VISVESVARAYA TECHNOLOGICAL UNIVERSITY
BELGAUM

COMPUTER NETWORK LABORATORY

(18CSL57)

(As per Visvesvaraya Technological University Syllabus)

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[As per Choice Based Credit System (CBCS)scheme]
(Effective from the academic year 2018 -2019)
SEMESTER – V

Subject Code	18CSL57	IA Marks	40
Number of Lecture Hours/Week	01I + 02P	Exam Marks	60
Total Number of Lecture Hours	36	Exam Hours	03

CREDITS – 02

Description (If any):

For the experiments below modify the topology and parameters set for the experiment and take multiple rounds of reading and analyze the results available in log files. Plot necessary graphs and conclude. Use NS2/NS3.
• Installation procedure of the required software must be demonstrated, carried out in groups and documented in the journal

Lab Experiments:

PART A

1. Implement three nodes point – to – point network with duplex links between them. Set thequeue size, vary the bandwidth and find the number of packetsdropped.
2. Implement transmission of ping messages/trace route over a network topology consisting of6 nodes and find the number of packets dropped due tocongestion.
3. Implement an Ethernet LAN using n nodes and set multiple traffic nodes andplot congestionwindow for different source /destination.
4. Implement simple ESS and with transmitting nodes in wire-less LAN by simulation anddetermine the performance with respect to transmission ofpackets.
5. Implement and study the performance of GSM on NS2/NS3 (Using MAC layer)or equivalentenvironment.
6. Implement and study the performance of CDMA on NS2/NS3 (Using stack called Call net)or equivalentenvironment.

PART B

Implement the following in Java:
1. Write a program for error detecting code using CRC-CCITT (16-bits).
2. Write a program to find the shortest path between vertices using bellman-fordalgorithm.
3. Using TCP/IP sockets, write a client – server program to make the client send the file name andto make the server send back the contents of the requested file ifpresent.
4. Writeaprogramondatagramsocketforclient/servertodisplaythemessagesonclientside,typedat the serverside.
5. Write a program for simple RSA algorithm to encrypt and decrypt thedata.
6. Write a program for congestion control using leaky bucketalgorithm.

Course Outcomes: By the end of the course, the student should be able to
CO1: Apply the routing, congestion control algorithms for a set of inputs.
CO2: Demonstrate Inter Process Communication, error detection and encryption technique.
CO 3: Analyse the performance of wired and wireless network for different topologies using simulator.
CO4: Evaluate the performance of GSM and CDMA network using simulator

PART – A

Simulation Exercises

NS2 Basics

NS or The Network Simulator is a discrete event network simulator. NS is popularly used in the simulation of routing and multicast protocols, and is heavily used in ad hoc networking research. NS is an object oriented simulator, written in C++, with an OTcl interpreter as a frontend. The simulator supports class hierarchy in C++ (the compiled hierarchy), and a similar class hierarchy within the OTcl interpreter (the interpreted hierarchy).

Some of the list of simulator commands commonly used in simulation scripts:
To create an instance of the simulator object and working with the instance
set ns[newSimulator] #Creates aninstance
set now[$ns now] #Returns scheduler's notion of currenttime
$nshalt #Stops or pauses thescheduler
$nsrun #Starts thescheduler
$ns at <time><event> #Schedules <event> to execute at specified <time>
$nsflush-trace #Flushes all trace object writebuffers
Creating a node and working withnodes
$nsnode #Create anode
$nodeid #Returns the address of thenode
$nodereset #Reset all agents attached to thenodes
Creating links between thenodes
$ns simplex-link <node 0><node1><bandwidth><delay><queue type>
#Simplex link between node 0 and node 1
$ns duplex-link <node 0><node 1><bandwidth. <delay><queue type>
#Duplex link between node 0 and node 1
$ns simplex-link-op <n1><n2><op><args>
#Set attributes like orientation, color to the link
$ns duplex-link-op <n1><n2><op><args>
#Set attributes like orientation, color to the link
$ns link-lossmodel <lossobj><from><to>
#Generate losses in the link <from> and <to>
$ns lossmodel <classobj><from><to>
#Insert a loss module in regular links
Queue Management
$ns queue-limit <n1><n2><limit>
#Sets a limit to maximum buffer size of the queue
Attaching Agents
$ns attach-agent <node><agent>
#Attaches an agent to the nodes

Simulation Program 1:

Simulate a three point – to – point network with duplex links between them. Set the queue size and vary the bandwidth and find the number of packets dropped.

Step1: Open text editor, type the below program and save with extension .tcl **(prog1.tcl)**

```
set ns [new Simulator]
set f [open 1.tr w]
$ns trace-all $f

set nf [open 1.nam w]
$ns namtrace-all $nf

proc finish {} {
     global f nf ns
     $ns flush-trace
     close $f
     close $nf
     exec nam 1.nam &
    exec echo "The number of packet drops is " &
    exec grep -c "^d" 1.tr &
     exit 0
}

set n0 [$ns node]
set n1 [$ns node]
set n2 [$ns node]

$ns duplex-link $n0 $n1 0.3Mb 10ms DropTail   #vary bandwidth 0.3, 0.4, 0.5 and0.7
$ns duplex-link $n1 $n2 0.3Mb 20ms DropTail   #vary bandwidth 0.3, 0.4, 0.5 and0.7
$ns queue-limit $n1 $n2 10

set udp [newAgent/UDP]
$ns attach-agent $n0$udp
set cbr0 [new Application/Traffic/CBR]
$cbr attach-agent $udp
$cbr set packetSize_ 500
$cbr set interval_ 0.005

set null [new Agent/Null]
$ns attach-agent $n2 $null

$ns connect $udp $null

$ns at 0.1 "$cbrstart"
$ns at 4.5 "$cbrstop"
```

```
$ns at 5.0 "finish"
$ns run
```

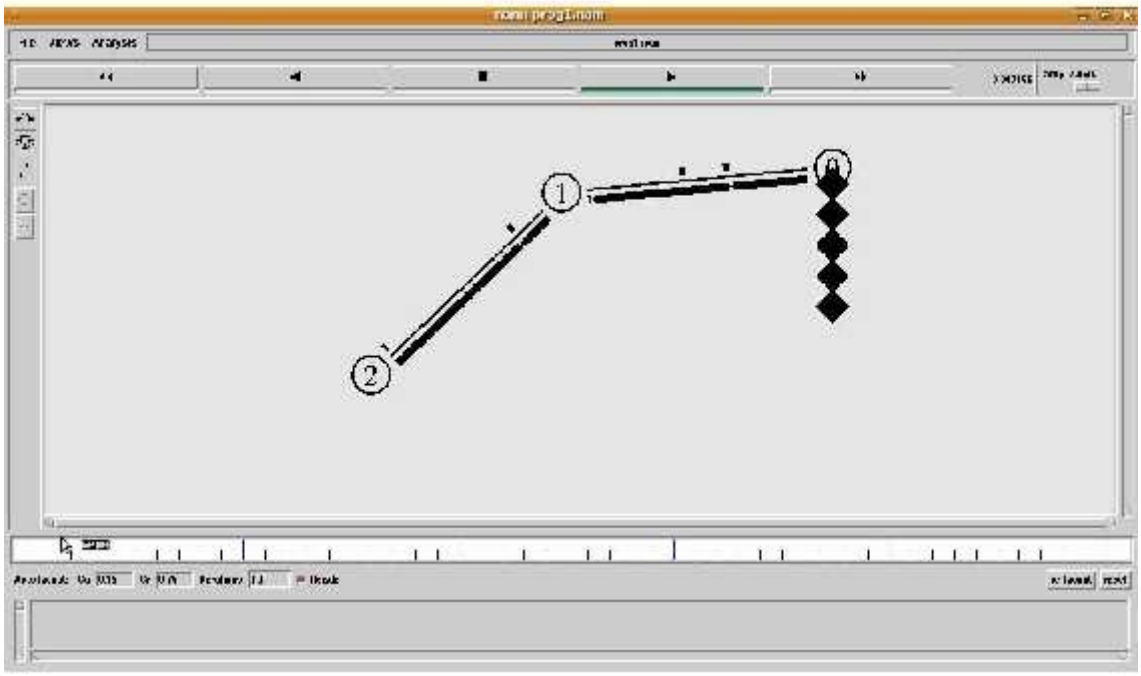
Step2: Open text editor, type the below program and save with extention .awk (**prog1.awk**)

```
BEGIN {
        dcount = 0;
        rcount = 0;
}
{
event = $1;
if(event == "d")
{
        dcount++;
}
if(event == "r")
{
        rcount++;
}
}
END {
printf("The no.of packets dropped : %d\n ",dcount);
printf ("The no.of packets recieved: %d\n ",rcount);
}
```

Step3: Run the simulation program

[root@localhost~]# ns prog1.tcl

(Here **"ns"** indicates network simulator. We get the topology shown in the snapshot.)



Step 4: Now press the play button in the simulation window and the simulation will begins.

Step 5: After simulation is completed run **awk file** to see the output ,

[root@localhost~]# awk –f prog1.awk prog1.tr

Number of packets dropped = 16

Step 6: To see the trace file contents open the file as ,

[root@localhost~]# vi prog1.tr

Simulation Program 2:

Implement transmission of ping messages/trace route over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion.

Step1: Open text editor, type the below program and save with extension .tcl (**prog2.tcl**)

```
set ns [new Simulator]
set f [open 2.tr w]
$ns trace-all $f
set nf [open 2.nam w]
$ns namtrace-all $nf

$ns color 1 Blue
$ns color 2Red

proc finish {}{
        global ns f nf
        $ns flush-trace
        close $f
        close $nf
        exec nam 2.nam &
        puts "The number of ping packets dropped are "
        exec grep "^d" 2.tr | cut -d " " -f 5 | grep -c "ping" &
        exit 0
}
set n0 [$ns node]
set n1 [$ns node]
set n2 [$ns node]
set n3 [$ns node]
set n4 [$ns node]
set n5 [$ns node]

$ns duplex-link  $n0 $n2 1Mb 10msDropTail
$ns duplex-link  $n1 $n2 1Mb 10msDropTail
$ns duplex-link $n2 $n3 0.5Mb 30ms DropTail
$ns duplex-link  $n3 $n4 1Mb 10msDropTail
$ns duplex-link  $n3 $n5 1Mb 10msDropTail

set ping0 [new Agent/Ping]
$ping0 set class_ 1
$ns attach-agent $n0 $ping0

set ping4 [new Agent/Ping]
$ping4 set class_ 2
$ns attach-agent $n4 $ping4
$ns connect $ping0$ping4

proc sendPingPacket {} {
        global ns ping0ping4
```

```
#change interval time 0.00125, 0.00150, 0.00175, 0.002
        set intervalTime 0.001
        set now [$ns now]
        $ns at [expr $now + $intervalTime] "$ping0send"
        $ns at [expr $now + $intervalTime] "$ping4send"
        $ns at [expr $now + $intervalTime] "sendPingPacket"
}

Agent/Ping instproc recv {from rtt} {
        $self instvar node_
        puts "The node [$node_ id] received an ping ACK from the node from $from
 with Round-Trip-Time $rtt ms"
}

$ns at 0.01 "sendPingPacket"
$ns at 10.0 "finish"
$ns run
```

Step2: Open text editor, type the below program and save with extention .awk (**prog2.awk**)

```
BEGIN {
count=0;
}
{
event=$1;
if(event=="d")
{
count++;
}
}
END {
printf("No of packets dropped: %d\n",count);
}
```

Step3: Run the simulation program

[root@localhost~]# ns prog2.tcl

(Here **"ns"** indicates network simulator. We get the topology shown in the snapshot.)

Step 4: Now press the play button in the simulation window and the simulation will begins

Simulation Program 3:

Implement an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source / destination.

Step1: Open text editor, type the below program and save with extension .tcl (**prog3.tcl**)

```
set ns [new Simulator]
set f [open 3.tr w]
$ns trace-all $f

set nf [open 3.nam w]
$ns namtrace-all $nf

$ns color 1 Blue
$ns color 2Red

proc finish {}{
        global ns f nf outFile1 outFile2
        $ns flush-trace
         close $f
        close $nf
        exec nam 3.nam &
        exec xgraph Congestion1.xg -geometry 400x400 &
        exec xgraph Congestion2.xg -geometry 400x400 &
        exit 0
}

set n0 [$ns node]
set n1 [$ns node]
set n2 [$ns node]
set n3 [$ns node]
set n4 [$ns node]
set n5 [$ns node]

$ns duplex-link $n0 $n2 2Mb 10msDropTail
$ns duplex-link $n1 $n2 2Mb 10msDropTail
$ns duplex-link $n2 $n3 0.6Mb 100ms DropTail

$ns duplex-link-op $n0 $n2 orient right-down
$ns duplex-link-op $n1 $n2 orient right-up
$ns duplex-link-op $n2 $n3 orient right

$ns make-lan "$n3 $n4 $n5" 10Mb 30ms LL Queue/DropTail Mac/802_3

set tcp1 [new Agent/TCP]
$ns attach-agent $n0 $tcp1
$tcp1 set fid_ 1
set ftp1 [new Application/FTP]
```

```
$ftp1 attach-agent $tcp1
set sink1 [new Agent/TCPSink]
$ns attach-agent $n4 $sink1
$ftp1 set maxPkts_ 1000
$ns connect $tcp1 $sink1

set tcp2 [new Agent/TCP]
$ns attach-agent $n1 $tcp2
$tcp2 set fid_ 1
set ftp2 [new Application/FTP]
$ftp2 attach-agent $tcp2
set sink2 [new Agent/TCPSink]
$ns attach-agent $n5 $sink2
$ftp2 set maxPkts_ 1000
$ns connect $tcp2 $sink2

set outFile1 [open Congestion1.xg w]
set outFile2 [open Congestion2.xg w]

proc findWindowSize {tcpSource outFile} {
        global ns
        set now [$ns now]
        set cWindSize [$tcpSource set cwnd_]
        puts $outFile "$now $cWindSize"
        $ns at [expr $now + 0.1] "findWindowSize $tcpSource $outFile"
}

$ns at 0.0 "findWindowSize $tcp1$outFile1"
$ns at 0.1 "findWindowSize $tcp2$outFile2"
$ns at 0.3 "$ftp1start"
$ns at 0.5 "$ftp2start"
$ns at 50.0 "$ftp1stop"
$ns at 50.0 "$ftp2stop"
$ns at 50.0 "finish"
$ns run
```

Step2: Open text editor, type the below program and save with extension .awk (**prog3.awk**)

```
BEGIN {
}
{
if($6=="cwnd_") {
printf("%f\t%f\n",$1,$7);
}
}
END {
}
```

Step3: Run the simulation program

[root@localhost~]# ns prog3.tcl

(Here **"ns"** indicates network simulator. We get the topology shown in the snapshot.)

Step 4: Now press the play button in the simulation window and the simulation will begin.

Step 5: After simulation is completed run **awk file** and generate the graph ,

[root@localhost~]# awk –f prog3.awk cwnd.tr > a1

[root@localhost~]# awk –f prog3.awk cwnd2.tr > a2

[root@localhost~]#xgraph a1 a2

Step 6: To see the trace file contents open the file as ,

[root@localhost~]# vi prog3.tr

Simulation Program 4:

Implement simple ESS and with transmitting nodes in wire-less LAN by simulation and determine the performance with respect to transmission of packets.

Step1: Open text editor, type the below program and save with extension .tcl (**prog4.tcl**)

```
if {$argc != 1} {
        error "Command: ns <ScriptName.tcl><Number_of_Nodes>"
        exit 0
}

#Define the simulation options
setval(chan)         Channel/WirelessChannel
setval(prop)
                     Propagation/TwoRayGround
setval(ant)          Antenna/OmniAntenna
setval(ll)           LL
setval(ifq)          Queue/DropTail/PriQueue
setval(ifqlen)       50
setval(netif)        Phy/WirelessPhy
setval(mac)          Mac/802_11
setval(rp)           AODV
setval(nn)           [lindex $argv 0]
setopt(x)           750
setopt(y)            750
setval(stop)         100

set ns [new Simulator]
set trfd [open 4.tr w]
set namfd [open 4.nam w]
$ns trace-all $trfd
$ns namtrace-all-wireless $namfd $opt(x) $opt(y)
set topo [new Topography]
$topo load_flatgrid $opt(x) $opt(y)
set god_ [create-god $val(nn)]

proc stop {} {
        global ns trfd namfd
        close $trfd
        close $namfd
        exec nam 4.nam &
#Calculate throughput = (number of packets received/time taken for simulation)
    set datasize1 1060
    set num1 [exec grep "^r" 6.tr | grep "_3_" | grep -c "AGT"]
    set time1100
    puts "The throughput from n1 to n3 is "
    puts "[expr ($datasize1*$num1)/$time1] bytes per second"
```

```
exit 0
```

```
}

$ns node-config -adhocRouting $val(rp) \
            -llType $val(ll) \
            -macType $val(mac) \
            -ifqType $val(ifq) \
            -channelType $val(chan) \
            -propType $val(prop) \
            -antType $val(ant) \
            -ifqLen $val(ifqlen) \
            -phyType $val(netif) \
            -topoInstance $topo \
            -agentTrace ON \
            -routerTrace ON \
            -macTrace OFF \
             -movementTrace OFF

for {set i 0} {$i < $val(nn)} {incr i} {
      set n($i) [$ns node]
}

for {set i 0} {$i < $val(nn)} {incr i}{
      set XX [exprrand()*750]
      set YY [exprrand()*750]
      $n($i) set X_$XX
      $n($i) set Y_$YY
}

for {set i 0} {$i < $val(nn)} {incr i} {
      $ns initial_node_pos $n($i) 30
}

set tcp1 [new Agent/TCP]
$ns attach-agent $n(1) $tcp1
set ftp1 [newApplication/FTP]
$ftp1 attach-agent $tcp1
set sink1 [new Agent/TCPSink]
$ns attach-agent $n(3) $sink1
$ns connect $tcp1 $sink1
$ns at 0.0 "destination"
proc destination {} {
      global ns val n
      set now [$ns now]
      set time 5.0
      for {set i 0} {$i < $val(nn)} {incr i}{
            set XX [exprrand()*750]
            set YY [exprrand()*750]
            $ns at [expr $now + $time] "$n($i) setdest $XX $YY 20.0"
      }
      $ns at [expr $now + $time] "destination"
```

```
}


for {set i 0} {$i < $val(nn)} {incr i} {
      $ns at $val(stop) "$n($i) reset"
}

$ns at 5.0 "$ftp1 start"
$ns at $val(stop) "$ns nam-end-wireless $val(stop)"
$ns at $val(stop) "stop"
$ns run
```

Step2: Open text editor, type the below program and save with extension .awk (**prog4.awk**)

```
BEGIN {
        count1=0
        count2=0
        pack1=0
        pack2=0
        time1=0
        time2=0
}
{if($1=="r"&& $3=="_1_" && $4=="AGT")
        {count1++
                pack1=pack1+$8
                time1=$2        }
        if($1=="r" && $3=="_2_" && $4=="AGT")
        {count2++
                pack2=pack2+$8
                time2=$2}
}
END{
printf("The Throughput from n0 to n1: %f Mbps \n", ((count1*pack1*8)/(time1*1000000)));
printf("The Throughput from n1 to n2: %f Mbps", ((count2*pack2*8)/(time2*1000000)));
}
```

Step3: Run the simulation program

[root@localhost~]# ns prog4.tcl

(Here **"ns"** indicates network simulator. We get the topology shown in the snapshot.)

Step 4: Now press the play button in the simulation window and the simulation will begins.

Step 5: After simulation is completed run **awk file** to see the output ,

[root@localhost~]# awk –f prog4.awk prog4.tr

Step 6: To see the trace file contents open the file as ,

[root@localhost~]# vi prog2.tr

Simulation Program 5:

Implement and study the performance of GSM on NS2/NS3 (Using MAC layer) or equivalent environment.

```
# General Parameters
setstop100      ;# Stoptime.

# Topology
settypegsm      ;#type oflink:

# AQM parameters
set minth 30
set maxth 0
set adaptive 1 ;# 1 for Adaptive RED, 0 for plain RED

# Traffic generation.
setflows0       ;# number of long-lived TCP flows
set window 30 ;# window for long-livedtraffic

# Plotting statistics.
set opt(wrap) 100 ;# wrap plots?
set opt(srcTrace) is ;# where to plot traffic
set opt(dstTrace) bs2 ;# where to plot traffic


#default downlink bandwidth in bps
set bwDL(gsm)9600

#default downlink propagation delay in seconds
set propDL(gsm).500


set ns [new Simulator]

set tf [open out.tr w]
$ns trace-all $tf

set nodes(is) [$ns node]
set nodes(ms) [$ns node]
set nodes(bs1) [$ns node]
set nodes(bs2) [$ns node]
set nodes(lp) [$ns node]


proc cell_topo {} {
  global ns nodes
  $ns duplex-link $nodes(lp) $nodes(bs1) 3Mbps 10ms DropTail
  $ns duplex-link $nodes(bs1) $nodes(ms) 1 1 RED
```

```
  $ns duplex-link $nodes(ms) $nodes(bs2) 1 1 RED
  $ns duplex-link $nodes(bs2) $nodes(is) 3Mbps 50ms DropTail
  puts "GSM Cell Topology"
}

proc set_link_params {t} {
  global ns nodes bwDL propDL
  $ns bandwidth $nodes(bs1) $nodes(ms) $bwDL($t)duplex
  $ns bandwidth $nodes(bs2) $nodes(ms) $bwDL($t)duplex

  $ns delay $nodes(bs1) $nodes(ms) $propDL($t)duplex
  $ns delay $nodes(bs2) $nodes(ms) $propDL($t)duplex

  $ns queue-limit $nodes(bs1) $nodes(ms)10
  $ns queue-limit $nodes(bs2) $nodes(ms)10
}

# RED and TCP parameters
Queue/RED set adaptive_ $adaptive
Queue/RED set thresh_ $minth
Queue/RED set maxthresh_ $maxth
Agent/TCP set window_ $window


source web.tcl

#Create topology
switch $type {
gsm -
 cdma {cell_topo}
 }
  set_link_params $type
  $ns insert-delayer $nodes(ms) $nodes(bs1) [newDelayer]
  $ns insert-delayer $nodes(ms) $nodes(bs2) [newDelayer]

# Set up forward TCP connection
if {$flows == 0} {
        set tcp1 [$ns create-connection TCP/Sack1 $nodes(is) TCPSink/Sack1 $nodes(lp) 0]
        set ftp1 [[set tcp1] attach-app FTP]
        $ns at 0.8 "[set ftp1] start"
}



proc stop {} {
        global nodes opt tf
        set wrap $opt(wrap)
        set sid [$nodes($opt(srcTrace)) id]
        set did [$nodes($opt(dstTrace)) id]
```

```
        set a "out.tr"

        set GETRC "../../../bin/getrc"
    set RAW2XG "../../../bin/raw2xg"

    exec $GETRC -s $sid -d $did -f 0 out.tr |\
      $RAW2XG -s 0.01 -m $wrap -r >plot.xgr
    exec $GETRC -s $did -d $sid -f 0 out.tr |\
      $RAW2XG -a -s 0.01 -m $wrap >> plot.xgr

        exec xgraph -x time -y packets plot.xgr &

        exit 0
}
$ns at $stop "stop"
$ns run
```

Simulation Program 6:

Implement and study the performance of CDMA on NS2/NS3 (Using stack called Call net) or equivalent environment.

```
# General Parameters
setstop100       ;# Stoptime.

# Topology
set type cdma ;#type of link


# AQM parameters
set minth 30
set maxth 0
set adaptive 1 ;# 1 for Adaptive RED, 0 for plain RED


# Traffic generation.
set flows 0 ;# number of long-lived TCP flows
set window 30 ;# window for long-lived traffic

# Plotting statics.
set opt(wrap) 100 ;# wrap plots?
set opt(srcTrace) is ;# where to plot traffic
set opt(dstTrace) bs2 ;# where to plot traffic

#default downlink bandwidth in bps
set bwDL(cdma) 384000


#default downlink propagation delay in seconds
set propDL(cdma) .150


set ns [new Simulator]

set tf [open out.tr w]
$ns trace-all $tf

set nodes(is) [$ns node]
set nodes(ms) [$ns node]
set nodes(bs1) [$ns node]
set nodes(bs2) [$ns node]
set nodes(lp) [$ns node]

proc cell_topo {} {
global ns nodes
$ns duplex-link $nodes(lp) $nodes(bs1) 3Mbps 10ms DropTail
```

```
$ns duplex-link $nodes(bs1) $nodes(ms) 1 1RED

$ns duplex-link $nodes(ms) $nodes(bs2) 1 1RED
$ns duplex-link $nodes(bs2) $nodes(is) 3Mbps 50ms DropTail
puts " cdma Cell Topology"
}

proc set_link_para {t} {
global ns nodes bwDL propDL
$ns bandwidth $nodes(bs1) $nodes(ms) $bwDL($t)duplex
$ns bandwidth $nodes(bs2) $nodes(ms) $bwDL($t)duplex

$ns delay $nodes(bs1) $nodes(ms) $propDL($t)duplex
$ns delay $nodes(bs2) $nodes(ms) $propDL($t)duplex

$ns queue-limit $nodes(bs1) $nodes(ms)20
$ns queue-limit $nodes(bs2) $nodes(ms)20
}

# RED and TCP parameters
Queue/RED set adaptive_ $adaptive
Queue/RED set thresh_ $minth
Queue/RED set maxthresh_ $maxth
Agent/TCP set window_ $window

source web.tcl

#Create topology
switch $type {
cdma {cell_topo}
}


set_link_para $type
$ns insert-delayer $nodes(ms) $nodes(bs1) [newDelayer]
$ns insert-delayer $nodes(ms) $nodes(bs2) [newDelayer]

# Set up forward TCP connection
if {$flows == 0} {
set tcp1 [$ns create-connection TCP/Sack1 $nodes(is) TCPSink/Sack1 $nodes(lp) 0]
set ftp1 [[set tcp1] attach-app FTP]
$ns at 0.8 "[set ftp1] start"
}

proc stop {} {
global nodes opt tf
set wrap $opt(wrap)
set sid [$nodes($opt(srcTrace)) id]
set did [$nodes($opt(dstTrace)) id]
```

```
set a "out.tr"


set GETRC "../../../bin/getrc"

set RAW2XG "../../../bin/raw2xg"

exec $GETRC -s $sid -d $did -f 0 out.tr |\
$RAW2XG -s 0.01 -m $wrap -r >plot.xgr

exec $GETRC -s $did -d $sid -f 0 out.tr |\
$RAW2XG -a -s 0.01 -m $wrap >> plot.xgr

exec xgraph -x time -y packets plot.xgr &
exit 0
}
$ns at $stop "stop"
$ns run
```

PART – B

Network Programs

Experiment No 1: - CRC

Problem Statement

Write a program for error detecting code using CRC-CCITT (16 bits).

Theory

CRC(Cyclic Redundancy Check) is an error detecting technique used in digital networks and storage devices to detect the accidental changes to raw data. It cannot be used for correcting errors.

If an error is detected in the received message, a 'Negative acknowledgement' is sent to the sender. The sender and the receiver agree upon a fixed polynomial called generator polynomial. The standard agreed generator polynomial is $x_{16}+x_{12}+x_5+x_0$ (any polynomial can be considered, of degree 16).

The CRC does error checking via polynomial division. The generated polynomial g(x) = $x_{16}+x_{12}+x_5+x_0$

16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1

→ 17 bits.

So the g(x) value is 10001000000100001

Algorithm:

1) Given a bit string (message to be sent), append 16 0S to the end of it (the number of 0s is the same as the degree of the generator polynomial) let this string + 0S be called as modified stringB
2) Divide B by agreed on polynomial g(x) and determine the remainder R(x). The16-bit remainder received is called aschecksum.
3) The message string is appended with checksum and sent to thereceiver.
4) At the receiver side, the received message is divided by generator polynomialg(x).
5) If the remainder is 0, the receiver concludes that there is no error occurred otherwise,the receiver concludes an error occurred and requires aretransmission.

Program:

```
import java.util.Scanner;
class crc
{
```

```
public String crc (String dividend, String divisor)
        {
                String str1, div;
int shift;
                shift = dividend.length( ) - divisor.length( );
                while (shift >= 0)
                                {
                //XORing the string



                                }
```

```
dividend =
Integer.toBinaryStrin
g
(Integer.parseInt(div
idend, 2 ) ^
(Integer.parseInt
(divisor, 2) <<
shift));
shift =
dividend.length( ) -
divisor.length( );
 if (dividend.length( ) < 16)
                    {
 while (dividend.length( ) != 16)
                              {
                                        dividend = "0" + dividend;
                              }
                    }
                    System.out.println("Div="+dividend);
 return dividend;
          }
 publicstaticvoid main (String args[ ])
          {
                    String data, checksum, syn, dividend, Received_data;
 int padding;
                    String polynomial = "10001000000100001";
                     Scanner sc = newScanner(System.in);

 //Data to be transmitted from sender side
                    System.out.println("Enter the data to be encrypted\n");
                    data = sc.next( );
                    dividend = data;
                    padding = polynomial.length( ) - 1;


  //Zero padding of data based onpolynomial
                     for(int i=0;i < padding;i++)
                    {
                              dividend += "0";
                    }

                    crc obj = new crc( );
                    checksum = obj.crc(dividend, polynomial);

                    //Generated Codeword
                    data = data + checksum;
                    System.out.println("Sender Checksum="+checksum);
                    System.out.println( "Code word transmitted overnetwork="+data);
```

```
//Data received at the receiver side
                System.out.println("Enter the received codeword\n");
                Received_data = sc.next( );
                syn = obj.crc(Received_data,polynomial);


                //Generated Syn bits after checking checksum
                if(Long.parseLong (syn) == 0)
                System.out.println("No error in data transmission");
                else
                System.out.println("Error in transmission");

        }
}
```

Output:

1. Enter the data to beencrypted
   10111
   Div=0110001011010110
   Sender Checksum=0110001011010110
   Code word transmitted overnetwork=101110110001011010110
   Enter the received codeword

   101110110001011010110
   Div=0000000000000000
   No error in data transmission

2. Enter the data to beencrypted
   10010
   Div=0011001001110011
   Sender Checksum=0011001001110011
   Code word transmitted overnetwork=100100011001001110011
   Enter the received codeword

   100100011001001110010
   Div=0000000000000001
   Error in transmission

Experiment No 2

Bellman-Ford algorithm

Problem Statement

Write a program to find the shortest path between vertices using bellman-ford algorithm.

Theory

Routing algorithm is a part of network layer software which is responsible for deciding which output line an incoming packet should be transmitted on. If the subnet uses datagram internally, this decision must be made anew for every arriving data packet since the best route may have changed since last time. If the subnet uses virtual circuits (connection Oriented), routing decisions are made only when a new established route is being setup.

Routing algorithms can be grouped into two major classes: adaptive and nonadaptive. Nonadaptive algorithms do not base their routing decisions on measurement or estimates of current traffic and topology. Instead, the choice of route to use to get from *I* to *J* (for all *I* and *J*) is compute in advance, offline, and downloaded to the routers when the network ids booted. This procedure is sometime called staticrouting.

Adaptive algorithms, in contrast, change their routing decisions to reflect changes in the topology, and usually the traffic as well. Adaptive algorithms differ in where they get information (e.g., locally, from adjacent routers, or from all routers), when they change the routes (e.g., every ΔT sec, when the load changes, or when the topology changes), and what metric is used for optimization (e.g., distance, number of hops, or estimated transit time).

Two algorithms in particular, distance vector routing and link state routing are the most popular. Distance vector routing algorithms operate by having each router maintain a table (i.e., vector) giving the best known distance to each destination and which line to get there. These tables are updated by exchanging information with the neighbors.

The distance vector routing algorithm uses Bellman-Ford routing algorithm and Ford-Fulkerson algorithm. In distance vector routing, each router maintains a routing table that contains two parts: the preferred out going line to use for that destination, and an estimate of the time or distance to that destination. The metric used might be number of hops, time delay in milliseconds, total number of packets queued along the path, or somethingsimilar.

The Routing tables are shared among the neighbors, and the tables at the router are updated, such that the router will know the shortest path to the destination.

Program:

```
importjava.io.*;
importjava.util.Scanner;
classdist_vec
{
        publicstaticvoid main(String args[])
        {
                intdmat[][];
                intdist[][];
                intvia[][];
                int n=0,i=0,j=0,k=0,count=0;
                Scanner in = new Scanner(System.in);
                System.out.println("enter the number of nodes\n");
                n = in.nextInt();
                dmat = newint[n][n];
                dist = newint[n][n];
                via = newint[n][n];
                System.out.println("enter the cost matrix\n");
                for(i=0;i<n;i++)
                for(j=0;j<n;j++)
                {
                        dmat[i][j] = in.nextInt();
                        dmat[i][i]=0;
                        dist[i][j]=dmat[i][j];
                        via[i][j]=j;
                }
                do
                {
                        count=0;
                        for(i=0;i<n;i++)
                        for(j=0;j<n;j++)
                        for(k=0;k<n;k++)
                        if(dist[i][j]>dmat[i][k]+dist[k][j])
                        {
                                dist[i][j]=dist[i][k]+dist[k][j];
                                via[i][j]=k;
                                count++;
                        }
                }
                while(count!=0);
                for(i=0;i<n;i++)
                {
                        System.out.println("state value for router"+i+" is");
                        for(j=0;j<n;j++)
                        {
                                System.out.println("To "+j+" -Via "+via[i][j]+" distance is
"+dist[i][j]);
```

```
}
                }
        }
}
```

Output:

enter the number of nodes

4

enter the cost matrix

0 3 23 999
999 0 2 999
999 999 999 5
999 999 999 999

state value for router0 is
To 0 -Via 0 distance is0
To 1 -Via 1 distance is3
To 2 -Via 1 distance is5
To 3 -Via 2 distance is 10
state value for router1 is
To 0 -Via 0 distance is999
To 1 -Via 1 distance is0
To 2 -Via 2 distance is2
To 3 -Via 2 distance is 7
state value for router2 is
To 0 -Via 0 distance is999
To 1 -Via 1 distance is999
To 2 -Via 2 distance is 0
To 3 -Via 3 distance is 5
state value for router3 is
To 0 -Via 0 distance is999
To 1 -Via 1 distance is999
To 2 -Via 2 distance is999
To 3 -Via 3 distance is 0

Experiment 3

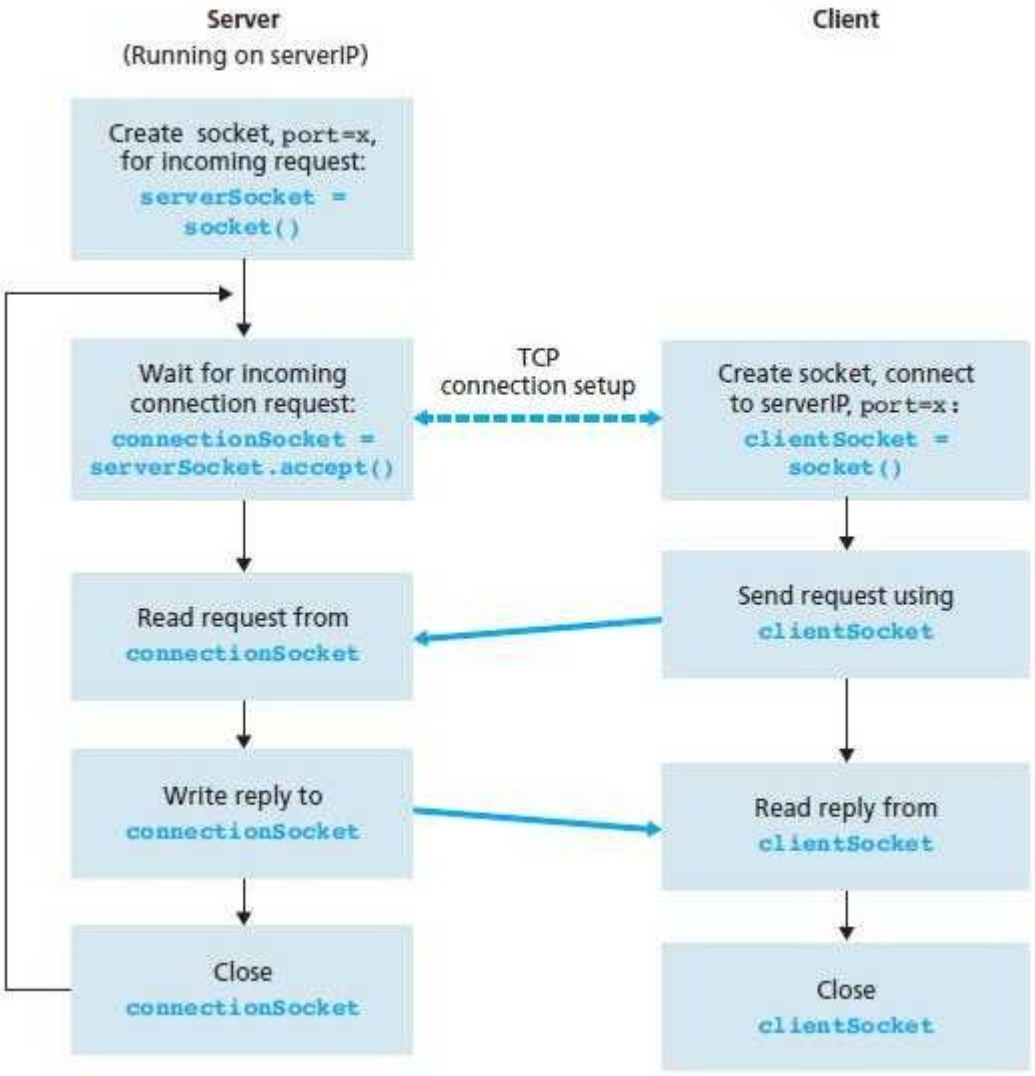
Client-Server Program using TCP/IP sockets

Problem statement:

Using TCP/IP sockets, write a client – server program to make the client send the file name and to make the server send back the contents of the requested file if present.

Theory:

Procedure:



// TCP Server Program

```
import java.net.*;
import  java.io.*;
public class TCPServer
{
        public static void main(String args[]) throws Exception
        {
        ServerSocketsersock=new ServerSocket(4000);
        System.out.println("Server ready for Connection");
        Socket sock=sersock.accept();
        System.out.println("Connection is Successful and waiting for chatting");
        InputStreamistream=sock.getInputStream();
        BufferedReaderfileRead=new BufferedReader(new InputStreamReader(istream));
        String fname=fileRead.readLine();
        BufferedReadercontentRead=new BufferedReader(new FileReader(fname));
        OutputStreamostream=sock.getOutputStream();
        PrintWriterpwrite=new PrintWriter(ostream,true);
        String str;
        while((str=contentRead.readLine())!=null)
        {
                pwrite.println(str);
        }
        sock.close();
        sersock.close();
        pwrite.close();
        fileRead.close();
        contentRead.close();

        }
}
```

// TCP Client Program

```
import java.net.*;
import java.io.*;
public classTCPClient
{
        public static void main(String args[]) throws Exception {
        Socket sock=new Socket("127.0.0.1",4000);
        System.out.println("Enter the filename");
        BufferedReaderkeyRead=new BufferedReader(new InputStreamReader(System.in));
        String fname=keyRead.readLine();
        OutputStreamostream=sock.getOutputStream();
        PrintWriterpwrite=new PrintWriter(ostream,true);
        pwrite.println(fname);
        InputStreamistream=sock.getInputStream();
        BufferedReadersocketRead=new BufferedReader(new InputStreamReader(istream));
```

```
        String str;
        while((str=socketRead.readLine())!=null)
        {
                System.out.println(str);
        }
        pwrite.close();
        socketRead.close();
        keyRead.close();
        }
}
```

Output:

run tcpserver.java program

Server ready for Connection

run tcpclient.java program

Enter the filename
ise.txt

Dept. of ISE (file content)

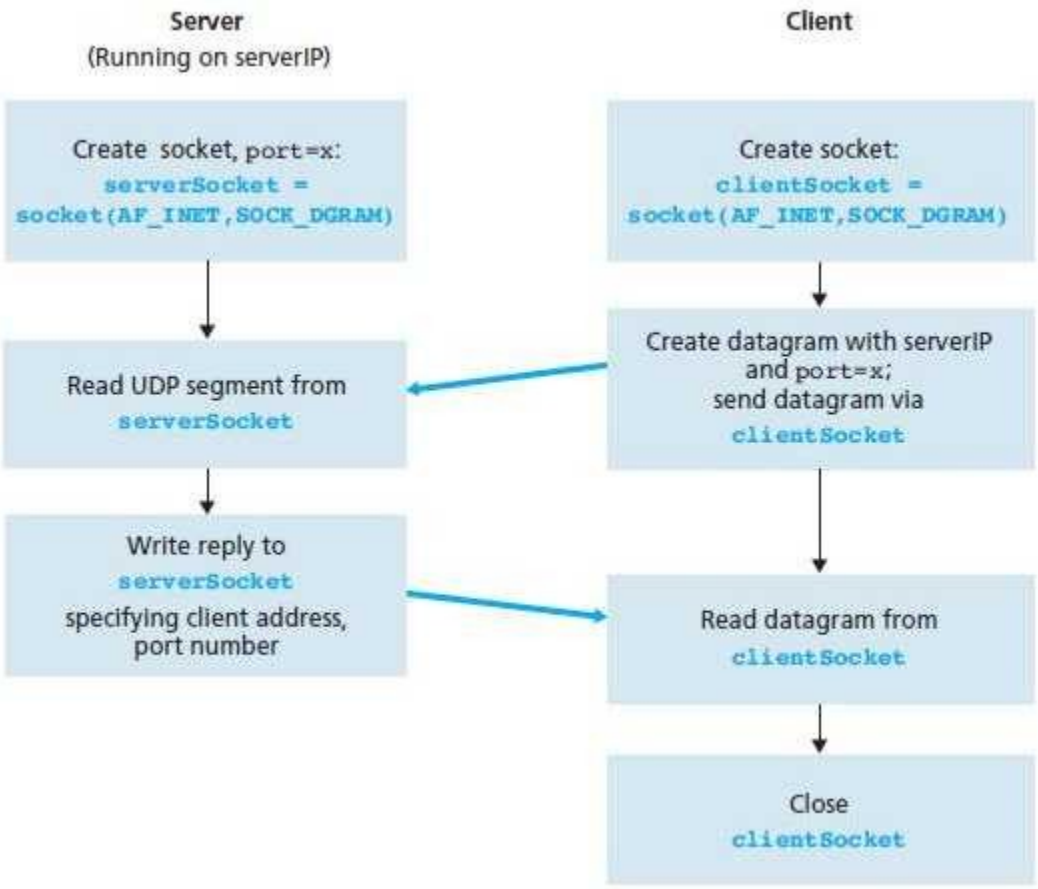
Experiment No 4
Client-Server Program using UDP Socket

Problem Statement

Write a program on datagram socket for client/server to display the messages on client side, typed at the server side.

Theory

Procedure:



//UDP **Server Program**

```
import java.io.*;
import java.net.*;
class UDPServer
{
public static void main(String args[ ]) throws Exception
{
        BufferedReaderinFromUser=new BufferedReader(new InputStreamReader(System.in));
        DatagramSocketserverSocket=new DatagramSocket(11117);
        byte[ ] receiveData=new byte[1024];
        byte[ ] sendData=new byte[1024];
        while(true)
```

```
{
                DatagramPacketreceivePacket=new
                DatagramPacket(receiveData, receiveData.length);
                serverSocket.receive(receivePacket);
                String sentence=new String(receivePacket.getData( ));
                System.out.println("Client Message:"+sentence);
                InetAddressIPAddress=receivePacket.getAddress( );
                int port=receivePacket.getPort( );
                String message=inFromUser.readLine( );
                sendData=message.getBytes( );
                DatagramPacketsendPacket=new DatagramPacket(sendData, sendData.length,
                IPAddress, port);
                serverSocket.send(sendPacket);
        }
}
}
// UDP Client Program
import java.net.*;
classUDPClient
{
public static void main(String args[ ]) throws Exception
{
        DatagramSocketclientSocket=new DatagramSocket( );
        InetAddressIPAddress=InetAddress.getByName("127.0.0.1
        "); byte[] sendData=new byte[1024];
        byte[] receiveData=new byte[1024];
        String sentence= "Hi, I am Client. Send me a message";
        sendData=sentence.getBytes( );
        DatagramPacketsendPacket=new DatagramPacket(sendData,sendData.length, IPAddress,
        11117);
        clientSocket.send(sendPacket);
        DatagramPacketreceivePacket=new DatagramPacket(receiveData, receiveData.length);
        clientSocket.receive(receivePacket);
        String reply=new String(receivePacket.getData( ));
        System.out.println("From Server:" + reply);
        clientSocket.close( );
}
}
```

Output:

run udpserver.java program

run client.java program

Server side: Message from client

Client Message: HI, I am Client. Send me a message

Send message from server

Acharya

Client side: Message from Server

From Server:Acharya_

Acharya

Experiment No 5
RSA Algorithm

Problem Statement

Write a program for simple RSA algorithm to encrypt and decrypt the data.

Theory

Cryptography is the study of creating ciphers(cipher text) and breaking them (cryptanalysis). The message to be encrypted, known as the plaintext, are transformed by a function that is parameterized by a key. The output of the encryption process, known as the ciphertext, is then transmitted. often by messenger or radio. The hacker, or intruder, hears and accurately copies down the complete ciphertext. However, unlike the intended recipient, he does not know the decryption key and so cannot decrypt the ciphertext easily.

There are several ways of classifying cryptographic algorithms. They are generally categorized based on the number of keys that are employed for encryption and decryption, and further defined by their application and use. The three types of algorithms are as follows:

1. Secret Key Cryptography (SKC): Uses a single key for both encryption and decryption. It is also known as symmetriccryptography.
2. Public Key Cryptography (PKC): Uses one key for encryption and another for decryption. It is also known as asymmetriccryptography.
3. Hash Functions: Uses a mathematical transformation to irreversibly "encrypt"information

Public-key cryptography has been said to be the most significant new development in cryptography. Modern PKC was first described publicly by Stanford University professor Martin Hellman and graduate student Whitfield Diffie in 1976. In public key cryptography, one key is used to encrypt the plaintext and the other key is used to decrypt the ciphertext.

In PKC, one of the keys is designated the public key and may be advertised as widely as the owner wants. The other key is designated the private key and is never revealed to another party. It is straight forward to send messages under this scheme. Public key of the receiver is used for encryption, so that only the receiver can decrypt the message (using his privatekey).

The RSA algorithm is named after Ron Rivest, Adi Shamir and Len Adleman, who invented it in 1977. The RSA algorithm can be used for both public key encryption and digitalsignatures.

Algorithm

1. Generate two large random primes, P and Q, of approximately equalsize.
2. Compute $N = P \times Q$
3. Compute $Z = (P-1) \times (Q-1)$.
4. Choose an integer E, $1 < E < Z$, such that GCD $(E, Z) = 1$
5. Compute the secret exponent D, $1 < D < Z$, such that $E \times D \equiv 1 \pmod{Z}$
6. The public key is (N, E) and the private key is (N, D).

Note: The values of P, Q, and Z should also be kept secret.

The message is encrypted using public key and decrypted using private key.

An example of RSA encryption

1. Select primes P=11, Q=3.
2. $N = P$ x Q = 11 x 3 = 33
   $Z = (P\text{-}1)$ x $(Q\text{-}1)$ = 10 x 2 = 20
3. Lets choose E=3
   Check GCD(E, P-1) = GCD(3, 10) = 1 (i.e. 3 and 10 have no common factors except 1),
   and check GCD(E, Q-1) = GCD(3, 2) = 1
   therefore GCD(E, Z) = GCD(3, 20) = 1
4. Compute D such that E x $D \equiv 1$ (mod Z)
   compute $D = E^{-1} \bmod Z = 3^{-1} \bmod 20$
   find a value for D such that Z divides ((E x D)-1)
   find D such that 20 divides 3D-1.
   Simple testing (D = 1, 2, ...) gives D = 7
   Check: (E x D)-1 = 3.7 - 1 = 20, which is divisible by Z.
5. Public key = (N, E) = (33, 3)
   Private key = (N, D) = (33,7).

Now say we want to encrypt the message m = 7,
Cipher code = $M^E \bmod N$
= $7^3 \bmod 33$
= 343 mod 33
= 13.

Hence the ciphertext c = 13.

To check decryption we compute Message' = $C^D \bmod N$
= $13^7 \bmod 33$
= 7.

Note that we don't have to calculate the full value of 13 to the power 7 here. We can make use of the fact that a = bc mod n = (b mod n).(c mod n) mod n so we can break down a potentially large number into its components and combine the results of easier, smaller calculations to calculate the final value.

Program:

```
importjava.util.*;
importjava.math.BigInteger;
importjava.lang.*;

class RSA
{
publicstaticvoid main(String[ ] args)
        {
                Random rand1=new Random(System.currentTimeMillis( ));
                Random rand2=new Random(System.currentTimeMillis( )*10);
                intpubkey=2;
                BigInteger p=BigInteger.probablePrime(32, rand1);
                BigInteger q=BigInteger.probablePrime(32, rand2);
                BigInteger n=p.multiply(q);
                BigInteger p_1=p.subtract(newBigInteger("1"));
                BigInteger q_1=q.subtract(newBigInteger("1"));
                BigInteger z=p_1.multiply(q_1);
```

```
while(true)     {
                BigInteger GCD=z.gcd(newBigInteger(""+pubkey));
                if(GCD.equals(BigInteger.ONE))
                        {
                break;
                        }
                pubkey++;
                }
                BigIntegerbig_pubkey=newBigInteger(""+pubkey);
                BigIntegerprvkey=big_pubkey.modInverse(z);
                System.out.println("public key : "+big_pubkey+","+n);
                System.out.println("private key : "+prvkey+","+n);
//RSA Encryption and Decryption
                Scanner sc = new Scanner(System.in);
                System.out.println("Enter the message to be encrypted");
                String msg = sc.nextLine( );

                byte[] bytes = msg.getBytes();
                for(inti=0;i<msg.length();i++)
                {
                intasciiVal=bytes[i];
                BigIntegerval=newBigInteger(""+asciiVal);
                BigIntegercipherVal=val.modPow(big_pubkey,n);

                        System.out.println("Cipher text: " +cipherVal);
                        BigIntegerplainVal=cipherVal.modPow(prvkey,n);
                        inti_plainVal=plainVal.intValue();
System.out.println("Plain text:"+Character.toString((char)i_plainVal));
                }
        }
}
```

Output:

```
public key : 5,13806019430595312251
private key : 5522407769265360173,13806019430595312251
Enter the message to be encrypted
acharya
Cipher text:8587340257
Plaintext:a
Cipher text:9509900499
Plaintext:c
Cipher text: 12166529024
Plaintext:h
Cipher text: 8587340257
Plaintext:a
Cipher text: 19254145824
Plaintext:r
Cipher text: 25937424601
```

Plaintext:y
Cipher text:8587340257
Plaintext:a

Experiment No 6
Leaky Bucket

Problem Statement

Write a program for congestion control using leaky bucket algorithm.

Theory

The congesting control algorithms are basically divided into two groups: open loop and closed loop. Open loop solutions attempt to solve the problem by good design, in essence, to make sure it does not occur in the first place. Once the system is up and running, midcourse corrections are not made. Open loop algorithms are further divided into ones that act at source versus ones that act at thedestination.

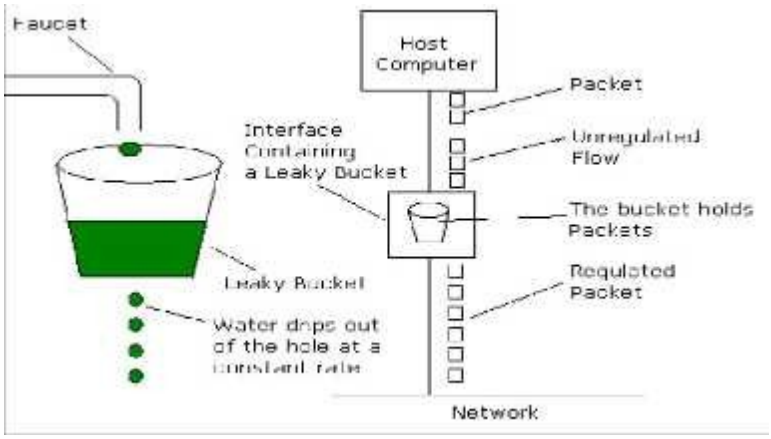
In contrast, closed loop solutions are based on the concept of a feedback loop if there is any congestion. Closed loop algorithms are also divided into two sub categories: explicit feedback and implicit feedback. In explicit feedback algorithms, packets are sent back from the point of congestion to warn the source. In implicit algorithm, the source deduces the existence of congestion by making local observation, such as the time needed for acknowledgment to comeback.

The presence of congestion means that the load is (temporarily) greater than the resources (in part of the system) can handle. For subnets that use virtual circuits internally, these methods can be used at the network layer.

Another open loop method to help manage congestion is forcing the packet to be transmitted at a more predictable rate. This approach to congestion management is widely used in ATM networks and is called **traffic shaping**.

The other method is the leaky bucket algorithm. Each host is connected to the network by an interface containing a leaky bucket, that is, a finite internal queue. If a packet arrives at the queue when it is full, the packet is discarded. In other words, if one or more process are already queued, the new packet is unceremoniously discarded. This arrangement can be built into the hardware interface or simulate d by the host operating system. In fact it is nothing other than a single server queuing system with constant servicetime.

The host is allowed to put one packet per clock tick onto the network. This mechanism turns an uneven flow of packet from the user process inside the host into an even flow of packet onto the network, smoothing out bursts and greatly reducing the chances ofcongestion.



Program

```
importjava.util.*;

classcongestioncontrol
{
publicstaticvoid main(String[ ] args)
        {
int time, output_rate, max_buffer_size, num_of_pkts, count=0, cur_buffer_size=0;
                Scanner in = newScanner(System.in);

System.out.println("Enter the maximum size of buffer");
max_buffer_size = in.nextInt( );

System.out.println("Enter the output rate of packets from the buffer");
output_rate = in.nextInt( );

System.out.println("Enter the number of arriving packets");
num_of_pkts = in.nextInt( );


int[] pkt_size = newint[num_of_pkts];
int[] arr_time_of_pkts =newint[num_of_pkts];


System.out.println("Enter the time of arrival of packets");
for(count=0;count<num_of_pkts;count++)
                {
arr_time_of_pkts[count] = in.nextInt( );
                }


                time=0;
                count=0;


while(count <num_of_pkts)
                {
if(time==arr_time_of_pkts[count])
                        {
                                Random rn = new Random();
pkt_size[count] = (rn.nextInt(10)+1) * 10;
System.out.println("Packet "+(count+1)+" has arrived & its size is:" +pkt_size[count]);
System.out.println("Current Size of buffer:"+cur_buffer_size);
if (cur_buffer_size + pkt_size [count] <max_buffer_size)
                                {


                                        cur_buffer_size += pkt_size[count];
```

```
System.out.println("Packet"+(count+1)+" arriving at "+arr_time_of_pkts[count]+" is
CONFORMING PACKET\n");
                                    }
                                    else
                                    {
System.out.println("Packet "+(count+1)+" arriving at "+arr_time_of_pkts[count]+" is NON
CONFORMING PACKET asit exceeds the buffer limit\n");
                                }
                                    count++;
                            }
                            time++;
                            cur_buffer_size -= output_rate;
                            if(cur_buffer_size< 0)
                            cur_buffer_size=0;
                    }
            }
}
```

Output:

```
Enter the maximum size of buffer
40
Enter the output rate of packets from thebuffer
30
Enter the number of arrivingpackets
5
Enter the time of arrival ofpackets
1
2
2
3
4
Packet 1 has arrived & its size is:30
Current Size of buffer:0
Packet1 arriving at 1 is CONFORMING PACKET

Packet 2 has arrived & its size is:60
Current Size of buffer:0
Packet 2 arriving at 2 is NON CONFORMING PACKET asit exceeds the buffer limit

Packet 3 has arrived & its size is:10
Current Size of buffer:0
Packet3 arriving at 2 is CONFORMING PACKET

Packet 4 has arrived & its size is:70
Current Size of buffer:0
Packet 4 arriving at 3 is NON CONFORMING PACKET asit exceeds the buffer limit

Packet 5 has arrived & its size is:40
Current Size of buffer:0
Packet 5 arriving at 4 is NON CONFORMING PACKET asit exceeds the buffer limit
```

Viva Questions

1) What is aLink?
A link refers to the connectivity between two devices. It includes the type of cables and protocols used in order for one device to be able to communicate with theother.

2) What are the layers of the OSI referencemodel?
There are 7 OSI layers: Physical Layer, Data Link Layer, Network Layer, Transport Layer, Session Layer, Presentation Layer and Application Layer.

3) What is backbonenetwork?
A backbone network is a centralized infrastructure that is designed to distribute different routes and data to various networks. It also handles management of bandwidth and various channels.

4) What is aLAN?
LAN is short for Local Area Network. It refers to the connection between computers and other network devices that are located within a small physical location.

5) What is anode?
A node refers to a point or joint where a connection takes place. It can be computer or device that is part of a network. Two or more nodes are needed in order to form a networkconnection.

6) What arerouters?
Routers can connect two or more network segments. These are intelligent network devices that store information in its routing table such as paths, hops and bottlenecks. With this info, they are able to determine the best path for data transfer. Routers operate at the OSI Network Layer.

7) What is point to pointlink?
It refers to a direct connection between two computers on a network. A point to point connection does not need any other network devices other than connecting a cable to the NIC cards of both computers.

8) What is anonymous FTP?
Anonymous FTP is a way of granting user access to files in public servers. Users that are allowed access to data in these servers do not need to identify themselves, but instead log in as an anonymousguest.

9) What is subnetmask?
A subnet mask is combined with an IP address in order to identify two parts: the extended network address and the host address. Like an IP address, a subnet mask is made up of 32 bits.

10) What is the maximum length allowed for a UTPcable?
A single segment of UTP cable has an allowable length of 90 to 100 meters. This limitation can be overcome by using repeaters and switches.

11) What is dataencapsulation?
Data encapsulation is the process of breaking down information into smaller manageable chunks before it is transmitted across the network. It is also in this process that the source and destination addresses are attached into the headers, along with parity checks.

12) Describe NetworkTopology
Network Topology refers to the layout of a computer network. It shows how devices and cables are physically laid out, as well as how they connect to one another.

13) What isVPN?
VPN means Virtual Private Network, a technology that allows a secure tunnel to be created across a network such as the Internet. For example, VPNs allow you to establish a secure dialup connection to a remoteserver.

14) Briefly describeNAT.
NAT is Network Address Translation. This is a protocol that provides a way for multiple computers on a common network to share single connection to the Internet.

15) What is the job of the Network Layer under the OSI referencemodel?
The Network layer is responsible for data routing, packet switching and control of network congestion. Routers operate under this layer.

16) How does a network topology affect your decision in setting up anetwork?
Network topology dictates what media you must use to interconnect devices. It also serves as basis on what materials, connector and terminations that is applicable for the setup.

17) What isRIP?
RIP, short for Routing Information Protocol is used by routers to send data from one network to another. It efficiently manages routing data by broadcasting its routing table to all other routers within the network. It determines the network distance in units of hops.

18) What are different ways of securing a computernetwork?
There are several ways to do this. Install reliable and updated anti-virus program on all computers. Make sure firewalls are setup and configured properly. User authentication will also help a lot. All of these combined would make a highly securednetwork.

19) What isNIC?
NIC is short for Network Interface Card. This is a peripheral card that is attached to a PC in order to connect to a network. Every NIC has its own MAC address that identifies the PC on the network.

20) What isWAN?

WAN stands for Wide Area Network. It is an interconnection of computers and devices that are geographically dispersed. It connects networks that are located in different regions and countries.

21) What is the importance of the OSI PhysicalLayer?
The physical layer does the conversion from data bits to electrical signal, and vice versa. This is where network devices and cable types are considered and setup.

22) How many layers are there underTCP/IP?
There are four layers: the Network Layer, Internet Layer, Transport Layer and Application Layer.

23) What are proxy servers and how do they protect computernetworks?
Proxy servers primarily prevent external users who identifying the IP addresses of an internal network. Without knowledge of the correct IP address, even the physical location of the network cannot be identified. Proxy servers can make a network virtually invisible to external users.

24) What is the function of the OSI SessionLayer?
This layer provides the protocols and means for two devices on the network to communicate with each other by holding a session. This includes setting up the session, managing information exchange during the session, and tear-down process upon termination of the session.

25) What is the importance of implementing a Fault Tolerance System? Arethere limitations?
A fault tolerance system ensures continuous data availability. This is done by eliminating asingle point of failure. However, this type of system would not be able to protect data in some cases, such as in accidentaldeletions.

26) What does 10Base-Tmean?
The 10 refers to the data transfer rate, in this case is 10Mbps. The word Base refers to base band, as oppose to broad band. T means twisted pair, which is the cable used for that network.

27) What is a private IPaddress?
Private IP addresses are assigned for use on intranets. These addresses are used for internal networks and are not routable on external public networks. These ensures that no conflicts are present among internal networks while at the same time the same range of private IP addresses are reusable for multiple intranets since they do not "see" eachother.

28) What isNOS?
NOS, or Network Operating System, is specialized software whose main task is to provide network connectivity to a computer in order for it to be able to communicate with other computers and connecteddevices.

29) What isDoS?
DoS, or Denial-of-Service attack, is an attempt to prevent users from being able to access the internet or any other network services. Such attacks may come in different forms and are done by a group of perpetuators. One common method of doing this is to overload the system server so it cannot anymore process legitimate traffic and will be forced to reset.

30) What is OSI and what role does it play in computernetworks?
OSI (Open Systems Interconnect) serves as a reference model for data communication. It is made up of 7 layers, with each layer defining a particular aspect on how network devices connect and

communicate with one another. One layer may deal with the physical media used, while another layer dictates how data is actually transmitted across the network.

31) What is the purpose of cables being shielded and having twistedpairs?
The main purpose of this is to prevent crosstalk. Crosstalks are electromagnetic interferences or noise that can affect data being transmitted across cables.

32) What is the advantage of address sharing?
By using address translation instead of routing, address sharing provides an inherent security benefit. That's because host PCs on the Internet can only see the public IP address of the external interface on the computer that provides address translation and not the private IP addresses on the internal network.

33) What are MACaddresses?
MAC, or Media Access Control, uniquely identifies a device on the network. It is also known as physical address or Ethernet address. A MAC address is made up of 6-byte parts.

34) What is the equivalent layer or layers of the TCP/IP Application layer in terms ofOSI reference model?
The TCP/IP Application layer actually has three counterparts on the OSI model: the Session layer, Presentation Layer and Application Layer.

35) How can you identify the IP class of a given IPaddress?
By looking at the first octet of any given IP address, you can identify whether it's Class A, B or C. If the first octet begins with a 0 bit, that address is Class A. If it begins with bits 10 then that address is a Class B address. If it begins with 110, then it's a Class C network.

36) What is the main purpose of OSPF?
OSPF, or Open Shortest Path First, is a link-state routing protocol that uses routing tables to determine the best possible path for data exchange.

37) What are firewalls?
Firewalls serve to protect an internal network from external attacks. These external threats can be hackers who want to steal data or computer viruses that can wipe out data in an instant. It also prevents other users from external networks from gaining access to the private network.

38) Describe star topology
Star topology consists of a central hub that connects to nodes. This is one of the easiest to setup and maintain.

39) What are gateways?
Gateways provide connectivity between two or more network segments. It is usually a computer that runs the gateway software and provides translation services. This translation is a key in allowing different systems to communicate on the network.

40) What is the disadvantage of a star topology?
One major disadvantage of star topology is that once the central hub or switch get damaged, the entire network becomes unusable.

41) What isSLIP?
SLIP, or Serial Line Interface Protocol, is actually an old protocol developed during the early UNIX days. This is one of the protocols that are used for remote access.

42) Give some examples of private networkaddresses.
10.0.0.0 with a subnet mask of 255.0.0.0
172.16.0.0 with subnet mask of 255.240.0.0
192.168.0.0 with subnet mask of 255.255.0.0

43) What is tracert?
Tracert is a Windows utility program that can used to trace the route taken by data from the router to the destination network. It also shows the number of hops taken during the entire transmission route.

44) What are the functions of a network administrator?
A network administrator has many responsibilities that can be summarize into 3 key functions: installation of a network, configuration of network settings, and maintenance/troubleshooting of networks.

45) Describe at one disadvantage of a peer to peer network.
When you are accessing the resources that are shared by one of the workstations on the network, that workstation takes a performance hit.

46) What is Hybrid Network?
A hybrid network is a network setup that makes use of both client-server and peer-to-peer architecture.

47) What is DHCP?
DHCP is short for Dynamic Host Configuration Protocol. Its main task is to automatically assign an IP address to devices across the network. It first checks for the next available address not yet taken by any device, then assigns this to a network device.

48) What is the main job of ARP?
The main task of ARP or Address Resolution Protocol is to map a known IP address to a MAC layer address.

49) What is TCP/IP?
TCP/IP is short for Transmission Control Protocol / Internet Protocol. This is a set of protocol layers that is designed to make data exchange possible on different types of computer networks, also known as heterogeneous network.

50) How can you manage a network using a router?
Routers have built in console that lets you configure different settings, like security and data logging. You can assign restrictions to computers, such as what resources it is allowed access, or what particular time of the day they can browse the internet. You can even put restrictions on what websites are not viewable across the entire network.

51) What protocol can be applied when you want to transfer files between different platforms, such between UNIX systems and Windows servers?
Use FTP (File Transfer Protocol) for file transfers between such different servers. This is possible because FTP is platform independent.

52) What is the use of a defaultgateway?

Default gateways provide means for the local networks to connect to the external network. The default gateway for connecting to the external network is usually the address of the external routerport.

53) One way of securing a network is through the use of passwords. What can be considered as good passwords?

Good passwords are made up of not just letters, but by combining letters and numbers. A password that combines uppercase and lowercase letters is favorable than one that uses all upper case or all lower case letters. Passwords must be not words that can easily be guessed by hackers, such as dates, names, favorites, etc. Longer passwords are also better than short ones.

54) What is the proper termination rate for UTP cables?

The proper termination for unshielded twisted pair network cable is 100 ohms.

55) What is netstat?

Netstat is a command line utility program. It provides useful information about the current TCP/IP settings of a connection.

56) What is the number of network IDs in a Class C network?

For a Class C network, the number of usable Network ID bits is 21. The number of possible network IDs is 2 raised to 21 or 2,097,152. The number of host IDs per network ID is 2 raised to 8 minus 2, or 254.

57) What happens when you use cables longer than the prescribed length?

Cables that are too long would result in signal loss. This means that data transmission and reception would be affected, because the signal degrades overlength.

58) What common software problems can lead to network defects?

Software related problems can be any or a combination of the following:
- client server problems
- application conflicts -
error in configuration
– protocol mismatch
- security issues
- user policy and rights issues

59) What is ICMP?

ICMP is Internet Control Message Protocol. It provides messaging and communication for protocols within the TCP/IP stack. This is also the protocol that manages error messages that are used by network tools such as PING.

60) What is Ping?

Ping is a utility program that allows you to check connectivity between network devices on the network. You can ping a device by using its IP address or device name, such as a computer name.

61) What is peer to peer?

Peer to peer are networks that does not reply on a server. All PCs on this network act as individualworkstations.

62) What is DNS?

DNS is Domain Name System. The main function of this network service is to provide host names to TCP/IP address resolution.

63) What advantages does fiber optics have over other media?
One major advantage of fiber optics is that is it less susceptible to electrical interference. It also supports higher bandwidth, meaning more data can be transmitted and received. Signal degrading is also very minimal over long distances.

64) What is the difference between a hub and a switch?
A hub acts as a multiport repeater. However, as more and more devices connect to it, it would not be able to efficiently manage the volume of traffic that passes through it. A switch provides a better alternative that can improve the performance especially when high traffic volume is expected across all ports.

65) What are the different network protocols that are supported by Windows RRAS services?
There are three main network protocols supported: NetBEUI, TCP/IP, and IPX.

66) What are the maximum networks and hosts in a class A, B and C network?
For Class A, there are 126 possible networks and 16,777,214 hosts
For Class B, there are 16,384 possible networks and 65,534 hosts
For Class C, there are 2,097,152 possible networks and 254 hosts

67) What is the standard color sequence of a straight-through cable?
orange/white, orange, green/white, blue, blue/white, green, brown/white, brown.

68) What protocols fall under the Application layer of the TCP/IP stack?
The following are the protocols under TCP/IP Application layer: FTP, TFTP, Telnet and SMTP.

69) You need to connect two computers for file sharing. Is it possible to do thiswithout using a hub or router?
Yes, you can connect two computers together using only one cable. A crossover type cable can be use in this scenario. In this setup, the data transmit pin of one cable is connected to the data receive pin of the other cable, and vice versa.

70) What is ipconfig?
Ipconfig is a utility program that is commonly used to identify the addresses information of a computer on a network. It can show the physical address as well as the IP address.

71) What is the difference between a straight-through and cross over cable?
A straight-through cable is used to connect computers to a switch, hub or router. A crossover cable is used to connect two similar devices together, such as a PC to PC or Hub to hub.

72) What is client/server?
Client/server is a type of network wherein one or more computers act as servers. Servers provide a centralized repository of resources such as printers and files. Clients refers to workstation that access theserver.

73) Describe networking.
Networking refers to the inter connection between computers and peripherals for data communication.
Networking can be done using wired cabling or through wireless link.

74) When you move the NIC cards from one PC to another PC, does the MAC address gets transferred as well?

Yes, that's because MAC addresses are hard-wired into the NIC circuitry, not the PC. This also means that a PC can have a different MAC address when the NIC card was replace by another one.

75) Explain clustering support

Clustering support refers to the ability of a network operating system to connect multiple servers in a fault-tolerant group. The main purpose of this is the in the event that one server fails, all processing will continue on with the next server in the cluster.

76) In a network that contains two servers and twenty workstations, where is the best place to install an Anti-virus program?

An anti-virus program must be installed on all servers and workstations to ensure protection. That's because individual users can access any workstation and introduce a computer virus when plugging in their removable hard drives or flash drives.

77) Describe Ethernet.

Ethernet is one of the popular networking technologies used these days. It was developed during the early 1970s and is based on specifications as stated in the IEEE. Ethernet is used in local area networks.

78) What are some drawbacks of implementing a ring topology?

In case one workstation on the network suffers a malfunction, it can bring down the entire network. Another drawback is that when there are adjustments and reconfigurations needed to be performed on a particular part of the network, the entire network has to be temporarily brought down as well.

79) What is the difference between CSMA/CD and CSMA/CA?

CSMA/CD, or Collision Detect, retransmits data frames whenever a collision occurred. CSMA/CA, or Collision Avoidance, will first broadcast intent to send prior to data transmission.

80) What is SMTP?

SMTP is short for Simple Mail Transfer Protocol. This protocol deals with all Internal mail, and provides the necessary mail delivery services on the TCP/IP protocol stack.

81) What is multicast routing?

Multicast routing is a targeted form of broadcasting that sends message to a selected group of user, instead of sending it to all users on a subnet.

82) What is the importance of Encryption on a network?

Encryption is the process of translating information into a code that is unreadable by the user. It is then translated back or decrypted back to its normal readable format using a secret key or password. Encryption help ensure that information that is intercepted halfway would remain unreadable because the user has to have the correct password or key forit.

83) How are IP addresses arranged and displayed?

IP addresses are displayed as a series of four decimal numbers that are separated by period or dots. Another term for this arrangement is the dotted decimal format. An example is 192.168.101.2

84) Explain the importance of authentication.

Authentication is the process of verifying a user's credentials before he can log into the network. It is normally performed using a username and password. This provides a secure means of limiting the access from unwanted intruders on the network.

85) What do mean by tunnel mode?

This is a mode of data exchange wherein two communicating computers do not use IPSec themselves. Instead, the gateway that is connecting their LANs to the transit network creates a virtual tunnel that uses the IPSec protocol to secure all communication that passes through it.

86) What are the different technologies involved in establishing WAN links?

Analog connections - using conventional telephone lines; Digital connections - using digital grade telephone lines; switched connections - using multiple sets of links between sender and receiver to move data.

87) What is one advantage of mesh topology?

In the event that one link fails, there will always be another available. Mesh topology is actually one of the most fault-tolerant network topology.

88) When troubleshooting computer network problems, what common hardware-related problems can occur?

A large percentage of a network is made up of hardware. Problems in these areas can range from malfunctioning hard drives, broken NICs and even hardware startups. Incorrectly hardware configuration is also one of those culprits to look into.

89) What can be done to fix signal attenuation problems?

A common way of dealing with such a problem is to use repeaters and hub, because it will help regenerate the signal and therefore prevent signal loss. Checking if cables are properly terminated is also a must.

90) How does dynamic host configuration protocol aid in network administration?

Instead of having to visit each client computer to configure a static IP address, the network administrator can apply dynamic host configuration protocol to create a pool of IP addresses known as scopes that can be dynamically assigned to clients.

91) Explain profile in terms of networking concept?

Profiles are the configuration settings made for each user. A profile may be created that puts a user in a group, for example.

92) What is sneakernet?

Sneakernet is believed to be the earliest form of networking wherein data is physically transported using removable media, such as disk,tapes.

93) What is the role of IEEE in computer networking?

IEEE, or the Institute of Electrical and Electronics Engineers, is an organization composed of engineers that issues and manages standards for electrical and electronic devices. This includes networking devices, network interfaces, cablings and connectors.

94) What protocols fall under the TCP/IP Internet Layer?

There are 4 protocols that are being managed by this layer. These are ICMP, IGMP, IP and ARP.

95) When it comes to networking, what arerights?

Rights refer to the authorized permission to perform specific actions on the network. Each user on the network can be assigned individual rights, depending on what must be allowed for that user.

96) What is one basic requirement for establishing VLANs?

A VLAN requires dedicated equipment on each end of the connection that allows messages entering the Internet to be encrypted, as well as for authenticating users.

97) What isIPv6?

IPv6 , or Internet Protocol version 6, was developed to replace IPv4. At present, IPv4 is being used to control internet traffic, butis expected to get saturated in the near future. IPv6 was designed to overcome this limitation.

98) What is RSA algorithm?

RSA is short for Rivest-Shamir-Adleman algorithm. It is the most commonly used public key encryption algorithm in use today.

99) What is mesh topology?

Mesh topology is a setup wherein each device is connected directly to every other device on the network. Consequently, it requires that each device have at least two network connections.