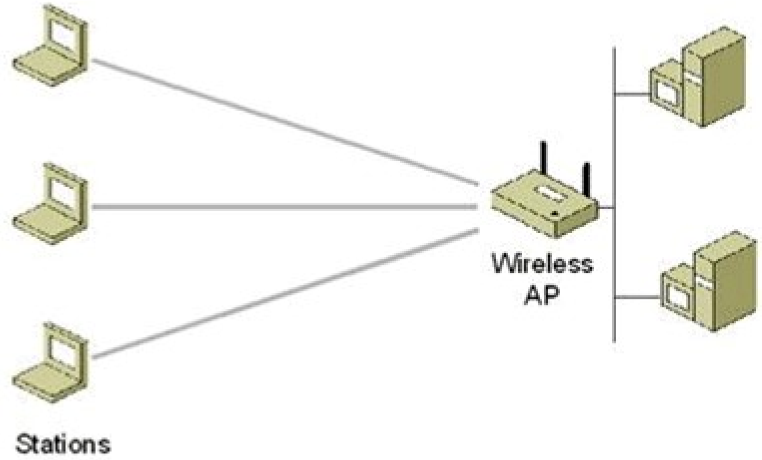
Simulation of WLAN using 802.11 MAC protocol



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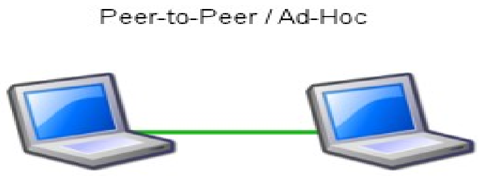
WLAN definition:
WLAN stands for wireless local area network. It links two or more devices using some wireless distribution method (typically spread-spectrum or OFDM radio), and usually providing a connection through an access point to the wider internet. This gives users the mobility to move around within a local coverage area and still be connected to the network. Most modern WLANs are based on IEEE 802.11standards, marketed under the Wi-Fi brand name.

Project goal

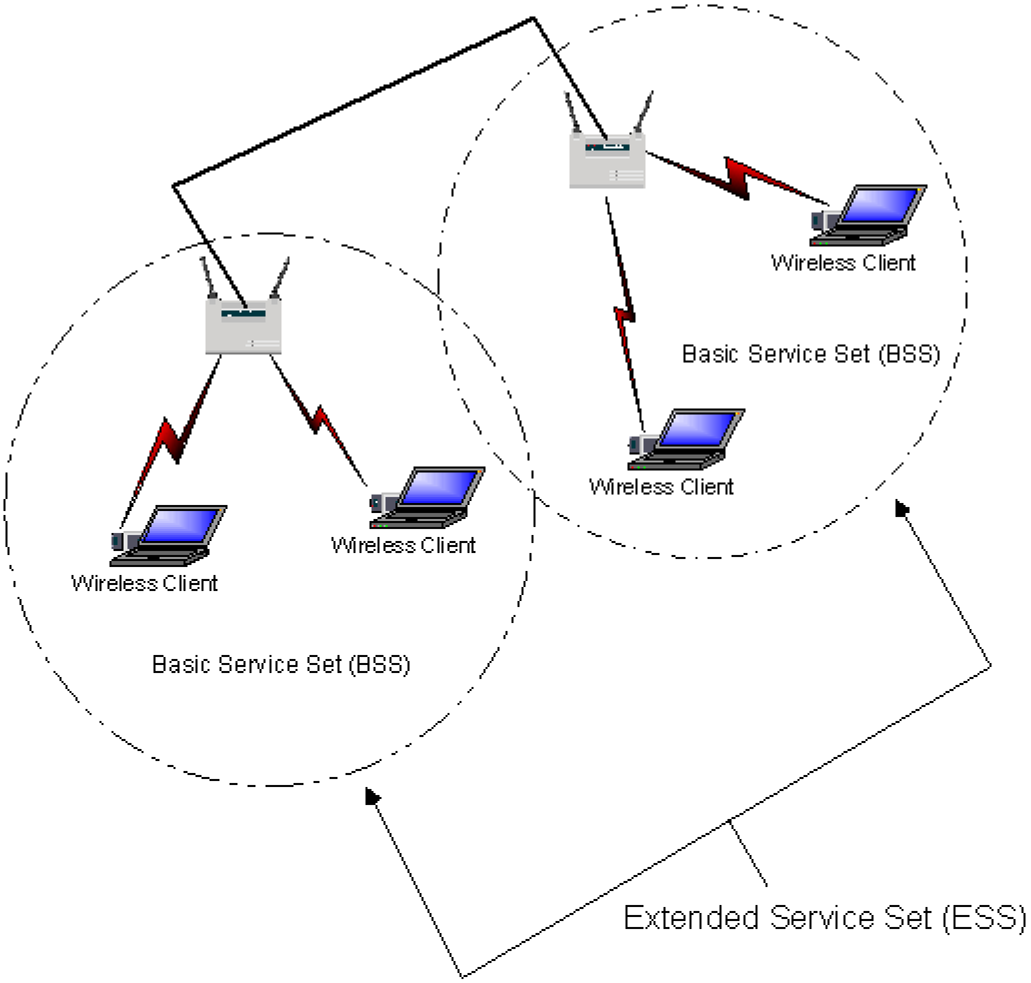
1. To understand IEEE 802.11 standard and the following features in wireless LANs:
- Ad hoc network configuration.
- RTS/CTS exchange.
- Infrastructure network configuration.
- Access Point Functionality.
- PCF access mode.

Ad hoc network configuration: On wireless computer networks,ad-hoc mode is a method for wireless devices to directly communicate with each other. Operating in ad-hoc mode allows all wireless devices within range of each other to discover and communicate in peer-to-peer fashion without involving central access points.



RTS/CTS exchange: IEEE 802.11 Medium Access Control (MAC) called Distributed Coordination Function (DCF) provides two different access modes, namely, 2-way (basic access) and 4-way (RTS/CTS) handshaking. The 4-way handshaking has been introduced in order to combat the hidden terminal phenomenon. It has been also proved that such a mechanism can be beneficial even in the absence of hidden terminals, because of the collision time reduction.
RTS: request to send.
CTS:clear to send

Infrastructure network configuration: In this configuration devices communicate with each other through access point. They dont communicate with each other directly. The infrastructure mode is shown below



Access point functionality: The function of a wireless access point is to allow wireless devices such as projectors,laptops and PDAs to access a local area network. Wireless access points mainly act as switches to spread connections wirelessly. This access point is used in infrastructure mode.

PCF access mode:Point coordination function (**PCF**) is a Media Access Control (MAC) technique used in IEEE 802.11 based WLANs. It resides in a point coordinator also known as Access Point (AP), to coordinate the communication within the network.

Project idea and scope

The outstanding feature of WLAN networks is giving the users the freedom of mobility while they are connected to the network.

Every station that can be connected to an 802.11 network is called a station. A station may be a wireless client or an Access Point.

A Basic Service Sets (BSS) is a set of stations that can communicate with one another. When BSS contains no access point and all the stations in the BSS communicate directly with each other, the BSS is called an independent BSS (IBSS) that is also known as ad-hoc network. Such network has no connection to a wired network or other Basic Service Sets.

When a BSS includes an access point (AP), the BSS is no longer independent and is called an infrastructure BSS (IBSS). An infrastructure BSS can communicate with stations in the other BSSs using AP. The AP provides both the connection to the wired LAN and the local relay function within the BSSs. A set of connected BSSs is called an Extended Service Set (ESS).

A Distribution System (DS) that can be a wired or a wireless LAN connects access points in such a system.

The function of the WLAN MAC is to provide fair mechanism to control the access to the shared wireless media. It performs this function through two different access mechanisms: the contention-based mechanism, called the distributed coordination function (DCF), and a centrally controlled access mechanism, called the point coordination function (PCF).

DCF that is the basic 802.11 MAC protocol, relies on CSMA/CA with binary exponential backoff and an optional CTS/RTS to share the medium between the stations. However, such approach suffers from collision and cannot guarantee a level of QoS.

PCF is an optional extension and is available only in IBSS mode where APs send Beacon frames at regular intervals. There are two intervals between these beacon frames: the first interval is Contention Free Period (CFP) when APs send Contention Free Poll packets (CF-Poll) to the stations to let them send a packet. The second interval is Contention Period (CP) when DCF is used.

The goal of this LAB is to simulate the behavior of 802.11 protocols in different conditions and evaluate the effect of several parameters on the network performance.

Definition of some important terms used in this project

control traffic received:

no of bits of control traffic received by a node.

Delay:

it is the data transfer delay experienced by a node.

Data dropped:

no of data packets dropped by a node.

Retransmission attempts:

the number of attempts a node makes before successful transmission of a data packet.

Back off slots:

no of slots a node is prevented from transmitting data.

Throughput:

it is the average rate of successful message delivery over a communication channel**.**

Media access delay:

The time a network interface waits before it can access a shared network.

RTS/CTS:

RTS/CTS (Request to Send / Clear to Send) is the optional mechanism used by the 802.11 wireless networking protocol to reduce frame collisions introduced by the hidden node problem. Originally the protocol fixed the exposed node problem as well, but modern RTS/CTS includes ACKs and does not solve the exposed node problem.

PCF:

The original 802.11 MAC defines another coordination function called the point coordination function (PCF). This is available only in "infrastructure" mode, where stations are connected to the network through an Access Point (AP). This mode is optional, and only very few APs or Wi-Fi adapters actually implement it APs send beacon frames at regular intervals (usually every 0.1 second). Between these beacon frames, PCF defines two periods: the Contention Free Period (CFP) and the Contention Period (CP). In the CP, DCF is used. In the CFP, the AP sends Contention-Free-Poll (CF-Poll) packets to each station, one at a time, to give them the right to send a packet. The AP is the coordinator. Although this allows for a better management of QoS, PCF does not define classes of traffic as is common with other QoS systems.

DCF:

The basic 802.11 MAC layer uses the distributed coordination function (DCF) to share the medium between multiple stations. DCF relies on CSMA/CA and optional 802.11 RTS/CTS to share the medium between stations.

Case1: BSS simulation

In this simulation we considered 10nodes. The arrangement of ten nodes is as shown below.

We edited the following node parameters:

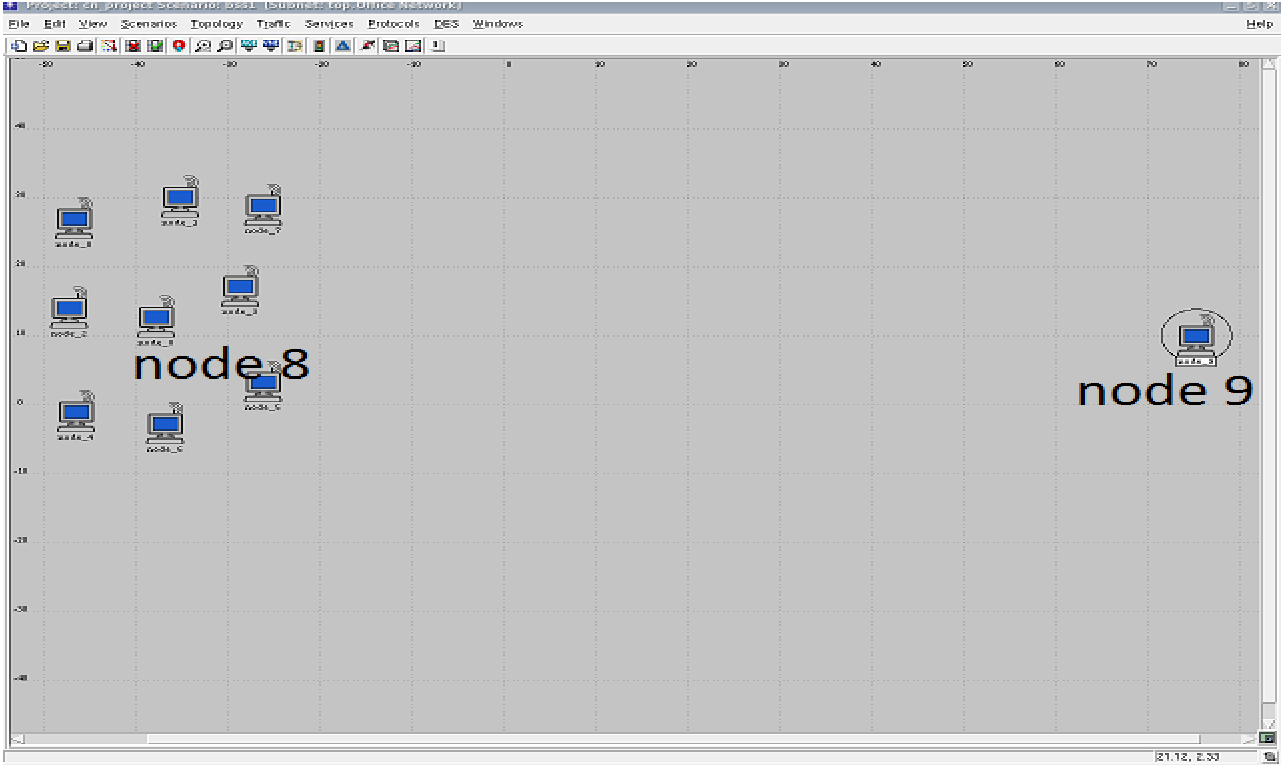
start time : exponential(10)

On state time: exponential(10)

off state time:exponential(90)

inter arrival time: exponential(0.0012)

packet size(bytes): exponential(1500)



For simulation two nodes outputs were given Node8 and node9. Nine nodes are very near to each other and one node node9 was far from all the nodes. So I took one of the nodes which are very close to each other and the far node for simulation purpose and the output was plotted for the following:

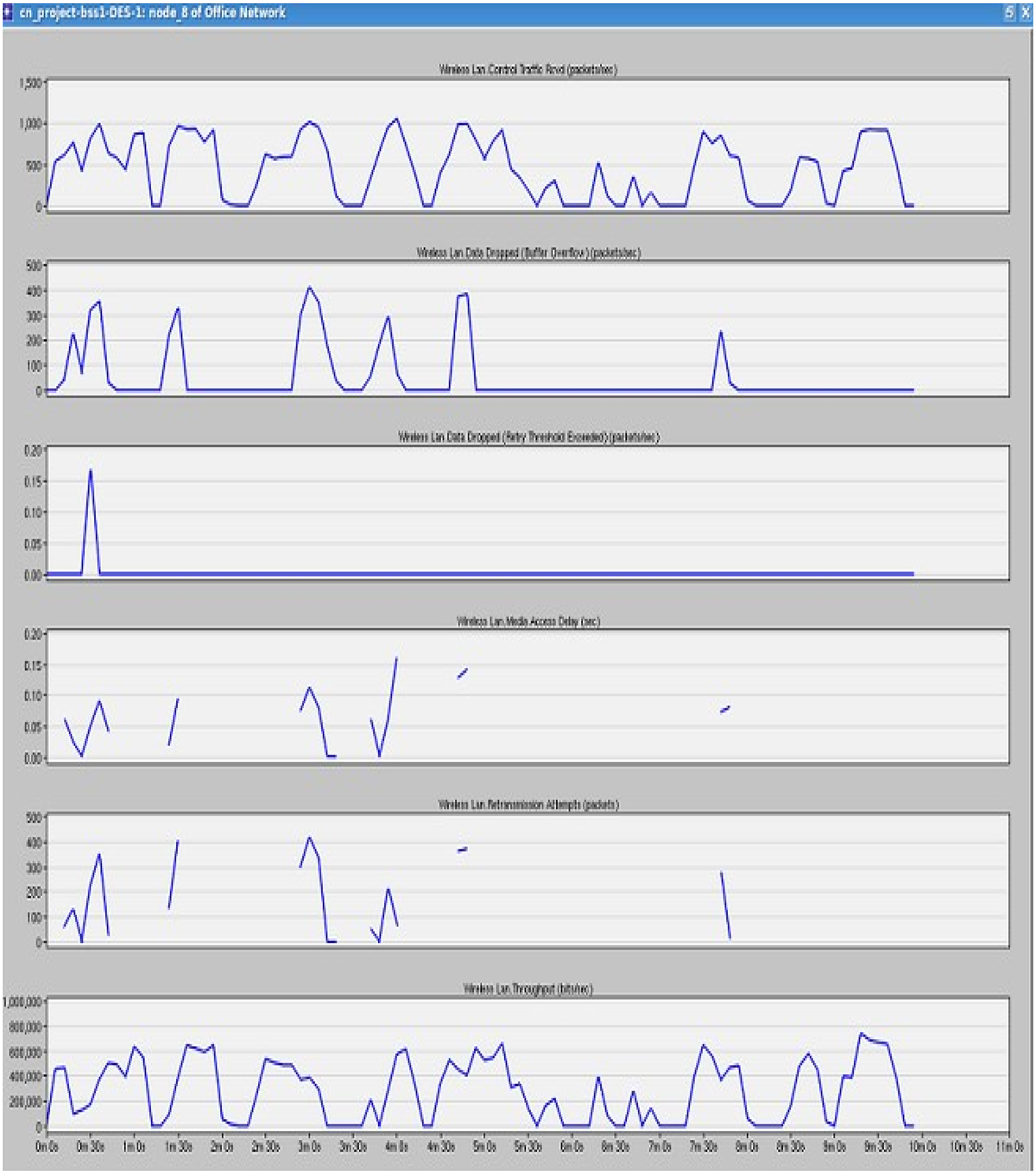
1. control traffic received.
2. Data dropped(buffer overflow)(packets/second).
3. Data dropped(retry threshold)(packets/second).
4. Media access delay.

5. Retransmission attempts.
6. Throughput.

BSS simulation results: These results I took without RTS/CTS.

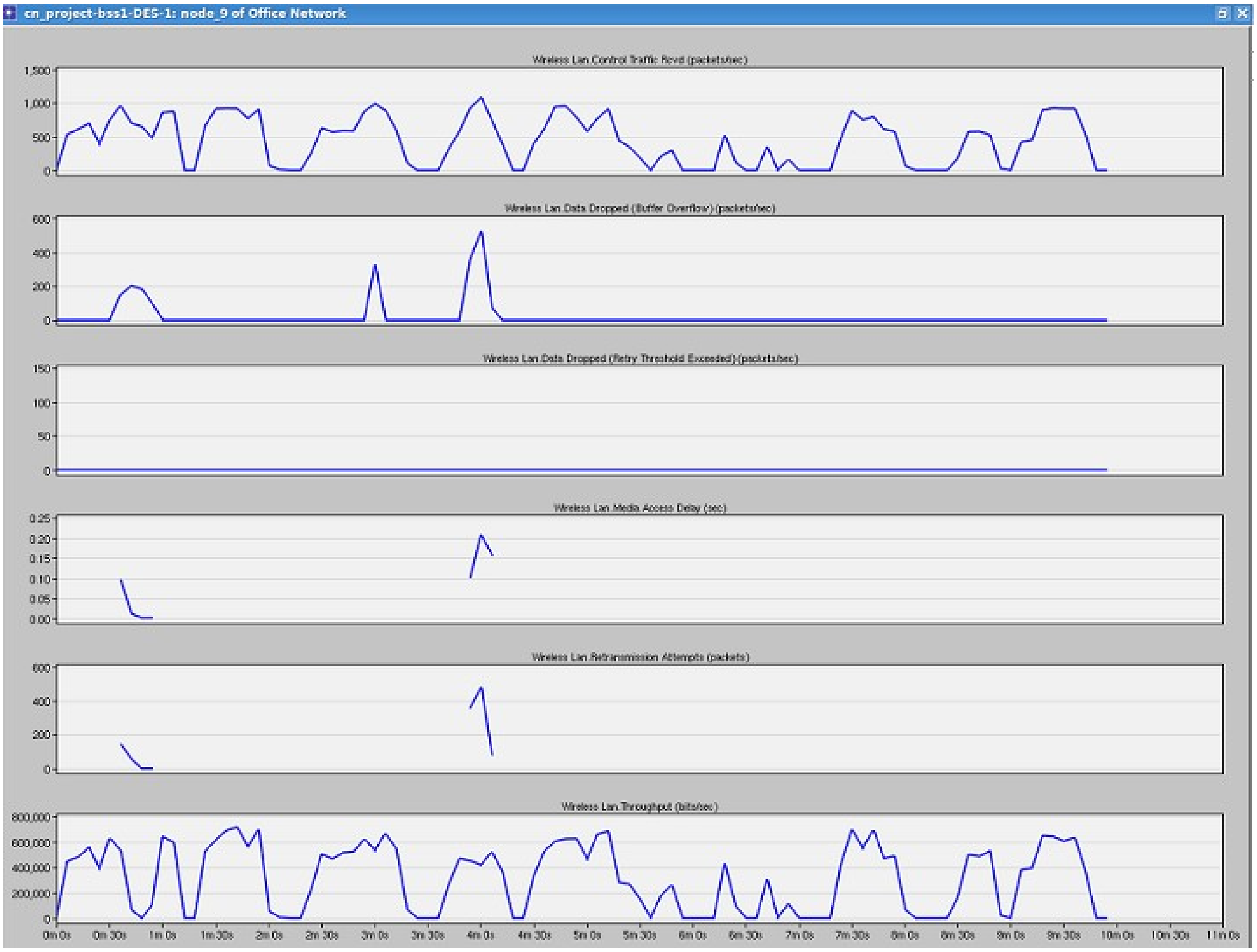
Node8:

simulation duration is 10minutes



Node9:

simulation duration=10minutes



Observations from the above two nodes:

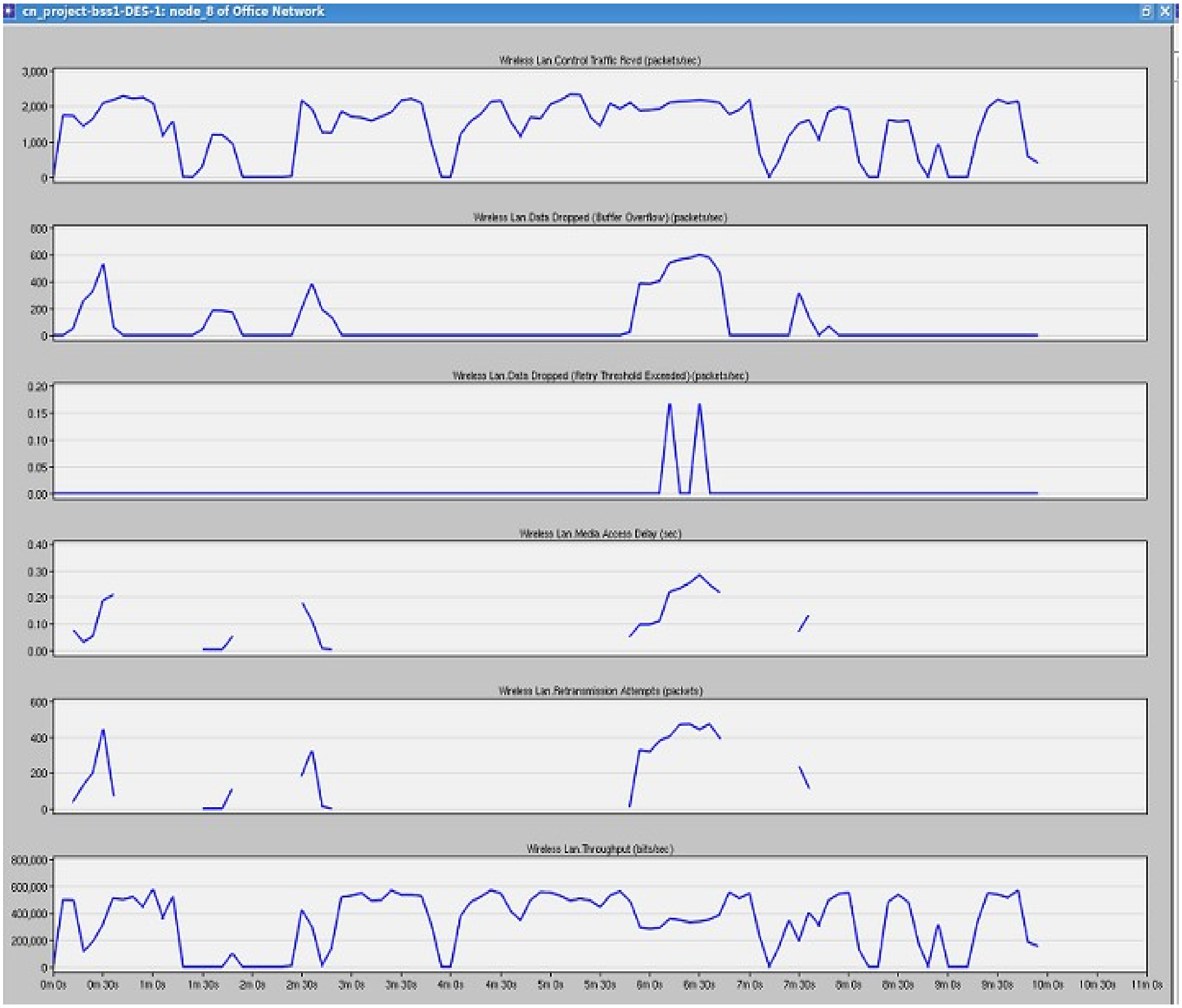
1. from the above simulation reults of the two nodes we can observe that as we are not using RTS threshold so the overhead will be less so therefore we can say that control traffic received is less.
2. We can also observe that the throughput is good because of no overhead present.
3. Media access delay is less as we are not using RTS.
4. Retransmission attempts are more.
5. Data dropped is more.

BSS simulation considering RTS/CTS threshold of 256:

in this case we have to set the
RTS threshold parameter =256.
start time : exponential(10)
On state time: exponential(10)
off state time:exponential(90)
inter arrival time: exponential(0.0012)
packet size(bytes): exponential(1500)

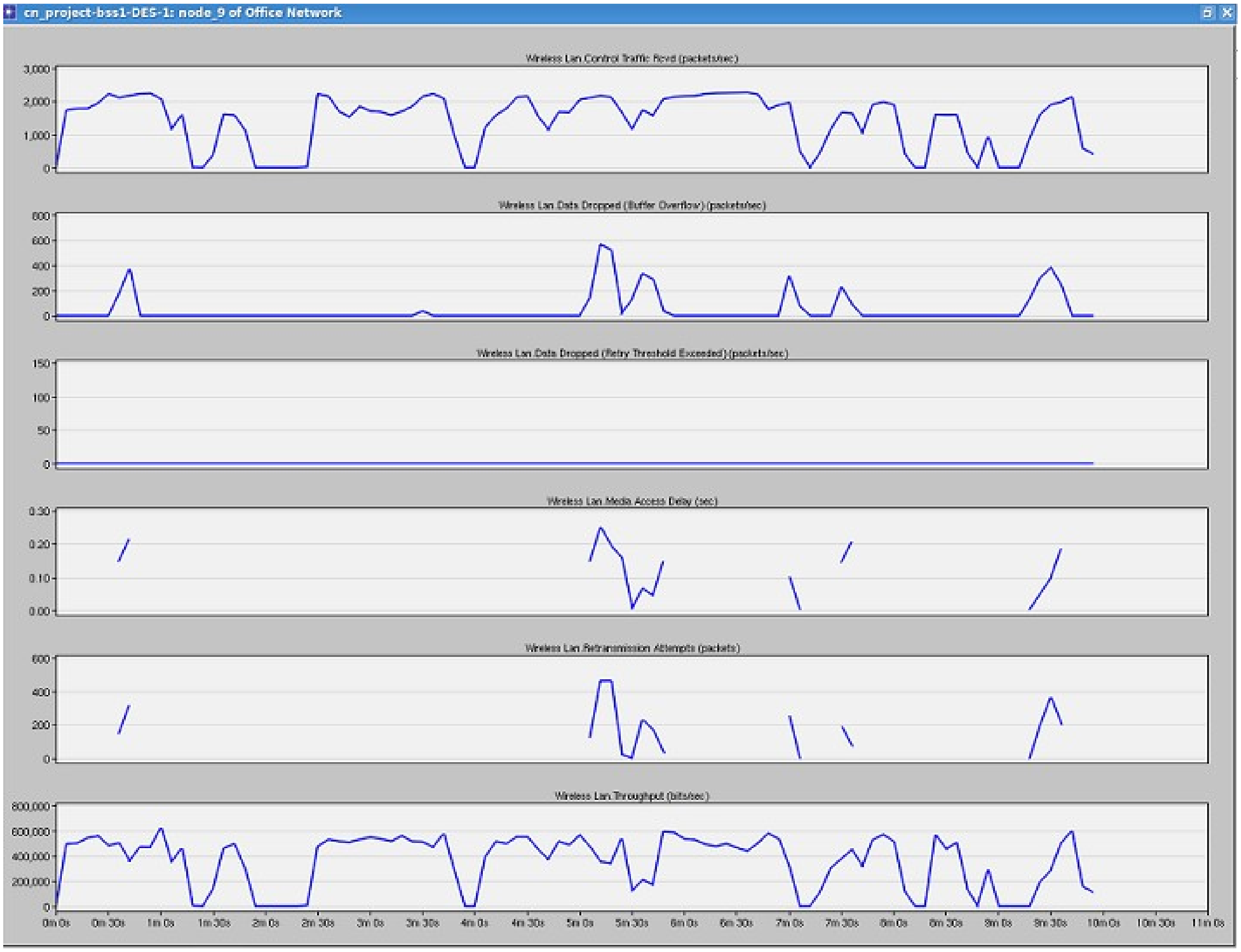
Node8:

simulation duration is 10minutes



Node9:

simulation duration is 10minutes



Wireless Lan Control Traffic Rcvd (packets/sec)

Wireless Lan Data Dropped (Buffer Overflow) (packets/sec)

Wireless Lan Data Dropped (Retry Threshold Exceeded) (packets/sec)

Wireless Lan Media Access Delay (sec)

Wireless Lan Retransmission Attempts (packets)

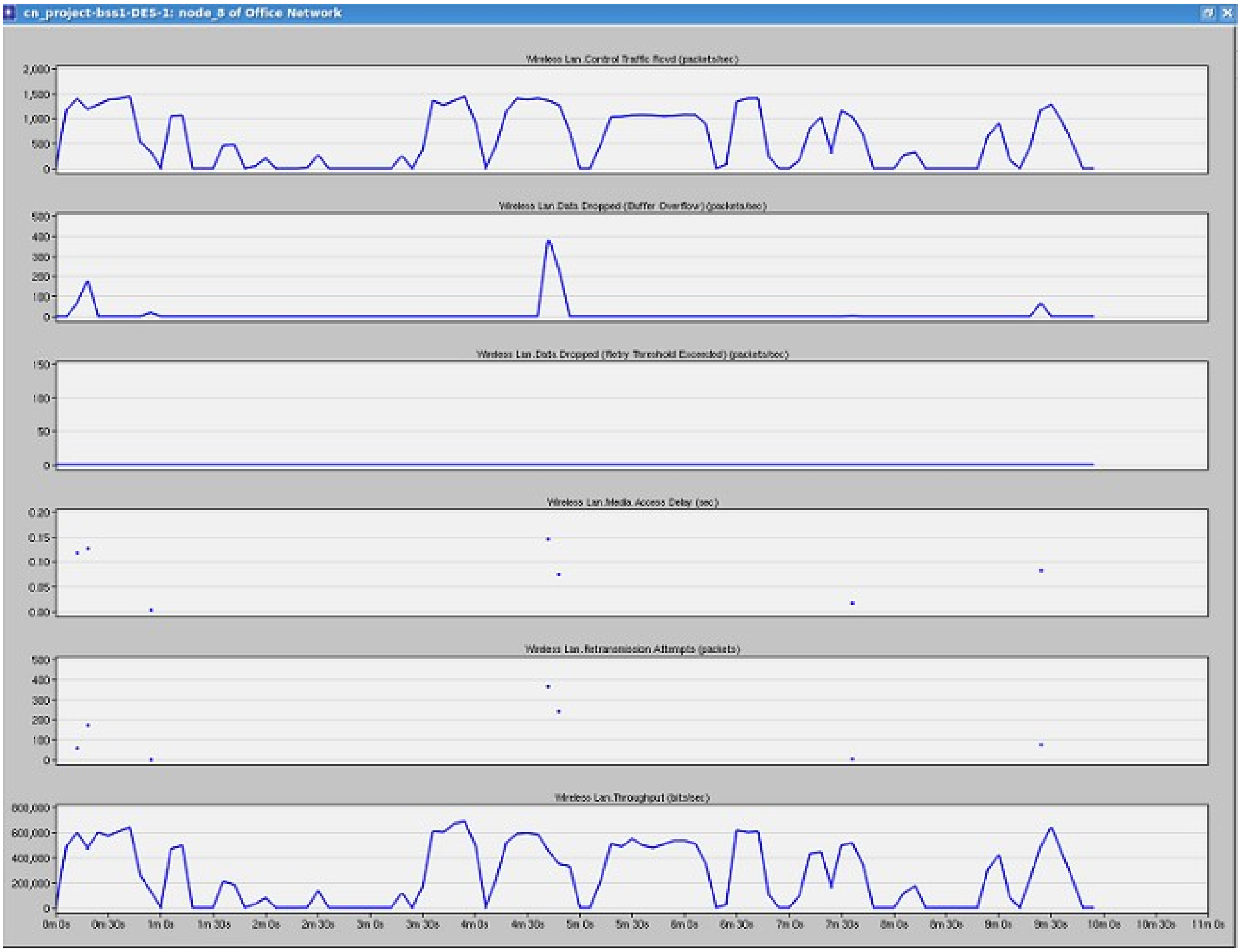
Wireless Lan Throughput (bits/sec)

Observations:

1. we can observe that because of the overhead present due to RTS threshold of 256 the control traffic received is more and the throughput is less.
2. If we increase the RTS threshold to a much higher value the throughput and control traffic will be much increased.
3. The trade of using RTS is the increasing of Media Access Delay (as shown in the following graph). Since RTS frames waiting to receive CTS (Clear-toSend) frame will take a certain period of time while data are waiting in the transmission buffer, while without using RTS, data are send immediately once it is ready to send.
4. Data dropped is less.
5. Retransmission attempts are less.

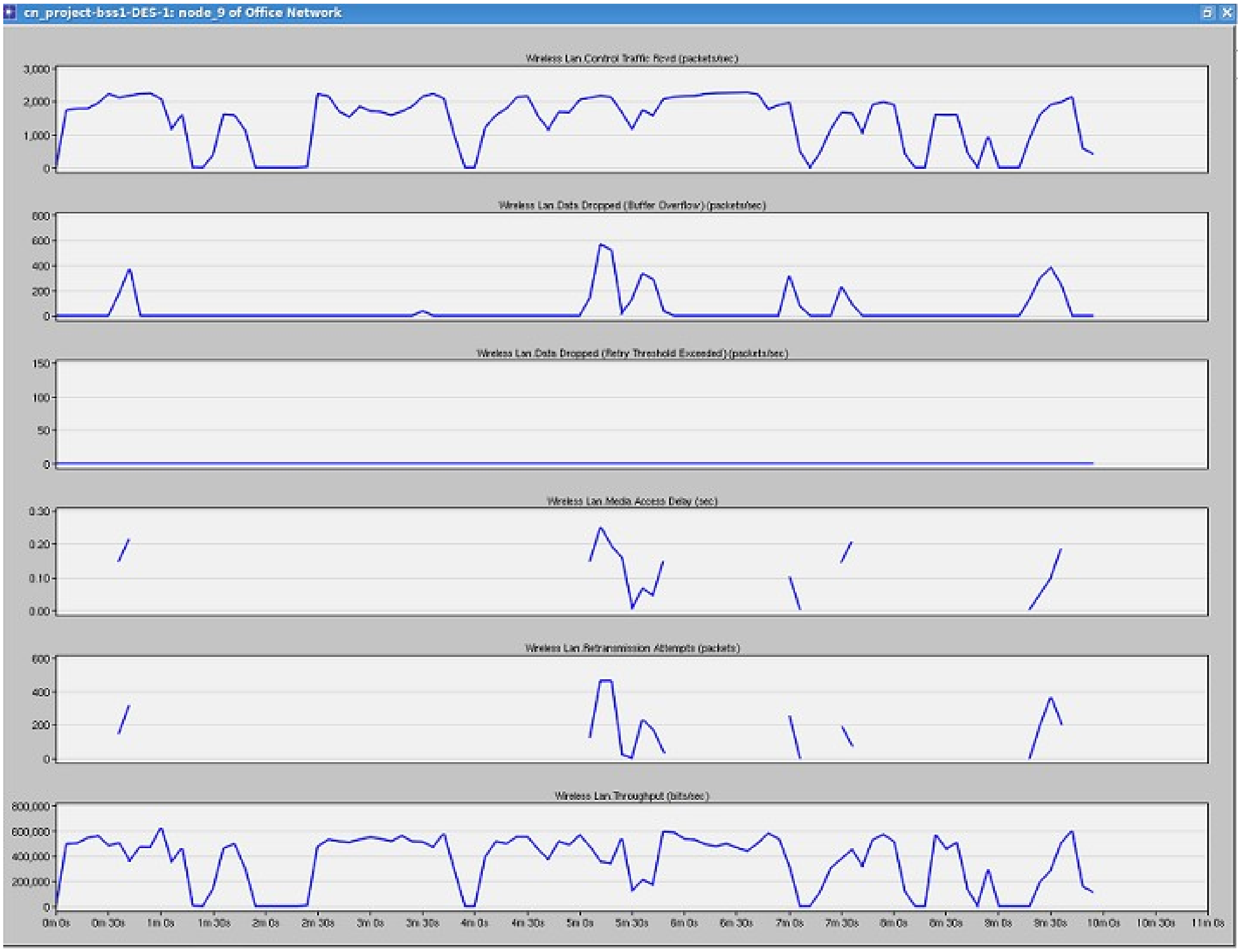
BSS simulation considering RTS/CTS threshold of 1024:
in this case we have to set the
RTS threshold parameter =1024.
start time : exponential(10)
On state time: exponential(10)
off state time:exponential(90)
inter arrival time: exponential(0.0012)
packet size(bytes): exponential(1500)

Node8:
simulation duration is 10minutes


cn_project-bss1-DES-1: node_8 of Office Network
Wireless Lan.Control Traffic Rcvd (packets/sec)
2,000
1,500
1,000
500
0
Wireless Lan.Data Dropped (Buffer Overflow) (packets/sec)
500
400
300
200
100
0
Wireless Lan.Data Dropped (Retry Threshold Exceeded) (packets/sec)
150
100
50
0
Wireless Lan.Media Access Delay (sec)
0.20
0.15
0.10
0.05
0.00
Wireless Lan.Retransmission Attempts (packets)
500
400
300
200
100
0
Wireless Lan.Throughput (bits/sec)
800,000
600,000
400,000
200,000
0
0m 0s
0m 30s
1m 0s
1m 30s
2m 0s
2m 30s
3m 0s
3m 30s
4m 0s
4m 30s
5m 0s
5m 30s
6m 0s
6m 30s
7m 0s
7m 30s
8m 0s
8m 30s
9m 0s
9m 30s
10m 0s
10m 30s
11m 0s

Node9:

simulation duration is 10minutes



Observations:

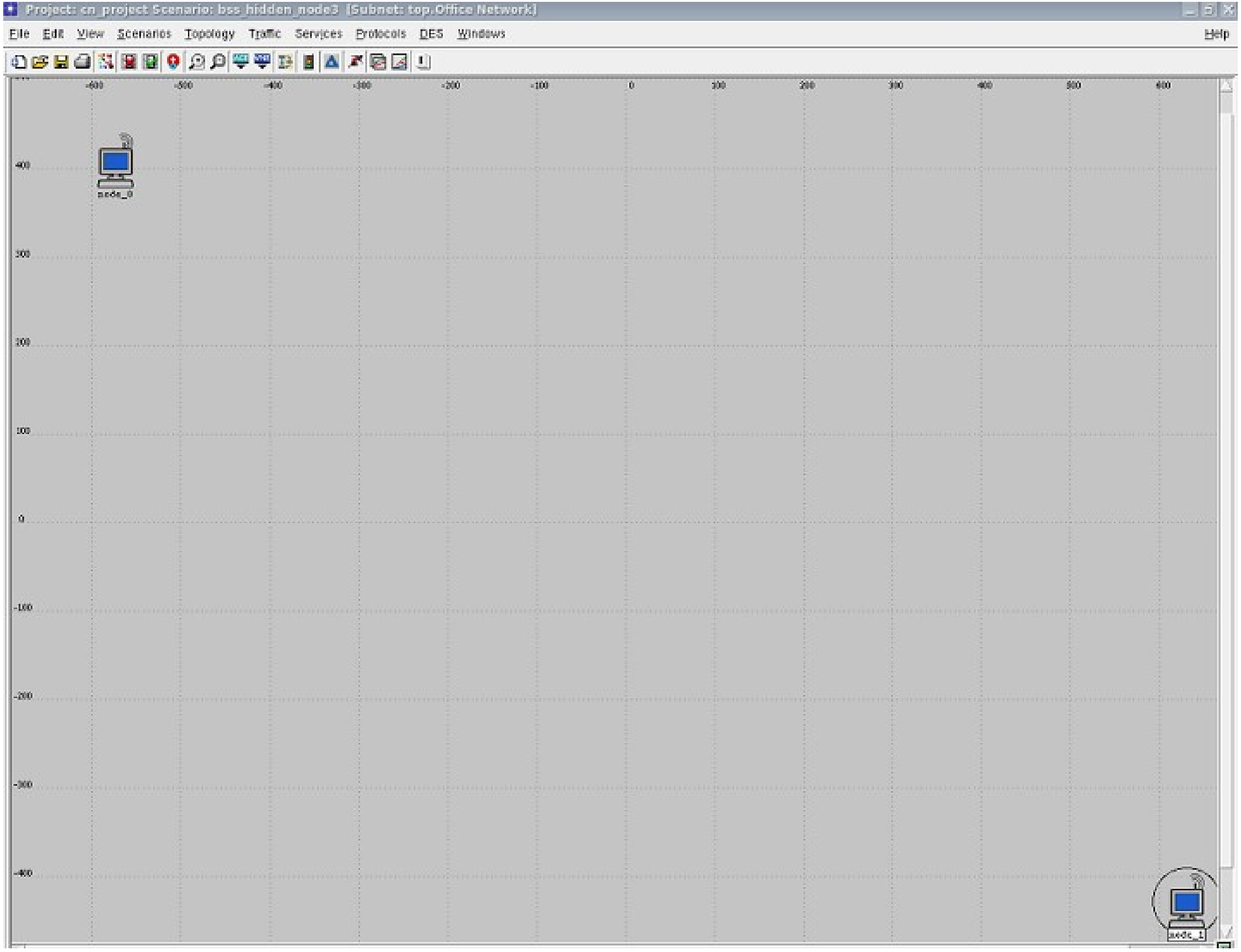
1. because we increased the overhead bits the control traffic is much increased and the throughput is much reduced.
2. The trade of using RTS is the increasing of Media Access Delay (as shown in the following graph). Since RTS frames waiting to receive CTS (Clear-toSend) frame will take a certain period of time while data are waiting in the transmission buffer, while without using RTS, data are send immediately once it is ready to send.
3. Data dropped is less.
4. Retransmission attempts are less.

Case2: Hidden node scenario

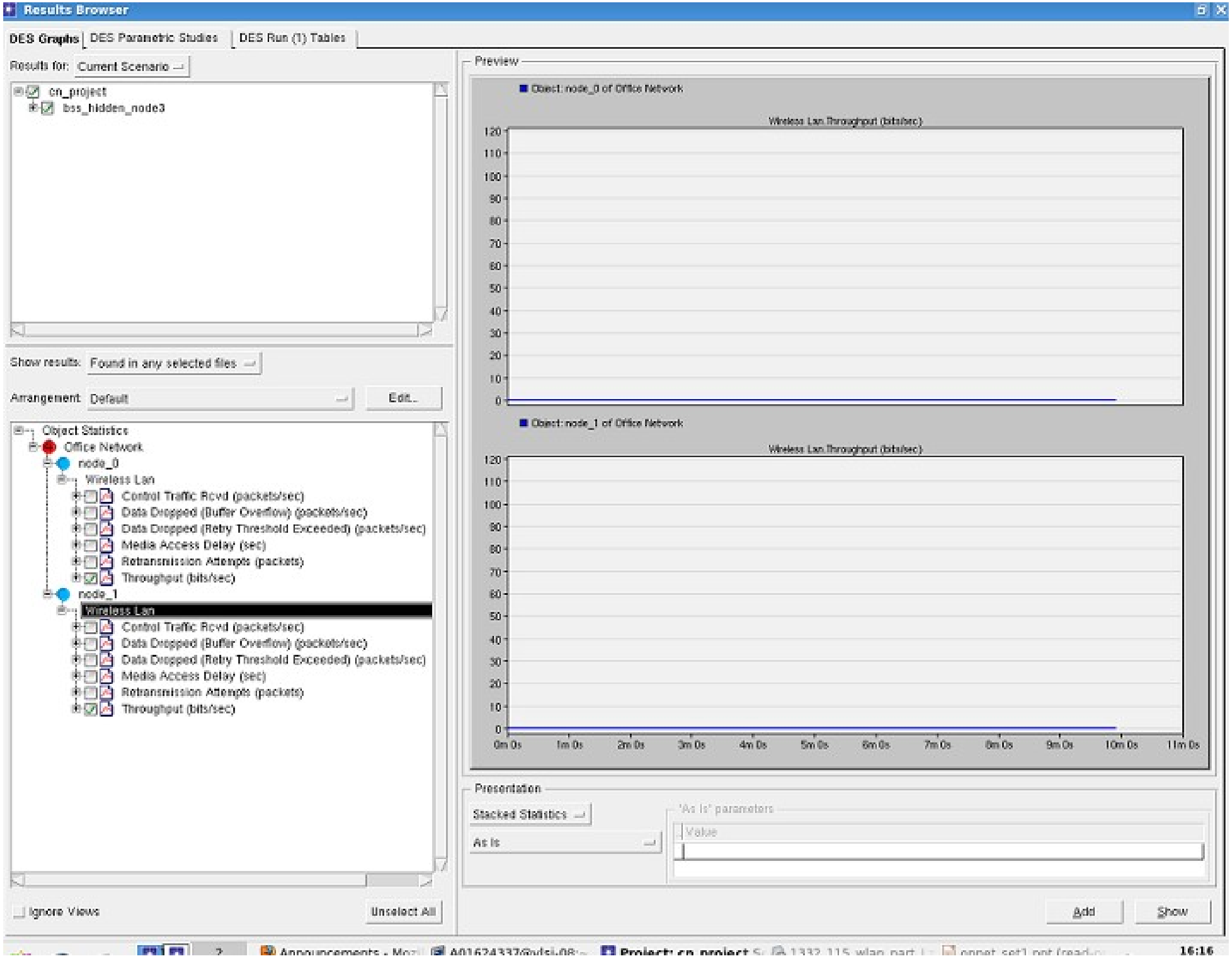
Hidden node: In wireless networking, the **hidden node problem** or **hidden terminal problem** occurs when a node is visible from a wireless access point (AP), but not from other nodes communicating with said AP. This leads to difficulties in media access control.

In the below scenario shown first we considered two nodes. First we need to keep the two nodes at a particular distance and measure the throughput. Then if there is any throughput we need to increase the distance between the two nodes till the throughput of the two will be zero. Now we can say that the two nodes are hidden from each other. Now comes the problem of hidden node.

Checking hidden node scenario:

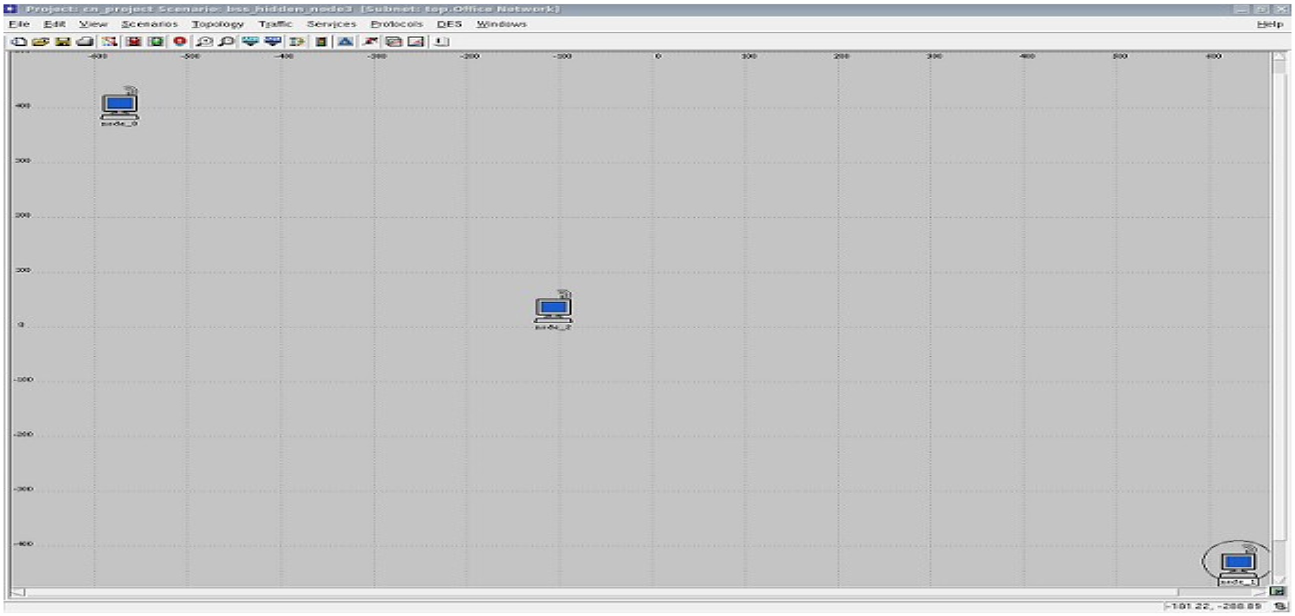


Throughput of the two hidden nodes:



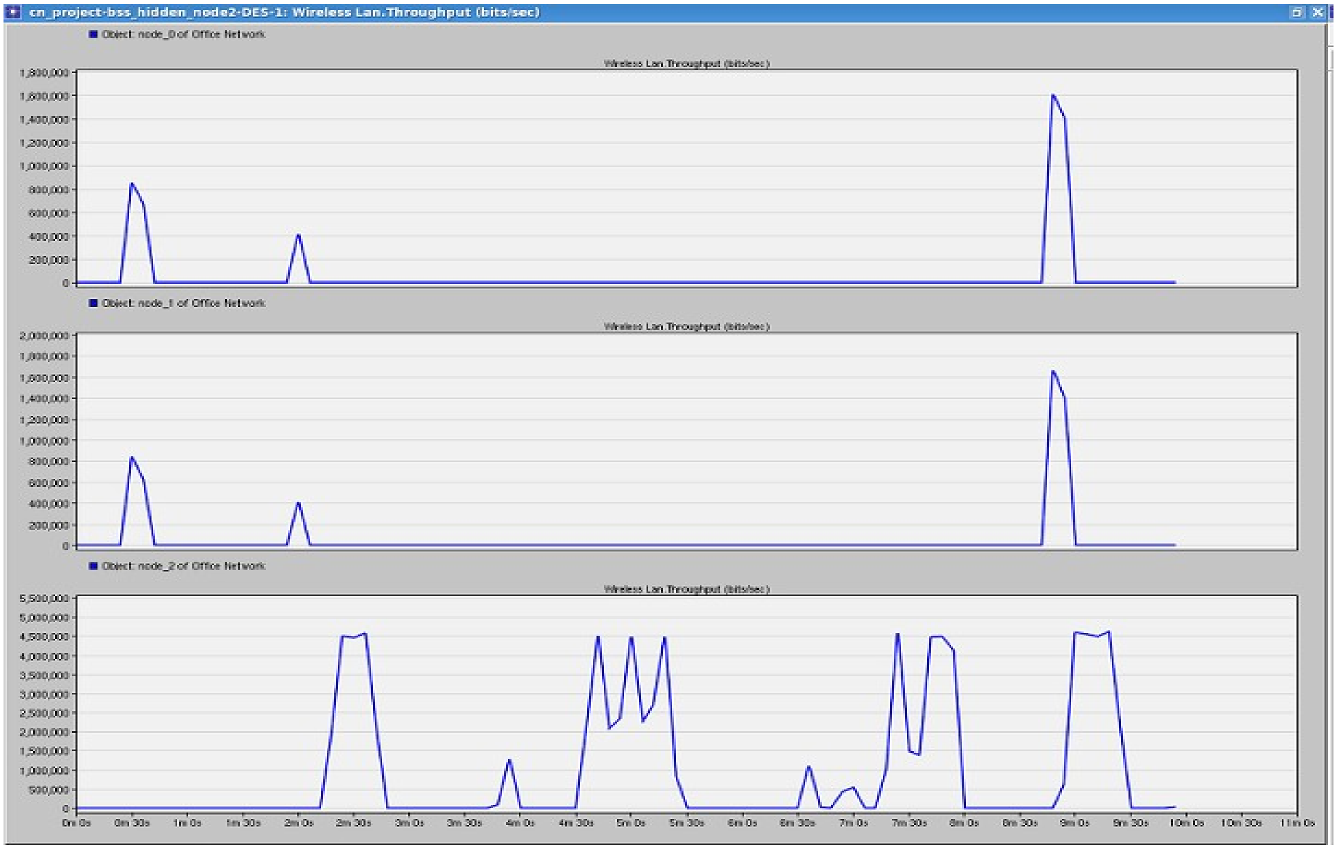
Hidden nodes: in this scenario we introduce an other node which receives the signals from the two nodes node0 and node1. The two nodes will trasmit the signal to only node2. That is the two nodes are hidden from each other. So when both the nodes try to send the signal to node2 at the same time collision may take place. This is hidden node problem.

Actual hidden node scenario:



Hidden node throughputs:

we measure the throughputs at three nodes node0,node1,node2. The following are the throughput results.



We need to change the following parameters:

RTS threshold: none

start time : exponential(10)

On state time: exponential(10)

off state time:exponential(90)

inter arrival time: exponential(0.0012)

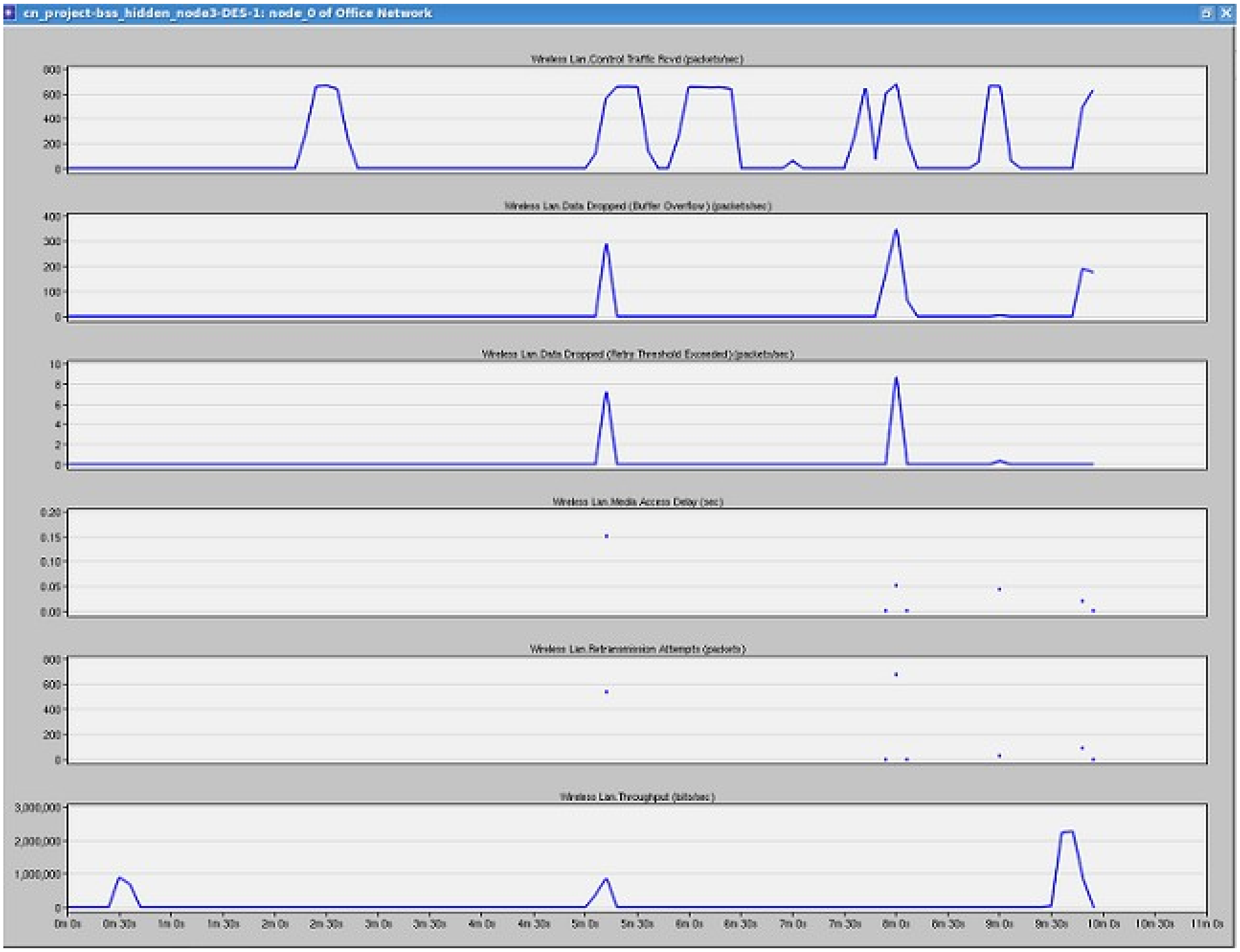
packet size(bytes): exponential(1500)

We check the following output parameters for the nodes:

1. control traffic received.
2. Data dropped(buffer overflow)(packets/second).
3. Data dropped(retry threshold)(packets/second).
4. Media access delay.
5. Retransmission attempts.
6. Throughput**.**

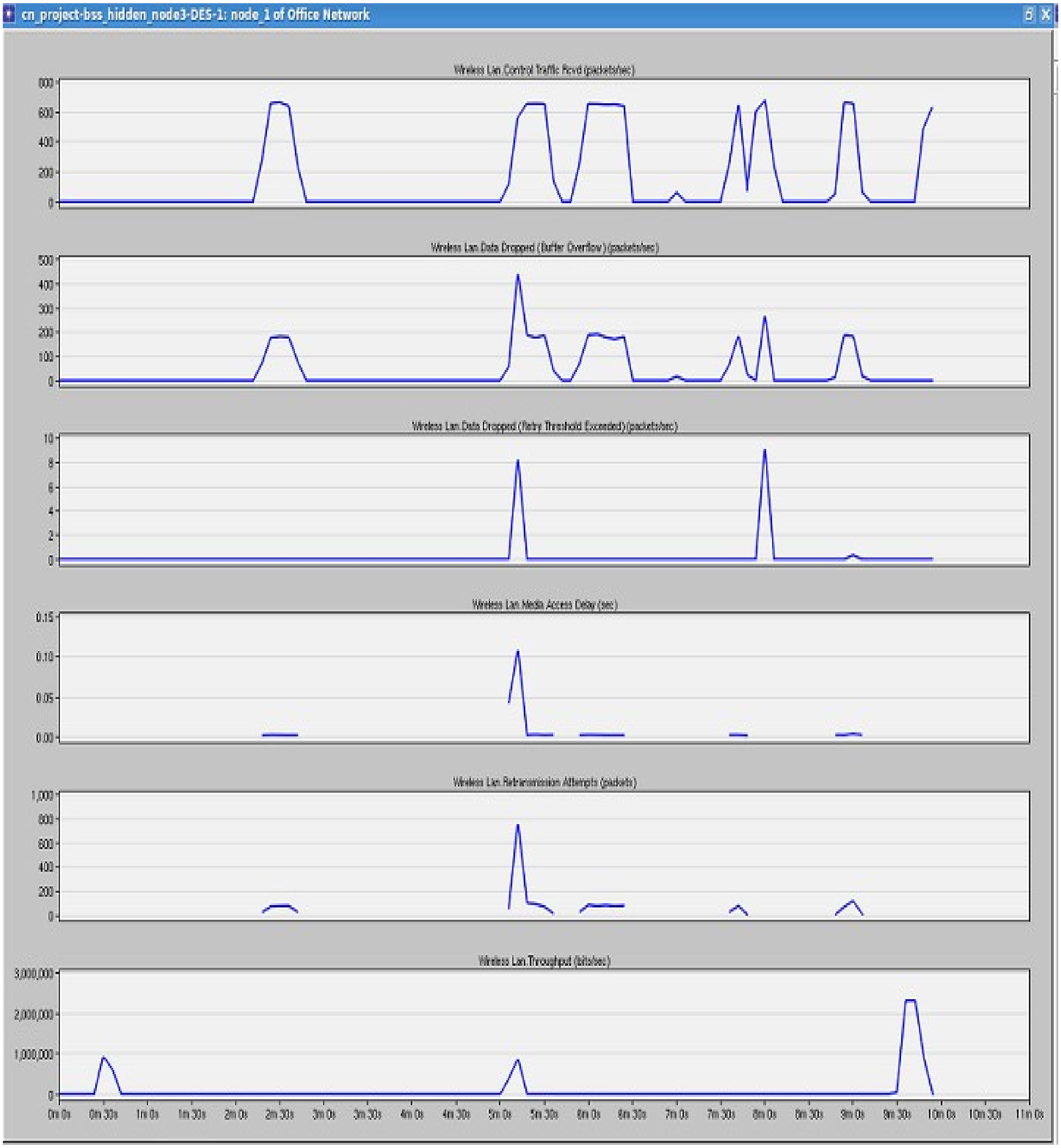
Hidden node 0:

simulation duration :10minutes


cn_project-bss_hidden_node3-DES-1: node_0 of Office Network
Wireless Lan.Control Traffic Rcvd (packets/sec)
800
600
400
200
0
Wireless Lan.Data Dropped (Buffer Overflow) (packets/sec)
400
300
200
100
0
Wireless Lan.Data Dropped (Retry Threshold Exceeded) (packets/sec)
10
8
6
4
2
0
Wireless Lan.Media Access Delay (sec)
0.20
0.15
0.10
0.05
0.00
Wireless Lan.Retransmission Attempts (packets)
800
600
400
200
0
Wireless Lan.Throughput (bits/sec)
3,000,000
2,000,000
1,000,000
0
0m 0s
0m 30s
1m 0s
1m 30s
2m 0s
2m 30s
3m 0s
3m 30s
4m 0s
4m 30s
5m 0s
5m 30s
6m 0s
6m 30s
7m 0s
7m 30s
8m 0s
8m 30s
9m 0s
9m 30s
10m 0s
10m 30s
11m 0s

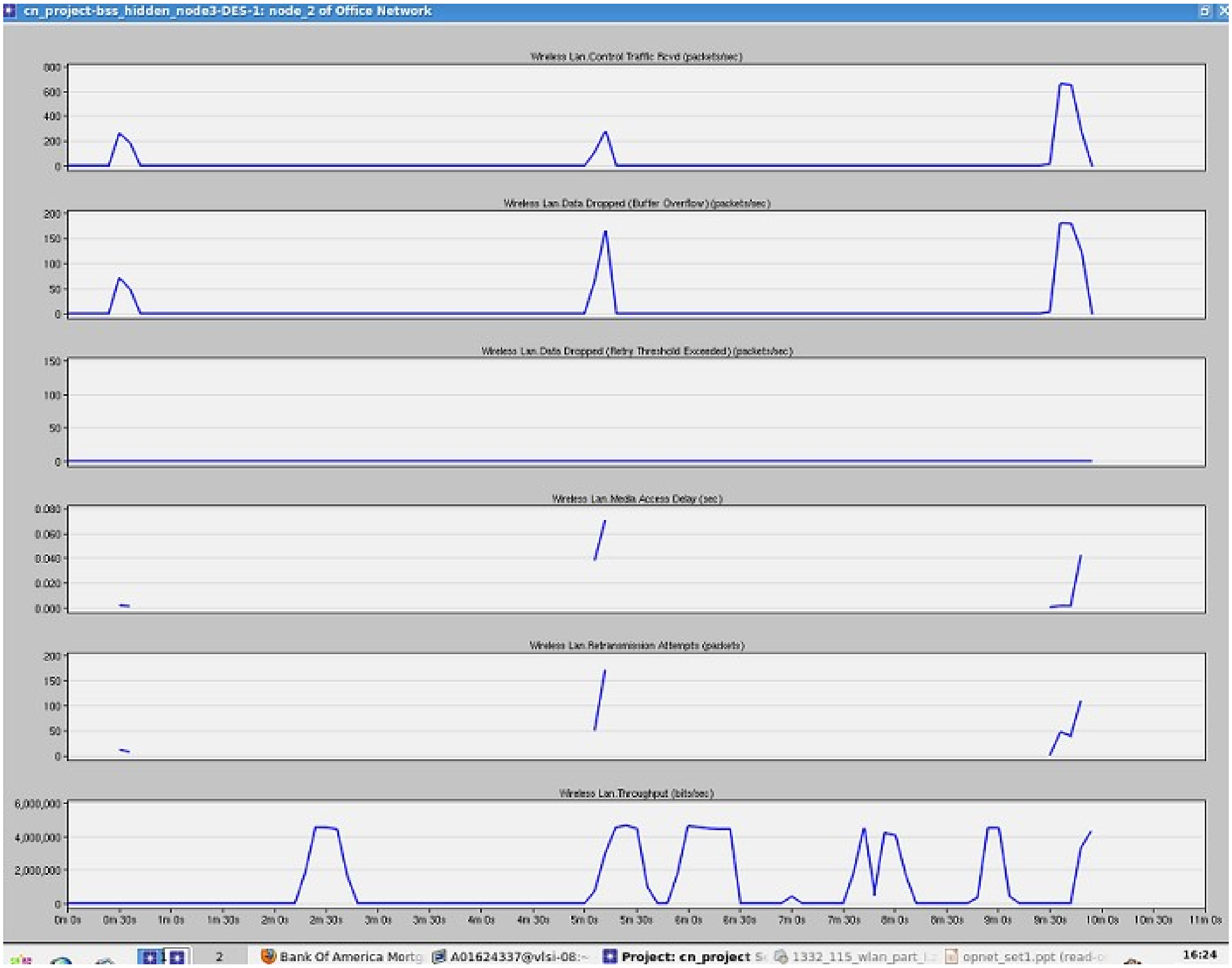
Hidden node 1:

simulation duration is 10minutes



Hidden node 2:

simulation duration is 10minutes


cn_project-bss_hidden_node3-DES-1: node_2 of Office Network
Wireless Lan.Control Traffic Rcvd (packets/sec)
800
600
400
200
0
Wireless Lan.Data Dropped (Buffer Overflow) (packets/sec)
200
150
100
50
0
Wireless Lan.Data Dropped (Retry Threshold Exceeded) (packets/sec)
150
100
50
0
Wireless Lan.Media Access Delay (sec)
0.080
0.060
0.040
0.020
0.000
Wireless Lan.Retransmission Attempts (packets)
200
150
100
50
0
Wireless Lan.Throughput (bits/sec)
6,000,000
4,000,000
2,000,000
0
0m 0s
0m 30s
1m 0s
1m 30s
2m 0s
2m 30s
3m 0s
3m 30s
4m 0s
4m 30s
5m 0s
5m 30s
6m 0s
6m 30s
7m 0s
7m 30s
8m 0s
8m 30s
9m 0s
9m 30s
10m 0s
10m 30s
11m 0s
2
Bank Of America Mortg
A01624337@vlsi-08:~
Project: cn_project S
1332_115_wlan_part_
opnet_set1.ppt (read-o
16:24

Observations from the above two nodes:

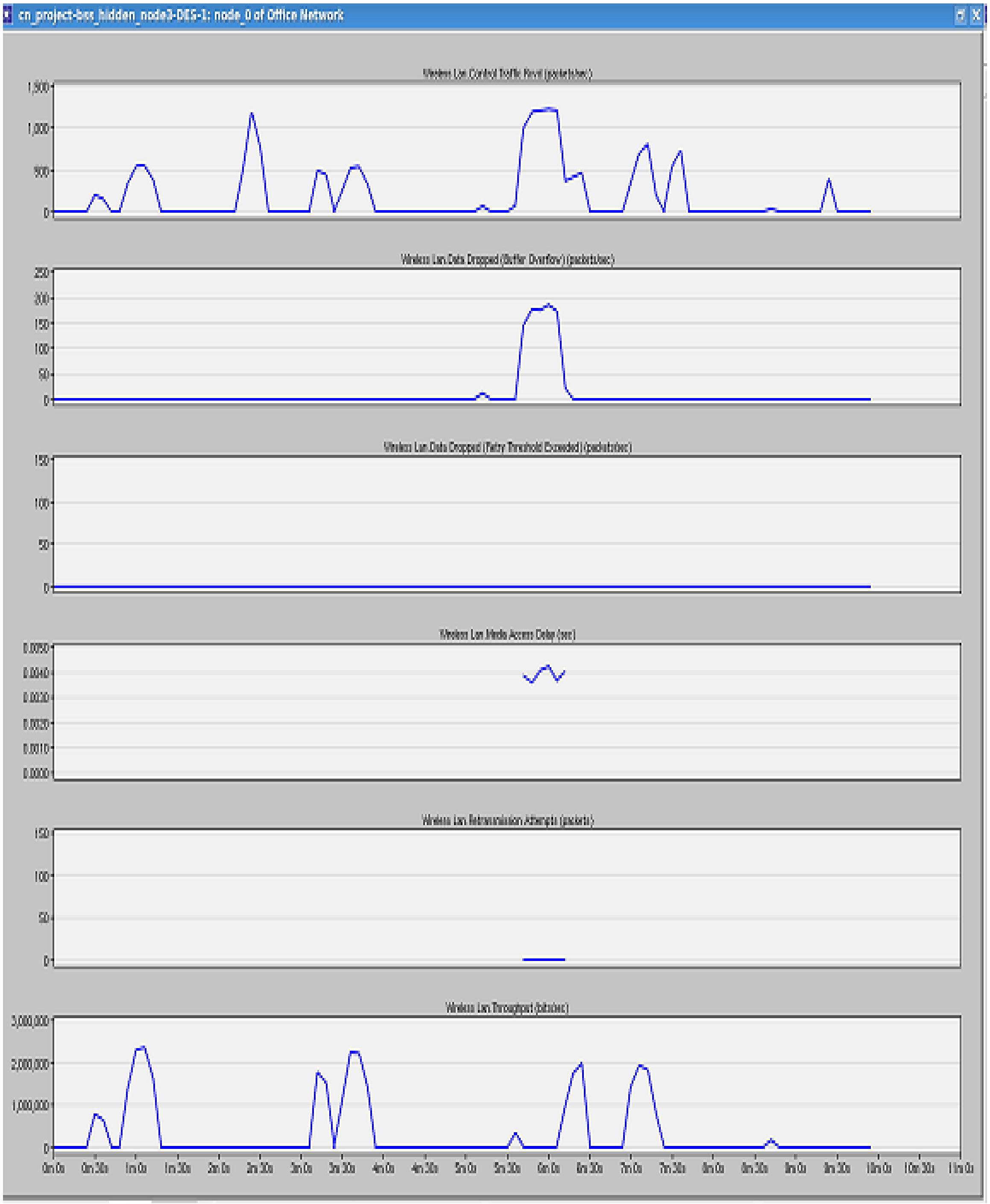
6. from the above simulation reults of the two nodes we can observe that as we are not using RTS threshold so the overhead will be less so therefore we can say that control traffic received is less.
7. We can also observe that the throughput is good because of no overhead present.
8. Media access delay is less as we are not using RTS.
9. Retransmission attempts are more.
10. Data dropped is more.

Hidden node scenario with RTS threshold 256:

RTS threshold=256
start time : exponential(10)
On state time: exponential(10)
off state time:exponential(90)
inter arrival time: exponential(0.0012)
packet size(bytes): exponential(1500)

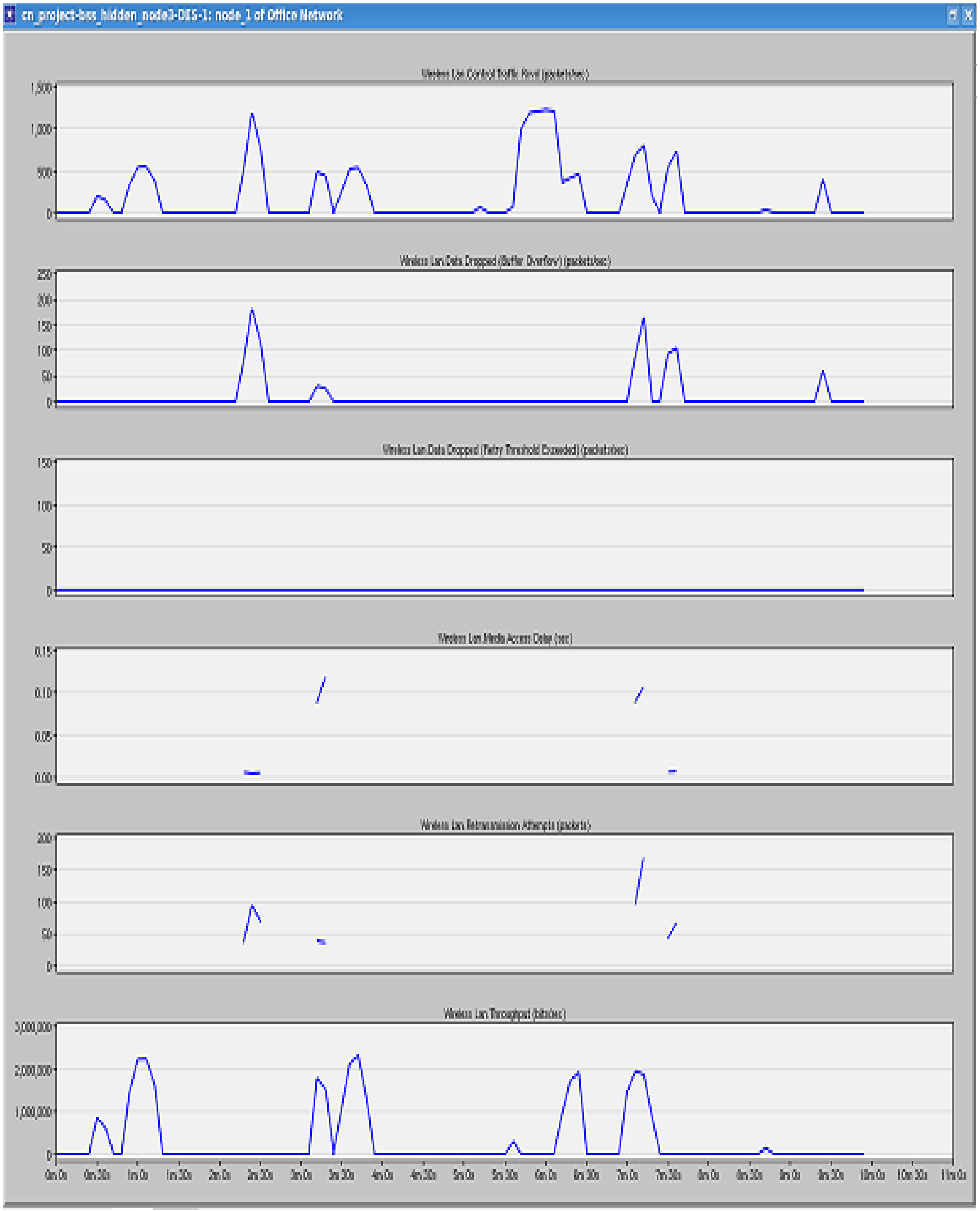
Node0:

simulation duration:10minutes.


cn_project-bss_hidden_node3-DES-1: node_0 of Office Network
Wireless Lan Control Traffic Rcvd (packets/sec)
1,500
1,000
500
0
Wireless Lan Data Dropped (Buffer Overflow) (packets/sec)
250
200
150
100
50
0
Wireless Lan Data Dropped (Retry Threshold Exceeded) (packets/sec)
150
100
50
0
Wireless Lan Media Access Delay (sec)
0.0050
0.0040
0.0030
0.0020
0.0010
0.0000
Wireless Lan Retransmission Attempts (packets)
150
100
50
0
Wireless Lan Throughput (bits/sec)
3,000,000
2,000,000
1,000,000
0
0m 0s
0m 30s
1m 0s
1m 30s
2m 0s
2m 30s
3m 0s
3m 30s
4m 0s
4m 30s
5m 0s
5m 30s
6m 0s
6m 30s
7m 0s
7m 30s
8m 0s
8m 30s
9m 0s
9m 30s
10m 0s
10m 30s
11m 0s

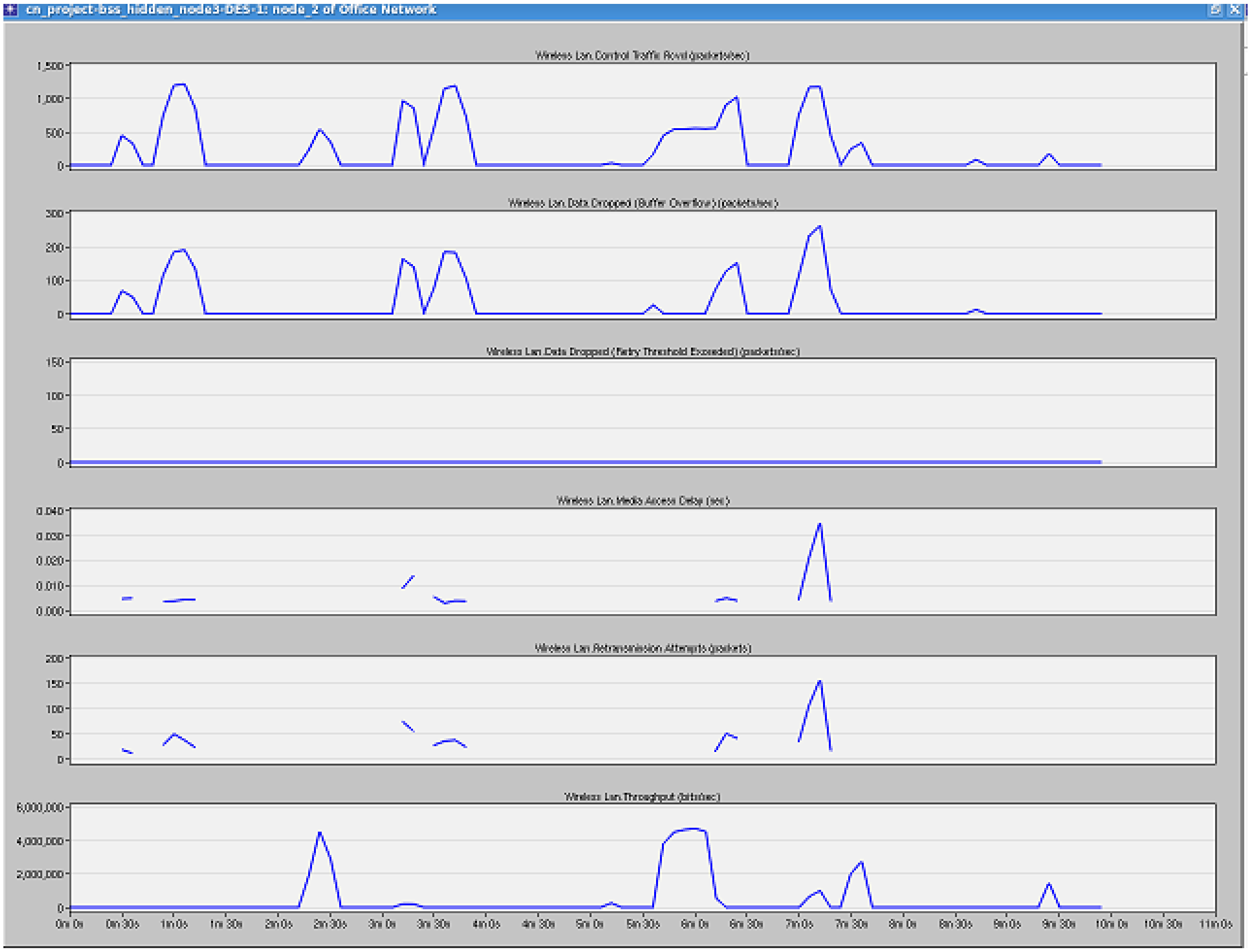
Node1:

simulation duration:10minutes


cn_project-bss_hidden_node3-DES-1: node_1 of Office Network
Wireless Lan.Control Traffic Rcvd (packets/sec)
1,500
1,000
500
0
Wireless Lan.Data Dropped (Buffer Overflow) (packets/sec)
250
200
150
100
50
0
Wireless Lan.Data Dropped (Retry Threshold Exceeded) (packets/sec)
150
100
50
0
Wireless Lan.Media Access Delay (sec)
0.15
0.10
0.05
0.00
Wireless Lan.Retransmission Attempts (packets)
200
150
100
50
0
Wireless Lan.Throughput (bits/sec)
3,000,000
2,000,000
1,000,000
0
0m 0s
0m 30s
1m 0s
1m 30s
2m 0s
2m 30s
3m 0s
3m 30s
4m 0s
4m 30s
5m 0s
5m 30s
6m 0s
6m 30s
7m 0s
7m 30s
8m 0s
8m 30s
9m 0s
9m 30s
10m 0s
10m 30s
11m 0s

Node2:

simulation duration:10minutes.


cn_project-bss_hidden_node3-DES-1: node_2 of Office Network
Wireless Lan.Control Traffic Rcvd (packets/sec)
1,500
1,000
500
0
Wireless Lan.Data Dropped (Buffer Overflow) (packets/sec)
300
200
100
0
Wireless Lan.Data Dropped (Retry Threshold Exceeded) (packets/sec)
150
100
50
0
Wireless Lan.Media Access Delay (sec)
0.040
0.030
0.020
0.010
0.000
Wireless Lan.Retransmission Attempts (packets)
200
150
100
50
0
Wireless Lan.Throughput (bits/sec)
6,000,000
4,000,000
2,000,000
0
0m 0s
0m 30s
1m 0s
1m 30s
2m 0s
2m 30s
3m 0s
3m 30s
4m 0s
4m 30s
5m 0s
5m 30s
6m 0s
6m 30s
7m 0s
7m 30s
8m 0s
8m 30s
9m 0s
9m 30s
10m 0s
10m 30s
11m 0s

Observations:

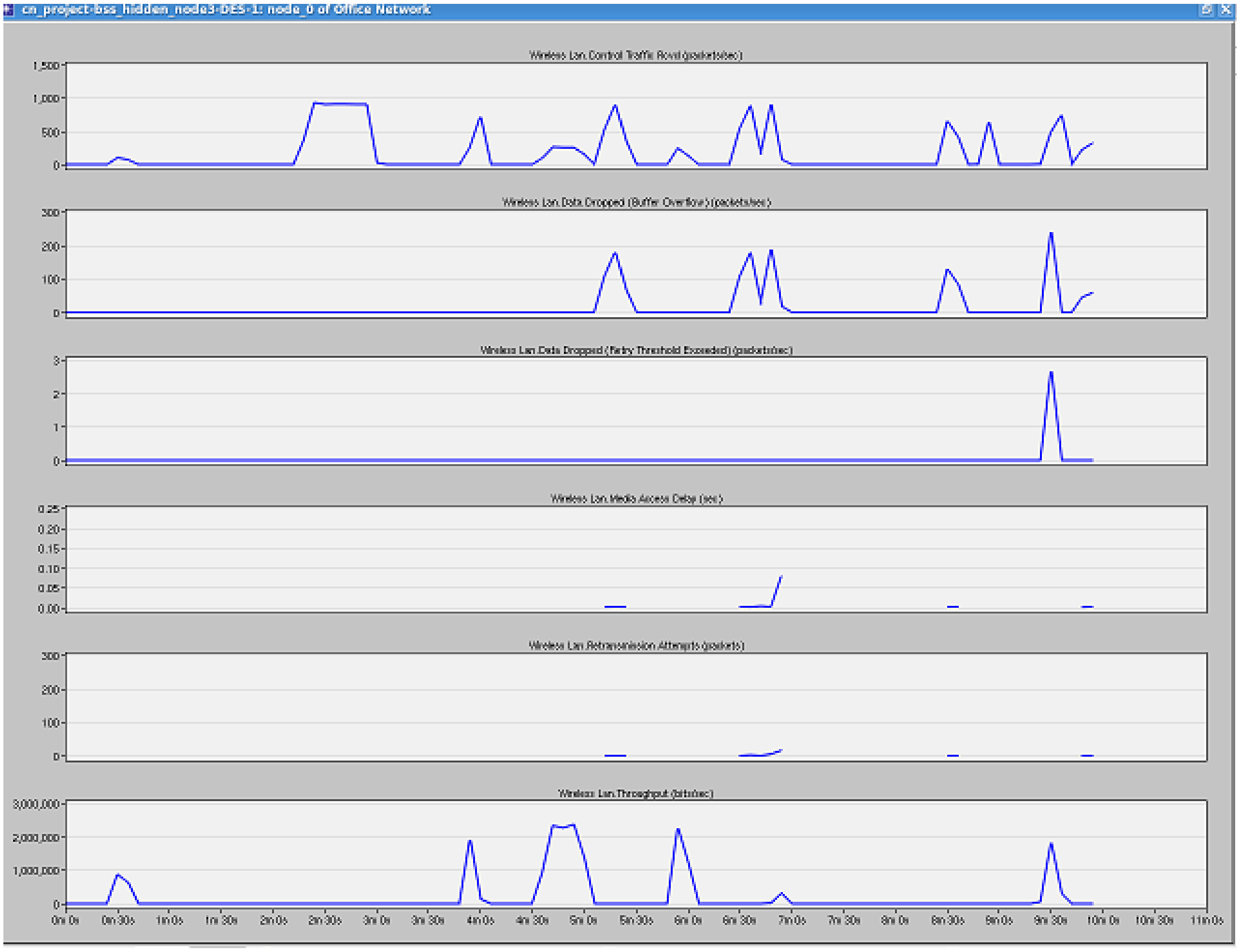
1. we can observe that because of the overhead present due to RTS threshold of 256 the control traffic received is more and the throughput is less.
2. If we increase the RTS threshold to a much higher value the throughput and control traffic will be much increased.
3. The trade of using RTS is the increasing of Media Access Delay (as shown in the following graph). Since RTS frames waiting to receive CTS (Clear-toSend) frame will take a certain period of time while data are waiting in the transmission buffer, while without using RTS, data are send immediately once it is ready to send.
4. Data dropped is less.
5. Retransmission attempts are less.

Hidden node scenario with RTS threshold 1024:

RTS threshold=1024
start time : exponential(10)
On state time: exponential(10)
off state time:exponential(90)
inter arrival time: exponential(0.0012)
packet size(bytes): exponential(1500)

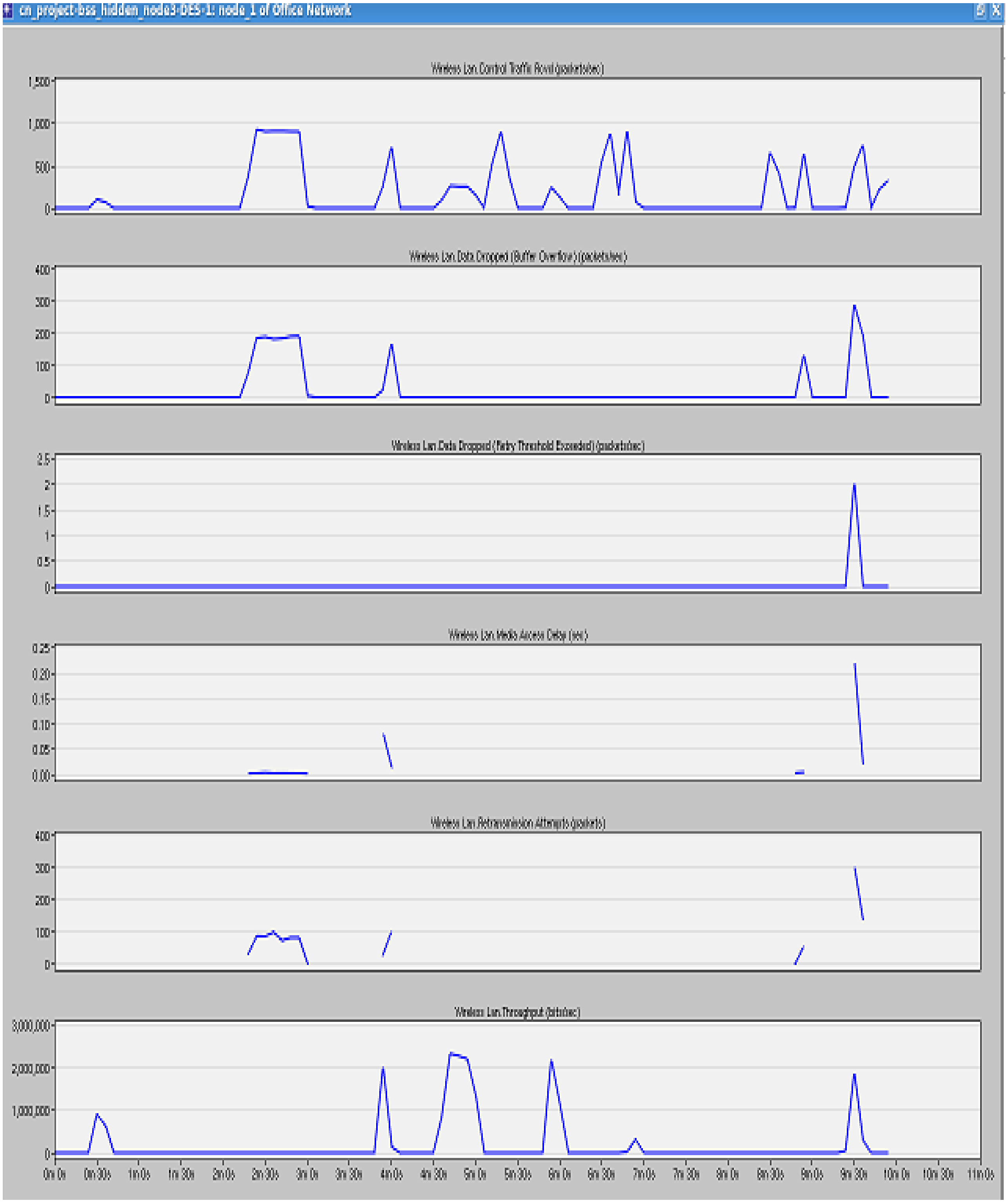
Node0:

simulation duration:10minutes


cn_project-bss_hidden_node3-DES-1: node_0 of Office Network
Wireless Lan.Control Traffic Rcvd (packets/sec)
1,500
1,000
500
0
Wireless Lan.Data Dropped (Buffer Overflow) (packets/sec)
300
200
100
0
Wireless Lan.Data Dropped (Retry Threshold Exceeded) (packets/sec)
3
2
1
0
Wireless Lan.Media Access Delay (sec)
0.25
0.20
0.15
0.10
0.05
0.00
Wireless Lan.Retransmission Attempts (packets)
300
200
100
0
Wireless Lan.Throughput (bits/sec)
3,000,000
2,000,000
1,000,000
0
0m 0s
0m 30s
1m 0s
1m 30s
2m 0s
2m 30s
3m 0s
3m 30s
4m 0s
4m 30s
5m 0s
5m 30s
6m 0s
6m 30s
7m 0s
7m 30s
8m 0s
8m 30s
9m 0s
9m 30s
10m 0s
10m 30s
11m 0s

Node1:

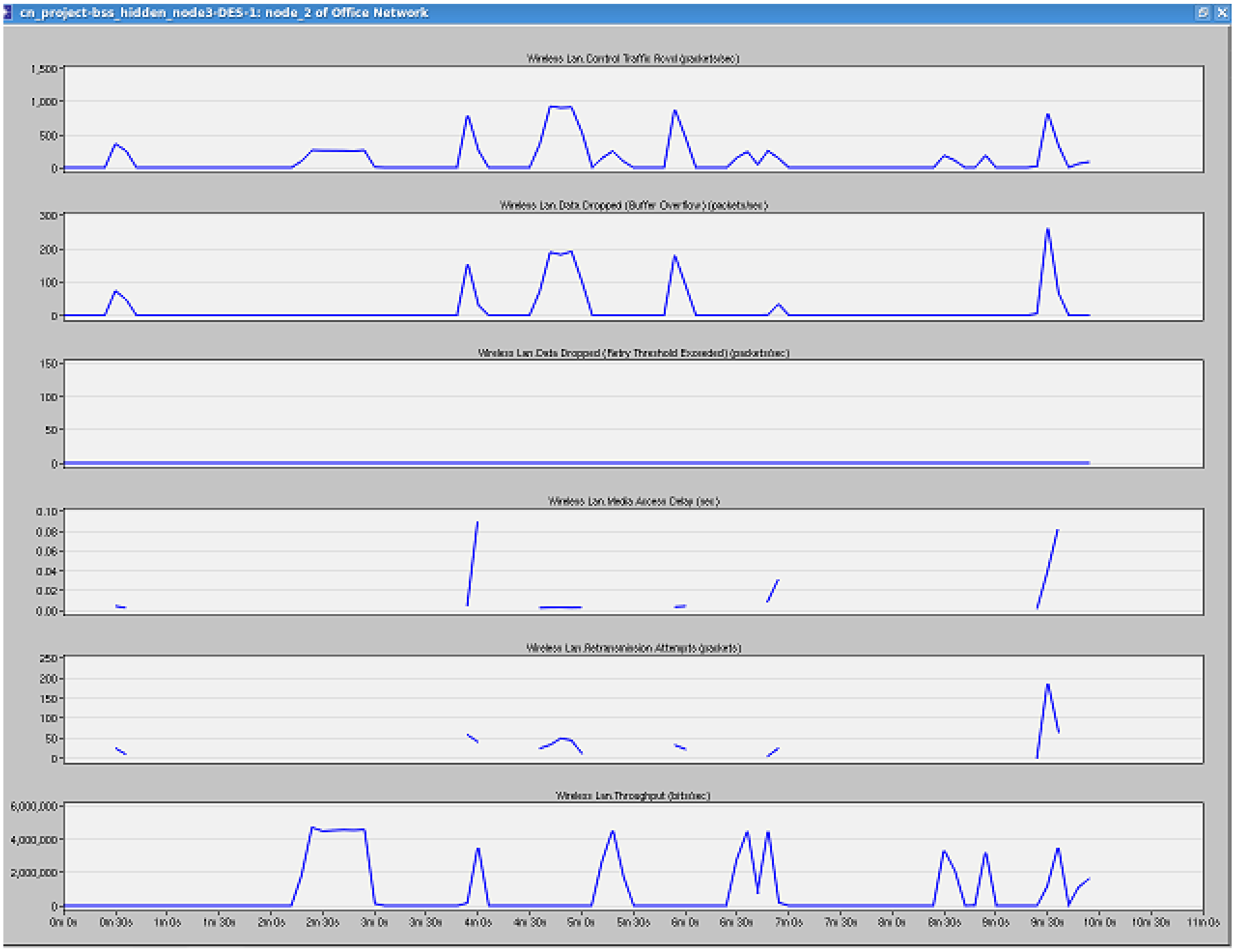
simulation duration:10minutes



cn_project-bss_hidden_node3-DES-1: node_1 of Office Network
Wireless Lan.Control Traffic Rcvd (packets/sec)
1,500
1,000
500
0
Wireless Lan.Data Dropped (Buffer Overflow) (packets/sec)
400
300
200
100
0
Wireless Lan.Data Dropped (Retry Threshold Exceeded) (packets/sec)
2.5
2
1.5
1
0.5
0
Wireless Lan.Media Access Delay (sec)
0.25
0.20
0.15
0.10
0.05
0.00
Wireless Lan.Retransmission Attempts (packets)
400
300
200
100
0
Wireless Lan.Throughput (bits/sec)
3,000,000
2,000,000
1,000,000
0
0m 0s
0m 30s
1m 0s
1m 30s
2m 0s
2m 30s
3m 0s
3m 30s
4m 0s
4m 30s
5m 0s
5m 30s
6m 0s
6m 30s
7m 0s
7m 30s
8m 0s
8m 30s
9m 0s
9m 30s
10m 0s
10m 30s
11m 0s

Node2:

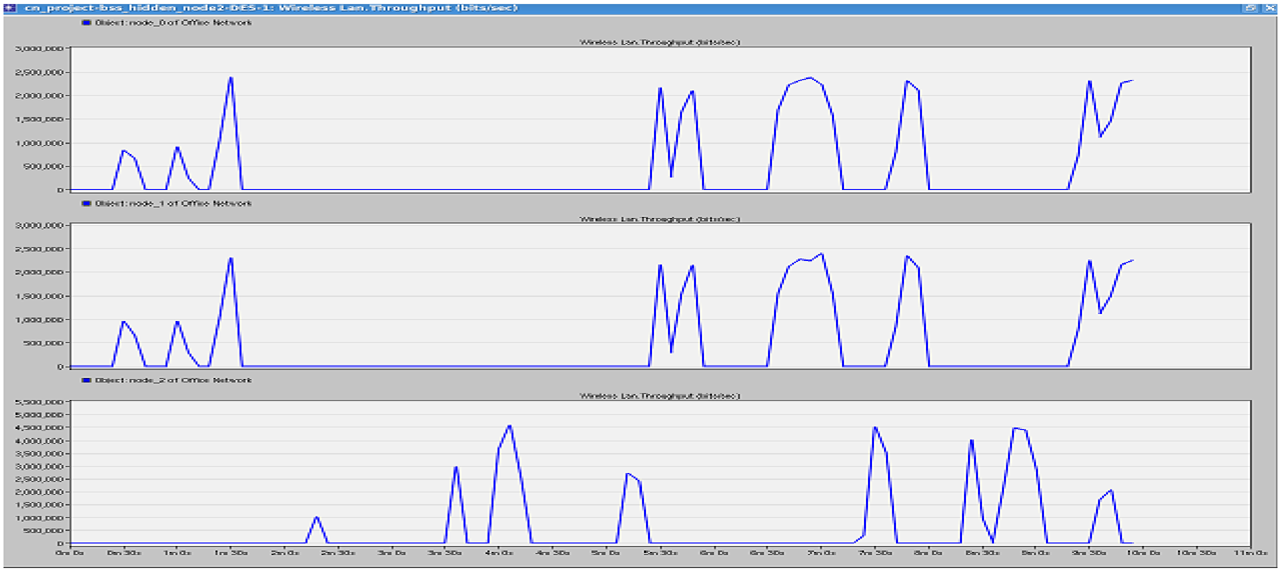
simulation duration:10minutes



Observations:

1. Because we increased the overhead bits the control traffic is much increased and the throughput is much reduced.
2. The trade of using RTS is the increasing of Media Access Delay (as shown in the following graph). Since RTS frames waiting to receive CTS (Clear-toSend) frame will take a certain period of time while data are waiting in the transmission buffer, while without using RTS, data are send immediately once it is ready to send.
3. Data dropped is less.
4. Retransmission attempts are less.

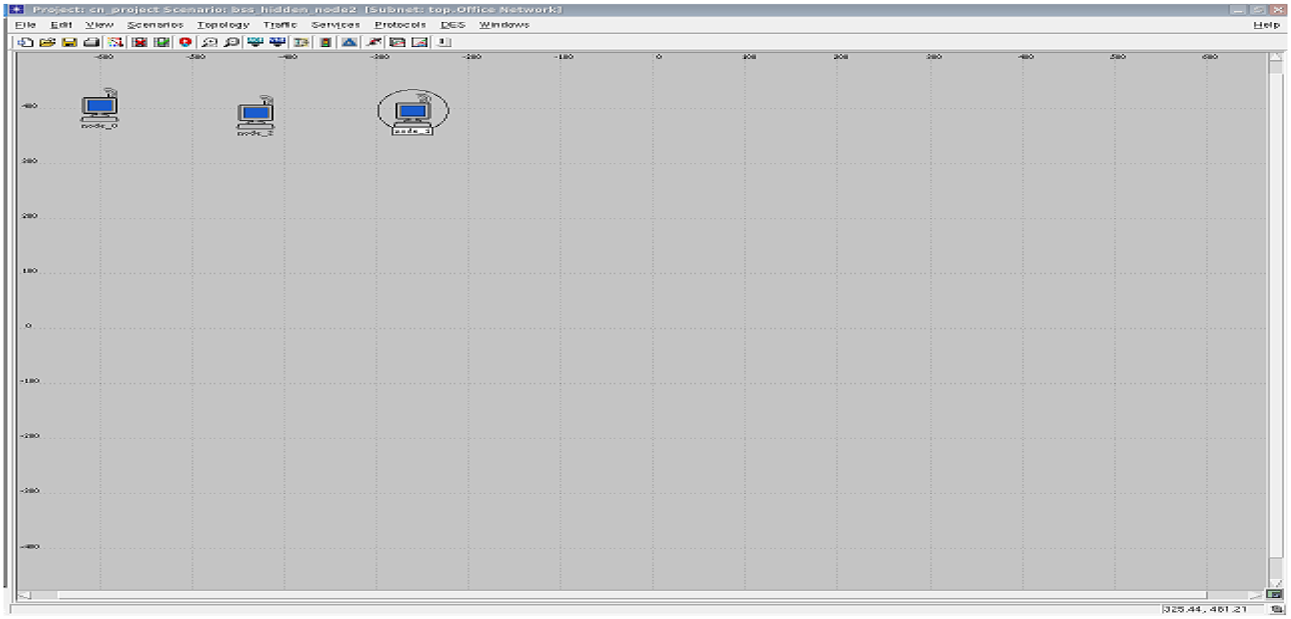
Hidden node scenario throughputs considering RTS threshold:



Case3: No Hidden Node Scenario

No hidden node: in this scenario there wont be any hidden nodes. That is node1 and node0 will transmit the data to node2 only but they are not hidden from each other. Node1 will know that there is a node called node0 which is also transmitting the signals to node2, similarly node0 knows that node1 is also transmitting the signals to node2. So there wont be any collision problems present.

No hidden scenario:

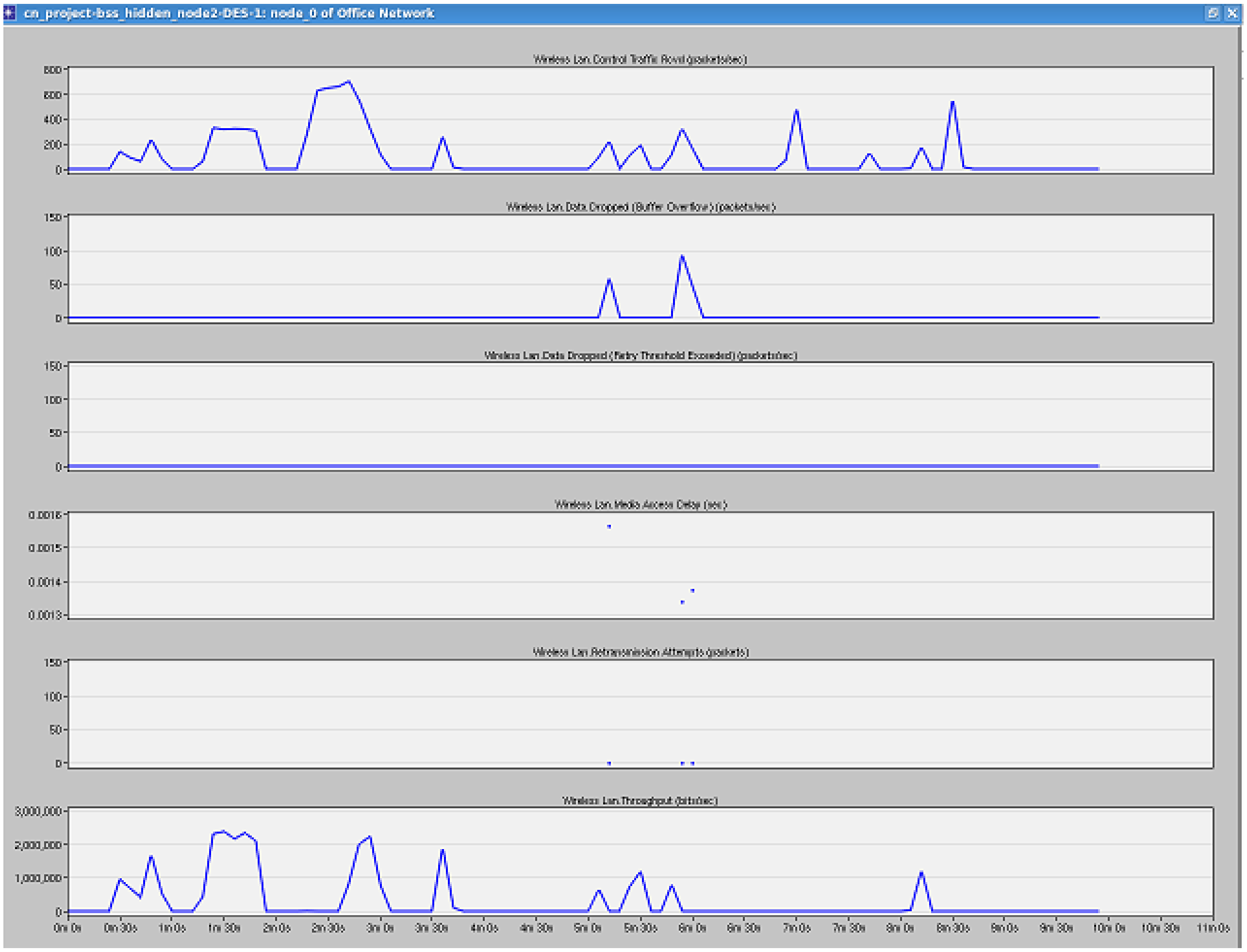


The following are the attributes we need to change:
RTS threshold=none
start time : exponential(10)
On state time: exponential(10)
off state time:exponential(90)
inter arrival time: exponential(0.0012)
packet size(bytes): exponential(1500)

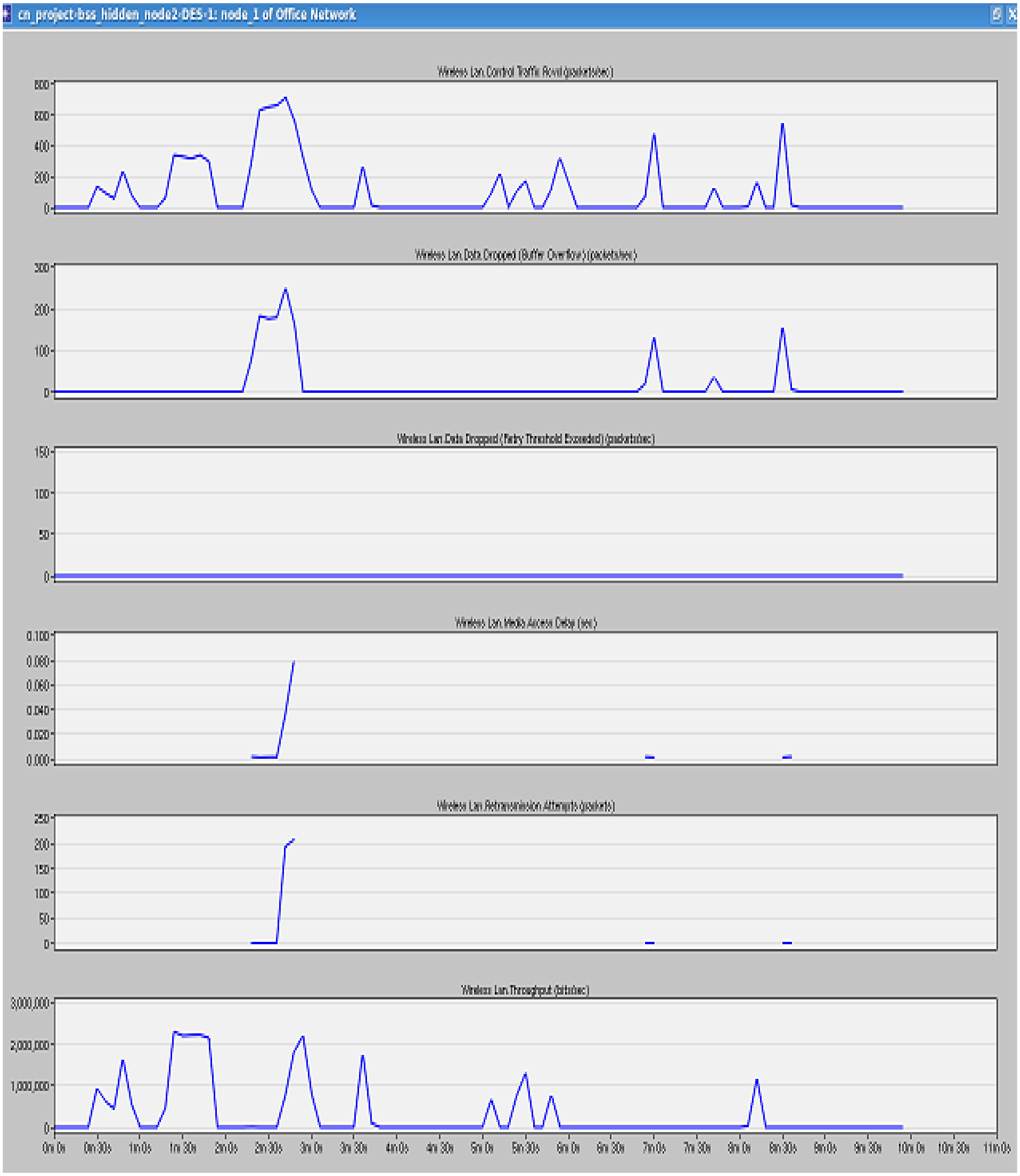
The following are the output parameters we are interested in:

1. control traffic received.
2. Data dropped(buffer overflow)(packets/second).
3. Data dropped(retry threshold)(packets/second).
4. Media access delay.
5. Retransmission attempts.
6. Throughput**.**

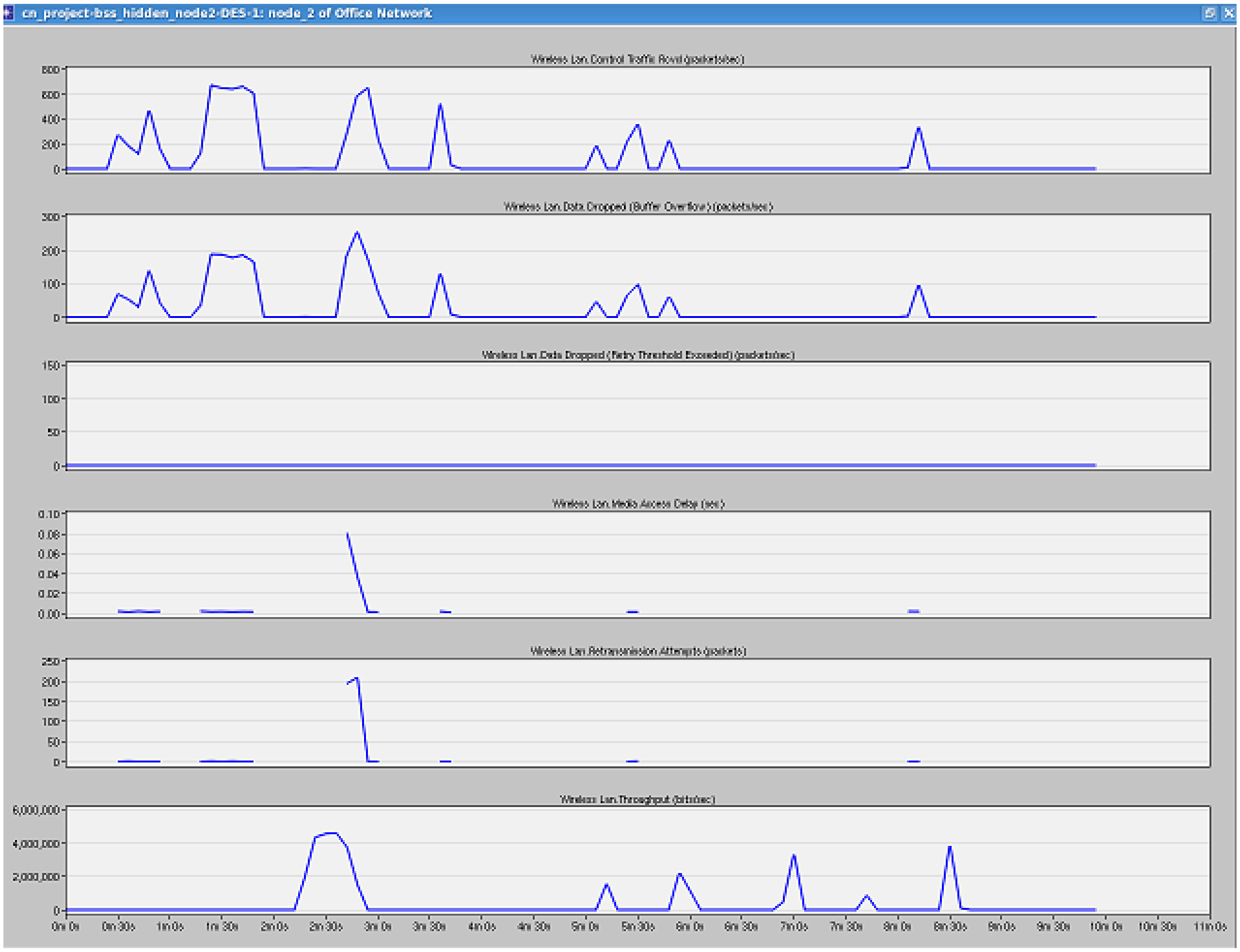
Node0:simulation duration is 10mins


cn_project-bss_hidden_node2-DES-1: node_0 of Office Network
Wireless Lan.Control Traffic Rcvd (packets/sec)
800
600
400
200
0
Wireless Lan.Data Dropped (Buffer Overflow) (packets/sec)
150
100
50
0
Wireless Lan.Data Dropped (Retry Threshold Exceeded) (packets/sec)
150
100
50
0
Wireless Lan.Media Access Delay (sec)
0.0016
0.0015
0.0014
0.0013
Wireless Lan.Retransmission Attempts (packets)
150
100
50
0
Wireless Lan.Throughput (bits/sec)
3,000,000
2,000,000
1,000,000
0
0m 0s
0m 30s
1m 0s
1m 30s
2m 0s
2m 30s
3m 0s
3m 30s
4m 0s
4m 30s
5m 0s
5m 30s
6m 0s
6m 30s
7m 0s
7m 30s
8m 0s
8m 30s
9m 0s
9m 30s
10m 0s
10m 30s
11m 0s

Node1:simulation duration is 10mins



Node2:simulation duration is 10mins



Observations from the above two nodes:

1. From the above simulation results of the two nodes we can observe that as we are not using RTS threshold so the overhead will be less so therefore we can say that control traffic received is less.
2. We can also observe that the throughput is good because of no overhead present.
3. Media access delay is less as we are not using RTS.
4. Retransmission attempts are more.
5. Data dropped is more.

No hidden node scenario with RTS threshold of 256:

The following are the attributes we need to change:

RTS threshold=256

start time : exponential(10)

On state time: exponential(10)

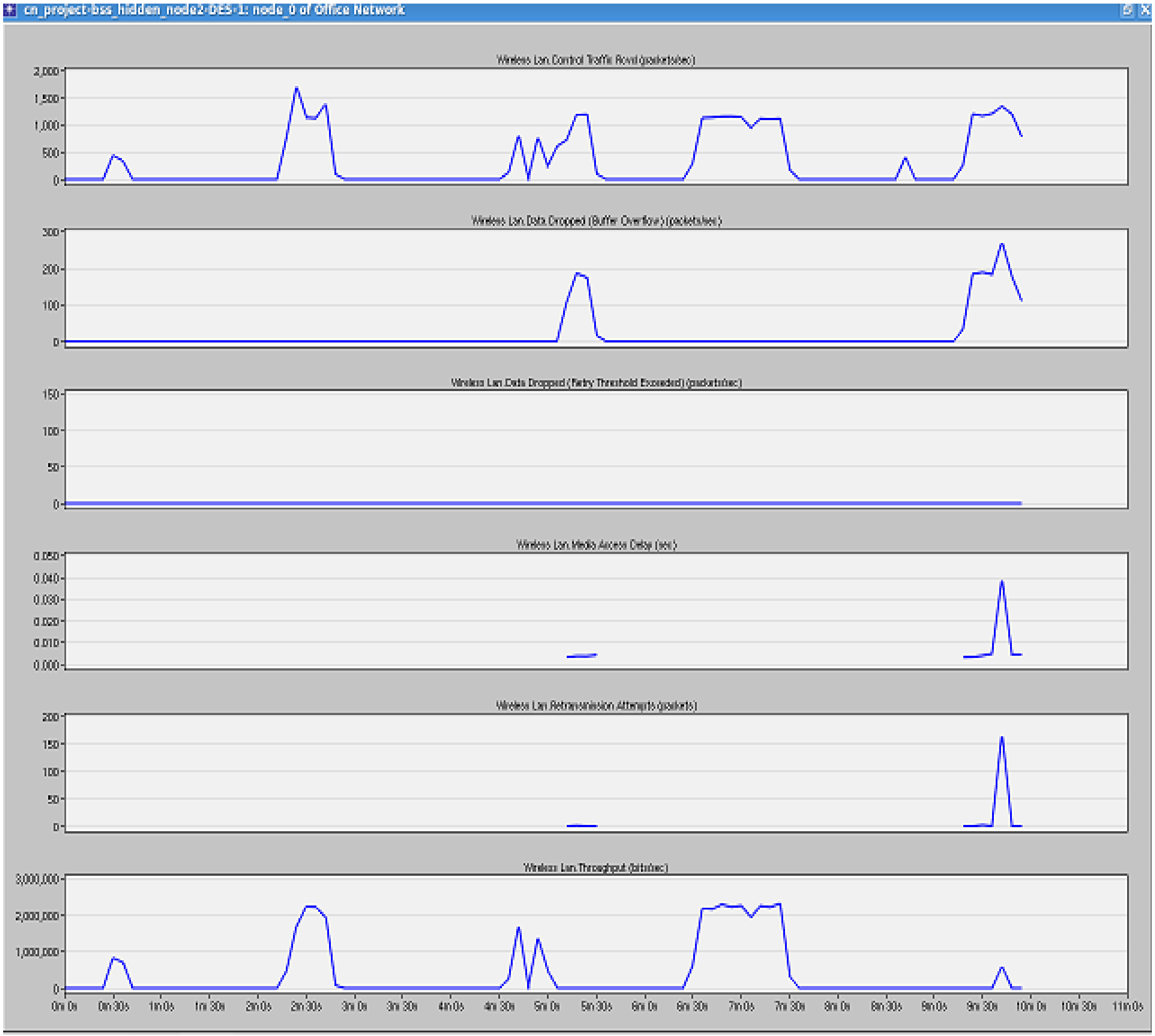
off state time:exponential(90)

inter arrival time: exponential(0.0012)

packet size(bytes): exponential(1500)

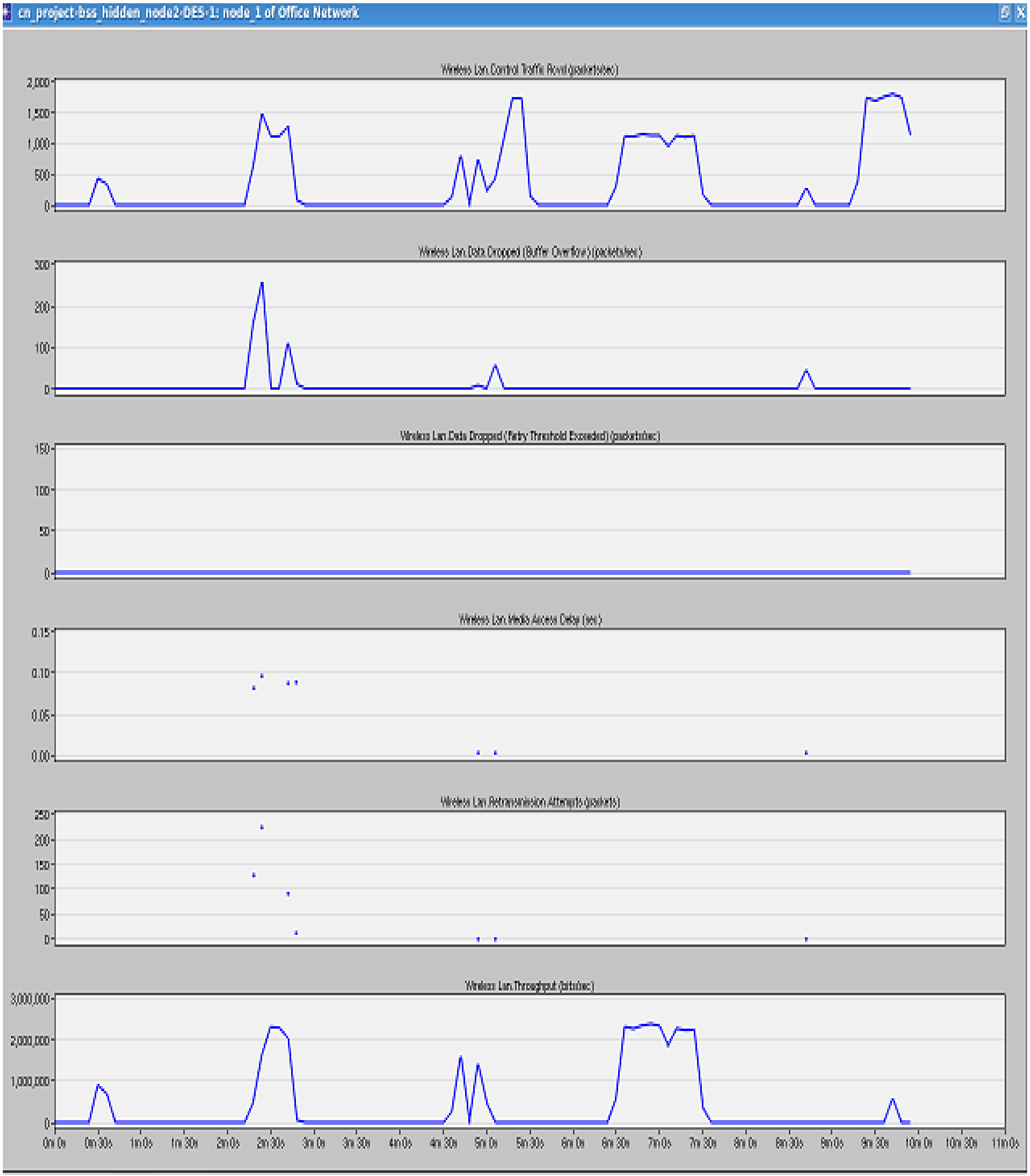
Node0:

simulation duration is 10minutes

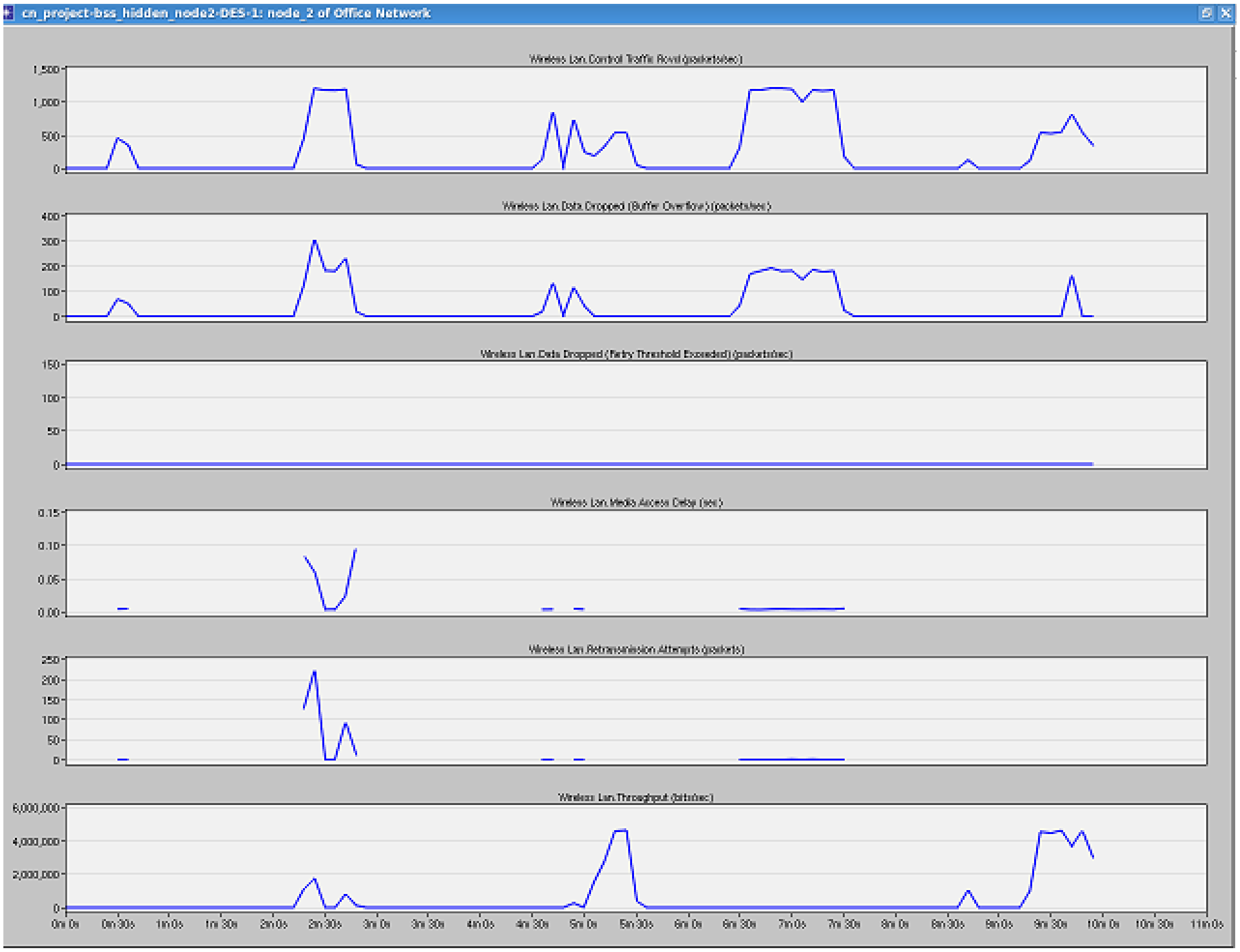


Node1:

simulation duration is 10minutes


cn_project-bss_hidden_node2-DES-1: node_1 of Office Network
Wireless Lan.Control Traffic Rcvd (packets/sec)
2,000
1,500
1,000
500
0
Wireless Lan.Data Dropped (Buffer Overflow) (packets/sec)
300
200
100
0
Wireless Lan.Data Dropped (Retry Threshold Exceeded) (packets/sec)
150
100
50
0
Wireless Lan.Media Access Delay (sec)
0.15
0.10
0.05
0.00
Wireless Lan.Retransmission Attempts (packets)
250
200
150
100
50
0
Wireless Lan.Throughput (bits/sec)
3,000,000
2,000,000
1,000,000
0
0m 0s
0m 30s
1m 0s
1m 30s
2m 0s
2m 30s
3m 0s
3m 30s
4m 0s
4m 30s
5m 0s
5m 30s
6m 0s
6m 30s
7m 0s
7m 30s
8m 0s
8m 30s
9m 0s
9m 30s
10m 0s
10m 30s
11m 0s

Node2: simulation duration is 10minutes



Observations:

1. we can observe that because of the overhead present due to RTS threshold of 256 the control traffic received is more and the throughput is less.
2. If we increase the RTS threshold to a much higher value the throughput and control traffic will be much increased.
3. The trade of using RTS is the increasing of Media Access Delay (as shown in the following graph). Since RTS frames waiting to receive CTS (Clear-toSend) frame will take a certain period of time while data are waiting in the transmission buffer, while without using RTS, data are send immediately once it is ready to send.
4. Data dropped is less.
5. Retransmission attempts are less.

No hidden node scenario with RTS threshold of 1024:

The following are the attributes we need to change:

RTS threshold=none

start time : exponential(10)

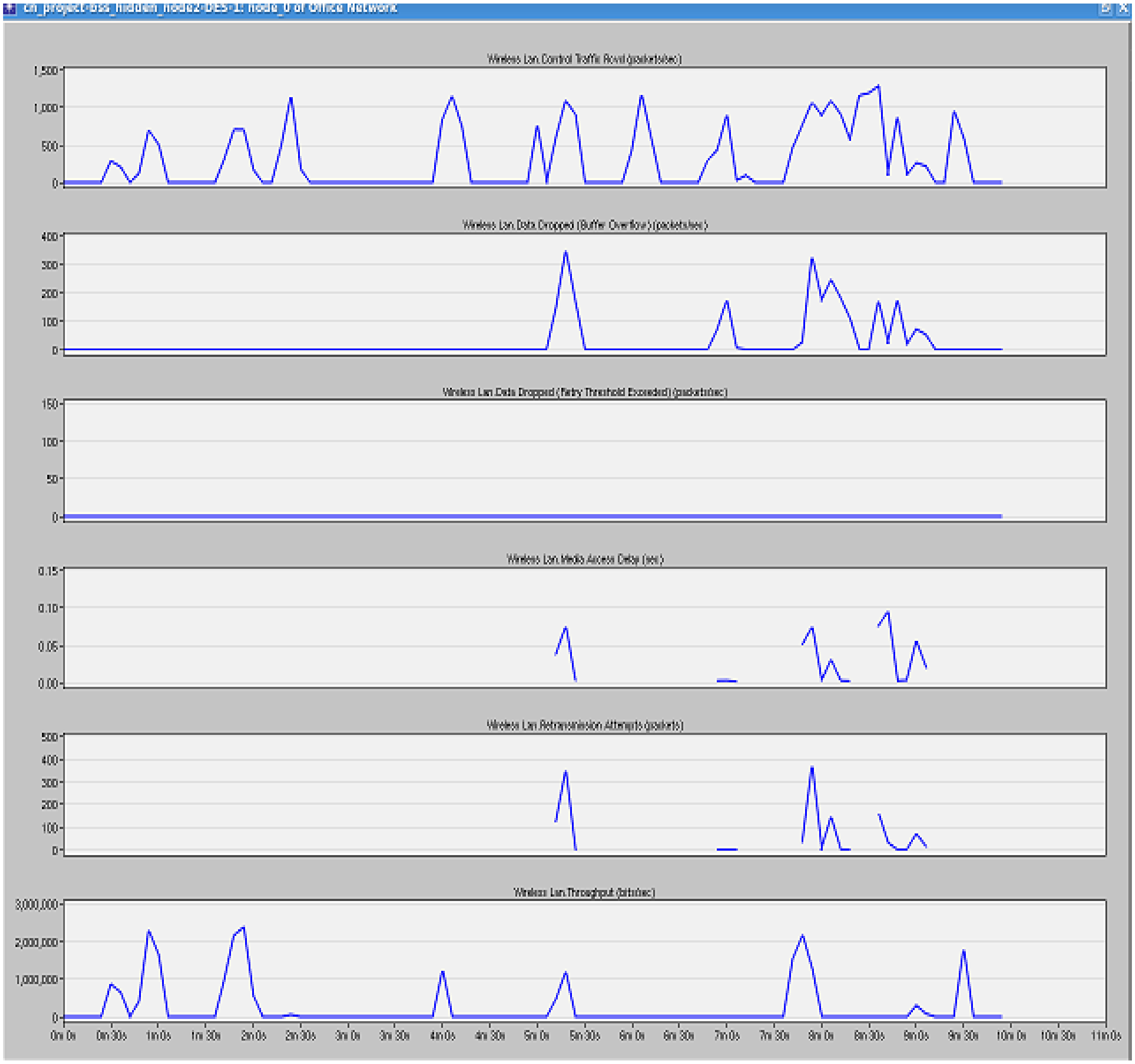
On state time: exponential(10)

off state time:exponential(90)

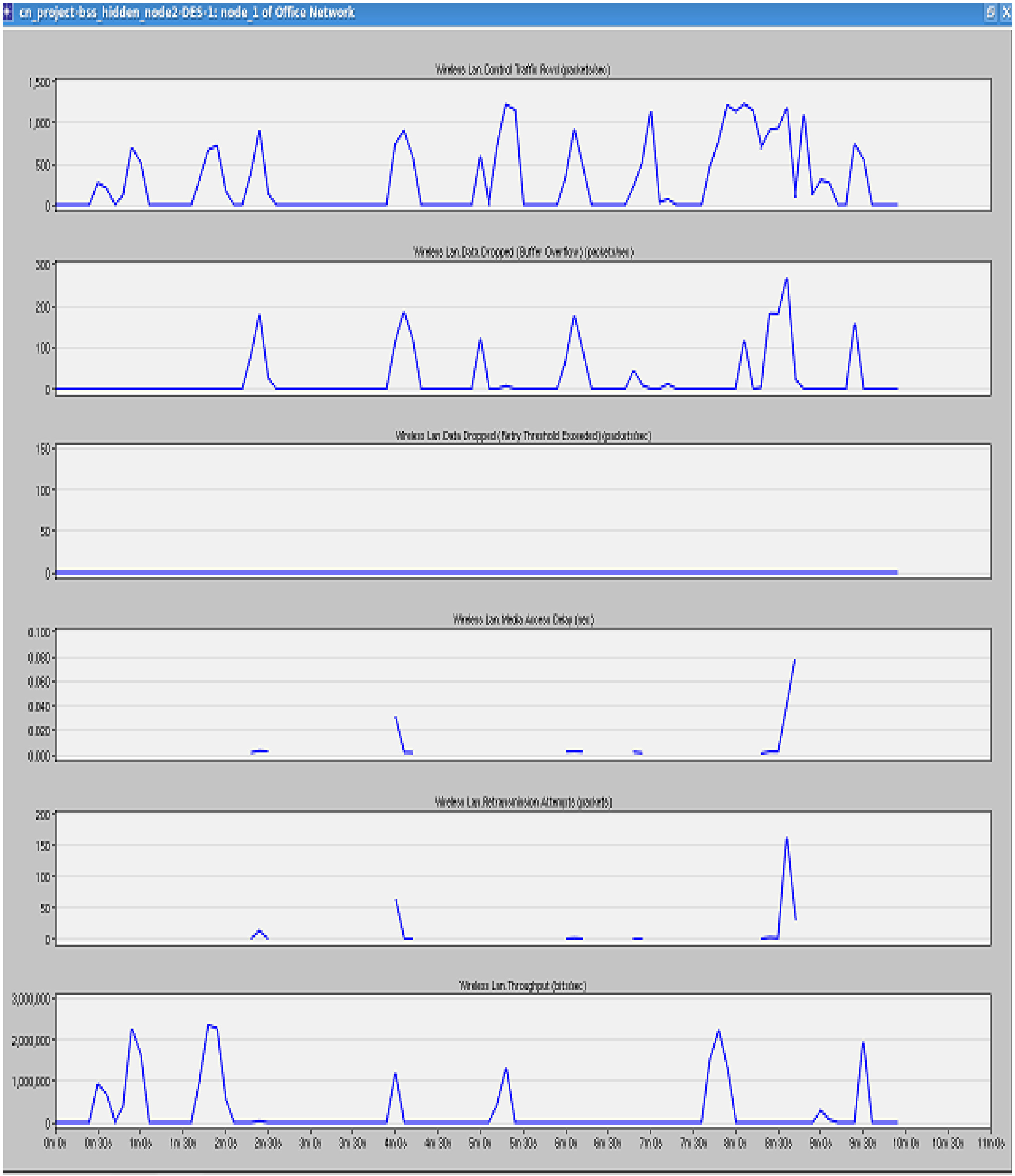
inter arrival time: exponential(0.0012)

packet size(bytes): exponential(1500)

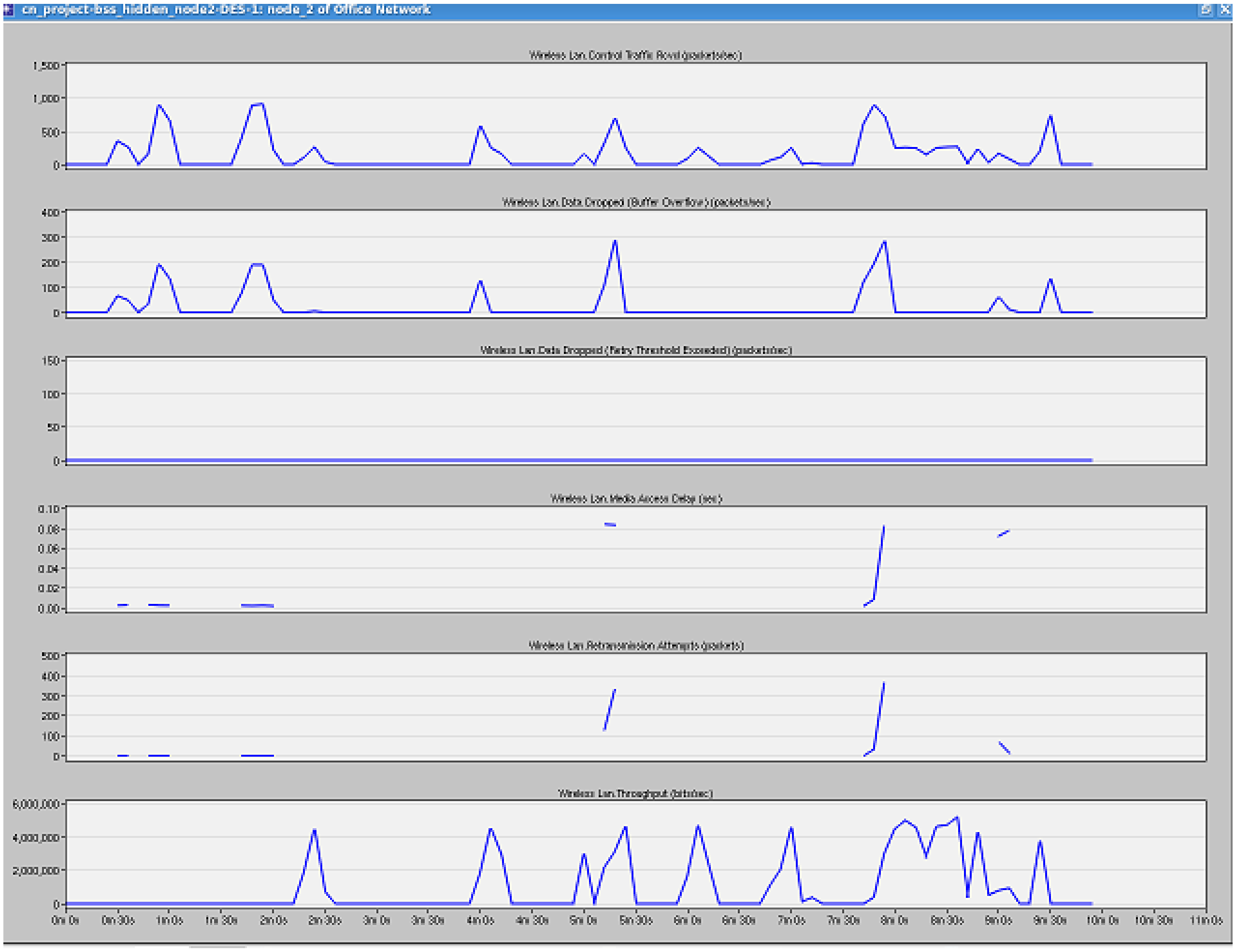
Node0:



Node1:


cn_project-bss_hidden_node2-DES-1: node_1 of Office Network
Wireless Lan.Control Traffic Rcvd (packets/sec)
1,500
1,000
500
0
Wireless Lan.Data Dropped (Buffer Overflow) (packets/sec)
300
200
100
0
Wireless Lan.Data Dropped (Retry Threshold Exceeded) (packets/sec)
150
100
50
0
Wireless Lan.Media Access Delay (sec)
0.100
0.080
0.060
0.040
0.020
0.000
Wireless Lan.Retransmission Attempts (packets)
200
150
100
50
0
Wireless Lan.Throughput (bits/sec)
3,000,000
2,000,000
1,000,000
0
0m 0s
0m 30s
1m 0s
1m 30s
2m 0s
2m 30s
3m 0s
3m 30s
4m 0s
4m 30s
5m 0s
5m 30s
6m 0s
6m 30s
7m 0s
7m 30s
8m 0s
8m 30s
9m 0s
9m 30s
10m 0s
10m 30s
11m 0s

Node2:

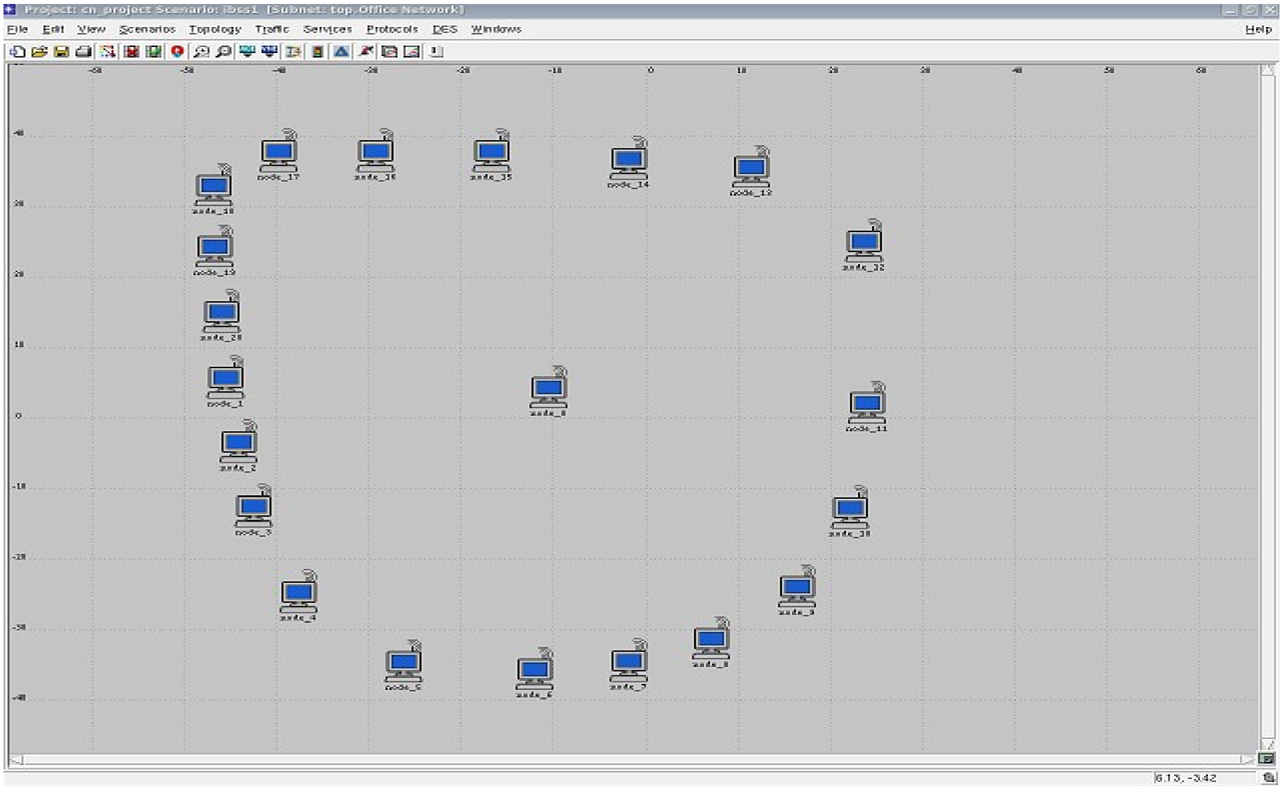


observations:

1. Because we increased the overhead bits the control traffic is much increased and the throughput is much reduced.
2. The trade of using RTS is the increasing of Media Access Delay (as shown in the following graph). Since RTS frames waiting to receive CTS (Clear-toSend) frame will take a certain period of time while data are waiting in the transmission buffer, while without using RTS, data are send immediately once it is ready to send.
3. Data dropped is less.
4. Retransmission attempts are less.

IBSS simulation

IBSS scenario:



In this scenario we take 20 nodes as the work stations and one node as the access point. These 20nodes will communicate with each other using this access point.

we change the following parameters:

configuration at the access point:

start time: exponential(10)

access point functionality:enabled.

PCF functionality:enabled.

Configuration at Distributed coordinated function node:

start time: exponential(10)

On state time:exponential(10)

Off state time:exponential(90)

interarrival time:exponential(0.0012)

Packet size(bytes):exponential(1500)

access point functionality :disabled.

Configuration at point coordinated function node:

start time: exponential(10)

On state time:exponential(10)

Off state time:exponential(90)

interarrival time:exponential(0.0012)

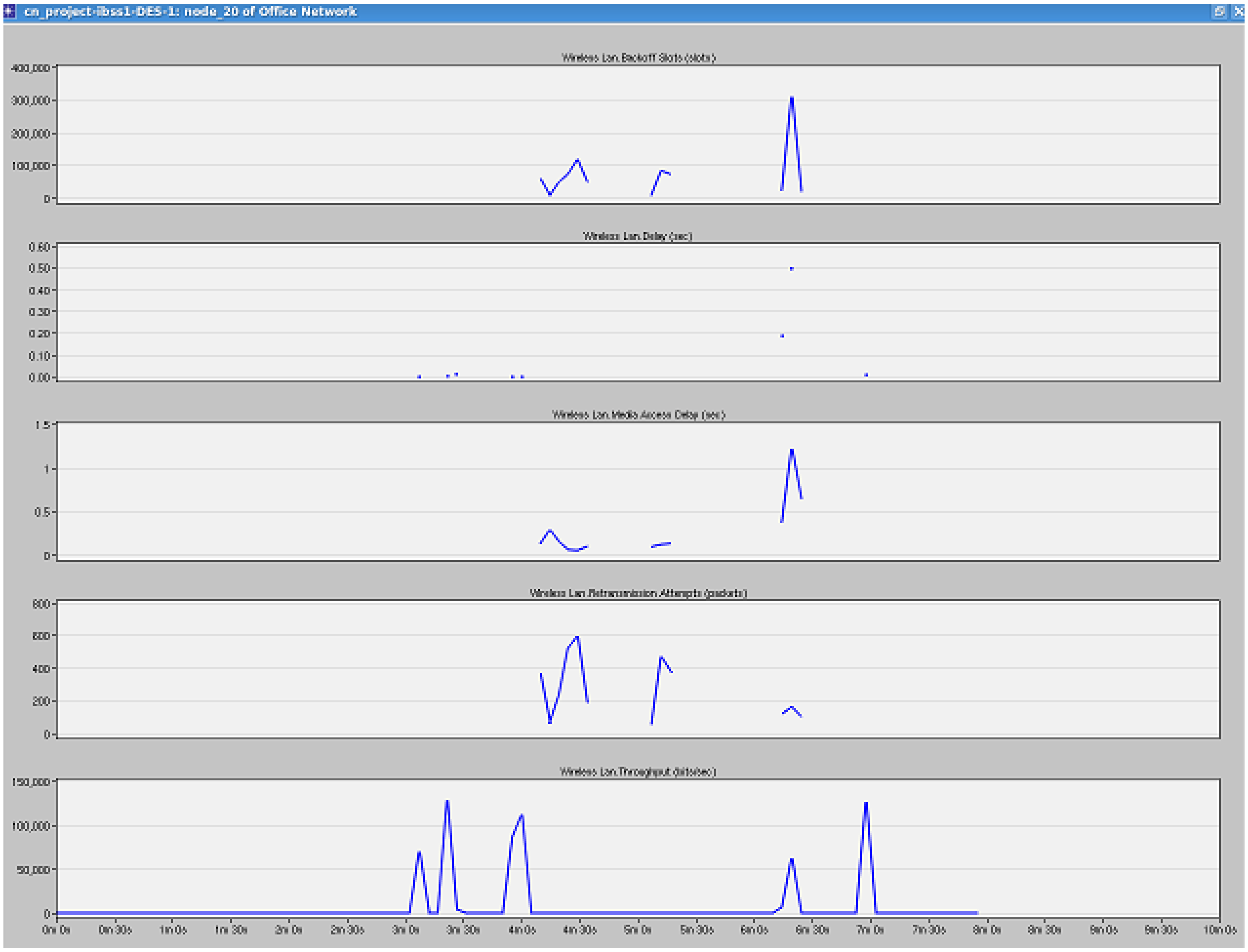
Packet size(bytes):exponential(1500)

access point functionality :disabled.
PCF function:enabled.

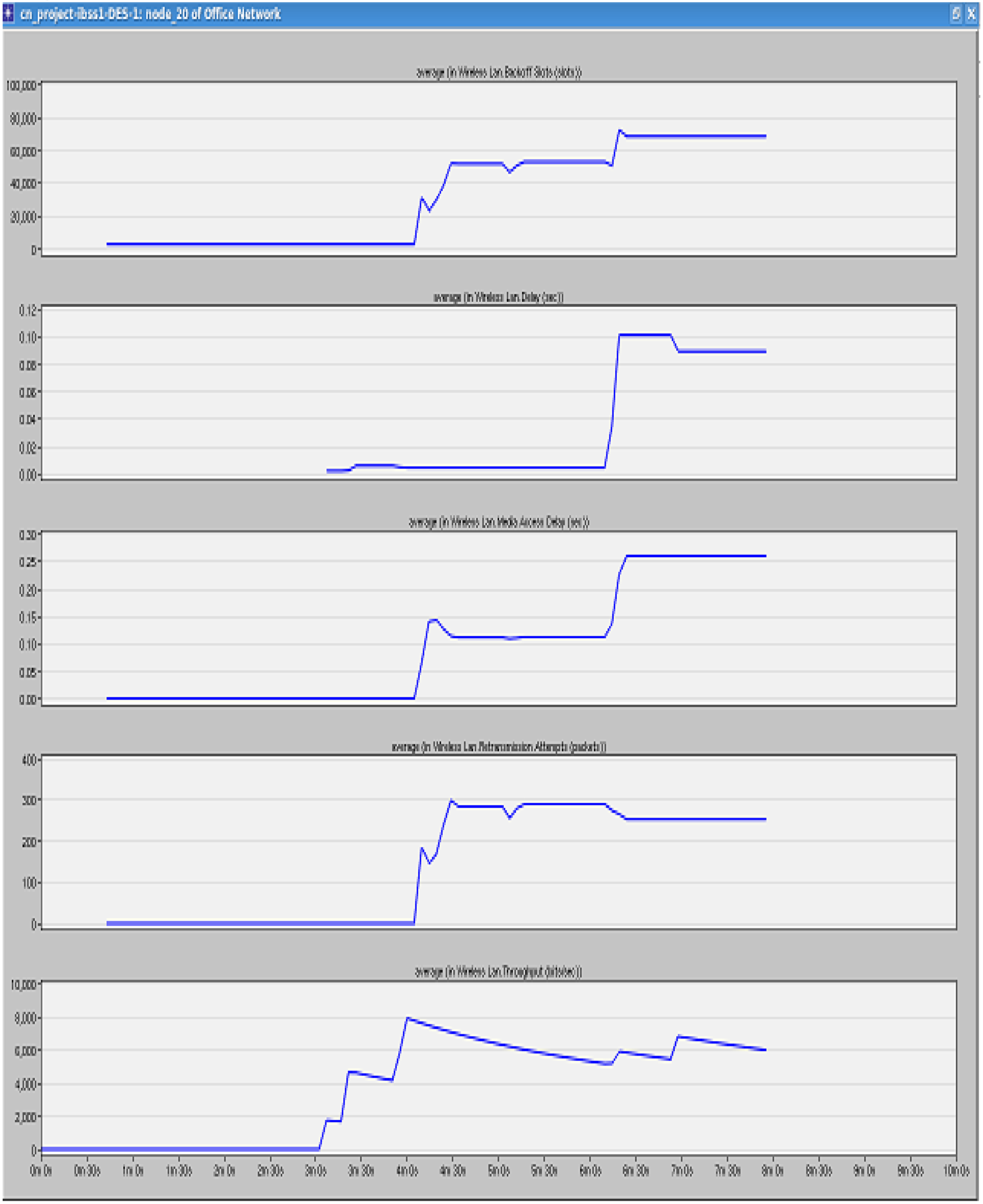
The following are the output parameters we are interested in:

1. throughput.
2. Retransmission attempts.
3. Media access delay.
4. Delay.
5. Back off slots.

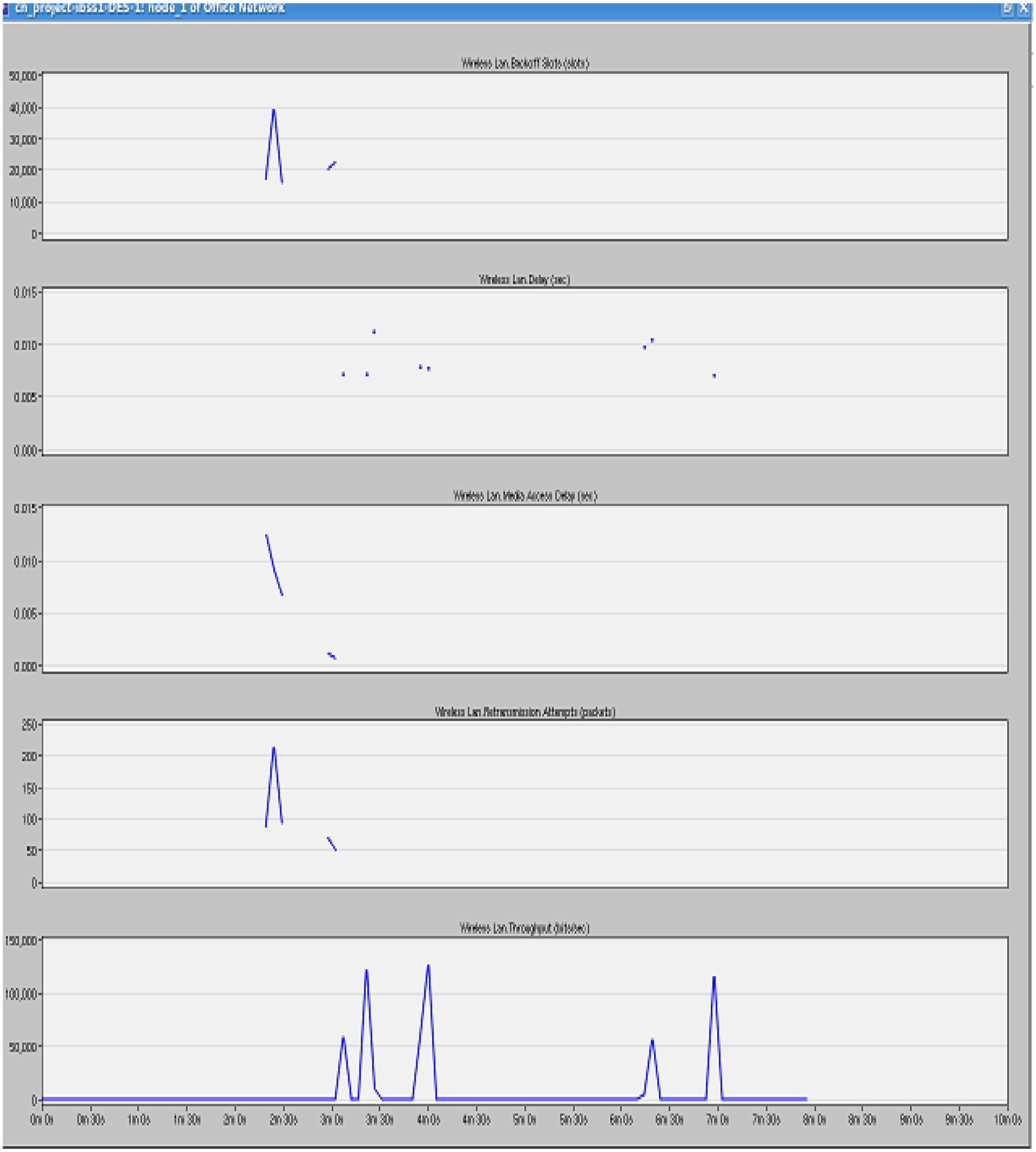
The following are the graphs for DCF node:
as is:
simulation duration is 10minutes



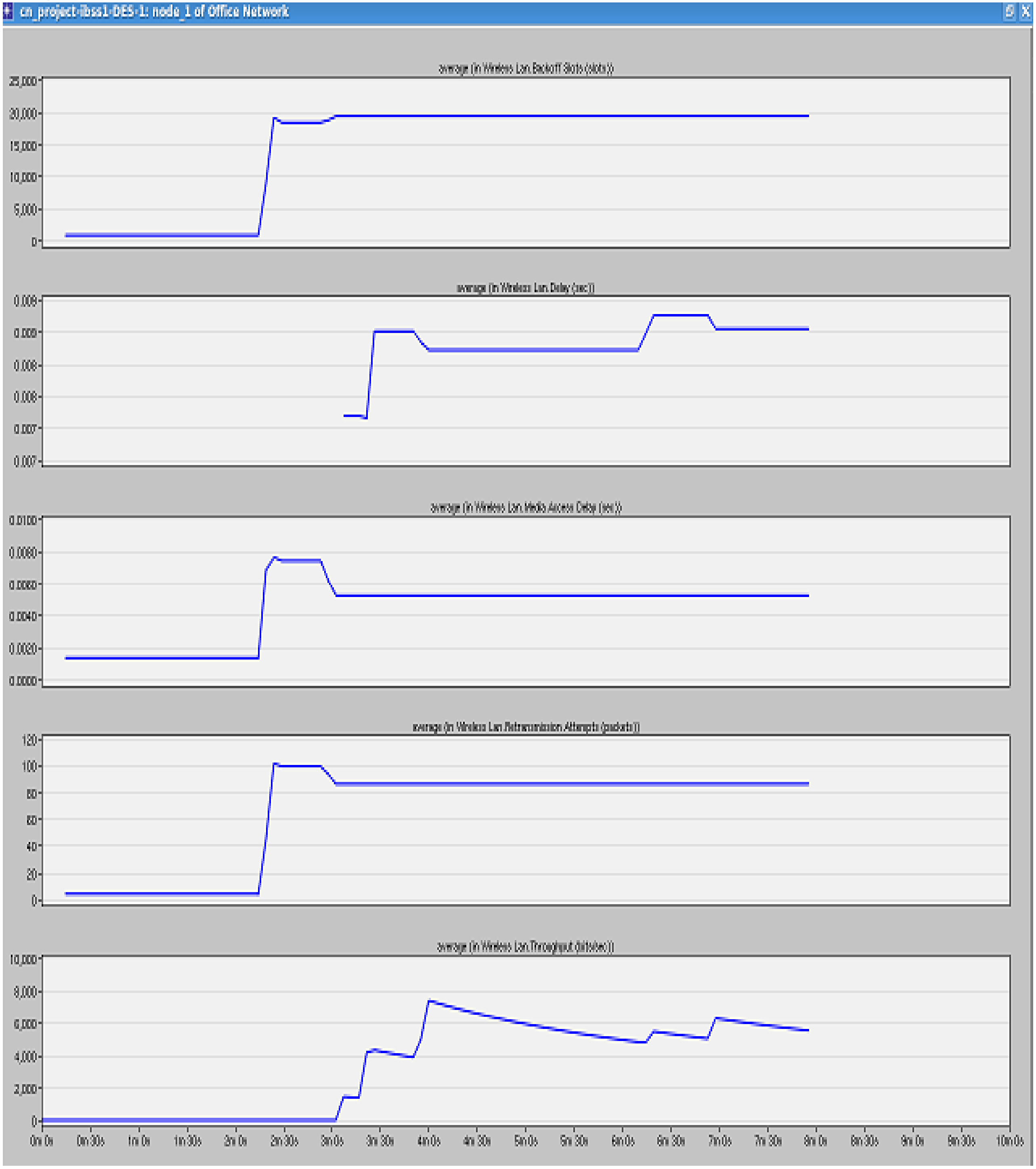
Average:


cn_project-ibss1-DES-1: node_20 of Office Network
average (in Wireless Lan Backoff Slots (slots))
100,000
80,000
60,000
40,000
20,000
0
average (in Wireless Lan Delay (sec))
0.12
0.10
0.08
0.06
0.04
0.02
0.00
average (in Wireless Lan Media Access Delay (sec))
0.30
0.25
0.20
0.15
0.10
0.05
0.00
average (in Wireless Lan Retransmission Attempts (packets))
400
300
200
100
0
average (in Wireless Lan Throughput (bits/sec))
10,000
8,000
6,000
4,000
2,000
0
0m 0s
0m 30s
1m 0s
1m 30s
2m 0s
2m 30s
3m 0s
3m 30s
4m 0s
4m 30s
5m 0s
5m 30s
6m 0s
6m 30s
7m 0s
7m 30s
8m 0s
8m 30s
9m 0s
9m 30s
10m 0s

The following are the graphs for the PCF node:
as is:



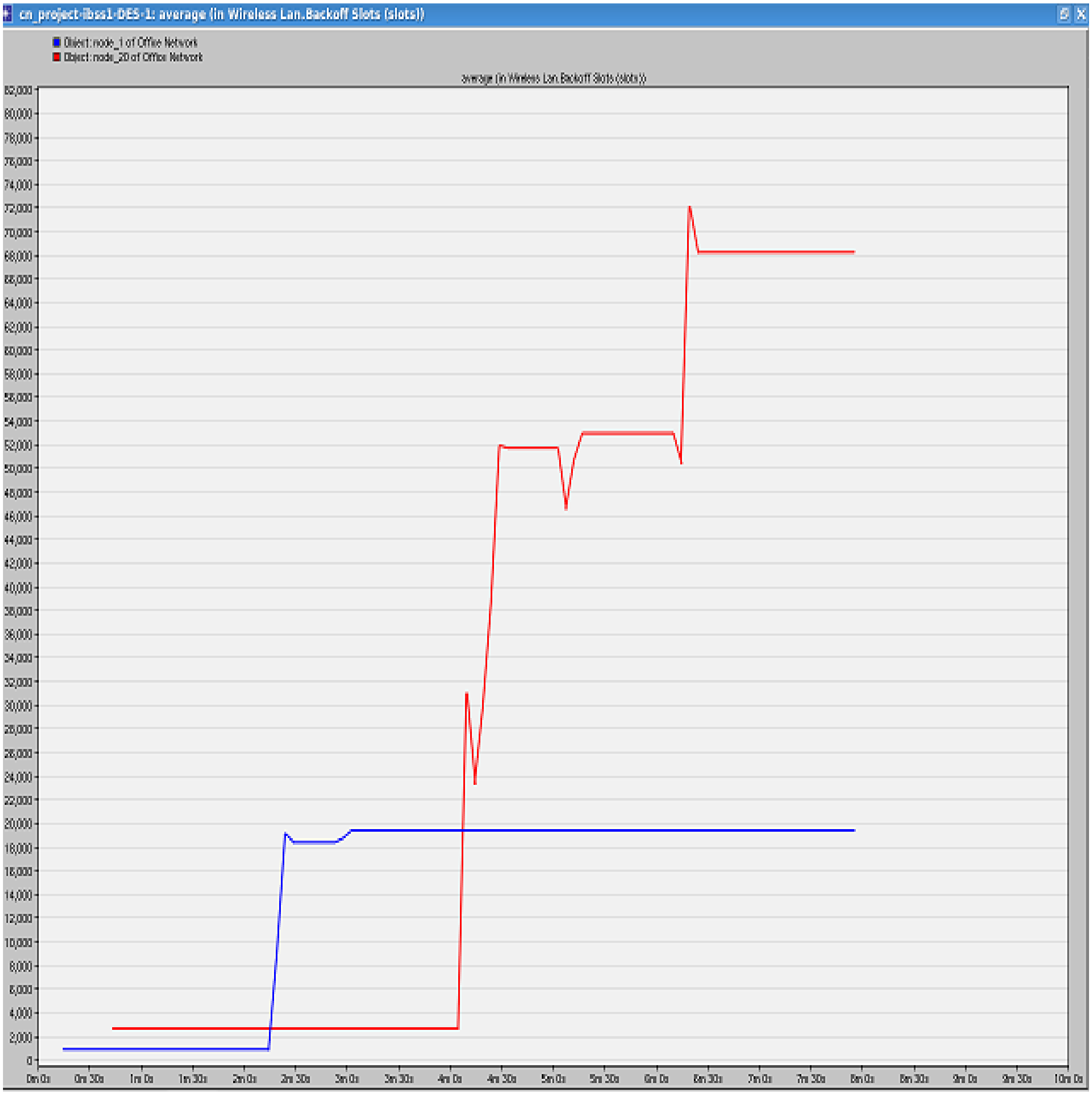
Average:


cn_project-ibss1-DES-1: node_1 of Office Network
average (in Wireless Lan.Backoff Slots (slots))
25,000
20,000
15,000
10,000
5,000
0
average (in Wireless Lan.Delay (sec))
0.009
0.009
0.008
0.008
0.007
0.007
average (in Wireless Lan.Media Access Delay (sec))
0.0100
0.0080
0.0060
0.0040
0.0020
0.0000
average (in Wireless Lan.Retransmission Attempts (packets))
120
100
80
60
40
20
0
average (in Wireless Lan.Throughput (bits/sec))
10,000
8,000
6,000
4,000
2,000
0
0m 0s
0m 30s
1m 0s
1m 30s
2m 0s
2m 30s
3m 0s
3m 30s
4m 0s
4m 30s
5m 0s
5m 30s
6m 0s
6m 30s
7m 0s
7m 30s
8m 0s
8m 30s
9m 0s
9m 30s
10m 0s

Overlaid statistics:

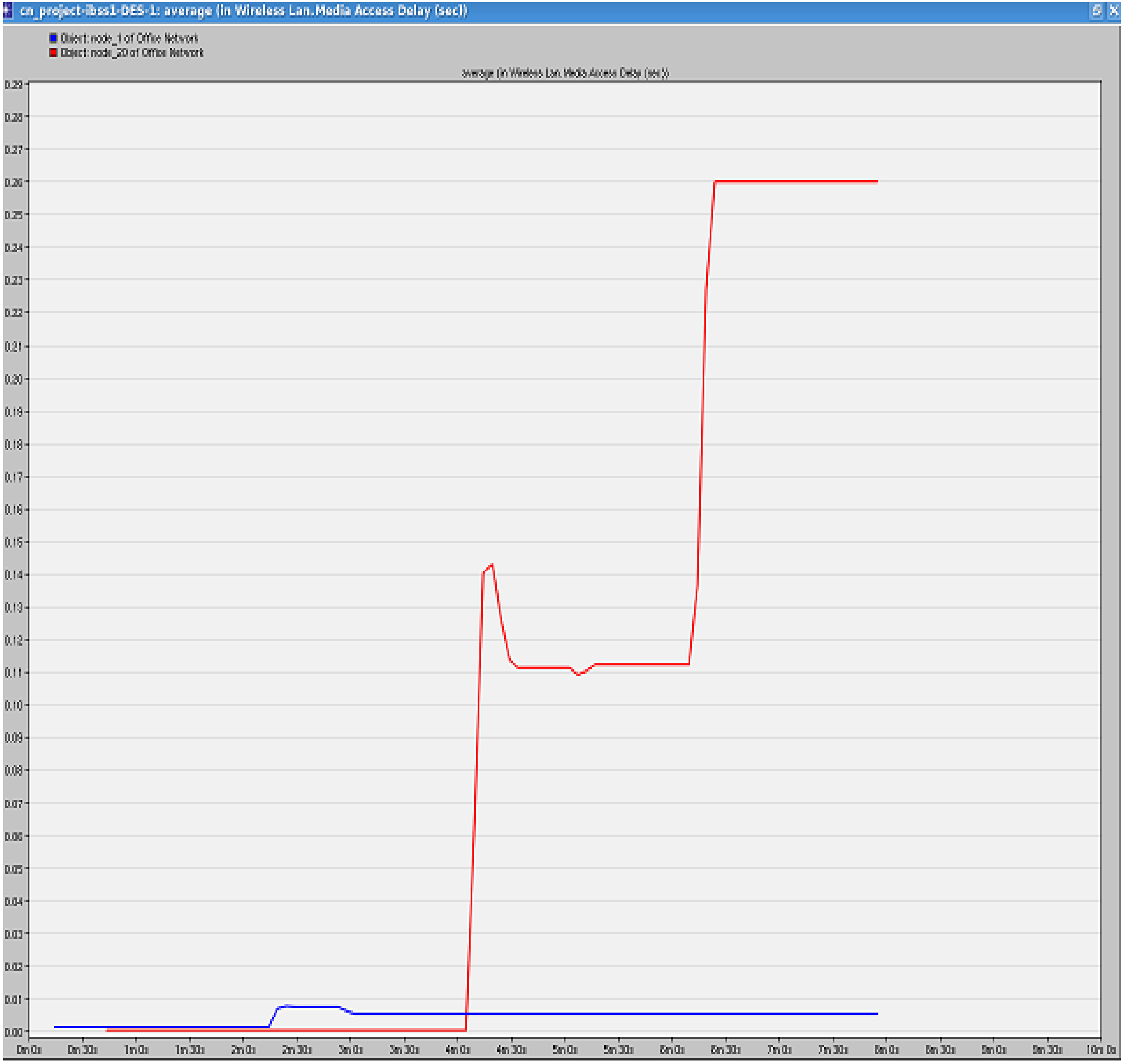
these statistics are used to compare PCF and DCF nodes for different output parameters.

Back off slots:



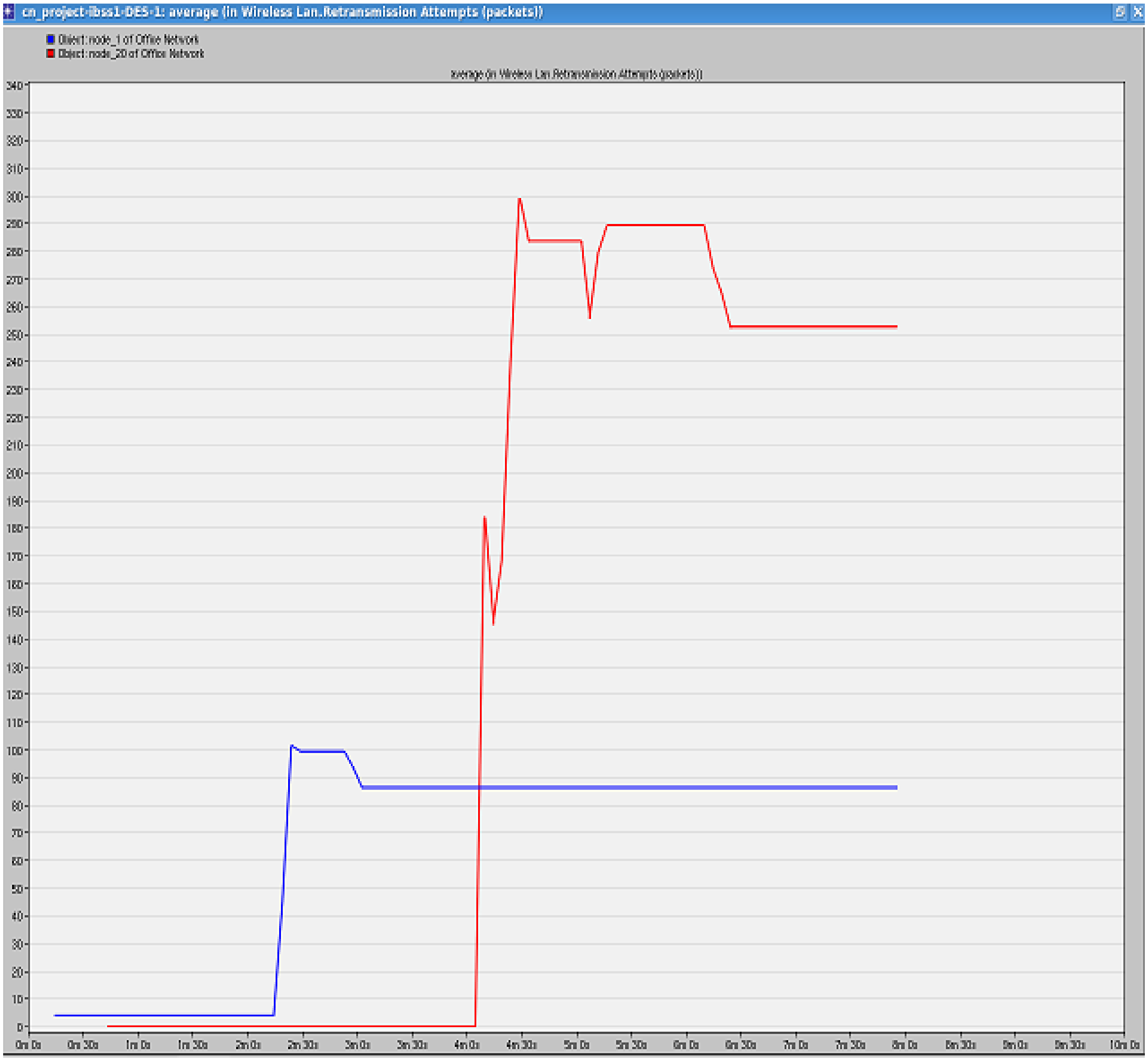
From the above graph we can say that for PCF node the back off slots are less.

Media access delay:



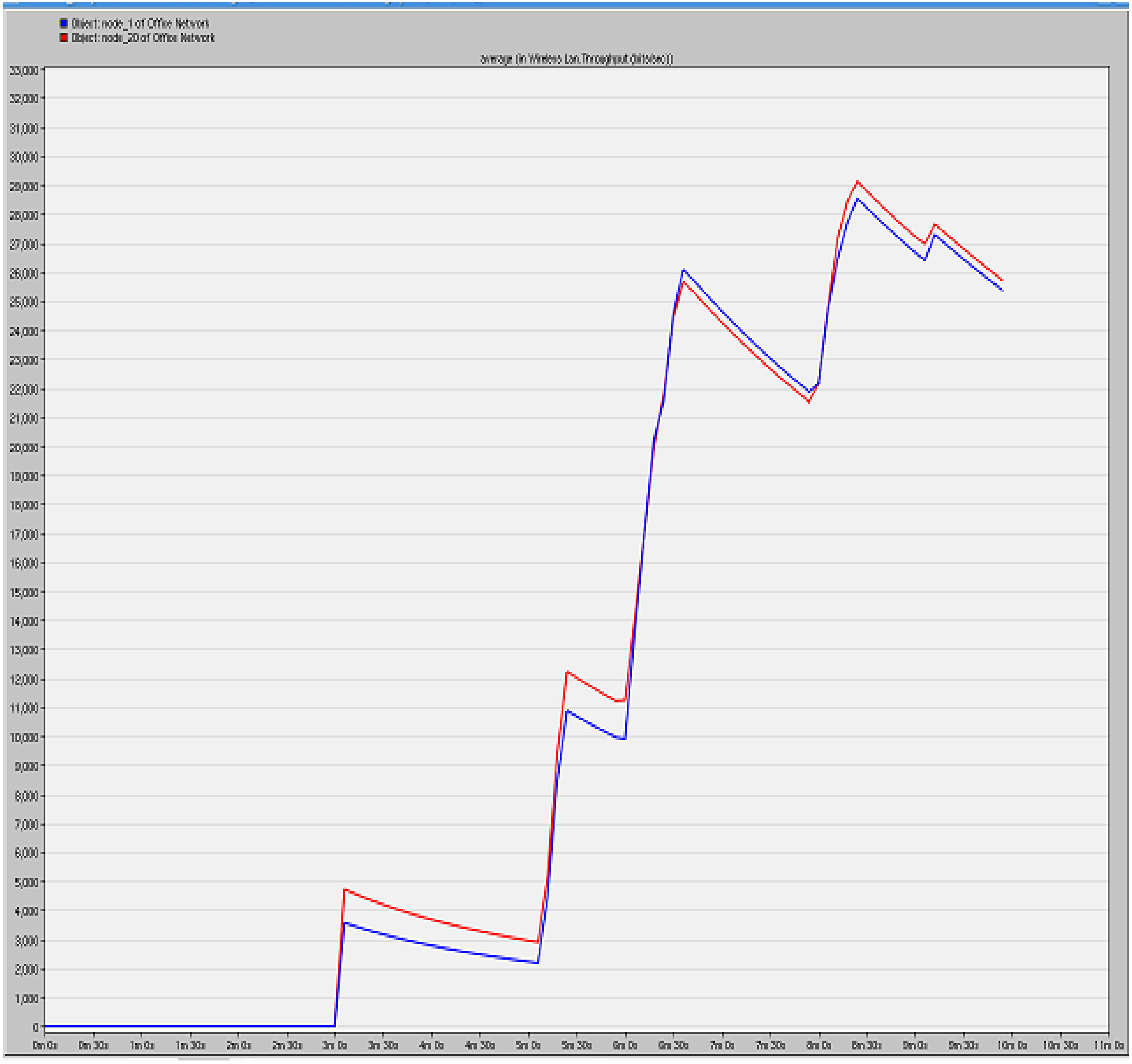
from the above graph we can observe that the media access delay is less for PCF node compared to DCF node.

wireless LAN retransmission attempts:



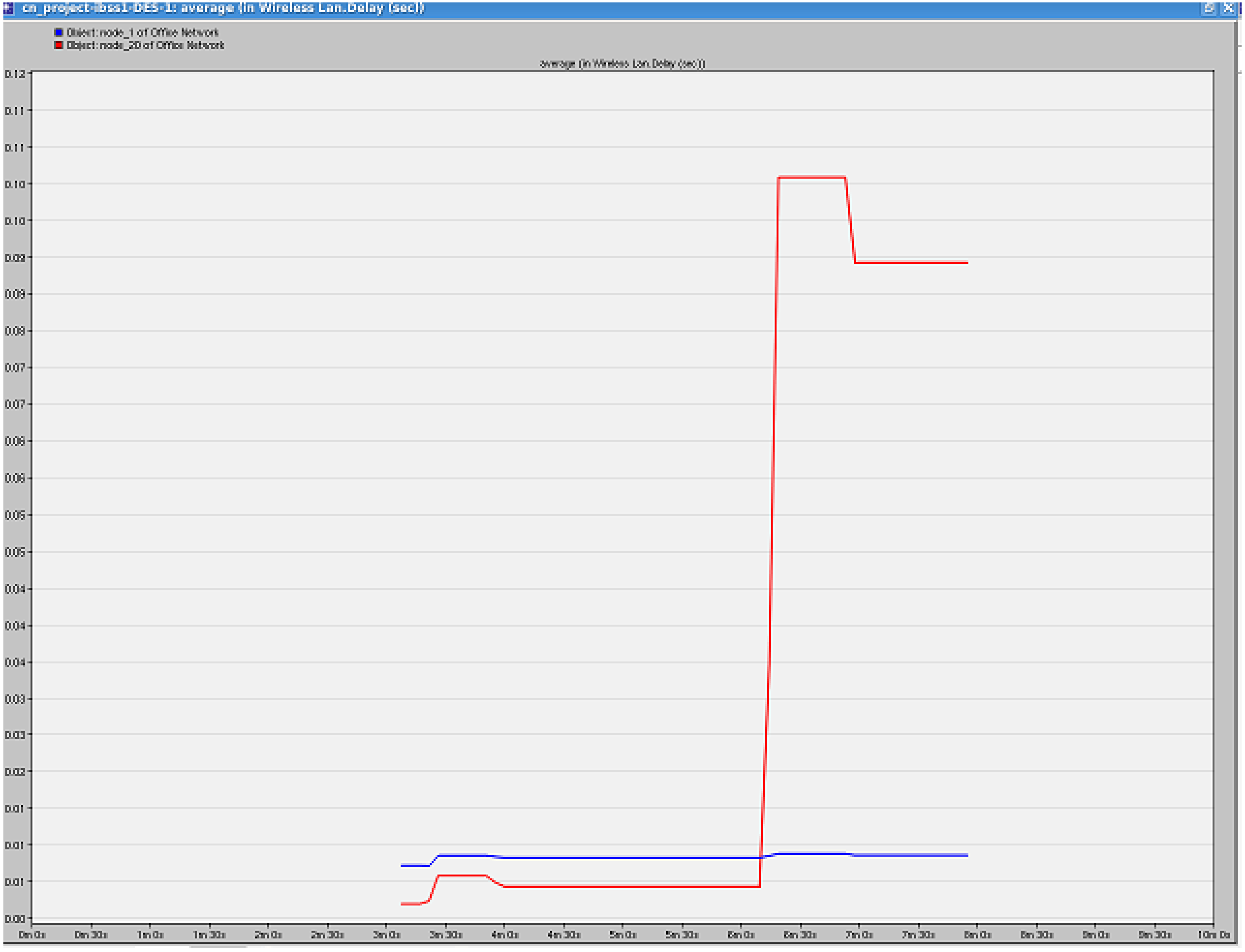
we can observe that retransmission attempts are less in PCF node than DCF node.

Throughput:



from the above graphs we can observe that throughput of PCF node is slightly less than the DCF node at some points.

wireless LAN delay:



from the above graph we can observe PCF node delay is less than DCF node.

Conclusion:

1. we have created BSS scenario for different network parameters and analyzed the results from the graphs obtained.
2. Similarly we have created IBSS scenario in which few nodes are PCF enabled and few are DCF enabled and we have analyzed their graphs and compared many output scenarios in case of PCF and DCF modes.
3. We have even considered the hidden node scenario case and no hidden node scenario for various network parameters and analyzed their results.