SSN College of Engineering, Kalavakkam
Department of Computer Science and Engineering
V Semester - CSE 'B'
UCS1511 NETWORKS LAB

Exercise 9: SIMULATION OF ROUTING PROTOCOLS

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AIM: Write tcl script to simulate the routing protocols in wired networks

a. Distance Vector Routing
ALGORITHM:
1. The Simulator class is used to create a new variable ns.
2. Set namtrace for enabling animation to simulate the environment.
3. The color field here is used to discriminate the different data packets travelling across the nodes.
4. Then the various nodes n0,n1..etc are declared accordingly.
5. The duplex links between the nodes is set appropriately.
6. Following this the orientation of these nodes in the simulator is decided upon.
7. A UDP connection is set up between the node n0 and n5 and also between the nodes n1 and n5.
8. The CBR here facilitates this UDP connection.
9. The rtproto command is used for determining the routing protocol whether DV-distance vector or LS-link state routing is to be used.
10. The rtmodel down command facilitates in keeping the required links down for some time.

CODE:
```
set ns [new Simulator]

$ns color 1 red
$ns color 2 blue

set n0 [$ns node]
set n1 [$ns node]
set n2 [$ns node]
set n3 [$ns node]
set n4 [$ns node]
set n5 [$ns node]
set n6 [$ns node]
set n7 [$ns node]
set n8 [$ns node]
set n9 [$ns node]
set n10 [$ns node]
set n11 [$ns node]

set nr [open out.tr w]
$ns trace-all $nr
set nf [open out.nam w]
$ns namtrace-all $nf

proc finish { } {
global ns nr nf
$ns flush-trace
close $nf
close $nr
exec nam out.nam &
exit 0
}

$ns duplex-link $n0 $n1 1Mb 10ms DropTail
$ns duplex-link $n1 $n2 1Mb 10ms DropTail
$ns duplex-link $n2 $n3 1Mb 10ms DropTail
$ns duplex-link $n3 $n4 1Mb 10ms DropTail
$ns duplex-link $n4 $n5 1Mb 10ms DropTail
$ns duplex-link $n5 $n6 1Mb 10ms DropTail
$ns duplex-link $n6 $n7 1Mb 10ms DropTail
$ns duplex-link $n7 $n8 1Mb 10ms DropTail

$ns duplex-link $n0 $n8 1Mb 10ms DropTail
$ns duplex-link $n1 $n10 1Mb 10ms DropTail
$ns duplex-link $n0 $n9 1Mb 10ms DropTail
```

```
$ns duplex-link $n9 $n11 1Mb 10ms DropTail
$ns duplex-link $n10 $n11 1Mb 10ms DropTail
$ns duplex-link $n11 $n5 1Mb 10ms DropTail


$ns duplex-link-op $n0 $n1 orient right
$ns duplex-link-op $n1 $n2 orient down
$ns duplex-link-op $n2 $n3 orient down
$ns duplex-link-op $n3 $n4 orient left
$ns duplex-link-op $n4 $n5 orient left
$ns duplex-link-op $n5 $n6 orient left
$ns duplex-link-op $n6 $n7 orient left
$ns duplex-link-op $n7 $n8 orient up
$ns duplex-link-op $n8 $n0 orient up
$ns duplex-link-op $n5 $n11 orient up
$ns duplex-link-op $n0 $n9 orient right-down
$ns duplex-link-op $n9 $n11 orient right
$ns duplex-link-op $n11 $n10 orient right
$ns duplex-link-op $n1 $n10 orient left-down

set udp0 [new Agent/UDP]
$ns attach-agent $n0 $udp0
$udp0 set fid_ 1

set cbr0 [new Application/Traffic/CBR]
$cbr0 set packetSize_ 1000
$cbr0 set rate_ 0.10mb
$cbr0 set random_ true
$cbr0 attach-agent $udp0

set null0 [new Agent/Null]
$ns attach-agent $n5 $null0
$ns connect $udp0 $null0

set udp1 [new Agent/UDP]
$ns attach-agent $n1 $udp1
$udp1 set fid_ 2

set cbr1 [new Application/Traffic/CBR]
$cbr1 set packetSize_ 1000
$cbr1 set rate_ 0.10mb
$cbr1 set random_ true
$cbr1 attach-agent $udp1

set null1 [new Agent/Null]
```
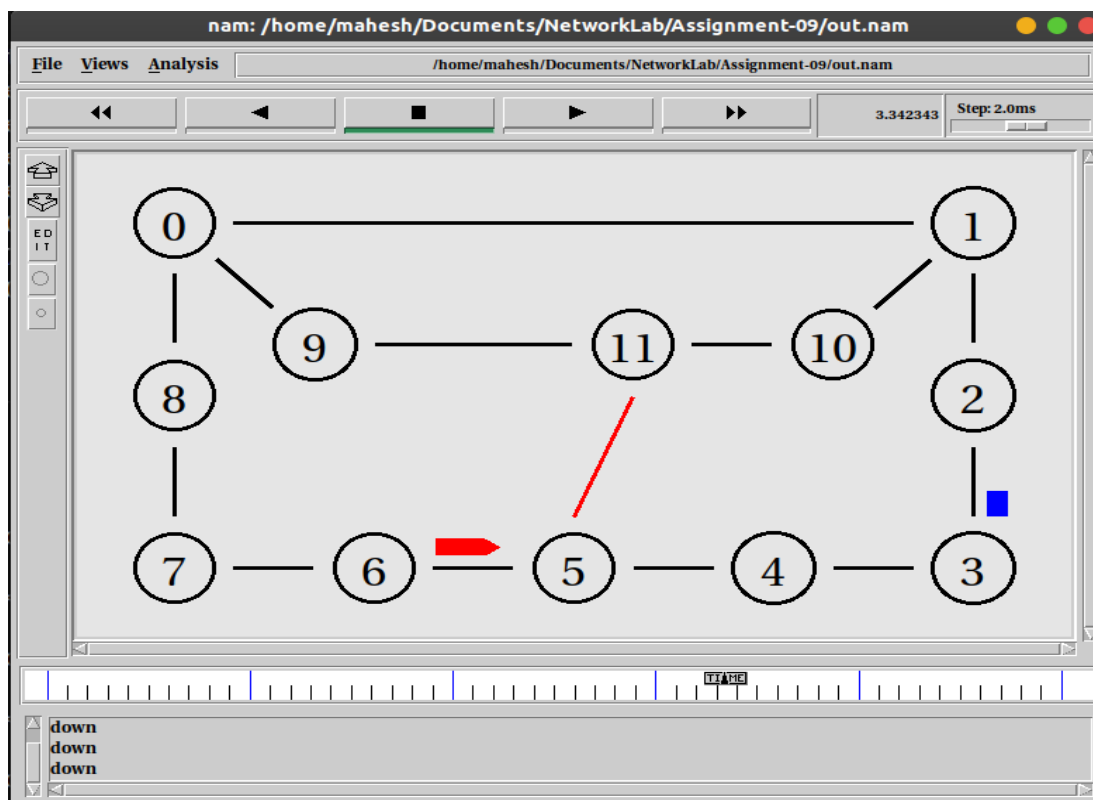
```
$ns attach-agent $n5 $null1
$ns connect $udp1 $null1


$ns rtproto DV
$ns rtmodel-at 3.0 down $n11 $n5
$ns rtmodel-at 2.0 down $n7 $n6
$ns rtmodel-at 4.0 up $n11 $n5
$ns rtmodel-at 3.0 up $n7 $n6
$ns at 0.0 "$cbr0 start"
$ns at 0.75 "$cbr1 start"
$ns at 5.0 "finish"
$ns run
```

SCREENSHOT:

Trace file:

```
out.tr
~/

+ 0.00017 0 8 rtProtoDV 12 ------- 0 0.2 8.1 -1 2
- 0.00017 0 8 rtProtoDV 12 ------- 0 0.2 8.1 -1 2
+ 0.00017 0 9 rtProtoDV 12 ------- 0 0.2 9.1 -1 3
- 0.00017 0 9 rtProtoDV 12 ------- 0 0.2 9.1 -1 3
r 0.010266 0 8 rtProtoDV 12 ------- 0 0.2 8.1 -1 2
+ 0.010266 8 0 rtProtoDV 12 ------- 0 8.1 0.2 -1 8
- 0.010266 8 0 rtProtoDV 12 ------- 0 8.1 0.2 -1 8
r 0.010266 0 9 rtProtoDV 12 ------- 0 0.2 9.1 -1 3
+ 0.010266 9 0 rtProtoDV 12 ------- 0 9.1 0.2 -1 9
- 0.010266 9 0 rtProtoDV 12 ------- 0 9.1 0.2 -1 9
+ 0.010266 9 11 rtProtoDV 12 ------- 0 9.1 11.1 -1 10
- 0.010266 9 11 rtProtoDV 12 ------- 0 9.1 11.1 -1 10
r 0.020362 8 0 rtProtoDV 12 ------- 0 8.1 0.2 -1 8
r 0.020362 9 0 rtProtoDV 12 ------- 0 9.1 0.2 -1 9
+ 0.020362 0 8 rtProtoDV 12 ------- 0 0.2 8.1 -1 17
- 0.020362 0 8 rtProtoDV 12 ------- 0 0.2 8.1 -1 17
+ 0.020362 0 9 rtProtoDV 12 ------- 0 0.2 9.1 -1 18
- 0.020362 0 9 rtProtoDV 12 ------- 0 0.2 9.1 -1 18
r 0.020362 9 11 rtProtoDV 12 ------- 0 9.1 11.1 -1 10
+ 0.020362 11 5 rtProtoDV 12 ------- 0 11.1 5.2 -1 19
- 0.020362 11 5 rtProtoDV 12 ------- 0 11.1 5.2 -1 19
+ 0.020362 11 9 rtProtoDV 12 ------- 0 11.1 9.1 -1 20
- 0.020362 11 9 rtProtoDV 12 ------- 0 11.1 9.1 -1 20
+ 0.020362 11 10 rtProtoDV 12 ------- 0 11.1 10.1 -1 21
- 0.020362 11 10 rtProtoDV 12 ------- 0 11.1 10.1 -1 21
r 0.030458 0 8 rtProtoDV 12 ------- 0 0.2 8.1 -1 17
+ 0.030458 8 0 rtProtoDV 12 ------- 0 8.1 0.2 -1 28
- 0.030458 8 0 rtProtoDV 12 ------- 0 8.1 0.2 -1 28
```

```
out.tr
~/
+ 0.319433 9 11 rtProtoDV 12 ------- 0 9.1 11.1 -1 207
- 0.319433 9 11 rtProtoDV 12 ------- 0 9.1 11.1 -1 207
r 0.329529 9 0 rtProtoDV 12 ------- 0 9.1 0.2 -1 206
r 0.329529 9 11 rtProtoDV 12 ------- 0 9.1 11.1 -1 207
+ 0.399578 5 11 rtProtoDV 12 ------- 0 5.2 11.1 -1 250
- 0.399578 5 11 rtProtoDV 12 ------- 0 5.2 11.1 -1 250
+ 0.408238 7 6 rtProtoDV 12 ------- 0 7.1 6.2 -1 255
- 0.408238 7 6 rtProtoDV 12 ------- 0 7.1 6.2 -1 255
r 0.409674 5 11 rtProtoDV 12 ------- 0 5.2 11.1 -1 250
+ 0.418162 11 5 rtProtoDV 12 ------- 0 11.1 5.2 -1 262
- 0.418162 11 5 rtProtoDV 12 ------- 0 11.1 5.2 -1 262
+ 0.418162 11 9 rtProtoDV 12 ------- 0 11.1 9.1 -1 263
- 0.418162 11 9 rtProtoDV 12 ------- 0 11.1 9.1 -1 263
+ 0.418162 11 10 rtProtoDV 12 ------- 0 11.1 10.1 -1 264
- 0.418162 11 10 rtProtoDV 12 ------- 0 11.1 10.1 -1 264
r 0.418334 7 6 rtProtoDV 12 ------- 0 7.1 6.2 -1 255
r 0.428258 11 5 rtProtoDV 12 ------- 0 11.1 5.2 -1 262
r 0.428258 11 9 rtProtoDV 12 ------- 0 11.1 9.1 -1 263
r 0.428258 11 10 rtProtoDV 12 ------- 0 11.1 10.1 -1 264
v 1 link-down 5 11
v 1 link-down 11 5
v 1 link-down 6 7
v 1 link-down 7 6
+ 1 11 9 rtProtoDV 12 ------- 0 11.1 9.1 -1 575
- 1 11 9 rtProtoDV 12 ------- 0 11.1 9.1 -1 575
+ 1 11 10 rtProtoDV 12 ------- 0 11.1 10.1 -1 576
- 1 11 10 rtProtoDV 12 ------- 0 11.1 10.1 -1 576
r 1.010096 11 9 rtProtoDV 12 ------- 0 11.1 9.1 -1 575
```

b) Link State Routing

Code:

```
set ns [new Simulator]

$ns color 1 red
$ns color 2 blue

set n0 [$ns node]
set n1 [$ns node]
set n2 [$ns node]
set n3 [$ns node]
set n4 [$ns node]
set n5 [$ns node]
set n6 [$ns node]
set n7 [$ns node]
set n8 [$ns node]
```

```
set n9 [$ns node]
set n10 [$ns node]
set n11 [$ns node]

set nr [open out.tr w]
$ns trace-all $nr
set nf [open out.nam w]
$ns namtrace-all $nf

proc finish { } {
global ns nr nf
$ns flush-trace
close $nf
close $nr
exec nam out.nam &
exit 0
}

$ns duplex-link $n0 $n1 1Mb 10ms DropTail
$ns duplex-link $n1 $n2 1Mb 10ms DropTail
$ns duplex-link $n2 $n3 1Mb 10ms DropTail
$ns duplex-link $n3 $n4 1Mb 10ms DropTail
$ns duplex-link $n4 $n5 1Mb 10ms DropTail
$ns duplex-link $n5 $n6 1Mb 10ms DropTail
$ns duplex-link $n6 $n7 1Mb 10ms DropTail
$ns duplex-link $n7 $n8 1Mb 10ms DropTail

$ns duplex-link $n0 $n8 1Mb 10ms DropTail
$ns duplex-link $n1 $n10 1Mb 10ms DropTail
$ns duplex-link $n0 $n9 1Mb 10ms DropTail
$ns duplex-link $n9 $n11 1Mb 10ms DropTail
$ns duplex-link $n10 $n11 1Mb 10ms DropTail
$ns duplex-link $n11 $n5 1Mb 10ms DropTail


$ns duplex-link-op $n0 $n1 orient right
$ns duplex-link-op $n1 $n2 orient down
$ns duplex-link-op $n2 $n3 orient down
$ns duplex-link-op $n3 $n4 orient left
$ns duplex-link-op $n4 $n5 orient left
$ns duplex-link-op $n5 $n6 orient left
```

```
$ns duplex-link-op $n6 $n7 orient left
$ns duplex-link-op $n7 $n8 orient up
$ns duplex-link-op $n8 $n0 orient up
$ns duplex-link-op $n5 $n11 orient up
$ns duplex-link-op $n0 $n9 orient right-down
$ns duplex-link-op $n9 $n11 orient right
$ns duplex-link-op $n11 $n10 orient right
$ns duplex-link-op $n1 $n10 orient left-down

set udp0 [new Agent/UDP]
$ns attach-agent $n0 $udp0
$udp0 set fid_ 1

set cbr0 [new Application/Traffic/CBR]
$cbr0 set packetSize_ 1000
$cbr0 set rate_ 0.10mb
$cbr0 set random_ true
$cbr0 attach-agent $udp0

set null0 [new Agent/Null]
$ns attach-agent $n5 $null0
$ns connect $udp0 $null0

set udp1 [new Agent/UDP]
$ns attach-agent $n1 $udp1
$udp1 set fid_ 2

set cbr1 [new Application/Traffic/CBR]
$cbr1 set packetSize_ 1000
$cbr1 set rate_ 0.10mb
$cbr1 set random_ true
$cbr1 attach-agent $udp1

set null1 [new Agent/Null]
$ns attach-agent $n5 $null1
$ns connect $udp1 $null1

$ns rtproto LS
$ns rtmodel-at 3.0 down $n11 $n5
$ns rtmodel-at 2.0 down $n7 $n6
$ns rtmodel-at 4.0 up $n11 $n5
```
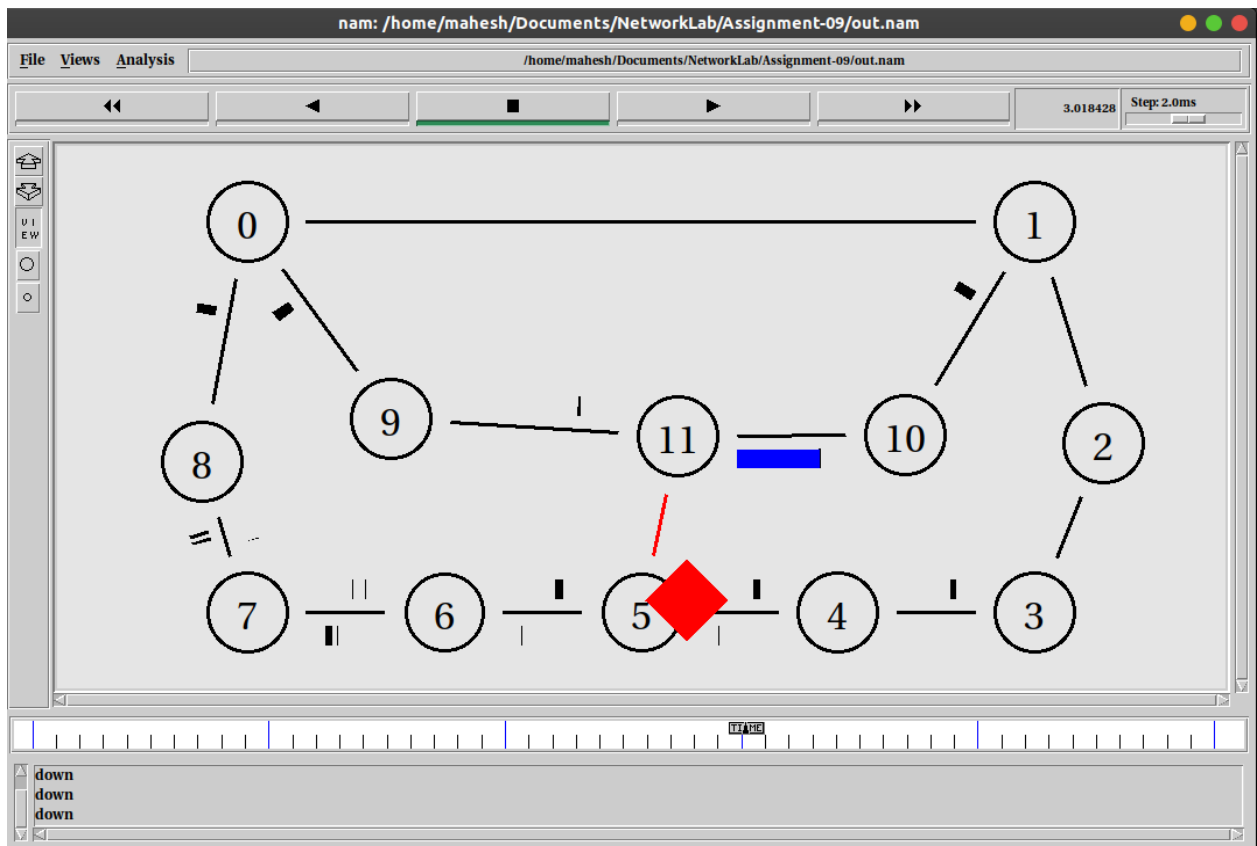
$ns rtmodel-at 3.0 up $n7 $n6
$ns at 0.0 "$cbr0 start"
$ns at 0.75 "$cbr1 start"
$ns at 5.0 "finish"
$ns run

Screenshots:

Trace file:

```
+ 0.00017 0 8 rtProtoLS 100 ------- 0 0.2 8.1 -1 2
- 0.00017 0 8 rtProtoLS 100 ------- 0 0.2 8.1 -1 2
+ 0.00017 0 9 rtProtoLS 100 ------- 0 0.2 9.1 -1 3
- 0.00017 0 9 rtProtoLS 100 ------- 0 0.2 9.1 -1 3
r 0.01097 0 8 rtProtoLS 100 ------- 0 0.2 8.1 -1 2
+ 0.01097 8 0 rtProtoLS 20 ------- 0 8.1 0.2 -1 8
- 0.01097 8 0 rtProtoLS 20 ------- 0 8.1 0.2 -1 8
r 0.01097 0 9 rtProtoLS 100 ------- 0 0.2 9.1 -1 3
+ 0.01097 9 0 rtProtoLS 20 ------- 0 9.1 0.2 -1 9
- 0.01097 9 0 rtProtoLS 20 ------- 0 9.1 0.2 -1 9
+ 0.01097 9 11 rtProtoLS 100 ------- 0 9.1 11.1 -1 10
- 0.01097 9 11 rtProtoLS 100 ------- 0 9.1 11.1 -1 10
r 0.02113 8 0 rtProtoLS 20 ------- 0 8.1 0.2 -1 8
r 0.02113 9 0 rtProtoLS 20 ------- 0 9.1 0.2 -1 9
r 0.02177 9 11 rtProtoLS 100 ------- 0 9.1 11.1 -1 10
+ 0.02177 11 9 rtProtoLS 20 ------- 0 11.1 9.1 -1 17
- 0.02177 11 9 rtProtoLS 20 ------- 0 11.1 9.1 -1 17
+ 0.02177 11 5 rtProtoLS 100 ------- 0 11.1 5.2 -1 18
- 0.02177 11 5 rtProtoLS 100 ------- 0 11.1 5.2 -1 18
+ 0.02177 11 10 rtProtoLS 100 ------- 0 11.1 10.1 -1 19
- 0.02177 11 10 rtProtoLS 100 ------- 0 11.1 10.1 -1 19
r 0.03193 11 9 rtProtoLS 20 ------- 0 11.1 9.1 -1 17
r 0.03257 11 5 rtProtoLS 100 ------- 0 11.1 5.2 -1 18
+ 0.03257 5 11 rtProtoLS 20 ------- 0 5.2 11.1 -1 26
- 0.03257 5 11 rtProtoLS 20 ------- 0 5.2 11.1 -1 26
r 0.03257 11 10 rtProtoLS 100 ------- 0 11.1 10.1 -1 19
+ 0.03257 10 11 rtProtoLS 20 ------- 0 10.1 11.1 -1 27
- 0.03257 10 11 rtProtoLS 20 ------- 0 10.1 11.1 -1 27
```

```
r 0.442778 0 8 rtProtoLS 100 ------- 0 0.2 8.1 -1 313
+ 0.442778 8 0 rtProtoLS 20 ------- 0 8.1 0.2 -1 324
- 0.442778 8 0 rtProtoLS 20 ------- 0 8.1 0.2 -1 324
r 0.449922 0 9 rtProtoLS 20 ------- 0 0.2 9.1 -1 319
r 0.449922 1 10 rtProtoLS 20 ------- 0 1.2 10.1 -1 321
r 0.450562 0 8 rtProtoLS 100 ------- 0 0.2 8.1 -1 320
+ 0.450562 8 0 rtProtoLS 20 ------- 0 8.1 0.2 -1 329
- 0.450562 8 0 rtProtoLS 20 ------- 0 8.1 0.2 -1 329
r 0.452938 8 0 rtProtoLS 20 ------- 0 8.1 0.2 -1 324
r 0.460722 8 0 rtProtoLS 20 ------- 0 8.1 0.2 -1 329
v 1 link-down 5 11
v 1 link-down 11 5
v 1 link-down 6 7
v 1 link-down 7 6
+ 1 11 9 rtProtoLS 100 ------- 0 11.1 9.1 -1 622
- 1 11 9 rtProtoLS 100 ------- 0 11.1 9.1 -1 622
+ 1 11 10 rtProtoLS 100 ------- 0 11.1 10.1 -1 623
- 1 11 10 rtProtoLS 100 ------- 0 11.1 10.1 -1 623
r 1.0108 11 9 rtProtoLS 100 ------- 0 11.1 9.1 -1 622
+ 1.0108 9 11 rtProtoLS 20 ------- 0 9.1 11.1 -1 630
- 1.0108 9 11 rtProtoLS 20 ------- 0 9.1 11.1 -1 630
+ 1.0108 9 0 rtProtoLS 100 ------- 0 9.1 0.2 -1 631
- 1.0108 9 0 rtProtoLS 100 ------- 0 9.1 0.2 -1 631
r 1.0108 11 10 rtProtoLS 100 ------- 0 11.1 10.1 -1 623
+ 1.0108 10 11 rtProtoLS 20 ------- 0 10.1 11.1 -1 632
- 1.0108 10 11 rtProtoLS 20 ------- 0 10.1 11.1 -1 632
+ 1.0108 10 1 rtProtoLS 100 ------- 0 10.1 1.2 -1 633
- 1.0108 10 1 rtProtoLS 100 ------- 0 10.1 1.2 -1 633
r 1.02006 9 11 rtProtoLS 20 ------- 0 9.1 11.1 -1 630
```

LEARNING OUTCOMES:

- I learnt to implement distance vector routing protocol and link state routing protocol using ns2.
- I learnt to analyse the simulation.