR (constant bit rate)</td>
</tr>
<tr>
<td>Traffic Generation (Max connections)</td>
<td>0.5 of total nodes</td>
</tr>
<tr>
<td>Traffic Generation Rate</td>
<td>5kbps</td>
</tr>
<tr>
<td>Simulation time (min)</td>
<td>0,8,48,58,110,200</td>
</tr>
</tbody>
</table>
Initially the connection between the nodes can not be established because the nodes are far away and the first packet was send at time 8s but connection is not opened due to their distance meanwhile dynamic node start moving towards the static node at time 48s we again measured the output but still they are not in the range of each another. At time 58s node 0, 4 still not in range and started sending and receiving packets through node 1, 2. At time 110s they came into each others range and directly communicate with each other total simulation time is 200s, therefore after this time no connection will be opened.

**NAM Output**
The Network Animator NAM is a graphic tool to use with ns-2. It requires a nam-tracefile recorded during the simulation and will then show a visual representation of the simulation. At different pause time we have seen the NAM representation of nodes below for AODV protocol.

Similarly we can run DSDV and DSR and many more protocols under ns-2 and can observe their output under NAM for DSDV and DSR.
III. XGRAPH

I have generated three xgraphs of traffic vs. time for AODV, DSDV and DSR. The routing protocols are too slow to react and create an alternative route.

The xgraph of DSDV shows that at time 58s, communication between nodes 0, 4 has been started through multihop path and this multihop path continued upto 60s and after that node 0, 4 communicates directly. (See Figure-5)

The simulation with the same parameters as before is repeated with AODV. The xgraph of AODV shows that at time 58s, communication between nodes 0, 4 has been started through single hop path and this path continued as a long single phases as compared to two phase path in DSDV. (See Figure-6)

The simulation with the same parameters as before is repeated with DSR. The xgraph of DSR shows that at time 40s, communication between nodes 0, 4 has been started at 40s which is second phase, phase 3 starts around 60s as compared to two phase path in DSDV. (See Figure-7)
IV. Packet Information
We can get the information of no of packets transferred by looking the last sequence no of lines appears on our screen. We can get the packet information by following command (See Figure-8).

```
# grep "^r" simple.tr | grep "tcp" | grep "_I_AGT>
```

Figure-5: Screenshot- XGRAPH for DSDV

Figure-6: Screenshot- XGRAPH for AODV

Figure-7: Screenshot- XGRAPH for DSR

Figure-8: Graph-Packet Information
V. CONCLUSION
The Ns-2 simulation analysis concludes the results that DSDV is suitable for real
time traffic as there is no latency in route discovery, but in AODV there is delay due
to route discovery, called route acquisition delay which may not be appropriate for
real time communication. DSDV was not able to provide 4th phase in Xgraph it
implies connection was ended much earlier as compared to DSR or AODV. In large
networks the Overhead in DSDV is more and maintaining routing table at every
node is difficult. But, in AODV overhead is less as it maintains small tables to
maintain local connectivity. DSDV cannot handle mobility at high speeds due to
lack of alternative routes hence routes in routing table is stale. While in AODV this
is the other way, as it find the routes on demand. Therefore we can say DSDV is
suitable for small networks but for larger networks we have to use AODV or DSR.

Total number of packets transferred using DSR is much higher than in DSDV. In
DSR, 6750 data packets have been transferred whereas in DSDV with the same
parameters 2036 packets were sent and in case of AODV 3989 packets have been
sent. IF we want to sent data packets at higher speed then DSR is more suitable than
DSDV or AODV for moderate mobility but under more stressful situation even DSR
could not give good results. Therefore from our simulation and literature study we
conclude that AODV is better in overall performance as it is an improvement of
DSDV and DSR.

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ABOUT AUTHORS

**Prinima Gupta** is presently working as Asst. Professor in MCA Department, Manav Rachna College of Engineering, Faridabad. She has completed MCA from Kurukshetra University, Kurukshetra, M.Phil from Vinayaka Mission University, Tamilnadu and presently doing Ph.D from Singhania University, (Raj.). She has 7+ yrs of teaching experience. She has total 08 National/International publications. Her area of specialization includes Computer Networks and Computer Architecture.

**Prof. (Dr.) R. K Tuteja** is presently working as Director (Academics) in NCICS, Israna, Panipat. He has 45 years of teaching experience. He was successfully guided 30 Ph.D research students and 17 students for M. Phil. Degree. He has published 134 Research papers in National/International Journals. He has worked as Head of Statistics/ Mathematics/ Computers Science & Application Department at M. D. University Rohtak.