



RAMCO INSTITUTE OF TECHNOLOGY

Dept. of Computer Science and Engineering

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Virtual Lab

Routing In Mobile Ad hoc Networks

<http://vlabs.iitkgp.ernet.in/ant/7/>

Prepared By

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Topic: Network simulator on Mobile Ad-hoc Networks

1. Objectives:

- Make the students to design and simulate Mobile Ad-hoc Network in graphically using Network Simulation tool(NS-2)
- Analysis performance of various routing protocols such as DSR and AODV.

2. Network simulator.

The Network simulator2 (NS2) designed to simulate and design mobile Adhoc network that views graphically. It shows the network traffic (packet movement) visually and how the packets transferred from source node to destination node. Students can visualize the mobility of the nodes for MANET simulation. We can design both wired and wireless networks with various network protocols such as DSR, AODV, and DSDV, etc. Also, we perform analytical studies using network performance metrics such as packet delivery ratio, end-to-end delay, and throughput. This gives research insights and motivation to do research in this domain. We can install NS2 Linux environment.

The following link is used to access the virtual lab.

<http://vlab.co.in/>

// URL for Virtual lab

<http://vlab.iitkgp.ernet.in/ant/7/>

// URL for MANET simulation

This virtual lab is designed and implemented by IIT Kharagpur, India. This simulation supports various computer networks such as Local Area Network, Satellite Network, Wi-Fi Network, WiMAX Network, Mobile Ad-hoc Network, Wireless Sensor Network, Bluetooth Network, and ZigBee Network.

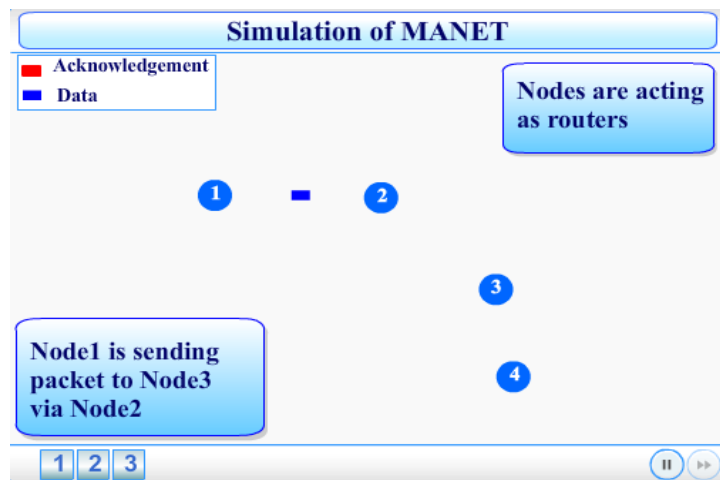
3. Manual

3.1 Introduction.

The prime goal of this simulation is setup MANET with various routing protocols like AODV, DSR, and DSDV. The simulation is written by TCL script [2]. The network performance is analyzed by trace file. The trace file is generated automatically after the simulation is completed. The trace file contains all activities that happened during the simulation and it recorded all the data based on the event. This simulation shows the MANET setup, how a packet is transferred from source to destination, what happens if the network gets disrupted, and how new routing path is constructed after disruption or topology changes or node dead. This simulation is set up with four mobile nodes and performs packet transfer and acknowledgment, route disruption and new route formation. This simulation contains an introduction, theory, simulation, self-evaluation, procedure, exercises and references section to get the insight of routing in MANET.

3.2 Instructions to perform a simulation experiment.

- Visit to the following URL to perform a simulation for Routing in MANET.
<http://vlabs.iitkgp.ernet.in/ant/7/>
- This page contains five tabs such as Introduction, theory, Simulation, Self-evaluation, procedure, exercise and references to perform the MANET simulation.
- Select the simulation tab.
- Click button 1 to setup a MANET with four nodes. It shows how nodes form a network automatically and perform packet transformation from node1 to node 4 with acknowledgment. Figure 1 shows the simulation view.



- Figure1 : Simulation view of four nodes

- Then, Click button 2. It describes and shows a packet transformation when disruption of routing path between node 1 to node2. Here, when node2 moved out of the coverage, new routing path will be constructed between node 1 and node 2 without node2. Figure 2 shows the route disruption scenario.

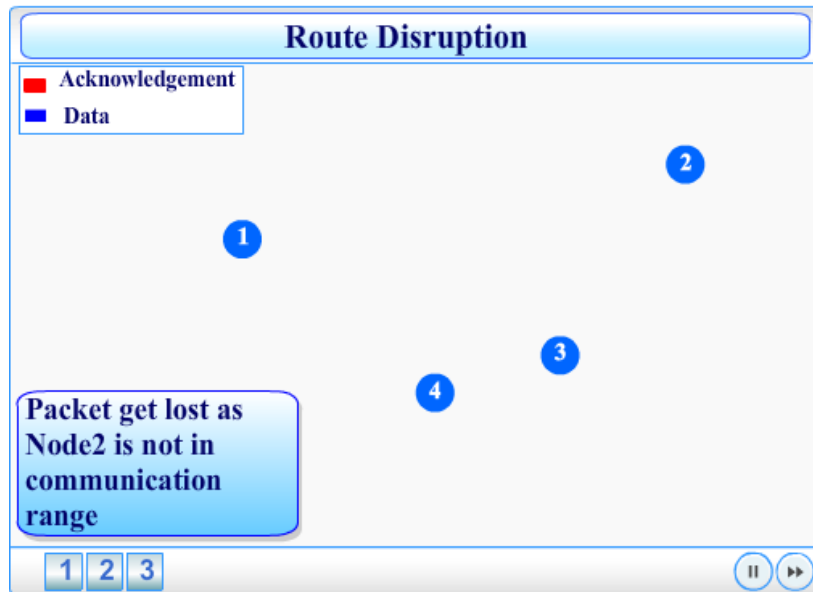


Figure 2: Node mobility.

New routing path (path: Node1 – node 4 – node 3) will be constructed automatically when node2 moves out of the transmission range. Figure 3 shows the packet transformation through new routing path and figure 4 shows the how acknowledgment packet transfer from destination node(node3) to the source node (node1).

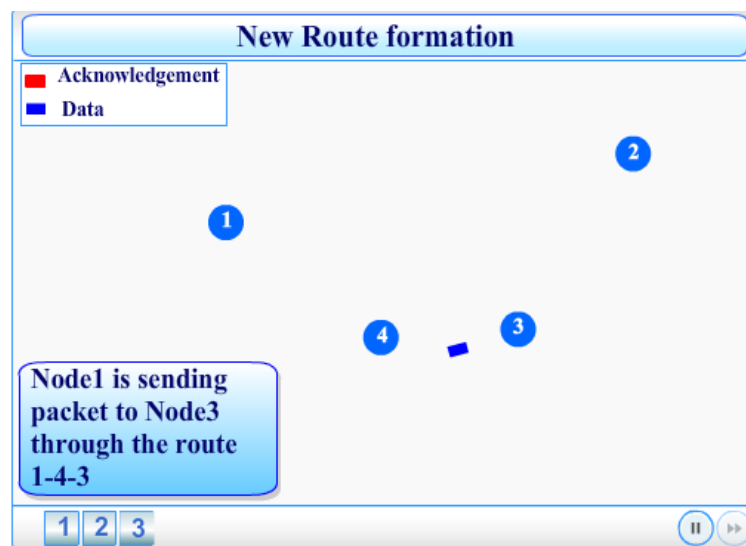


Figure 3: Packet transformation through new route.

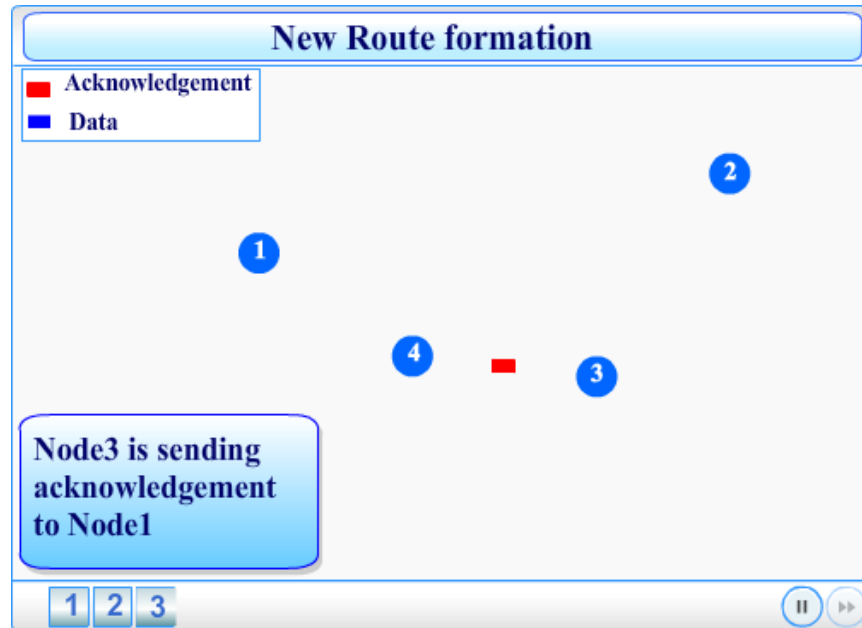


Figure 4: Acknowledgement packet transformation

3.3 NS-2 INSTALLATION

NS2 can be installed in Linux environment [2]. Installation steps are given below.

- Copy ns-allinone-2.34.tar.gz package to /root folder
- Right click & do extract here
 - ❖ It will create ns-allinone-2.34 folder
- Open the terminal and go to ns-allinone-2.34 folder
 - ❖ cd /root/ ns-allinone-2.34
- To install type the command
 - ❖ ./install
- Open another terminal : set the environment variable open the /etc/profile file
 - ❖ gedit /etc/profile
- Enter these variable in end of profile
 - ❖ export PATH=\$PATH
 - ❖ export LD_LIBRARY_PATH=
 - ❖ export TCL_LIBRARY=

Copy the value of PATH, LD_LIBRARY_PATH, and TCL_LIBRARY environment variables and paste it in /etc/profile file.

3.3.1 Example:

- set the environment variable
 - ❖ export PATH=\$PATH:/root/ns-allinone-2.34/tcl8.4.15/unix:/root/ns-allinone-2.34/tk8.4.15/unix:/root/ns-allinone-2.34/bin
 - ❖ export LD_LIBRARY_PATH=/root/ns-allinone-2.34/lib:/root/ns-allinone-2.34/otcl-1.13
 - ❖ export TCL_LIBRARY=/root/ns-allinone-2.34/tcl8.4.15/library

3.4 Frequent Ask Questions and answers.

1. How nodes can be increased in simulation?
2. How can set the node property and routing protocol in same MANET scenario?
3. How can we analyse the performance of the MANET?
4. How can develop, design and implement new protocol for our research?

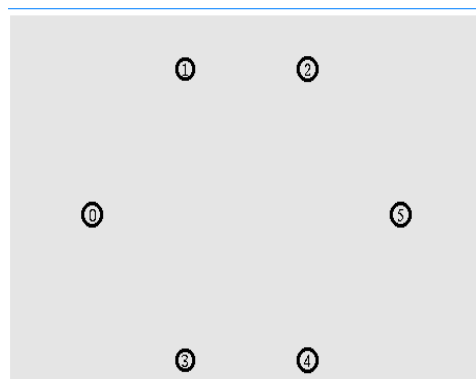
3.4.1 Answer

1. How nodes can be increased in simulation?

We write a TCL script in NS2 for MANET simulation. We can increase number of nodes using the following scripts.

```
#Create six nodes
for {set i 0} {$i < 6} {incr i} {
    set n($i) [$ns node]
}

#Create links between the nodes
for {set i 0} {$i < 6} {incr i} {
    $ns duplex-link $n($i) $n([expr ($i+1)%7]) 1Mb 10ms
DropTail
}
}
```



#Code for creating specific number of nodes

```
for {set i 0 } {$i < val(nn)}{incr i} {  
    set node_($i) [$ns_ node]  
}
```

#Define a node position randomly

```
for {set i 0}{$i < $val(nn)}{incr i}{  
    $ns_ initial_node_pos $node_($i) 30  
}
```

2. How can set the node property and routing protocol in same MANET scenario?

The following TCL scripts used to node setting and routing protocol for MANET.

node configuration

```
$ns_ node-config - adhocRouting AODV\  
- llType LL \  
- macType Mac/802_11 \  
- ifqType $qtype \  
- ifqLen 50 \  
- antType Antenna/OmniAntenna \  
-propType Propagation/TwoRayGround \  
- phyType Phy/WirelessPhy \  
- channelType Channel/WirelessChannel\  
- topoInstance $topo \  
- agentTrace ON \  
- routerTrace ON \  
- macTrace OFF
```

3. How can we analyse the performance of the MANET?

The performance metrics such as hop-count, packet delivery ratio and end-to-end delay used to analyses the MANET performance. The simulation result provides a trace file that contains the activities of each node based on the event. The trace file format is as follows.

```
s-t 163.001503520 -Hs 0 -Hd -2 -Ni 0 -Nx 300.00 -Ny 500.00 -Nz  
0.0 -Ne -1.000000 -NI AGT -Nw --- -Ma 0 -Md 0 -Ms 0 -Mt 0 -Is  
0.0 -Id 2.0 -It cbr -Il 200 -If 1 -Ii 77 -Iv 32 -Pn cbr -Pi 32 -Pf 0 -Po 0
```

Field 0: Event type

- ❖ s:send r:receive d:drop f:forward

Field 1: General tag

- ❖ -t: time

Field 3: Next hop info

- -Hs: id for this node
- -Hd: id for next hop towards the destination

Field 4: Node property type tag

- Ni: node id
- Nx –Ny –Nz: node's x/y/z coordinate
- Ne: Node energy level
- Nl: trace level, such as AGT, RTR, MAC
- Nw: reason for the event

Field 5: Packet info at MAC level

- ❖ Ma: duration
- ❖ Md: dest's Ethernet address
- ❖ Ms: src's Ethernet address
- ❖ Mt: Ethernet type

Field 6: Packet information at IP level

- ❖ Is: source address, source port number
- ❖ Id: dest address, dest port number
- ❖ It: packet type
- ❖ Il: packet size
- ❖ If: flow id
- ❖ Ii: unique id
- ❖ Iv: TTL value

Field 7:

- ❖ Packet info at “Application level” which consists of the type of application like ARP, TCP, and Adhoc routing protocols like DSDV, DSR, AODV etc. The field consists of a leading –**P** and the list of tags for different applications.

Then, write an awk script that takes data from trace file and give the report for performance metrics such as packet delivery ratio, throughput, etc.

Case 1

1. Varying number of mobiles nodes

The protocols behavior such as packet delivery ratio and throughput can be analyzed by varying the number of nodes in the given topology area.

Table 1: AODV

No of nodes	Packet Delivery Ratio(PDR) %	Throughput %
20	78	85
30	79	86
40	78	85
50	79	85

Table 2: DSR

No of nodes	Packet Delivery Ratio(PDR) %	Throughput %
20	79	86
30	80	85
40	80	85
50	81	86

3.5 Reflection Report

- ❖ All the students worked and make a simulation for MANET in a virtual lab comfortably because it contains click and view strategies.
- ❖ Students get clear fundamental knowledge of forming Adhoc networks and how packets are transferred from source to destination.
- ❖ Students worked with joyfully because of visualization blow in their mind.
- ❖ Simulation with varying nodes taken a long time. Given the lecture, the period is not enough to complete the simulation with various scenarios. Next time, I need to pre-plan for this kind of lecture in advance and allotted more time because it gives more insights to MANET and it is core content of the course.
- ❖ I assisted to slow learners to complete the simulation in their systems.
- ❖ I faced a lot of issues to install NS2 in our lab and students' laptop.
- ❖ I conducted this virtual lab exercise and simulation with varying nodes for all 51 students (whole class). I felt that few students not comfortable to work with simulation

in our lab. In the future, I will plan to conduct this exercise for a small group that will provide more information to students.

- ❖ All the students are given good feedback and some of the students preferred their final year project in this field

3.6 Conclusion

This MANET simulation provides simple ad-hoc network formation and network protocol behaviors. Also, it gives excellent procedure and visualizes for MANET. This virtual lab does not provide performance analysis procedures and implementation. The presented simulation of MANET promotes students self-learning capabilities.

References:

1. <http://www.jgyan.com/ns2/awk%20scripts%20for%20ns2%20result%20analysis.php>
2. <https://www.isi.edu/nsnam/ns/tutorial/>
3. <http://nile.wpi.edu/NS/>