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

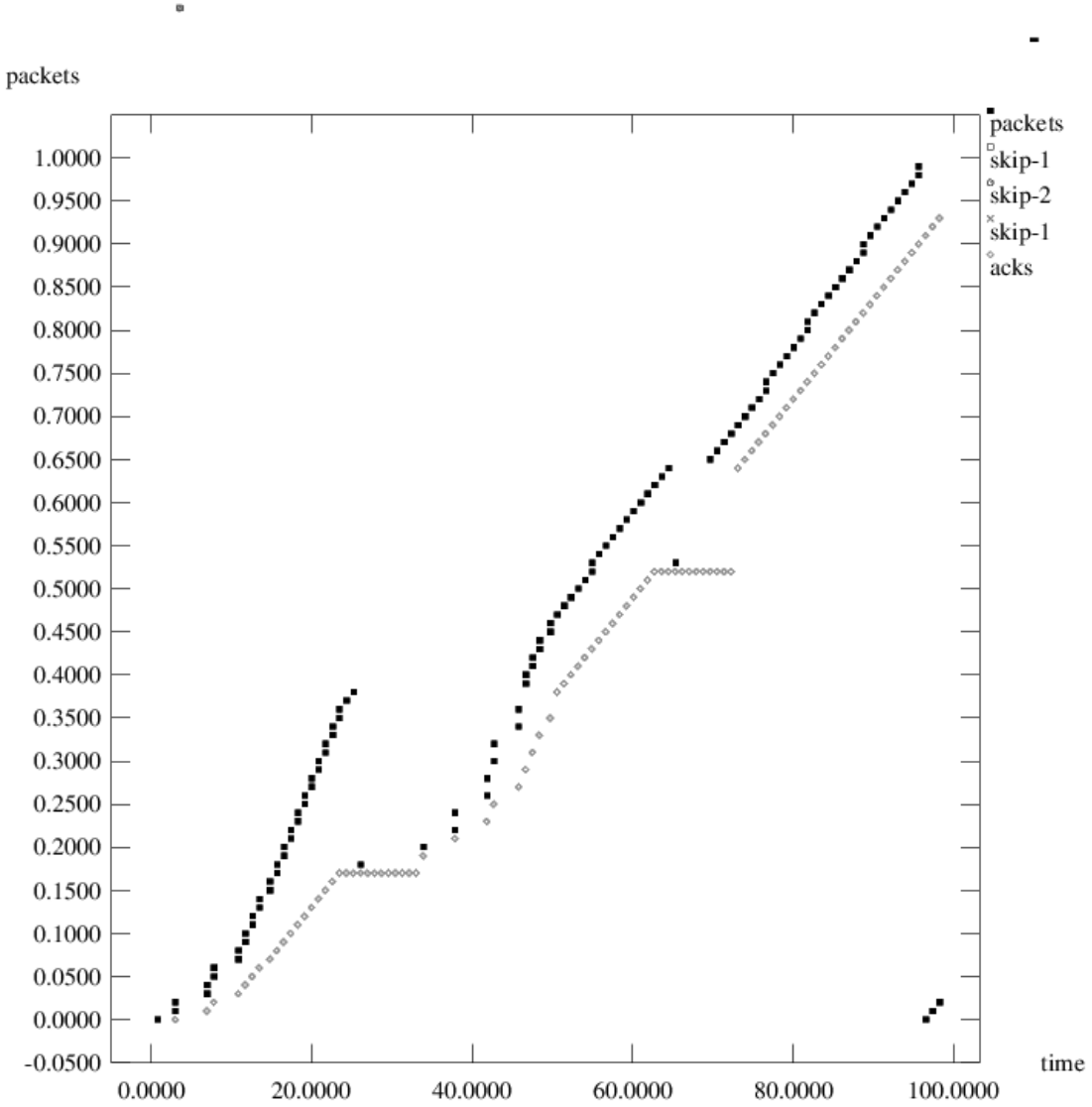
```
# General Parameters
set stop 100;  # Stop time.

# Topology
set type gsm;  #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 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) [new Delayer]
  $ns insert-delayer $nodes(ms) $nodes(bs2) [new Delayer]

# 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
```

Output:


packets
1.0000
0.9500
0.9000
0.8500
0.8000
0.7500
0.7000
0.6500
0.6000
0.5500
0.5000
0.4500
0.4000
0.3500
0.3000
0.2500
0.2000
0.1500
0.1000
0.0500
0.0000
-0.0500
0.0000
20.0000
40.0000
60.0000
80.0000
100.0000
time
packets
skip-1
skip-2
skip-1
acks

GSM Trace File:

Open Save

```
+ 0.8 0 3 tcp 40 ------- 0 0.0 4.0 0 0
- 0.8 0 3 tcp 40 ------- 0 0.0 4.0 0 0
r 0.850107 0 3 tcp 40 ------- 0 0.0 4.0 0 0
+ 0.850107 3 1 tcp 40 ------- 0 0.0 4.0 0 0
- 0.850107 3 1 tcp 40 ------- 0 0.0 4.0 0 0
r 1.38344 3 1 tcp 40 ------- 0 0.0 4.0 0 0
+ 1.38344 1 2 tcp 40 ------- 0 0.0 4.0 0 0
- 1.38344 1 2 tcp 40 ------- 0 0.0 4.0 0 0
r 1.916773 1 2 tcp 40 ------- 0 0.0 4.0 0 0
+ 1.916773 2 4 tcp 40 ------- 0 0.0 4.0 0 0
- 1.916773 2 4 tcp 40 ------- 0 0.0 4.0 0 0
r 1.92688 2 4 tcp 40 ------- 0 0.0 4.0 0 0
+ 1.92688 4 2 ack 40 ------- 0 4.0 0.0 0 1
- 1.92688 4 2 ack 40 ------- 0 4.0 0.0 0 1
r 1.936987 4 2 ack 40 ------- 0 4.0 0.0 0 1
+ 1.936987 2 1 ack 40 ------- 0 4.0 0.0 0 1
- 1.936987 2 1 ack 40 ------- 0 4.0 0.0 0 1
r 2.47032 2 1 ack 40 ------- 0 4.0 0.0 0 1
+ 2.47032 1 3 ack 40 ------- 0 4.0 0.0 0 1
- 2.47032 1 3 ack 40 ------- 0 4.0 0.0 0 1
r 3.003653 1 3 ack 40 ------- 0 4.0 0.0 0 1
+ 3.003653 3 0 ack 40 ------- 0 4.0 0.0 0 1
- 3.003653 3 0 ack 40 ------- 0 4.0 0.0 0 1
r 3.05376 3 0 ack 40 ------- 0 4.0 0.0 0 1
+ 3.05376 0 3 tcp 1040 ------- 0 0.0 4.0 1 2
- 3.05376 0 3 tcp 1040 ------- 0 0.0 4.0 1 2
+ 3.05376 0 3 tcp 1040 ------- 0 0.0 4.0 2 3
- 3.056533 0 3 tcp 1040 ------- 0 0.0 4.0 2 3
r 3.106533 0 3 tcp 1040 ------- 0 0.0 4.0 1 2
+ 3.106533 3 1 tcp 1040 ------- 0 0.0 4.0 1 2
- 3.106533 3 1 tcp 1040 ------- 0 0.0 4.0 1 2
r 3.109307 0 3 tcp 1040 ------- 0 0.0 4.0 2 3
+ 3.109307 3 1 tcp 1040 ------- 0 0.0 4.0 2 3
- 3.9732 3 1 tcp 1040 ------- 0 0.0 4.0 2 3
r 4.4732 3 1 tcp 1040 ------- 0 0.0 4.0 1 2
+ 4.4732 1 2 tcp 1040 ------- 0 0.0 4.0 1 2
- 4.4732 1 2 tcp 1040 ------- 0 0.0 4.0 1 2
```

Plain Text Tab Width: 8 Ln 1, Col 1 INS