Experiment No.: 4

Aim: Illustration of Hidden Terminal Problem

(NS-2) **Theory:**

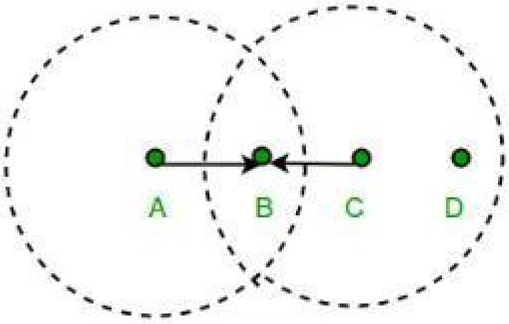
A wireless network with lack of centralized control entity, sharing of wireless bandwidth among network access nodes i.e. medium access control (MAC) nodes must be organized in decentralized manner. The hidden terminal problem occurs when a terminal is visible from a wireless access point (APs), but not from other nodes communicating with that AP. This situation leads the difficulties in medium access control sublayer over wireless networking.

In a formal way hidden terminal are nodes in a wireless network that are out of range of other node or a collection of nodes. Consider a wireless networking, each node at the far edge of the access point's range, which is known as A, can see the access point, but it is unlikely that the same node can see a node on the opposite end of the access point's range, C. These nodes are known as hidden. The problem is when nodes A and C start to send packets simultaneously to the access point B. Because the nodes A and C are out of range of each other and so cannot detect a collision while transmitting, Carrier sense multiple access with collision detection (CSMA/CD) does not work, and collisions occur, which then corrupt the data received by the access point. To overcome the hidden node problem, RTS/CTS handshaking (IEEE 802.11 RTS/CTS) is implemented in conjunction with the Carrier sense multiple accesses with collision avoidance (CSMA/CA) scheme. The same problem exists in a MANET.

The transmission range of access point A reaches at B, but not at access point C, similarly transmission range of access point C reaches B, but not at A. These nodes are known as hidden terminals. The problem occurs when nodes A and C start to send data packets simultaneously to the access point B. Because the access points A and C are out of range of each other and resultant they cannot detect a collision while transmitting, Carrier sense multiple access with collision detection (CSMA/CD) does not work, and collisions occur, which then corrupt the data received by the access point B due to the hidden terminal problem.

The hidden terminal analogy is described as follows:

- Terminal A sends data to B, terminal C cannot hear A
- Terminal C wants to send data to B, terminal C senses a "free" medium (CS fails) and starts transmitting
- Collision at B occurs, A cannot detect this collision (CD fails) and continues with its transmission to B
- Terminal A is "hidden" from C and vice versa.



Hidden Node Problem

The solution of hidden terminal problem is as follows.

When A wants to send a packet to B, A first sends a Request-to-send (RTS) to B. On receiving RTS, B responds by sending Clear-to-Send (CTS).

When C overhears a CTS, it keeps quiet for the duration of the transfer. Transfer duration is included in both RTS and CTS.

RTS and CTS are short frames, reduces collision chance.

Experiment 4

CODE:

Exp4.tcl

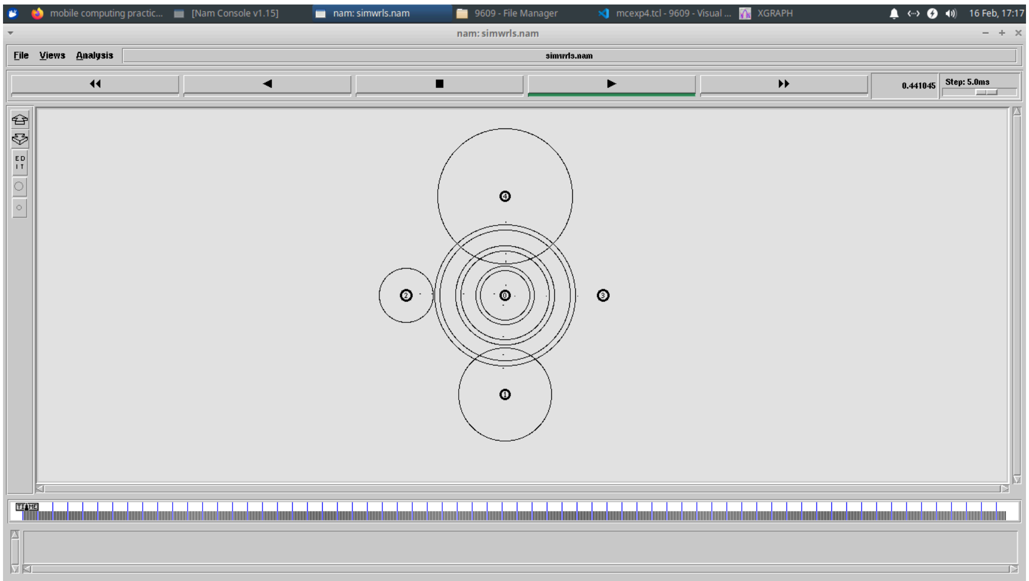
```
# Define options
set val(chan)           Channel/WirelessChannel     ;# channel type
set val(prop)           Propagation/FreeSpace   ;# radio-propagation model
set val(netif)          Phy/WirelessPhy        ;# network interface type
set val(mac)            Mac/802_11             ;# MAC type
set val(ifq)            Queue/DropTail/PriQueue              ;# interface queue type
set val(ll)     LL                      ;# link layer type
set val(ant)            Antenna/OmniAntenna         ;# antenna model
set val(ifqlen)         10000                  ;# max packet in ifq
set val(nn)             5                 ;# number of mobilenodes
set val(rp)             DSR                    ;# routing protocol
set val(x)              600               ;# X dimension of topography
set val(y)              600               ;# Y dimension of topography
set val(stop)   100             ;# time of simulation end
set val(R)      300
set opt(tr)     out.tr
set ns          [new Simulator]
set tracefd  [open $opt(tr) w]
set windowVsTime2 [open win.tr w]
set namtrace   [open simwrls.nam w]
  Mac/802_11 set dataRate_          1.2e6
Mac/802_11 set RTSThreshold_       100
$ns trace-all $tracefd
#$ns use-newtrace
$ns namtrace-all-wireless $namtrace $val(x) $val(y)

# set up topography object
set topo        [new Topography]

$topo load_flatgrid $val(x) $val(y)

create-god $val(nn)

#
#  Create nn mobilenodes [$val(nn)] and attach them to the channel.
#

# configure the nodes

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

Phy/WirelessPhy set CSThresh 30.5e-10
        for {set i 0} {$i < $val(nn) } { incr i } {
        set node_($i) [$ns node]
        }
$node_(0) set X_ $val(R)
$node_(0) set Y_ $val(R)
$node_(0) set Z_ 0
$node_(1) set X_ $val(R)
$node_(1) set Y_ 0
$node_(1) set Z_ 0
$node_(2) set X_ 0
$node_(2) set Y_ $val(R)
$node_(2) set Z_ 0
$node_(3) set X_ [expr $val(R) *2]
$node_(3) set Y_ $val(R)
$node_(3) set Z_ 0
$node_(4) set X_ $val(R)
$node_(4) set Y_ [expr $val(R) *2]
$node_(4) set Z_ 0
 for {set i 0} {$i<$val(nn)} {incr i} {
  $ns initial_node_pos $node_($i) 30
 }
# Generation of movements
 $ns at 0 "$node_(1) setdest $val(R) $val(R) 3.0"
$ns at 0 "$node_(2) setdest $val(R) $val(R) 3.0"
$ns at 0 "$node_(3) setdest $val(R) $val(R) 3.0"
$ns at 0 "$node_(4) setdest $val(R) $val(R) 3.0"
# Set a TCP connection between node_(0) and node_(1)
set tcp [new Agent/TCP/Newreno]
#$tcp set class_ 2
set tcp [new Agent/UDP]
$tcp set class_ 2
set sink [new Agent/Null]
$ns attach-agent $node_(1) $tcp
$ns attach-agent $node_(0) $sink
$ns connect $tcp $sink
set ftp [new Application/Traffic/CBR]
$ftp attach-agent $tcp
$ns at 0.0 "$ftp start"
# ##################################################
# For coloring but doesnot work
# ##################################################
$tcp set fid_ 1
```

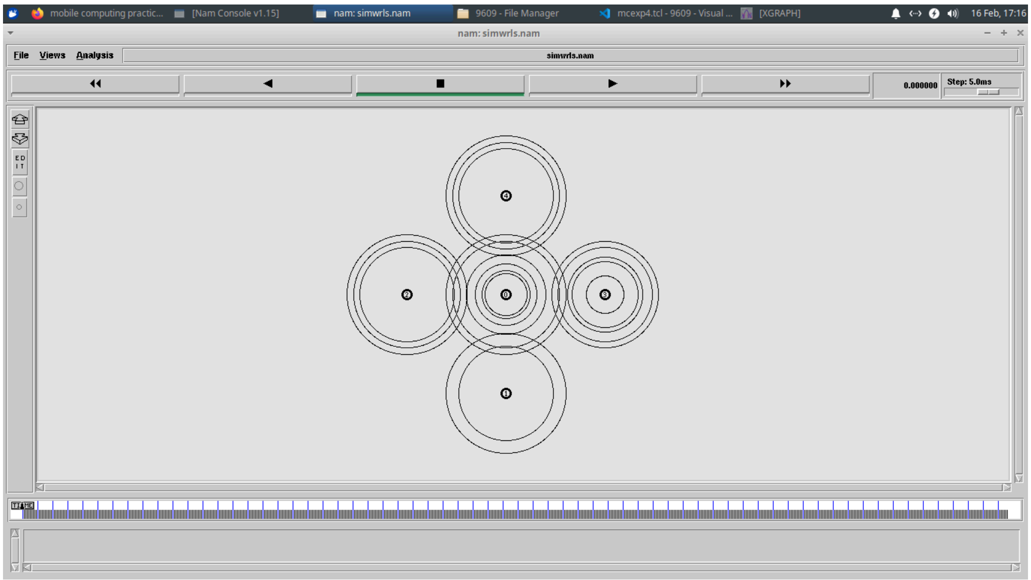
```
$ns color 1 blue
#//////////////////////////////////////////////////
set tcp [new Agent/UDP]
$tcp set class_ 2
set sink [new Agent/Null]
$ns attach-agent $node_(2) $tcp
$ns attach-agent $node_(0) $sink
$ns connect $tcp $sink
set ftp [new Application/Traffic/CBR]
$ftp attach-agent $tcp
$ns at  0.0 "$ftp start"
set tcp [new Agent/UDP]
$tcp set class_ 2
set sink [new Agent/Null]
$ns attach-agent $node_(3) $tcp
$ns attach-agent $node_(0) $sink
$ns connect $tcp $sink
set ftp [new Application/Traffic/CBR]
$ftp attach-agent $tcp
$ns at  0.0 "$ftp start"
set tcp [new Agent/UDP]
$tcp set class_ 2
set sink [new Agent/Null]
$ns attach-agent $node_(4) $tcp
$ns attach-agent $node_(0) $sink
$ns connect $tcp $sink
set ftp [new Application/Traffic/CBR]
$ftp attach-agent $tcp
$ns at  0.0 "$ftp start"
# Telling nodes when the simulation ends
#for {set i 0} {$i < $val(nn) } { incr i } {
 #   $ns at $val(stop) "$node_($i) reset";
#}

# ending nam and the simulation
$ns at $val(stop) "$ns nam-end-wireless $val(stop)"
$ns at $val(stop) "stop"
$ns at $val(stop) "puts \"end simulation\" ; $ns halt"
proc stop {} {
 exec awk -f fil.awk out.tr > out.xgr
exec xgraph out.xgr &

        global ns tracefd namtrace
        $ns flush-trace
        close $tracefd
  close $namtrace
        exec nam simwrls.nam &
}

$ns run
```

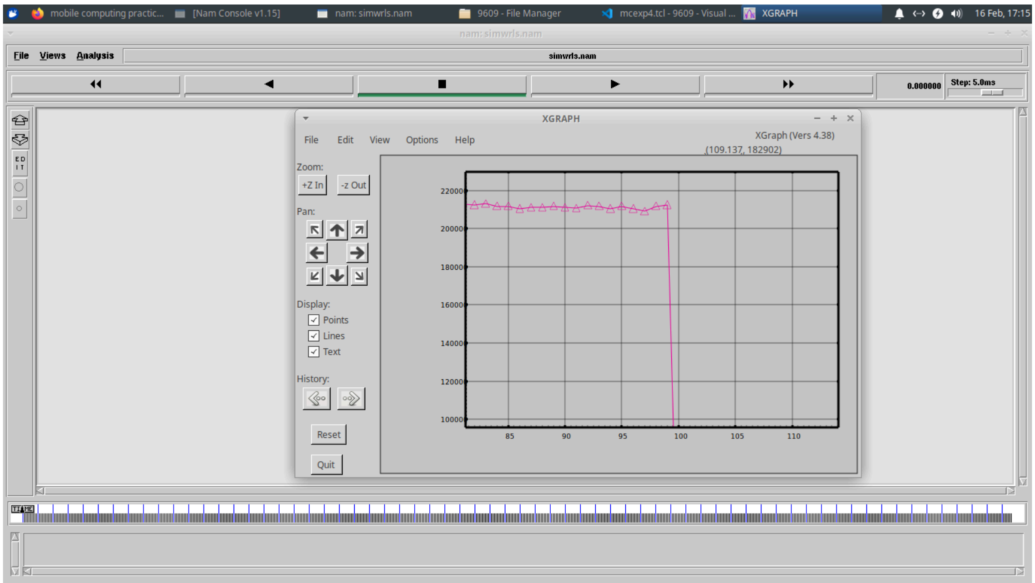
Fil.awk

```
BEGIN{
        sim_end = 200;
        i=0;
        while (i<=sim_end) {sec[i]=0; i+=1;};
}

{
        if ($1=="r" && $7=="cbr"&& $3=="_0_") {
        sec[int($2)]+=$8;
        };
}

END{
        i=0;
        while (i<=sim_end) {print i " " sec[i]; i+=1;};
}
```

OUTPUT:


mobile computing practic...
[Nam Console v1.15]
nam: simwrls.nam
9609 - File Manager
mcexp4.tcl - 9609 - Visual ...
XGRAPH
16 Feb, 17:17
nam: simwrls.nam
File
Views
Analysis
simwrls.nam
0.441045
Step: 5.0ms
4
2
0
3
1


mobile computing practic...
[Nam Console v1.15]
nam: simwrls.nam
9609 - File Manager
mcexp4.tcl - 9609 - Visual ...
[XGRAPH]
16 Feb, 17:16
nam: simwrls.nam
File
Views
Analysis
simwrls.nam
0.000000
Step: 5.0ms
4
2
0
3
1


mobile computing practic...
[Nam Console v1.15]
nam: simwrls.nam
9609 - File Manager
mcexp4.tcl - 9609 - Visual ...
XGRAPH
16 Feb, 17:15
nam: simwrls.nam
File
Views
Analysis
simwrls.nam
0.000000
Step: 5.0ms
XGRAPH
File
Edit
View
Options
Help
XGraph (Vers 4.38)
(109.137, 182902)
Zoom:
+Z In
-z Out
Pan:
Display:
☑ Points
☑ Lines
☑ Text
History:
Reset
Quit
22000
20000
18000
16000
14000
12000
10000
85
90
95
100
105
110

POSTLAB:

1. **Explain in brief what is the hidden terminal problem**
2. **How does HTP affect performance of wireless network**
3. **What is solution to hidden terminal problem?**
4. **How does hidden terminal problem differ from exposed terminal problem**

Explain in brief what is the hidden terminal problem?
The hidden terminal problem refers to a scenario in wireless networks where nodes are within range of a central node but out of range of each other, causing them to be unaware of each other's transmissions. This situation can lead to collisions when multiple nodes attempt to transmit data simultaneously, resulting in packet loss and degraded network performance.

How does HTP affect the performance of a wireless network?
HTP negatively impacts the performance of wireless networks by increasing the likelihood of collisions and packet loss. When nodes transmit data without being able to detect each other's transmissions, collisions occur at the central node, leading to retransmissions and reduced throughput. This results in decreased network efficiency, reliability, and increased latency.

What is the solution to the hidden terminal problem?
One solution to the hidden terminal problem is the implementation of Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) protocols. These protocols enable nodes to sense the wireless medium before transmitting data, allowing them to avoid collisions by waiting for the medium to be clear. Additionally, techniques such as Request-to-Send (RTS) and Clear-to-Send (CTS) can be employed to reserve the medium for transmission, reducing the occurrence of collisions.

How does the hidden terminal problem differ from the exposed terminal problem?
The hidden terminal problem differs from the exposed terminal problem in that the former occurs when nodes cannot detect each other's transmissions, leading to collisions when they simultaneously transmit data. On the other hand, the exposed terminal problem arises when a node refrains from transmitting data incorrectly believing that the medium is busy due to transmissions from other nodes, even though these transmissions would not interfere with its own transmission. This situation results in unnecessary delays in data transmission.