IRACST – International Journal of Computer Networks and Wireless Communications (IJCNWC), ISSN: 2250-3501
Vol.6, No 4, July-August 2016

Routing Load Analysis of AODV Protocol with Respect to Mobility of the Network using Ns2.34

Samiksha Nikam
College of Computer Application for Women, Satara
Affiliated to S.N.D.T .Women's University, Mumbai
Maharashtra, India

Dr.B.T. Jadhav
Y.C. Institute of Sciences, Satara
Affiliated to Shivaji University, Kolhapur
Maharashtra, India

Abstract—**: Nowadays People wish to use their laptops, mobile, PDA anywhere anytime. Ad hoc network gives this privilege to the users. It does not require any centralized control as each node act as a router. Routing protocol plays a key role in improving network performance. This paper focuses on AODV routing protocol. In AODV protocol during route discovery route request packet is flooded into the entire network and the reply from the destination or intermediate nodes sets up the path between the source and destination. Thus, multiple route reply packets (RREPs) in response to a single route request packet (RREQ) can lead to heavy control overhead which increases routing load in the network. Also due to unstable nature of an ad hoc network it is challenging to maintain low routing load and high throughput in the network. In this paper routing load and throughput of the network is evaluated by varying number of nodes in the network under low to high mobility scenario. This study is carried out using network simulator 2.34.**

Keywords-component; AODV, NRL, Network Simulator, Routing Protocol, NS2.34)

Terms Used: P.T. – Pause Time, N – Nodes, M.S.- Max. Speed, M.C.- Max. Connections

I.INTRODUCTION

Ad hoc network is an autonomous collection of mobile users communicate over relatively constrained bandwidth. The network topology may change unpredictably and rapidly over the time. The main goal of an ad hoc network routing protocol is to establish an optimal route between source and destination node. The route should be discovered and maintained with a minimum overhead and bandwidth consumption. Routing is a key factor for transfer of packets from source to destination. [1]

AODV is routing protocol used to route packets from source to destination. In this protocol instead of prior storing routes, they are created on demand. It saves memory requirement as well as bandwidth consumption. When source node demands route, multiple copies of route request query are flooded across the network and if the route is available then multiple acknowledgment packets from the destination and intermediated nodes are flooded across the network. This might increases the load on the network. This paper centers on routing load of the network and it is examined by varying number of nodes. The mobility of ad hoc network is one of important factor which affects performance of the network [5]. The routing load of the network for AODV protocol is analyzed under different five cases as mentioned in table 1.1.

TABLE 1.1 EXPERIMENTAL SETUP UNDER DIFFERENT SCENARIO

	P.T. (ms)	N	M.C.	M.S. (m/s)
Case 1	0	15 - 125	10	10
Case 2	25	15 - 125	10	10
Case 3	50	15 - 125	10	10
Case 4	75	15 - 125	10	10
Case 5	100	15 - 125	10	10

A. Ad hoc On Demand Vector (AODV) Routing Protocol

AODV routing protocol uses an on-demand approach for finding routes. It is packet routing protocol designed for use in mobile ad hoc network. It is based on DSDV and DSR algorithm. AODV protocol uses request/reply query approach to finding the route. Whenever there is a need for a path from any source to destination and if the route is not available then source initiate request packet (RREQ) containing destination address across the network [2, 3]. Nodes receiving this packet update their information for the source node and set up backward pointers to the source node in the route tables. A node receiving the RREQ send a packet (RREP) as an acknowledgment, if it is either the destination or if it has a route to the destination. Source node receives RREP packet route is established and data transmission starts. In reactive routing protocols, the route is calculated only when a node needs to send data to the destination node. Thus, route discovery is initiated only when needed. This saves overhead in maintaining unused routes. However, this may lead to larger initial delays. [4].

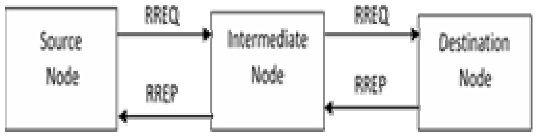

Figure1.1: Block diagram of AODV protocol path establishment

II. SIMULATION AND EXPERIMENTAL DESIGN

In this paper simulations carried out using network simulator NS2.34. The routing load and throughput of the network is evaluated when AODV protocol is used for routing. The analysis is done by varying nodes in different mobility scenario as mentioned in Table1.1. Nodes vary from 15 to 125. Rest of the parameters kept constant as mentioned in table 1.1.

The Performance parameters throughput (TH) and normalized routing load (NRL) are selected to evaluate the performance of AODV protocol. These two parameters play an important role to decide efficiency of an ad hoc network. Due to the mobility of ad hoc network, it is challenging to maintain high throughput without increasing routing load in the network. Low routing load and high throughput are desirable to improve protocol performance.

The simulations were performed using Network Simulator (NS2.34). Fig 1.2 shows various steps used in simulation. Initially scenario and traffic files are generated. These files are used as input for TCL script. After execution of TCL script two files are created i.e. NAM file and trace files. Trace files are used to analyze the behavior of network. Trace files are analyzed using AWK scripts [7].

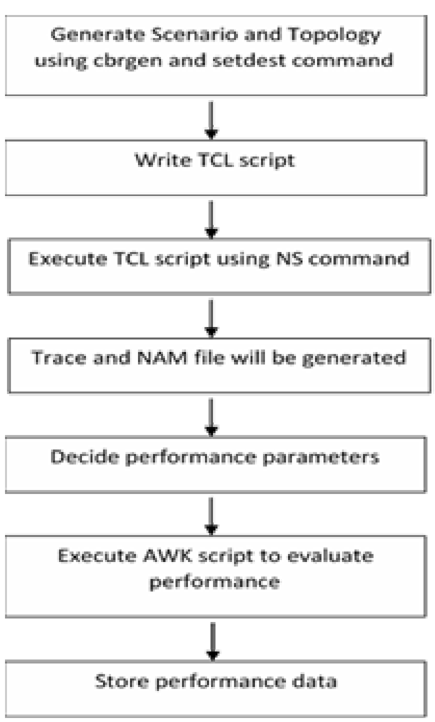

Figure. 1.2 Simulation Work Flow

Following fig 1.3 and fig1.4 shows topology created for 125 and 25 nodes respectively. The snap shot of trace file is shown in fig 1.5.

```
cbr-125-10
#
# nodes: 125, max conn: 10, send rate: 0.5, seed: 1.0
#
#
# 1 connecting to 2 at time 2.5568388786897245
#
set udp_(0) [new Agent/UDP]
$ns_ attach-agent $node_(1) $udp_(0)
set null_(0) [new Agent/Null]
$ns_ attach-agent $node_(2) $null_(0)
set cbr_(0) [new Application/Traffic/CBR]
$cbr_(0) set packetSize_ 512
$cbr_(0) set interval_ 0.5
$cbr_(0) set random_ 1
$cbr_(0) set maxpkts_ 10000
$cbr_(0) attach-agent $udp_(0)
$ns_ connect $udp_(0) $null_(0)
$ns_ at 2.5568388786897245 "$cbr_(0) start"
#
# 4 connecting to 5 at time 56.333118917575632
#
set udp_(1) [new Agent/UDP]
$ns_ attach-agent $node_(4) $udp_(1)
```

Figure. 1.3 Topology Files created using setdest command for Nodes

```
cbr-15-10
#
# nodes: 15, max conn: 10, send rate: 0.5, seed: 1.0
#
#
# 1 connecting to 2 at time 2.5568388786897245
#
set udp_(0) [new Agent/UDP]
$ns_ attach-agent $node_(1) $udp_(0)
set null_(0) [new Agent/Null]
$ns_ attach-agent $node_(2) $null_(0)
set cbr_(0) [new Application/Traffic/CBR]
$cbr_(0) set packetSize_ 512
$cbr_(0) set interval_ 0.5
$cbr_(0) set random_ 1
$cbr_(0) set maxpkts_ 10000
$cbr_(0) attach-agent $udp_(0)
$ns_ connect $udp_(0) $null_(0)
$ns_ at 2.5568388786897245 "$cbr_(0) start"
#
# 4 connecting to 5 at time 56.333118917575632
#
set udp_(1) [new Agent/UDP]
$ns_ attach-agent $node_(4) $udp_(1)
```

Figure. 1.4 Topology Files created using setdest command for Nodes 15

```
adhoc.tr
[2 0] [1 4]] (REQUEST)
r 2.557827536 _3_ RTR --- 0 AODV 48 [0 ffffffff 1 800] ------- [1:255 -1:255 30 0] [0x2 1 1 [2 0] [1 4]] (REQUEST)
r 2.557827609 _44_ RTR --- 0 AODV 48 [0 ffffffff 1 800] ------- [1:255 -1:255 30 0] [0x2 1 1 [2 0] [1 4]] (REQUEST)
r 2.557827672 _21_ RTR --- 0 AODV 48 [0 ffffffff 1 800] ------- [1:255 -1:255 30 0] [0x2 1 1 [2 0] [1 4]] (REQUEST)
r 2.557827674 _15_ RTR --- 0 AODV 48 [0 ffffffff 1 800] ------- [1:255 -1:255 30 0] [0x2 1 1 [2 0] [1 4]] (REQUEST)
r 2.557827701 _45_ RTR --- 0 AODV 48 [0 ffffffff 1 800] ------- [1:255 -1:255 30 0] [0x2 1 1 [2 0] [1 4]] (REQUEST)
s 2.558708542 _25_ RTR --- 0 AODV 48 [0 ffffffff 1 800] ------- [25:255 -1:255 29 0] [0x2 2 1 [2 0] [1 4]] (REQUEST)
r 2.559896836 _44_ RTR --- 0 AODV 48 [0 ffffffff 19 800] ------- [25:255 -1:255 29 0] [0x2 2 1 [2 0] [1 4]] (REQUEST)
r 2.559896901 _21_ RTR --- 0 AODV 48 [0 ffffffff 19 800] ------- [25:255 -1:255 29 0] [0x2 2 1 [2 0] [1 4]] (REQUEST)
r 2.559896979 _1_ RTR --- 0 AODV 48 [0 ffffffff 19 800] ------- [25:255 -1:255 29 0] [0x2 2 1 [2 0] [1 4]] (REQUEST)
r 2.559896993 _43_ RTR --- 0 AODV 48 [0 ffffffff 19 800] ------- [25:255 -1:255 29 0] [0x2 2 1 [2 0] [1 4]] (REQUEST)
r 2.559897246 _17_ RTR --- 0 AODV 48 [0 ffffffff 19 800] ------- [25:255 -1:255 29 0] [0x2 2 1
```

Figure. 1.5: Snap shot of Trace file generated during simulation for AODV protocol.

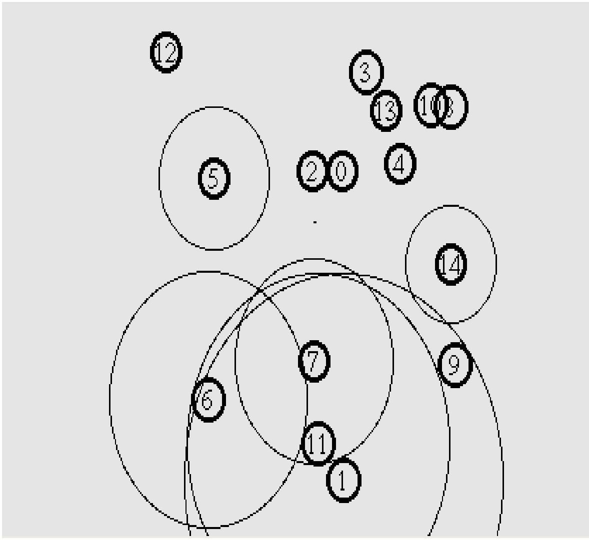

Figure1.6. Screen shot of animation file when Nodes = 15 and P.T. = 0

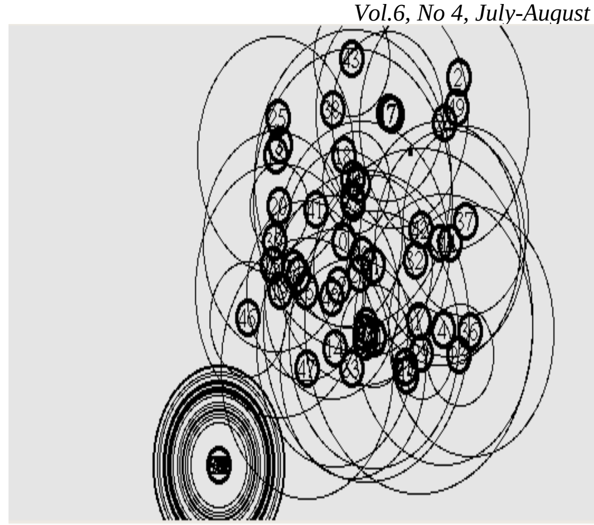

Figure 1.7. Screen shot of animation file when Nodes = 125 and P.T. =25

The experimental performance data under different mobility scenario is shown in Table 1.2.

TABLE 1.2 Experimental Performance Data under Different Mobility Scenario

		Case 1		Case 2		Case 3		Case 4		Case 5	
		P.T.= 0		P.T. = 25		P.T. = 50		P.T.= 75		P.T.=100	
Sr.no	**Nodes**	**TH1**	**NRL1**	**TH2**	**NRL2**	**TH3**	**NRL3**	**TH4**	**NRL4**	**TH5**	**NRL5**
1	15	48.22	0.295	48.22	0.254	48.23	0.241	48.53	0.18	46.86	0.159
2	20	48.19	0.384	48.05	0.339	48.22	0.299	48.38	0.256	48.82	0.171
3	25	47.83	0.491	48.32	0.4	48.43	0.376	48.37	0.321	48.78	0.239
4	30	48.11	0.522	48.19	0.53	48.46	0.457	48.48	0.356	48.53	0.276
5	35	48.35	0.643	48.53	0.677	48.22	0.57	48.4	0.452	48.56	0.311
6	40	48.13	0.794	48.14	0.777	48.16	0.677	48.39	0.55	48.85	0.356
7	45	48.32	0.969	48.34	0.864	48.27	0.868	48.55	0.596	48.68	0.46
8	50	48.03	1.062	47.91	1.069	48.45	0.904	48.73	0.733	48.23	0.543
9	55	47.91	1.543	48.23	0.939	48.47	0.982	48.7	0.769	48.56	0.626
10	60	48.24	1.251	48.37	1.261	47.73	1.257	48.36	1.05	48	0.717
11	65	48.27	1.735	48.39	1.38	48.41	1.349	48.79	0.973	48.83	0.726
12	70	48.14	1.887	49.03	1.724	47.9	1.728	48.59	1.029	48.35	0.831
13	75	47.79	2.012	47.42	1.936	47.72	1.992	47.73	1.296	47.99	0.871
14	80	47.73	2.093	47.45	2.084	47.25	2.004	48.5	1.224	48.27	1.085
15	85	47.91	2.599	47.88	2.211	46.26	2.588	47.68	1.56	48.14	1.127
16	90	46.48	2.875	46.81	2.559	46.72	2.319	47.77	1.665	48.33	1.147
17	95	46.41	2.723	47.3	2.618	47.03	2.327	47.77	1.834	48.1	1.196
18	100	46.69	3.290	45.66	2.999	47.58	2.464	45.89	2.474	48.15	1.406
19	105	47.27	2.985	45.8	3.703	47.32	2.577	47.66	1.867	46.36	1.856
20	110	47.42	3.172	46.89	3.242	46.72	3.078	46.71	2.628	47.51	1.804
21	115	44.75	3.866	46.56	3.927	46.42	3.284	46.35	2.784	46.95	2.042
22	120	46.93	4.077	45.2	4.237	45.63	3.943	46.91	2.454	46.99	2.024
23	125	46.94	4.214	46.13	4.003	45.87	3.807	46.78	3.054	46.48	2.27

Collective performance analysis is mentioned in Table 1.3. This analysis is done by observing performance data stored in Table 1.2. The performance parameter throughput is not mentioned in collective performance analysis because there is no considerable variation in throughput data. It approximately varies between the ranges 44 to 48 kbps during the experiment. It is observed that as the number of nodes and pause time increases simultaneously then routing load is decreasing.

Table 1.3 Collective Routing Load Analysis

Normalized Routing Load	Number of Nodes				
	P.T. = 0	P.T.= 25	P.T. = 50	P.T.= 75	P.T.= 100
0.1 - 0.99	15 – 45	15 - 55	15 - 55	15 - 65	15 – 75
1.0 - 1.99	50 - 70	60 – 75	60 – 75	70 – 95	80 – 110
2.0 – 2.99	75 - 95	80 - 100	80 - 105	100 - 120	115 – 125
3.0 – 3.99	100 - 115	105 - 115	110 - 125	125	-
4.0 - 4.3	120 - 125	120 – 125	-	-	-

It is observed from table 1.3 that under high mobility (P.T. =0) scenario when number of nodes increases routing load in the network is increases.

For E.g. When P.T. = 0, and Number of nodes = 15 – 45 then NRL is 0.1 to 0.99

Similarly When P.T. = 100 and Number of Nodes = 15 – 75 then NRL=0.1 to 0.99.

It is analyzed that to maintain desirable load in the network mobility (P.T.) and number of nodes can be adjusted

B. Performance Analysis

Nodes vs. NRL: it is observed from table 1.3 that as number of nodes increases under high mobility situation then routing load is increasing. As a number of nodes increases, multiple copies of RREP packets are flooded while establishing the route. Also, as nodes are increasing routing table entries and control packet information is increasing. This increases routing load in the network. The mobility affect routing load in the network. As node mobility varies from 0ms to100ms, it is observed that routing load is decreasing.

Nodes vs. Throughput: Table 1.3 shows collective routing load analysis for nodes vs. throughput under various pause time. Throughput gives a number of bits transmitted per unit time. It is observed that in the case of AODV protocol throughput is not highly depends upon a number of nodes in the network. Throughput is decreasing slightly as the number of nodes increasing. In AODV protocol route is formed on demand. Hence, there is a guarantee of route availability which results in approximately constant throughput .Throughput is measured under different mobility scenario. It is observed that as pause time is increasing network become more stable and throughput is slightly higher.

III. RESULT ANALYSIS

Graphical representation of routing Load vs. Number of nodes under different pause time scenario is shown in fig1.8. It is observed that the mobility affect routing load in the network. When number of nodes are increasing under high mobility then routing load is increasing. Whereas under low mobility scenario routing load decreases though number of nodes increases. From the graphical representation it is observed that when mobility is high (P.T. =0) normalized routing load is represented by top most green line in the graph in fig 1.8. When Mobility is low (P.T =100) Normalized routing load is represented by lower blue line in the graph

Similarly, graphical representation of throughput vs. number of nodes under variable pause time is shown in fig1.9. Throughput is measured by varying number of nodes under high to low mobility scenario. It is observed that as mobility decrease throughput is slightly increasing. When P.T = 0 throughput is lowest represented by blue line in the graph. When P.T. =100 throughput is highest represented by green line in the graph.

IV.CONCLUSION

In this paper normalized routing load and throughput of ad hoc network is measured against a variable number of the node under different mobility condition. It is observed that mobility plays a vital role to decide the efficiency of the network. When network is stable routing load decreases and throughput increases. When performance parameters routing load and throughput of the network is observed simultaneously it is noticed that as a number of nodes increases routing load is increasing and throughput is decreasing. It seems complex to maintain low routing load without decreasing the throughput of the network. The researcher suggested deciding scenario parameters i.e. number of nodes and mobility to maintain low routing load without decreasing the throughput of the network. Thus, performance of AODV protocol increases.

References

"Dmitri D. Perkins, Herman D. Hughes, and Charles B. Owen", Factors Affecting the Performance of Ad Hoc Networks", 0-7803-7400-2/02/© 2002 IEEE.

[2] Dr. Sanjay Sharma, Pushpinder Singh Patheja," Improving AODV Routing Protocol with Priority and Power Efficiency in Mobile Ad hoc WiMAX Network ",International Journal of Computer Technology and Electronics Engineering (IJCTEE),vol2 , issue1, ISSN 2249-6343,

[3] Dr.Umadevi Chezhiyan, "Measurment Based Analysis of Reactive Protocols in MANET", International Journal of Wired Communications Vol.1, Issue 2, April, 2013.

[4] Jitendra Moond, Dharm Singh, Naveen Choudhary," Advancements in AODV Routing Protocol - A Review" National Conference on Recent advances in Wireless Communication and Artificial Intelligence (RAWCAI-2014), International Journal of Computer Applications (0975 – 8887)

[5] Prashant Kumar Maurya , Gaurav Sharma , Vaishali Sahu , Ashish Roberts , Mahendra Srivastava,"An Overview of AODV Routing Protocol", International Journal of Modern Engineering Research (IJMER) Vol.2, Issue.3, May-June 2012 pp-728-732 ISSN: 2249-6645

[6] S H Manjula, C N Abhilash, Shaila K, K R Venugopal, L M Patnai ,"Performance of AODV Routing Protocol using Group and Entity Mobility Models in Wireless Sensor Networks"

[7] "Samiksha Nikam, B. T. Jadhav ", DELAY ANALYSIS OF ADHOC NETWORK USING NS 2.34, IJCRR Section: Technology Sci. Journal Impact Factor 4.016, Vol 8, Issue 9, May 2016

[8] Sheng Liu, Yang Yang, Weixing Wang ,"Research of AODV Routing Protocol for Ad Hoc Networks1" 2013 AASRI Conference on Parallel and Distributed Computing and Systems, Available online at www.sciencedirect.com

[9] Siddharth Singh, Dr.Naveen Hemrajani, "Performance Evaluation of AODV Routing Protocol in Wireless Sensor Networks with the Constraints of varying terrain areas by varying pause time" International Journal of

Emerging Trends & Technology in Computer Science (IJETTCS), Volume 2, Issue 1, January – February 2013 ISSN 2278-6856

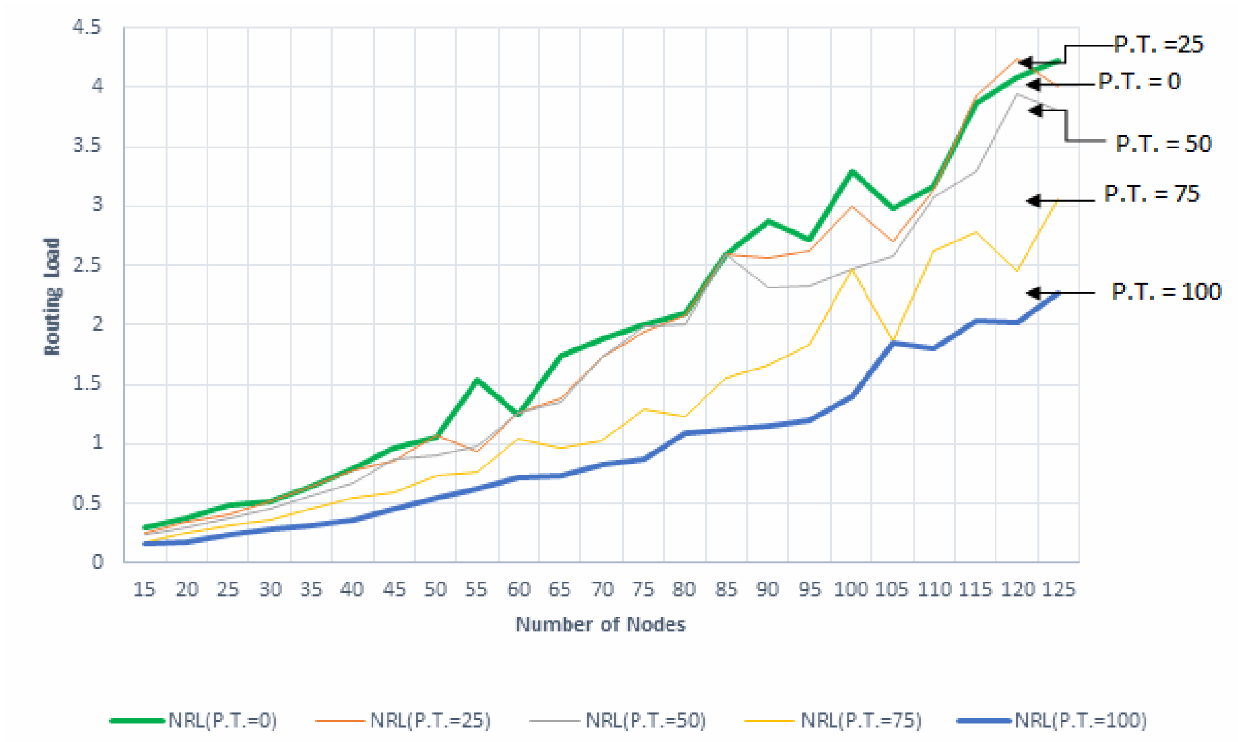

Fig 1.8 Collective Performance Analysis of Routing Load Vs. No .of Nodes