

MANET Simulation for Routing Protocols under the Variable Traffic Load

Dr. Neeraj Bhargava¹, Dr. Ritu Bhargava², Manish Mathuria³, Anchal Kumawat⁴

¹Associate Professor, Dept. of Computer Science, School of Engineering & Systems Sciences, MDS University, Ajmer, India

²Lecturer: Dept. of MCA, Govt. Woman Engineering College, Ajmer, India

³Research Scholar: Dept. of CE & IT, Govt. Engineering College, Ajmer, India

⁴Dept. of Computer Science, School of Engineering & Systems Sciences, MDS University, Ajmer, India

Abstract

A Mobile Ad Hoc Network (MANET) is a group of wireless mobile nodes which dynamically form a network without any pre-existing infrastructure. This paper discusses on the simulation results achieve which is based on varying no of connections. It focuses on three routing protocols, Dynamic Source Routing (DSR), Destination Sequence Distance Vector and Ad hoc On Demand Distance Vector (AODV) in terms of packet delivery ratio, delay, routing load and throughput. Simulation is carried out Network Simulation (NS2) for the evaluation of these three routing protocols. The simulation show that: AODV protocol suits better result than DSR and DSDV.

1. Introduction

An ad hoc network, or MANET (Mobile Ad hoc Network), is a network composed only of nodes, with no Access point. Messages are exchanged and relayed between nodes. In Fact, an ad hoc network has the capability of making communications possible even between two nodes that are not in direct range with each other. Packets to be exchanged between these two nodes are forward by intermediate node between, using a routing algorithm. Hence, MANET may spread over a larger distance, provided that its ends are interconnected by a chain of links between nodes (also called router in this architecture). Ad hoc network & infrastructure network as shown in Figure 1. That shows laptop can communicate with any other PDA's without wire and access point but in case of Infrastructure network communication provides only through access point.

A sensor network is also a special class of ad hoc network, composed of devices equipped with sensors to monitor temperature, sound, or any other environmental condition. These devices are usually deployed in large number and have limited

resources in terms of battery energy, bandwidth, memory and computational power.

Ad hoc network are needed as mobile hosts need to communicate with each with no fixed infrastructure and no administrative help because

- It may not be physically possible for the establishment of the infrastructure
- It may not be practically economical to establish the infrastructure.
- It may be because of expediency of the situation does not permit the installation of the infrastructure.

1.1. Application of Ad Hoc Network

Some of the situations, which motivate the construction of Ad hoc networks, these are as follows.

1. Area of Commercial field like a class of students may need to interact during a presentation and number of people entering in a seminar room wants to communicate with each other.
2. Area of Emergency system like a group of rescue workers may need to be quickly deployed after an earthquake.
3. A group of friends and business associates run into each other at an airport terminal and wish to share information.
4. Collaborative and distributed computing.

1.2. Advantages of Ad hoc Network

Ad Hoc Network consist so many advantages, these are the following -

- i. They provide access to information and services regardless of geographic position.
- ii. This network can be setup at any place and time or node can move in random fashion, so this network works without any pre-existing infrastructure.
- iii. These network share radio channels.

- iv. In this network nodes communicate wirelessly (without wire) and also share the same media.

1.3. Disadvantages of Ad hoc Network

Ad Hoc Network also contain disadvantages, these are the following –

- i. Availability of limited resources
- ii. Lack of authorization facilities.
- iii. Dynamic network topology makes it hard to detect malicious nodes.
- iv. Security protocols for wireless network cannot work for ad hoc network.
- v. In wired networks or infrastructure based wireless networks it would be possible to monitor the network traffic through routers or Base stations and implement security mechanisms at those points. Since MANETs don't have any such central points.
- vi. Nodes can leave or join the network at any point of time, if no proper authentication mechanism is used for associating nodes with the network intruders can easily join the network and carry out attacks.

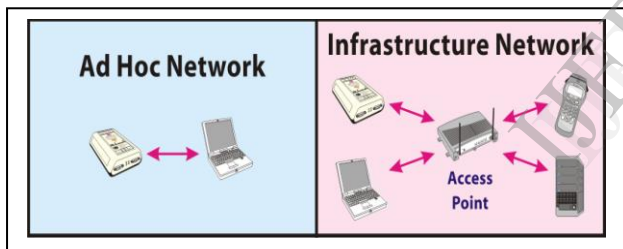


Figure 1. A Simple Structure of Ad hoc Network and Infrastructure network

Section II defines the Routing protocols of MANET to discover the route between nodes. Section III defines Methodology based on Performance Metrics (packet delivery ratio ,delay ,routing load and throughput)in terms of evaluating the performance of three routing protocols .Section IV describes simulation results and section V define as conclusion [1] [2] [15].

2. Routing protocols for MANET

The routing protocols for Mobile Ad-hoc Network are simply classified in three categories:

- 2.1 Proactive Routing Protocol
- 2.2 Reactive Routing Protocol
- 2.3 Hybrid Routing Protocol

2.1 Proactive Routing Protocol

Pro-active routing protocol is also known as Table-driven Routing protocol because routing protocol requires each node to maintain routing information to the every other node in the network

which should be consistent up-to-date routing information. On-demand routing protocols are mainly designed for the purpose is to reduce the overheads in table-driven protocols by maintaining information for active routes and each node to maintain one or more tables to store routing information and responds to changes in network topology by propagating updates throughout the network such as DSDV which shown as in figure 2. [7] [11] [2] [15]

2.1.1. Destination-Sequenced Distance-Vector Routing (DSDV)

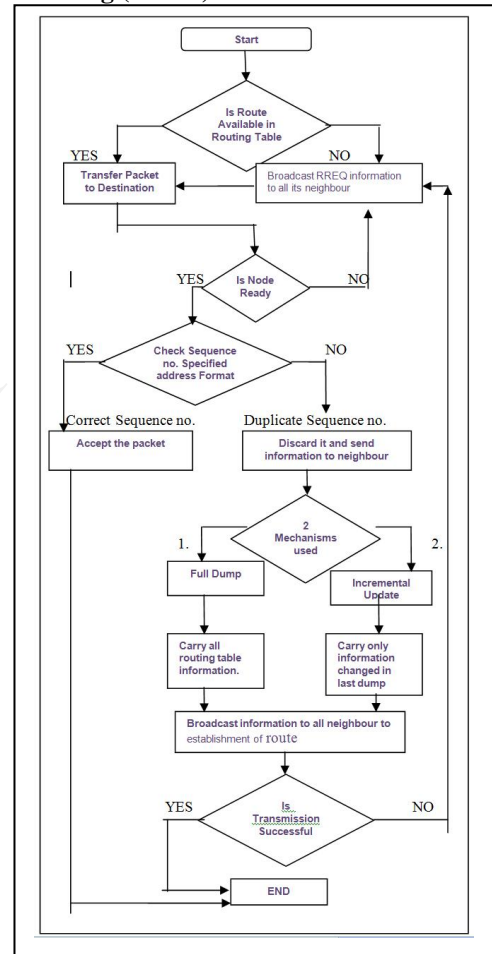


Figure 2. DSDV Routing Algorithm

2.2 Reactive Routing Protocol

Pro-active routing A Reactive routing protocol is also known as On-Demand Routing Protocol. On-Demand is in the sense that discovers the routes on demand. It reduces the overheads of Proactive routing protocol such as maintaining the route table or reduces the signalling overhead.

This type of routing mainly used to create the route, only when the source node wants to send the data to destination. When a source node does not find the route to the destination then it initiates route

discovery process within the network. Once a route has found or established, it is maintained by the form of route maintenance procedure.

Route maintenance check the destination becomes inaccessible along every path from the source or until the route is no longer desired then maintain the route or send this break information to every other intermediate node for recovery such as DSR and AODV[3] [7] [8] [10].

2.1.2 Dynamic Source Routing (DSR)

DSR is a Reactive routing protocol. Working of DSR as shown as figure 3 in flow diagram of DSR [3] [4] [16].

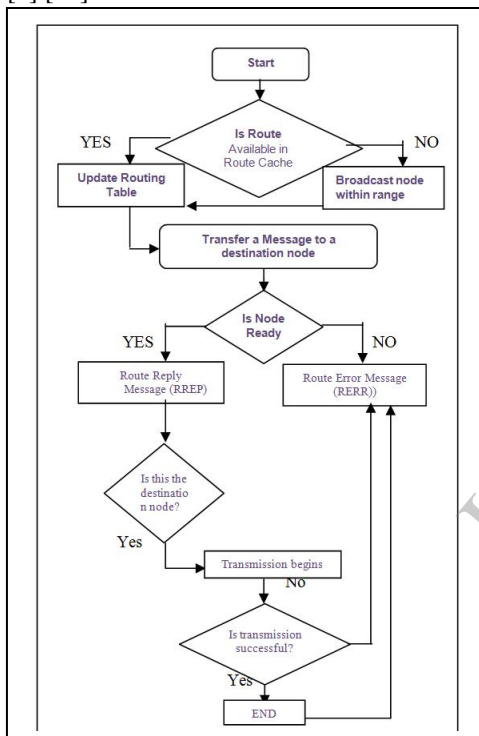


Figure 3. DSR Routing Algorithm

2.1.2. Ad hoc On-Demand Distance Vector Routing (AODV)

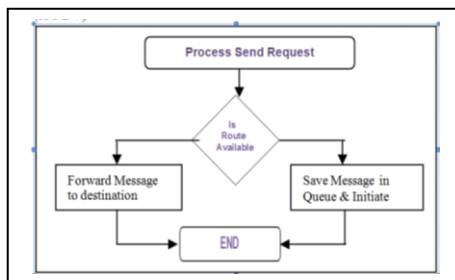


Figure 4. AODV Routing Algorithm

2.2 Hybrid Routing Protocol

This Routing Protocol mainly used to combine the facility of both routing protocol i.e. proactive

routing protocol and Reactive routing protocol such as ZRP, OGSR [3] [7] [8] [10].

3. Methodology of Performance metrics

We use tcl script and awk script for generating these performance metrics as shown as in figure 5 and 6 with the help of network simulation tool (ns-2). When we run this tcl script on ns2 terminal we can see that these types of lines will be displayed on terminal i.e. ns is existing ! after that we will run awk script for result as shown in figure 6.

```

set par1 [lindex $argv 0]
set par2 [lindex $argv 1]
set par3 [lindex $argv 2]
# Define options
set val(chan) Channel/WirelessChannel ;# channel type
set val(prop) Propagation/TwoRayGround ;# radio-propagation model
set val(netif) Phy/WirelessPhy ;# network interface type
set val(mac) Mac/802_11 ;# MAC type

if { $par1=="DSR" } {
    set val(ifq) CMUPriQueue} else
{
    set val(ifq) Queue/DropTail/PriQueue
}
# interface queue type
#set val(ifq) Queue/DropTail/PriQueue ;# interface queue type
set val(ll) LL ;# link layer type
set val(ant) Antenna/OmniAntenna ;# antenna model
set val(ifqlen) 100 ;# max packet in ifq
set val(nn) 50 ;# number of mobile nodes
set val(rp) $par1 ;# routing protocol
set val(sc) $par3 ;# scenario used in the simulation
set val(cp) $par2 ;# number of connections
set val(x) 1500 ;# X dimension of topography
set val(y) 600 ;# Y dimension of topography
set val(stop) 900 ;# time of simulation end
ns-random 0
Phy/WirelessPhy set bandwidth_ 11Mb;
Mac/802_11 set dataRate 2Mb;
Mac/802_11 set basicdataRate 11Mb;
# Simulation creation
set ns_ [new Simulator]
set tracefd [open "aodv.tr" w]
#set windowVsTime2 [open win.tr w]
set namtrace [open "aodv.nam" w]
$ns_ use-newtrace
$ns_ trace-all $tracefd
#$ns_ namtrace-all-wireless $namtrace $val(x) $val(y)
# set up topography object
set topo [new Topography]
$topo load_flatgrid $val(x) $val(y)
# Create channel #1
set chan_1_ [new $val(chan)]
set god_ [create-god $val(nn)]
# Create nn mobile nodes [$val(nn)] and attach them to the channel.
# configure the nodes
$ns_ node-config #-addressingType flat \
                -adhocRouting $val(rp) \
                -llType $val(ll) \
                -macType $val(mac) \
                -ifqType $val(ifq) \
                -ifqLen $val(ifqlen) \
                -antType $val(ant) \
                -propType $val(prop) \
    
```

```

-phyType $val(netif) \
-channel $chan_1_ \
-topoInstance $topo \
-agentTrace ON \
-routerTrace ON \
-macTrace ON \
-movementTrace OFF
for {set i 0} {$i < $val(nn)} {incr i}
{
    set node_($i) [$sns_node]
    $node_($i) random-motion 0
}
# Provide initial location in scenario
puts "Loading scenario file...";
source $val(sc)
# Set TCP connection pattern
puts "Loading connection pattern...";
source $val(cp)
# Printing the window size
# Define node initial position in nam
for {set i 0} {$i < $val(nn)} {incr i}
{
    #10 defines the node size for nam
    $ns_ initial_node_pos $node_($i) 20
}
# Telling nodes when the simulation ends
for {set i 0} {$i < $val(nn)} {incr i} {
    $ns_ at $val(stop) "$node_($i) reset";}
$ns_ at $val(stop) "puts \"NS EXITING...\" ; $ns_ halt"
# ending nam and the simulation
$ns_ at $val(stop) "$ns_ nam-end-wireless $val(stop)"
$ns_ at $val(stop) "stop"
proc stop {} {
    global ns tracefd namtrace
    $ns_ flush-trace
    close $tracefd
    close $namtrace
    #Call xgraph to display the results
    #exec xgraph out1.tr -geometry 800x400 &
    exec xgraph aodv.tr -geometry 800*400
}
puts "Starting Simulation..."
$ns_run

```

Figure 5. Tcl script for evaluating routing protocol.

```

# Receive versus send Packet Delivery Ratio
BEGIN {
sent = 0; rcv = 0; drop = 0;
macpkts = 0; agtpkts = 0
macb = 0; cbmo = 0; cbrb = 0;
agtrecev = 0; d_rt = 0;
drop=0;
rtpkts=0;
total_pktsize=0;
total_delay=0;
hdrsize=0;
} {
action = $1;
time = $3;
node_1 = $31;
node_2 = $33;
node = $9;
src = $35;
#node_1_address = $14;
#node_2_address = $15;
type = $19
cause = $21
seqno = $47
pktsize = $37
hops = $49
packet_id = $41
if(type == "AGT" && src == "cbr" ){
if ( action == "s" ) {

```

```

if (time < simulation_start || simulation_start == 0)
simulation_start = time;
sent ++
s_time[packet_id] = time
}if (action == "r" ) {
total_data_hops += hops
e_time[packet_id] = time
rcv ++
agtrecev ++
if(e_time[packet_id]> s_time[packet_id])
{
total_delay += delay
}
hdrsize=pktsize % 128
total_pktsize += pktsize-hdrsize
if (time > simulation_end)
simulation_end = time;
}}
/^d/ && /AGT/ && /-It cbr/ {drop++}
($1~/s/ || $1~/f/) && $19~/RTR/ && ($35~/AODV/ ||
$35~/DSDV/ || $35~/OLSR/ || $35~/AODVUU/ || $35~/DSR/ ||
$35~/message/ ){rtpkts ++}END{
#otime1 = tmp_e_time - s_time1
##thput1 = (8*total_pktsize /total_delay)/1000
simtime = simulation_end - simulation_start
thput = ((8*total_pktsize) /simtime)/1000
if (rcv!=0){ pdr = (rcv/sent)*100
avgdelay = total_delay/rcv
nrtovh = rtpkts/rcv
avghop = total_data_hops / rcv
print (" nrtovh\t" " avgdelay\t" " pdr \t" " "
thput\t" " avghop)
}Else{
print ("error")
}
}

```

Figure 6. Awk script for evaluating performance metrics

The main focus of this paper is to evaluate the performance of DSR, DSDV and AODV routing protocols using following metrics:

3.1 Packet Delivery Ratio

The Packet delivery ratio is the ratio of the number of delivered data packet to the destination. $PDR = \frac{\sum \text{No. of packet receive}}{\sum \text{No. of packet send}}$.

3.2 End to End Delay

End-to-end Delay is referred as the average time taken by a data packet to arrive in the destination. It also includes the delay caused by route discovery process and the queue in data packet transmission. Only the data packets that successfully delivered to destinations that counted. $\text{End-to-End Delay} = \frac{\sum (\text{arrive time} - \text{send time})}{\sum \text{No. of connections}}$.

3.3 Normalized Routing Load

The number of routing packets transmitted per data packet delivered at the destination. Each hop-wise transmission of a routing packet is counted as one transmission.

3.4 Throughput

Throughput refers that number of jobs completed in the given unit time. Throughput of the routing protocol means that how many packets are received in particular time interval. The unit of throughput measure in Kilobits per second (Kbps).

4. Simulation Results

The simulations are carried out using Network Simulator 2 (Ns-2.35). The basic steps for performing any simulation in ns2 as shown as in figure 8. Constant bit rate (CBR) traffic was used in the simulation. Simulation was done according to the number of connections which vary from up to 10, 20, 30, and 40. We need scenario file or traffic generation file for evaluating the performance of DSR, DSDV & AODV protocol.

For traffic generation we run the CBR generation tcl file consist some parameters. After writing these lines on terminal we find that trace file of that generated cbr-10-test file as shown as in figure 7.

```
ns cbrgen.tcl
ns cbrgen.tcl -type cbr -nn 10 -seed 1.0 -mc 10 -
rate 4.0 > cbr-10-test.
```

Whereas -

- type – refer as traffic /connection type
- nn –number of nodes
- seed – seed for generating random number .it is used to generate the random starting time of the traffic.
- mc – max. Number of connections.
- rate – packet rate = 1/ packet interval.

```
# nodes: 10, max conn: 10, send rate: 0.25, 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]
$scbr_(0) set packetSize_ 512
$scbr_(0) set interval_ 0.25
$scbr_(0) set random_ 1
$scbr_(0) set maxpkts_ 10000
```

Figure 7. Trace files output of cbr-10-test file.

To evaluate the performance metrics we will run above tcl script. For this we write following command on ns 2 terminal.

```
ns wireless.tcl DSDV cbr-10-test scen-1-test
ns wireless.tcl DSR cbr-10-test scen-1-test
ns wireless.tcl AODV cbr-10-test scen-1-test
```

Then simulation result will be displayed on terminal. The following table deals with the simulation Parameters which is used during the simulation.

Table 1. Simulation Parameter

Parameter	Value
Simulator	NS-2.35
Simulator Area	500mX500m
No. Of connections	10, 20, 30, 40
Pause Time	80sec

Packet Size	512
Routing Protocols	DSR,DSDV&AODV
Traffic Sources	CBR
Simulation Time	900 Sec.

4.1 Packet Delivery Ratio

Table 2. PDR analysis of DSR DSDV and AODV.

No. of Nodes	DSR	DSDV	AODV
10	99.9967	99.9902	99.9918
20	99.9947	99.9915	99.9947
30	99.9945	99.9937	99.9881
40	81.8407	84.9605	86.1919

4.2 End to End Delay

Table 3. Delay analysis of DSR DSDV and AODV.

No. of Nodes	DSR	DSDV	AODV
10	0.00771364	0.00782688	0.0080594
20	0.0102993	0.0106026	0.0104827
30	0.0180121	0.0219439	0.0191683
40	3.60001	7.03831	3.40899

4.3 Normalized Routing Load

Table 4. NRL analysis of DSR DSDV and AODV

No. of Nodes	DSR	DSDV	AODV
10	0.000195564	0.0584355	0.00897666
20	0.00103506	0.0381181	0.0117291
30	0.000967225	0.032812	0.01462729
40	0.0171368	0.0653654	0.119539

4.4 Throughput

Table 5. Throughput analysis of DSR DSDV and AODV

No. of Nodes	DSR	DSDV	AODV
10	0.33	279.541	279.642
20	427.72	427.814	428.039
30	575.688	575.449	576.384
40	588.33	610.753	619.14

5. Conclusion

This research evaluates the effect of traffic load for the number of connections varies with the help of reactive (DSR and AODV) and proactive (DSDV) routing protocols in the terms of 4 performance metrics i.e. packet delivery ratio, end-to-end delay, normalized routing load and

throughput. The results show from above tables 2,3,4,5 that the performance of the two reactive protocols (DSR and AODV) was better than proactive protocol (DSDV). The overall performance of AODV was better than the other two protocols. Instead, Packet Delivery Ratio all three performance metrics shows that AODV is better protocol. Thus, the result states that the AODV protocol is a best protocol under the traffic load.

6. References

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