DEBAGNIK KAR

KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY (KIIT)

Deemed to be University U/S 3 of the UGC Act, 1956

KIIT School of Electronics Engineering

1804373
ETC-06

WCN Lab Report (EC-3094)

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Experiment Number	01
Date of Experiment	15/12/2020
Date of Submission	12/01/2020
Name of student	Debagnik Kar
Roll Number	1804373
Section	ETC-06

Aim of the Experiment :-

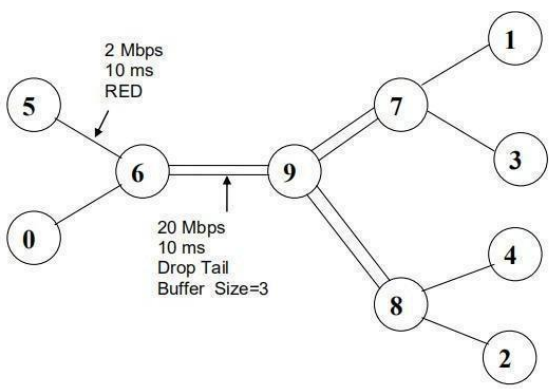
The aim of the experiment is simulation and calculation of throughput for a star connected network with 2 TCP and 1 UDP connection (using NS2 simulator).

Software Requirement :-

- Network Simulator 2
- Trace graph

Problem statement :-

Simulate and analyze the results for the following star connected network of 10 nodes with 2 TCP and 1 UDP connection (using NS2 Simulator).



In this network of 10 nodes (node ‘0’ through ‘9’), two FTP applications are running over TCP at nodes n(0) & n(1). Another CBR application is running over UDP at node n(2). The destinations of node 0, 1, 2 are 3, 4, and 5 respectively. The rest of the nodes are the intermediate routers. All the links are full duplex. Schedule: All the TCP connections start at 0.5 second and stop at 10.5 second. The UDP connection start at 1 sec and stops at 10 sec. Simulation time is from 0.5 sec to 11 sec.

Observation :-

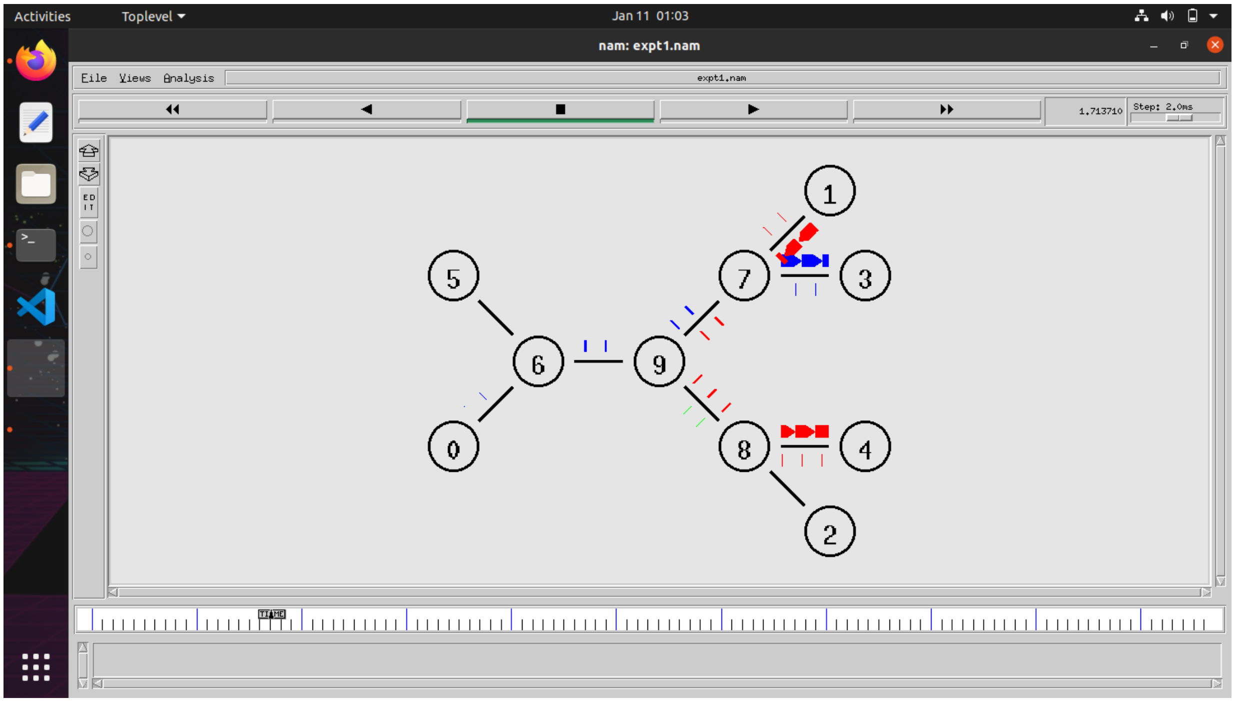


Fig 1.1: NAM Simulation of the code

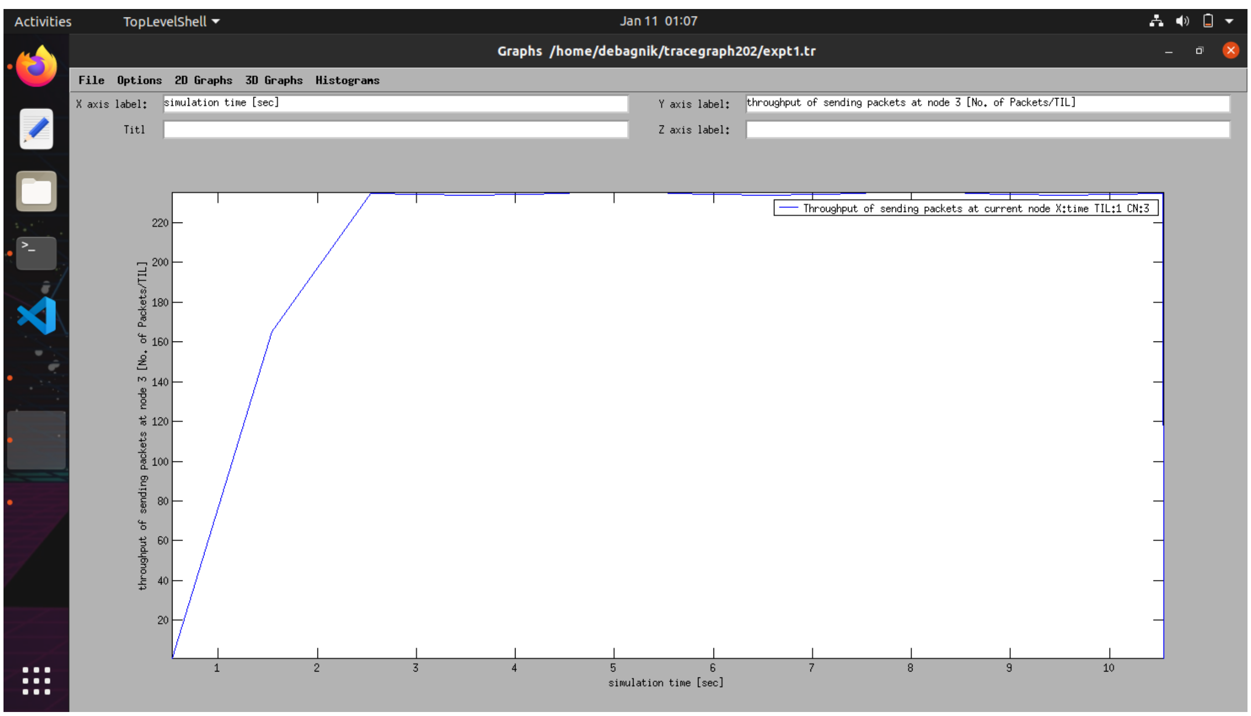


Fig 1.2: Throughput Diagram of sending packets at nodes 3

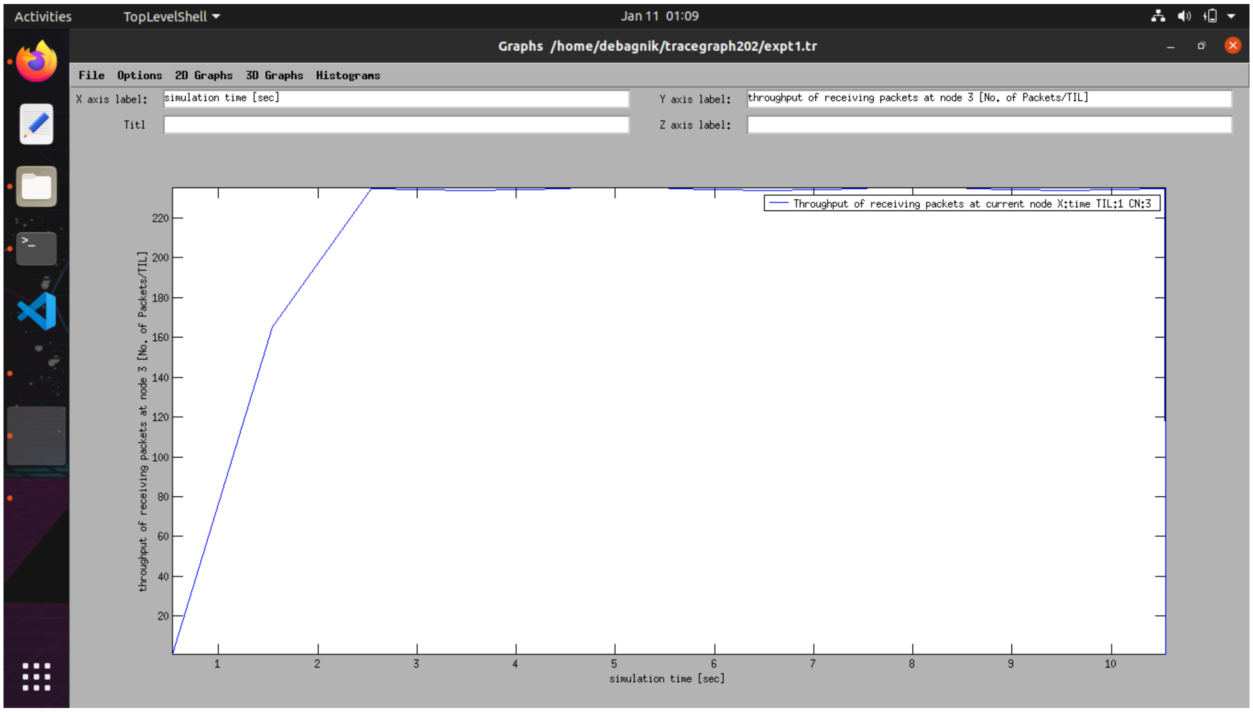


Fig 1.3: Throughput of receiving packets at current node

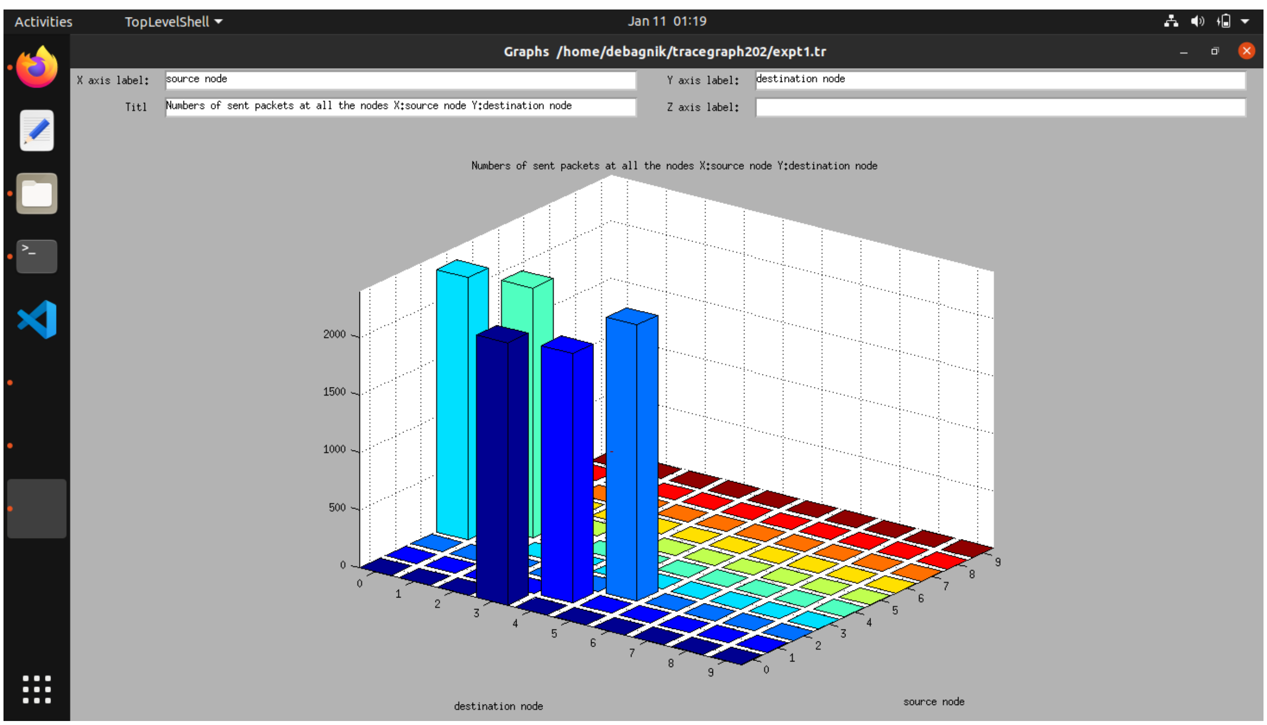


Fig 1.4: 3D diagram of number of packets at all the nodes

Conclusion :-

In this experiment we have constructed a star connected network and simulated with the help of NS2 software. After simulation both 2D and 3D graph was obtained and analyzed with the help of Trace Graph.

Experiment Number	02
Date of Experiment	22/12/2020
Date of Submission	12/01/2020
Name of student	Debagnik Kar
Roll Number	1804373
Section	ETC-06

Aim of the Experiment :-

Design and simulation of an IEEE 802.3 Ethernet Local Area Network (LAN) and observation of the TCP window using NS2 Simulator.

Software Requirement :-

- NS 2 (Network Simulator v2)
- NAM (Network Animator)
- Trace graph
- Xgraph

Theory:-

Ethernet is a set of technologies and protocols that are used primarily in LANs. It was first standardized in 1980s by IEEE 802.3 standard. IEEE 802.3 defines the physical layer and the medium access control (MAC) sub-layer of the data link layer for wired Ethernet networks. Ethernet is classified into two categories: classic Ethernet and switched Ethernet

IEEE 802.3: This was the original standard given for 10BASE-5. It used a thick single coaxial cable into which a connection can be tapped by drilling into the cable to the core. Here, 10 is the maximum throughput, i.e., 10 Mbps, BASE denoted use of baseband transmission, and 5 refers to the maximum segment length of 500m.

Observation :-

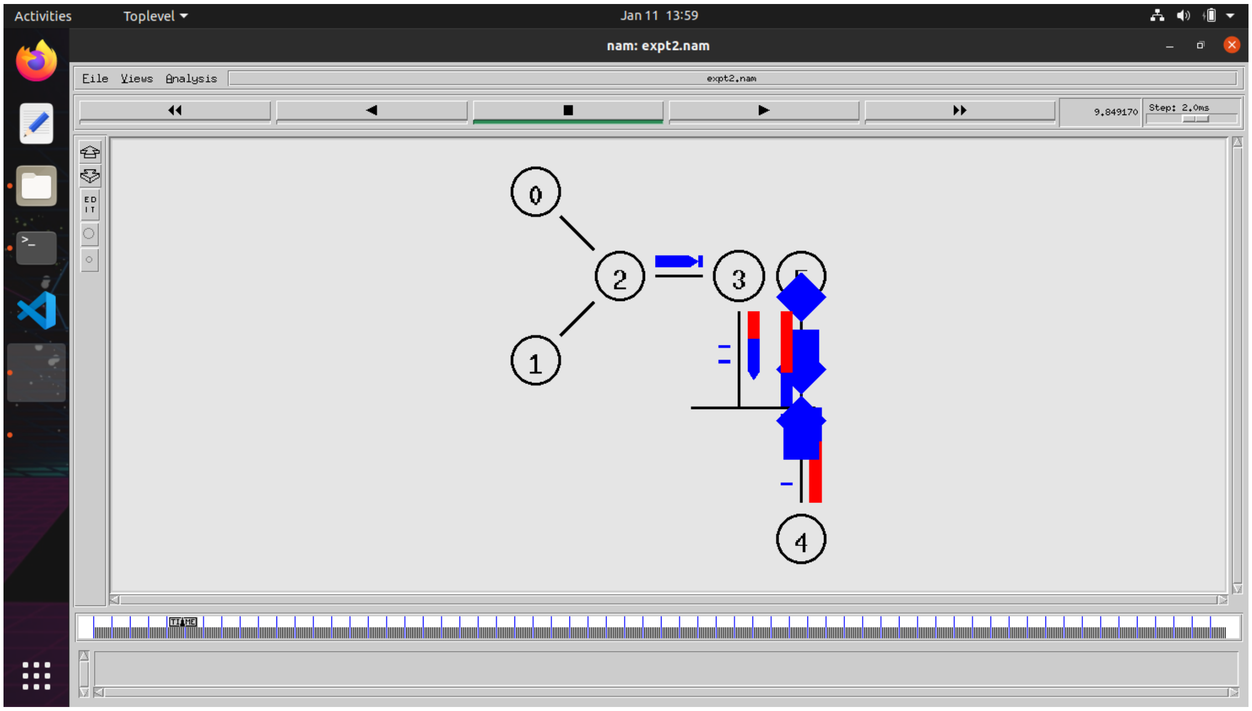


Fig 2.1: Network Animator simulation

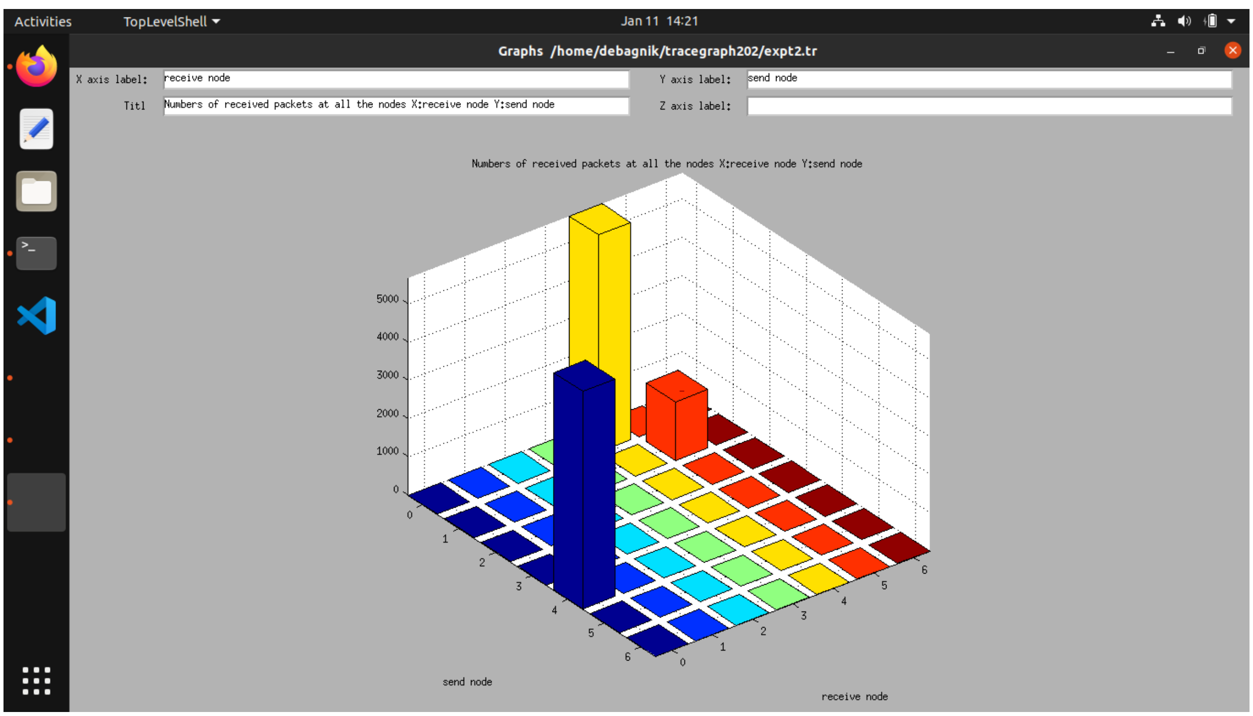


Fig 2.2: Graph of packets received at all nodes

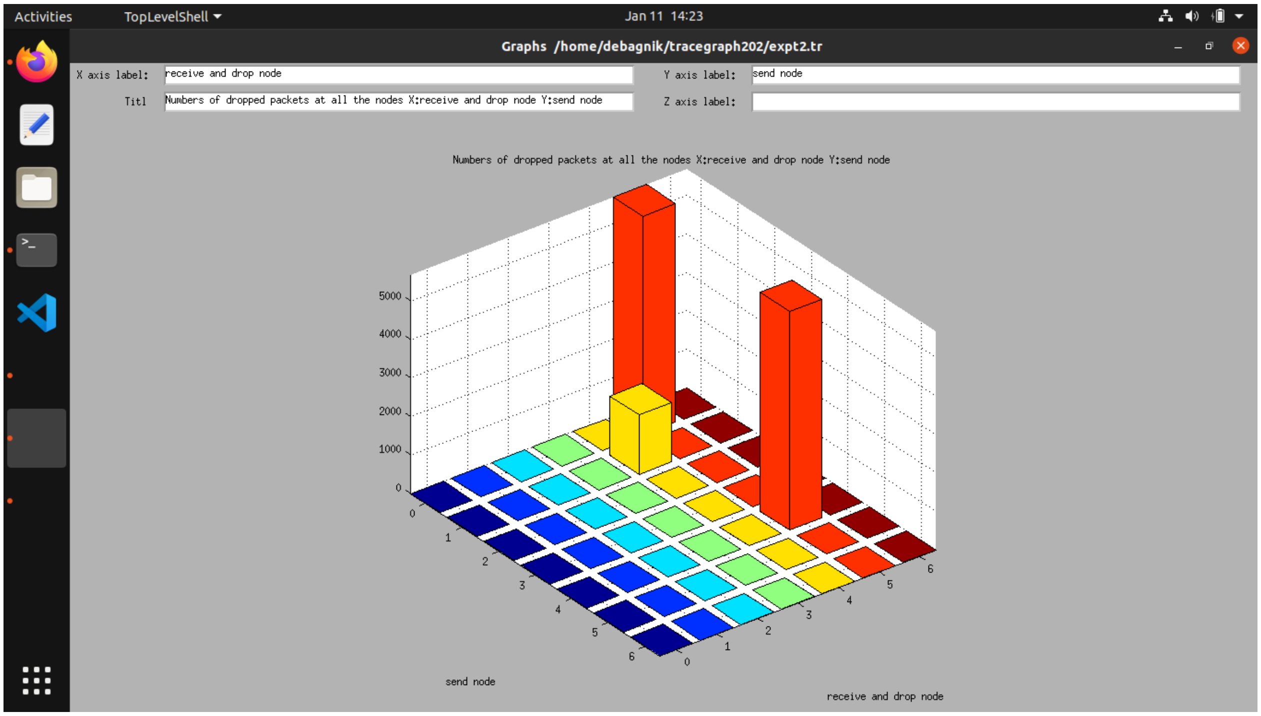


Fig 2.3: Graph of packets dropped at all nodes

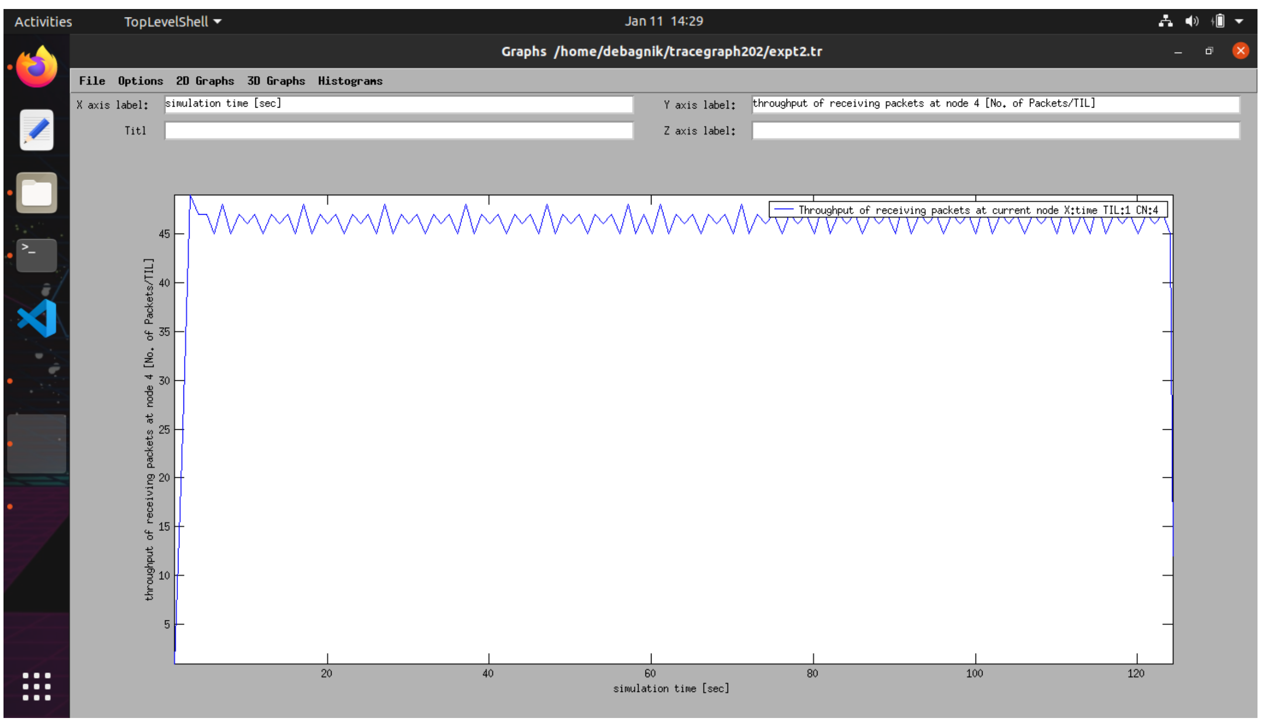


Fig 2.4: Throughput of the packets received between nodes 0 and 4

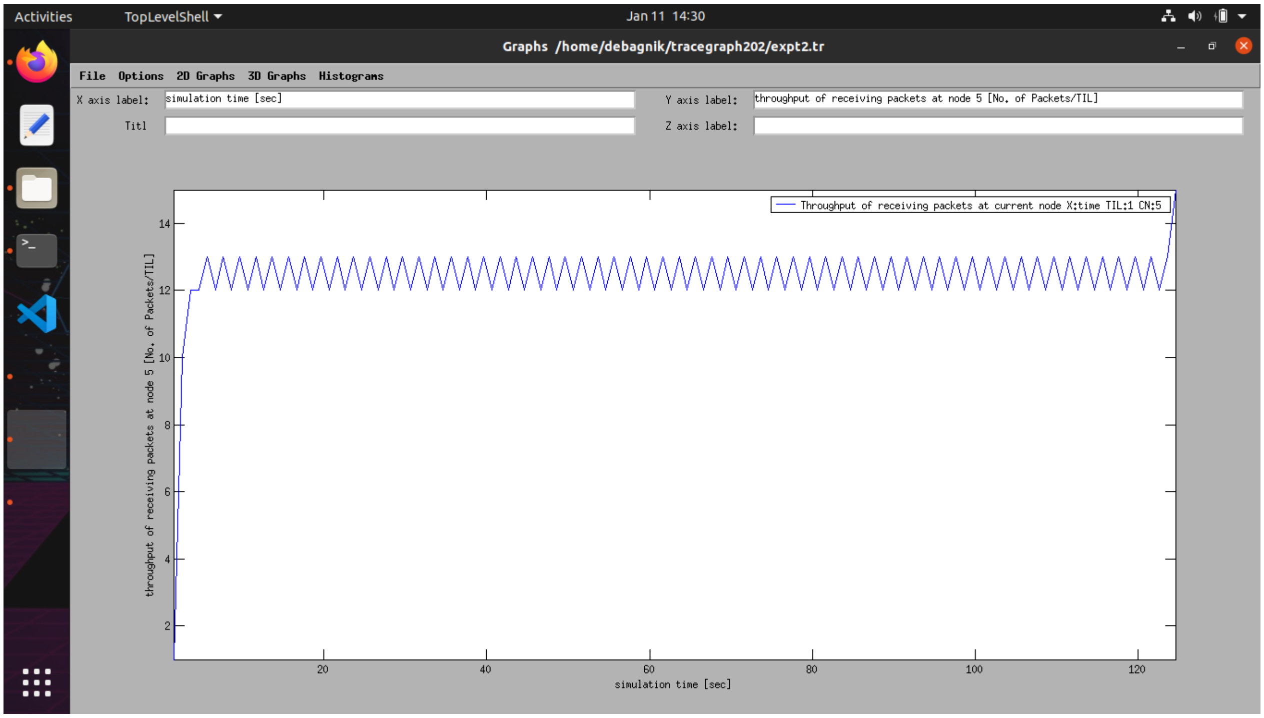


Fig 2.5: Throughput of the packet received between 1 and 5

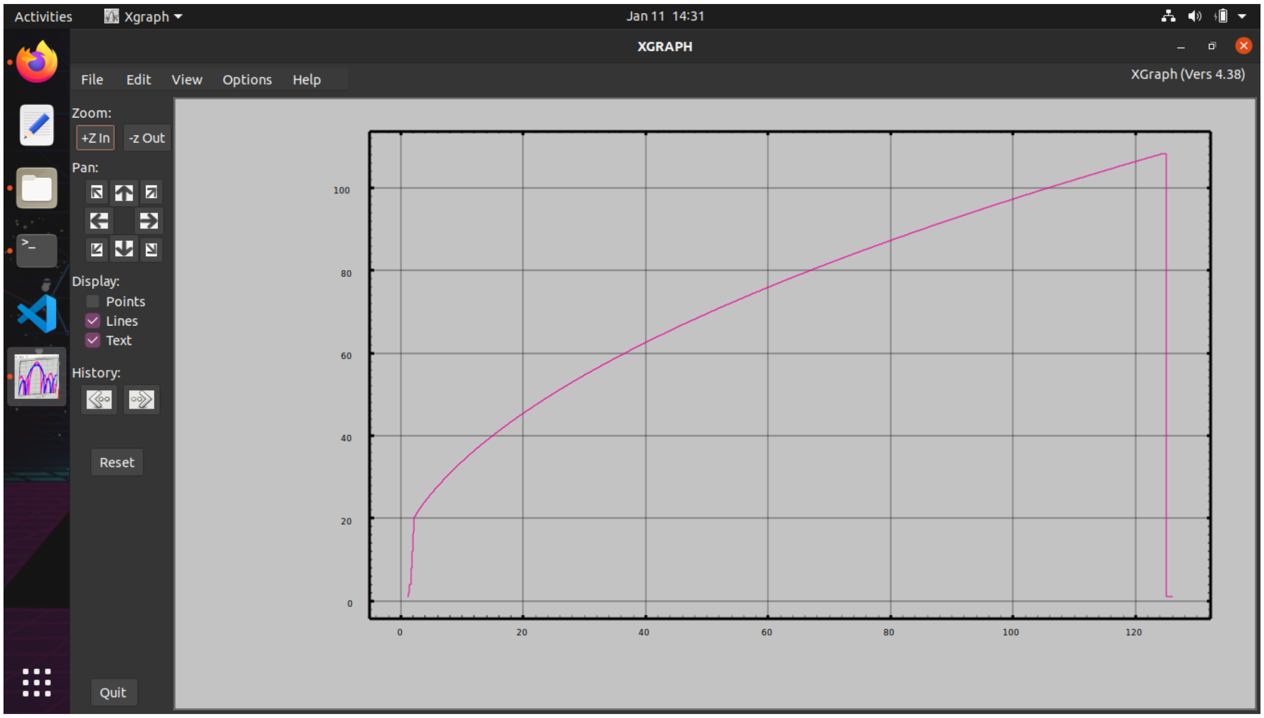


Fig 2.6: Plot of TCP Window by using XGraph

Conclusion :-

In this experiment we have constructed an IEEE 802.3 Ethernet Local Area Network (LAN) and simulated with the help of NS2 software. After simulation both 2D graphs were obtained and analyzed with the help of Trace Graph and XGraph.

Experiment Number	03
Date of Experiment	12/01/2021
Date of Submission	21/01/2021
Name of student	Debagnik Kar
Roll Number	1804373
Section	ETC-06

Aim of the Experiment :-

Simulation and investigation of the impact of 'Contention Window (cwnd)' size on the performance of IEEE 802.11 MAC protocol using NS2 Simulator.

Software Requirement :-

- Network Simulator v2 (NS2)
- Network Animator (NAM)
- Linux Terminal
- XGraph

Theory:-

IEEE 802.11 is part of the IEEE 802 set of local area network (LAN) protocols, and specifies the set of media access control (MAC) and physical layer (PHY) protocols for implementing wireless local area network (WLAN) Wi-Fi computer communication in various frequencies including, but not limited to, 2.4 GHz, 5 GHz, 6 GHz, and 60 GHz frequency bands. (Basically, a Wi-Fi Protocol)

They are the world's most widely used wireless computer networking standards, used in most home and office networks to allow laptops, printers, smartphones, and other devices to communicate with each other and access the Internet without connecting wires. They are created and maintained by the Institute of Electrical and Electronics Engineers (IEEE) LAN/MAN Standards Committee (IEEE 802). The base version of the standard was released in 1997, and has had subsequent amendments. The standard and amendments provide the basis for wireless network products using the Wi-Fi brand. While each amendment is officially revoked when it is incorporated in the latest version of the standard, the corporate world tends to market to the revisions because they concisely denote capabilities of their products. As a result, in the marketplace, each revision tends to become its own standard.

<u>Observation :-</u>

Contention window size	3x3	3x3	3x3	4x4	4x4	4x4	5x5	5x5	5x5
	PS	PR	PDR	PS	PR	PDR	PS	PR	PDR
2	22498	3341	0.148	39868	2639	0.0662	62050	2373	0.0382
7	22464	3506	0.156	39808	2628	0.0660	62045	2132	0.0343
15	22452	3688	0.164	39927	3029	0.0758	62134	2229	0.0358
31	22441	4040	0.180	39878	3188	0.0799	62202	2552	0.0410
63	22404	4135	0.186	39828	3571	0.0896	62170	3104	0.0499
127	22444	4113	0.183	39791	3132	0.0787	62172	2610	0.0420

Table 3.1: Observation taken from Linux terminal

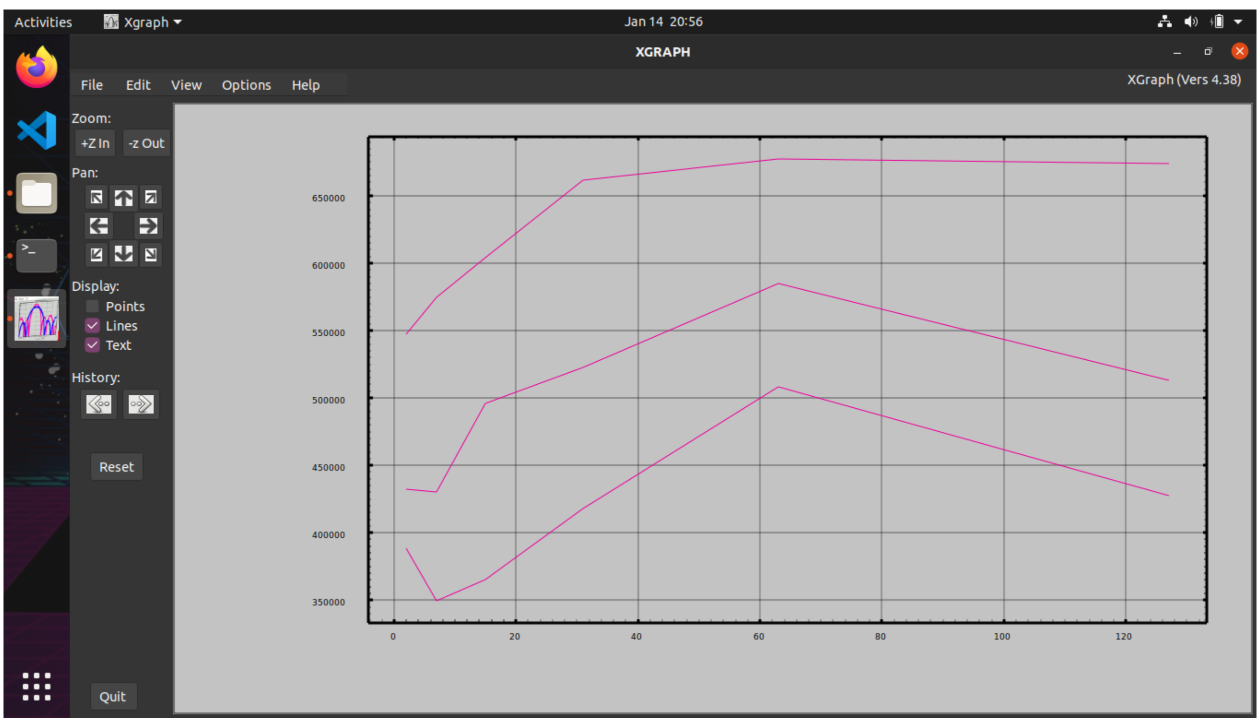


Fig 3.1: Throughput graph using XGraph

Inference/Discussion:-

We observe that PDR increases initially to a maximum value and then decreases, the optimal Contention window Size at 63 for each network population. We also observed that the CW Size varies inversely with the network population. Looking the trend of the observation we can predict that the CW Size will also be optimal at 63 and the PDR will be significantly lower than the observed nodes.

Conclusion :-

In this experiment we can conclude that the contention window size varies inversely with the population of the network and the PDR is optimal at a specific value of CW Size which is found to be 63.

Experiment Number	04
Date of Experiment	19/01/2021
Date of Submission	02/02/2021
Name of student	Debagnik Kar
Roll Number	1804373
Section	ETC-06

Aim of the Experiment :-

Design, configuration and simulation of multiple VLANs implemented using CISCO routers & switches and analysis of traffic in network

Software Requirement :-

- Cisco Packet Tracer 7.3.1 in Linux system

Theory:-

A Virtual Local Area Network is a logical group of workstations, Servers and network devices that appear to be on the same LAN despite their geographical distribution. The purpose of implementing a VLAN is to improve the performance of a network or apply appropriate security features.

Problem Specification: -

Sl.no.	VLAN no	Name	Network address	IP Configuration	Gateway
1	VLAN 10	OFFICE 1	192.168.1.0/24	192.168.1.2 - 192.168.1.3	192.168.1.1
2	VLAN 20	OFFICE 2	192.168.2.0/24	192.168.2.2 - 192.168.2.3	192.168.2.1
3	VLAN 30	OFFICE 3	192.168.3.0/24	192.168.2.2 - 192.168.3.3	192.168.3.1
4	VLAN 40	OFFICE 4	192.168.4.0/24	192.168.4.2 - 192.168.4.3	192.168.4.1
5	VLAN 50	SERVER	10.0.0.0/8	10.0.0.2	10.0.0.1

Default Subnet mask for is 255.255.255.0 for class C address.

- End Device specifications: Generic PC/Laptop/Server
- Switch Specification: CISCO 2950T-24 (IEEE 802.3 fast ethernet Standerd-100-base_Tx)
- Router Specification: Generic Router-PT-Empty, NIC(IEEE 802.3fast ethernet standerd-100-Base_Tx)
- Cable Specification: Copper Straight (End devices – switches - router), Copper-Cross (Inter-Router)

Observation :-

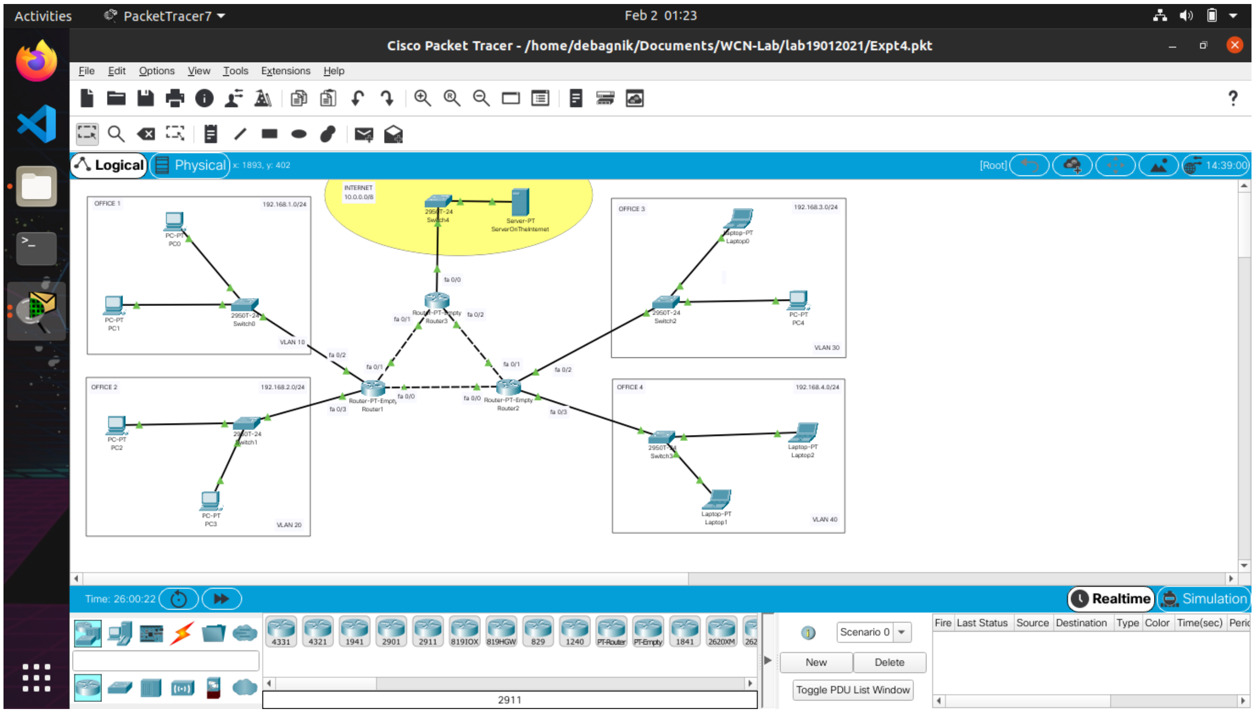


Fig 4.1: Network diagram as per specification (Logical view)

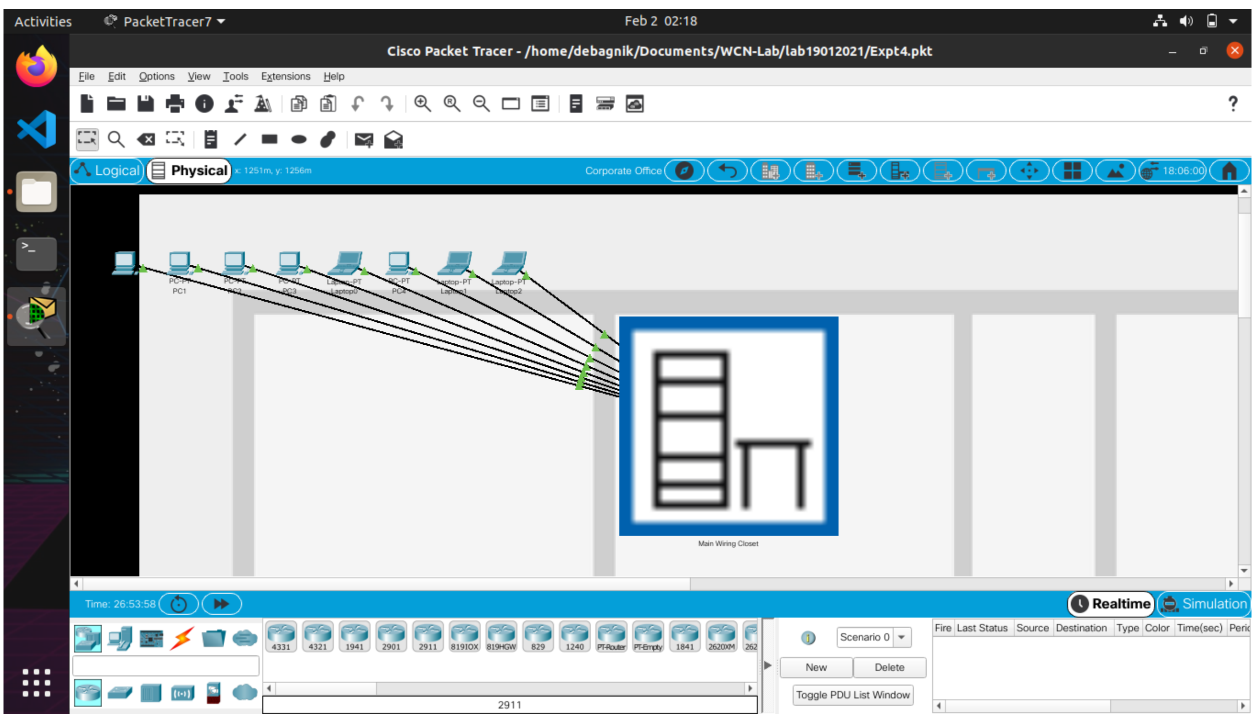


Fig 4.2: Network Diagram as per specification (Physical view)

Fig 4.3: Physical View of the network cabinet (Extra zoomed).

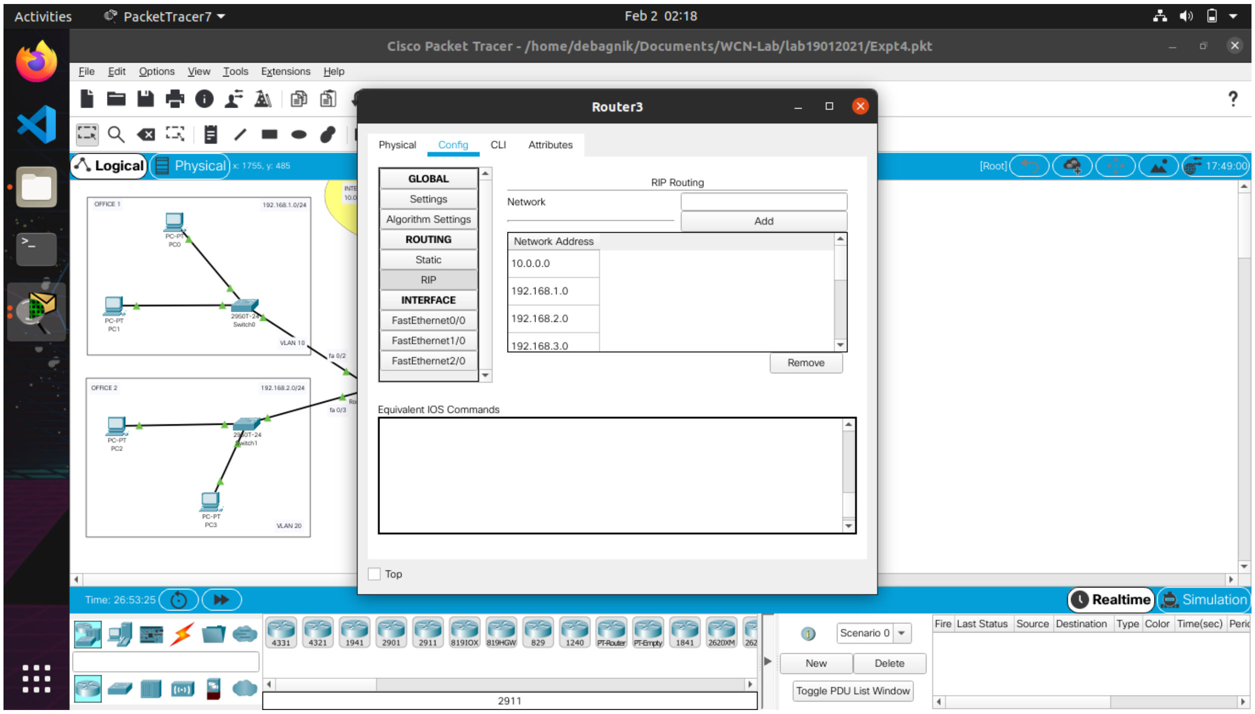


Fig 4.4: Routing Information Protocol Configuration

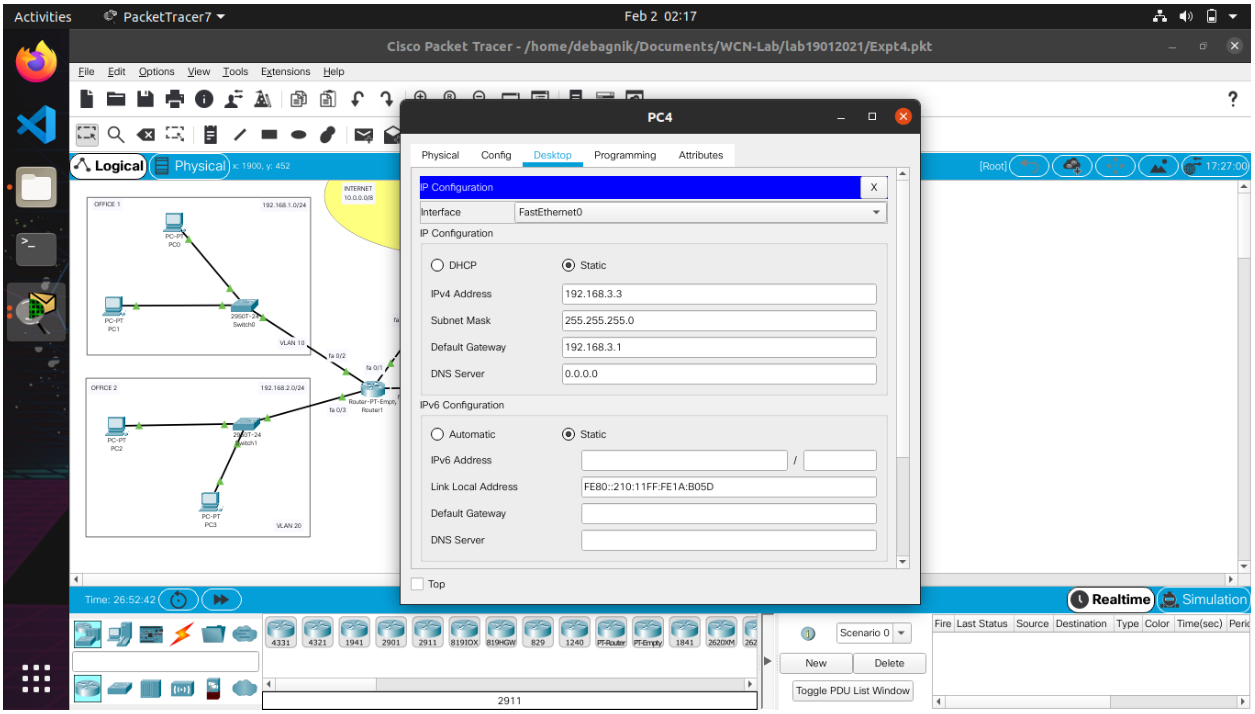


Fig 4.5: IP configuration of end devices (PC4)

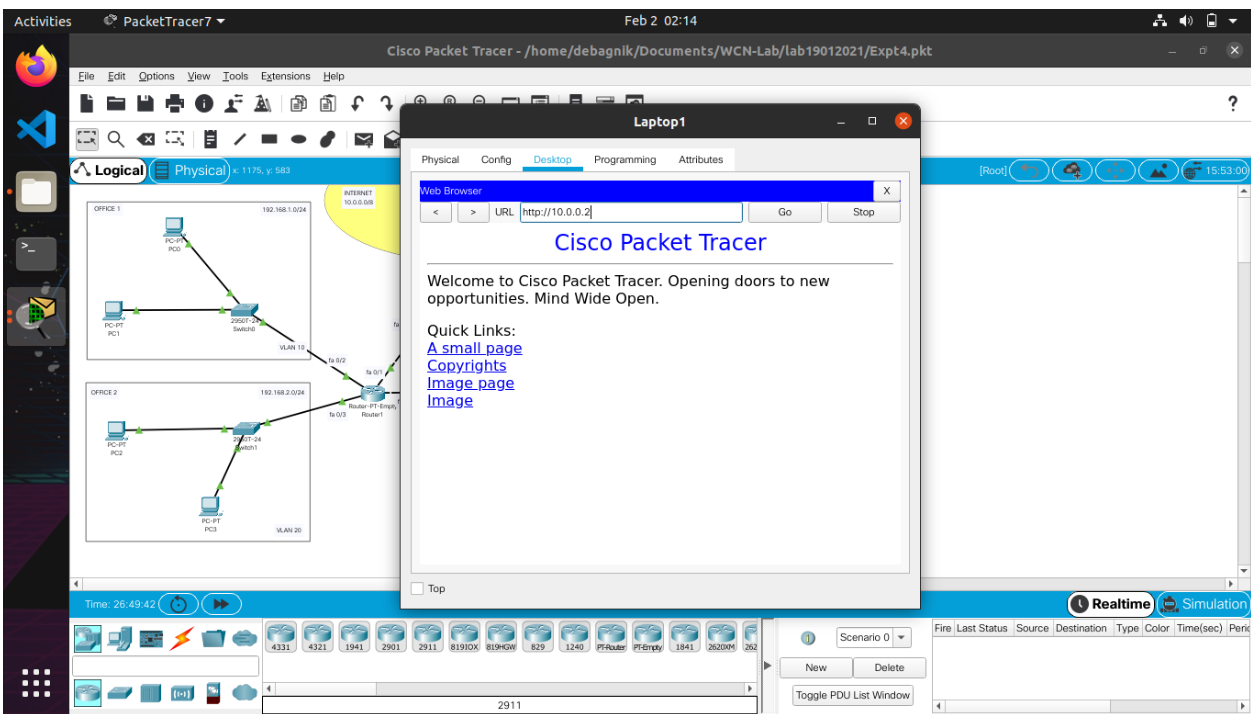
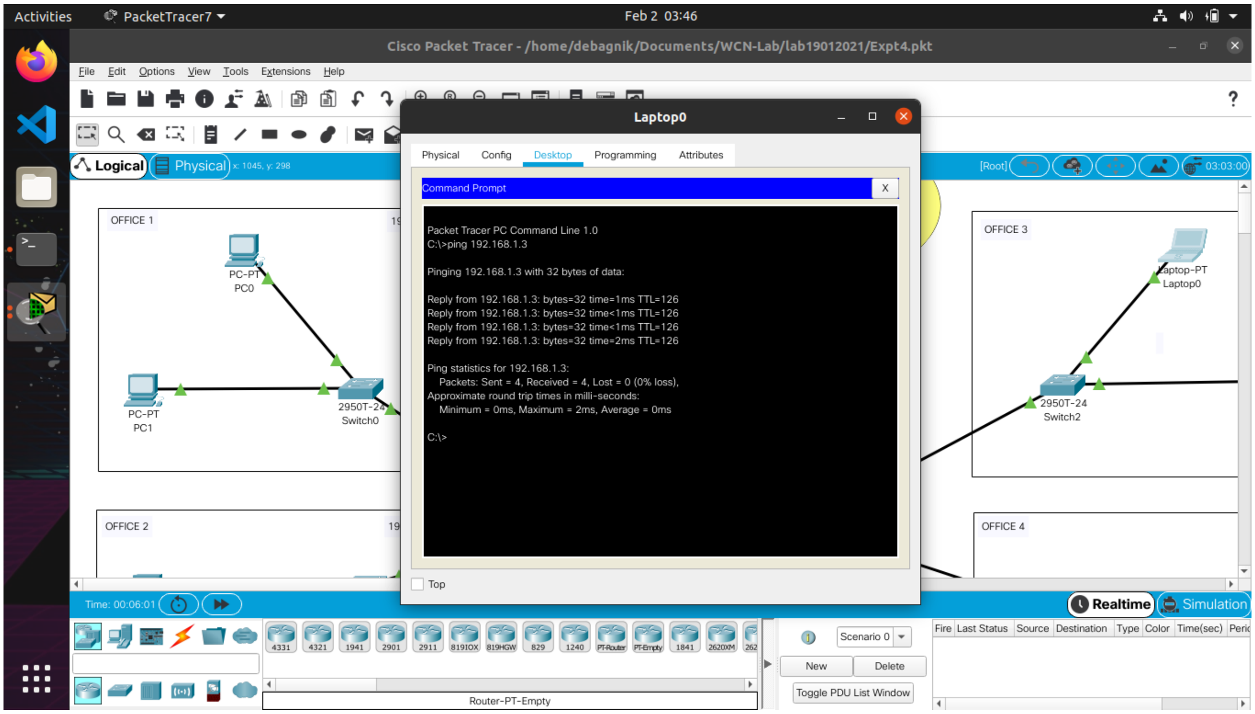
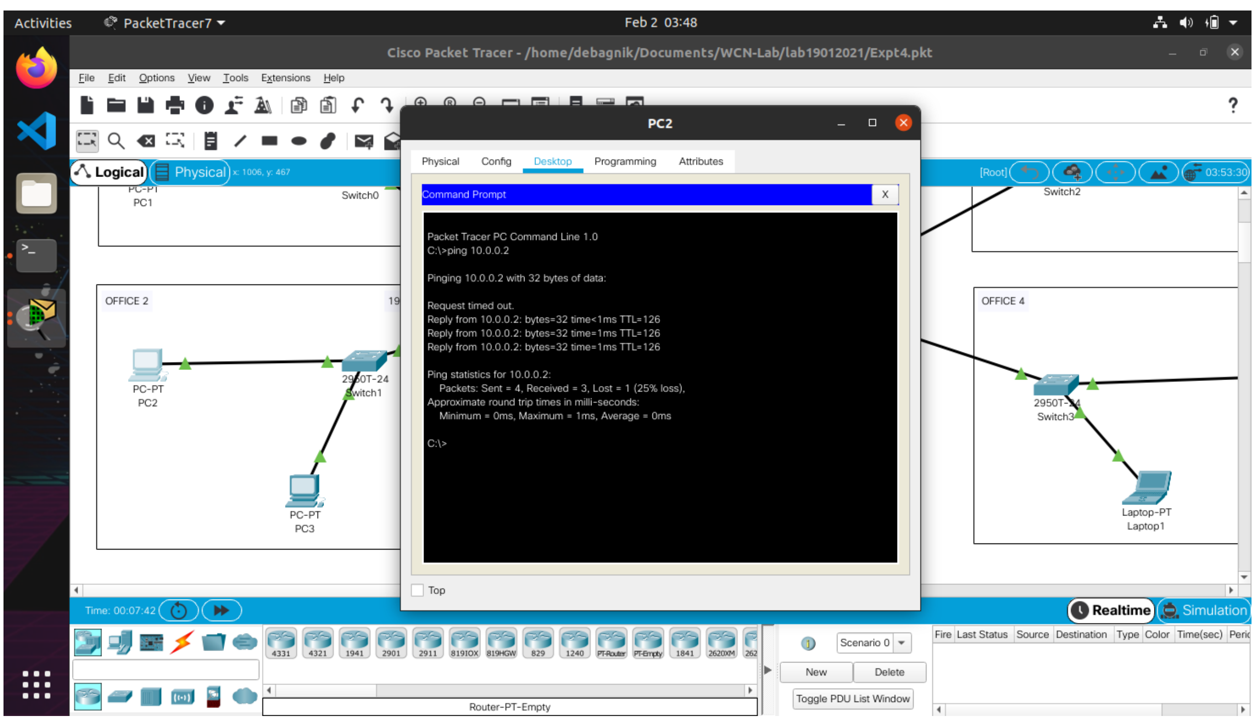


Fig 4.6: Web page hosted at the server accessed by laptop 1

Pinging the PC1 (192.168.1.3) situated at office 1 from Laptop0 (192.168.3.2) at office 3 gives the following results.



Pinging the Server (10.0.0.2) from PC2 (192.168.2.2) situated at office 2 gives the following results.



Conclusion :-

In this experiment we got a brief idea about cisco packet tracer and realized how there are different advantages and focal points of utilizing a cisco packet tracer part of learning fundamental and critical ideas of configuration and reproduction virtual local area network. It is a simple and easy to use device to comprehend different ideas of computer networks. We designed and configured a network of devices, switches, and routers with multiple VLANs which was later simulated and analyzed successfully using CISCO Packet Tracer. We also analyzed the traffic in the network. The result obtained is shown above.

Experiment Number	05
Date of Experiment	02/02/2021
Date of Submission	01/03/2021
Name of student	Debagnik Kar
Roll Number	1804373
Section	ETC-06

Aim of the Experiment :-

Design, configuration and simulation of wired and wireless (heterogeneous) network using CISCO networking devices and analysis of traffic in network using CISCO Packet Tracer.

Software Requirement :-

- Cisco Packet Tracer 7.3.1

Problem statement :-

Name	Network Address	IP Configuration	Gateway
OFFICE_1	192.168.1.0/24	192.168.1.100 - 192.168.1.111	192.168.1.1
OFFICE_2	192.168.2.0/24	192.168.2.100 - 192.168.2.106	192.168.2.1
OFFICE_3	192.168.3.0/24	192.168.3.100 - 192.168.3.103	192.168.3.1

- IP configuration: Dynamic Host Configuration Protocol

  Default Subnet mask 255.255.255.0 for class-C Networks

- Internet (Network address: 10.0.0.0/8) Class A Network Default Subnet mask: 255.0.0.0, Hosted in a generic server IP Address 10.0.0.2 Default gateway 10.0.0.1

- End Device specifications: Generic PC/Laptop/Server

- Switch Specification: CISCO 2950T-24 (IEEE 802.3 fast ethernet Standerd-100-base_Tx)

- Router Specification: Generic Router-PT-Empty, NIC(IEEE 802.3fast ethernet standerd-100-Base_Tx)

- Cable Specification: Copper Straight (End devices – switches - router), Copper-Cross (Inter-Router)

<u>Observation :-</u>

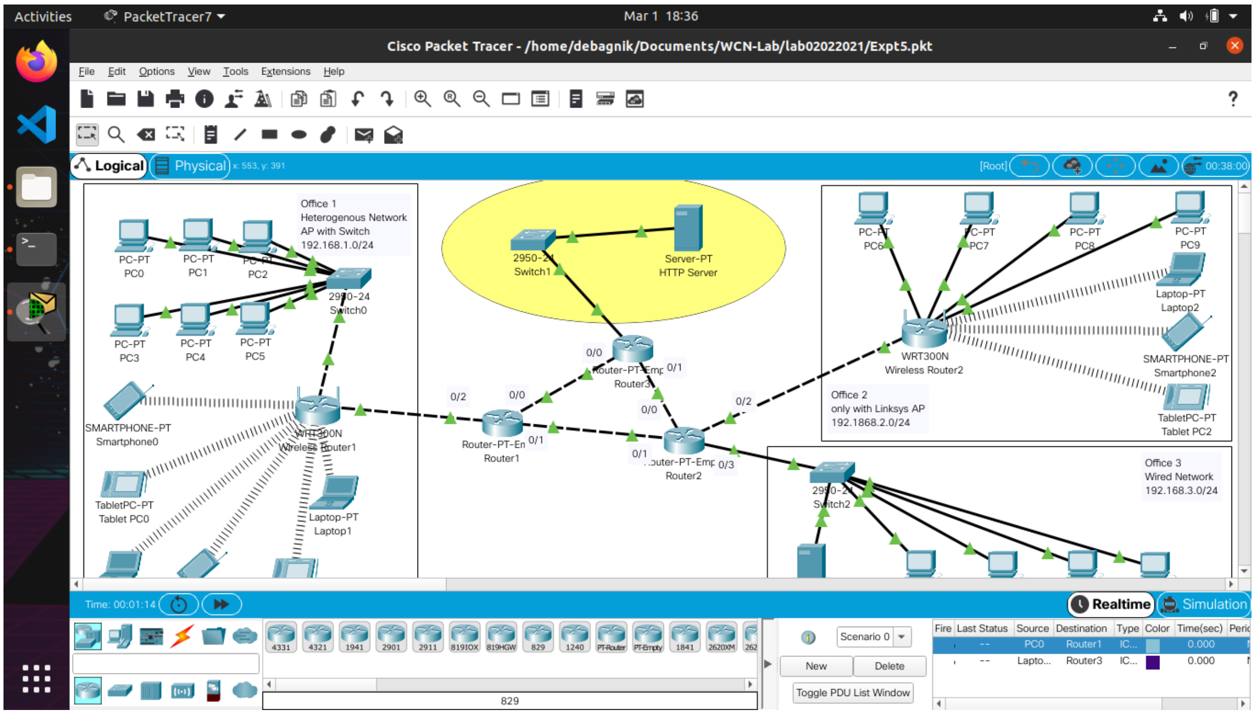


Fig 5.1: Network configuration diagram as per specification

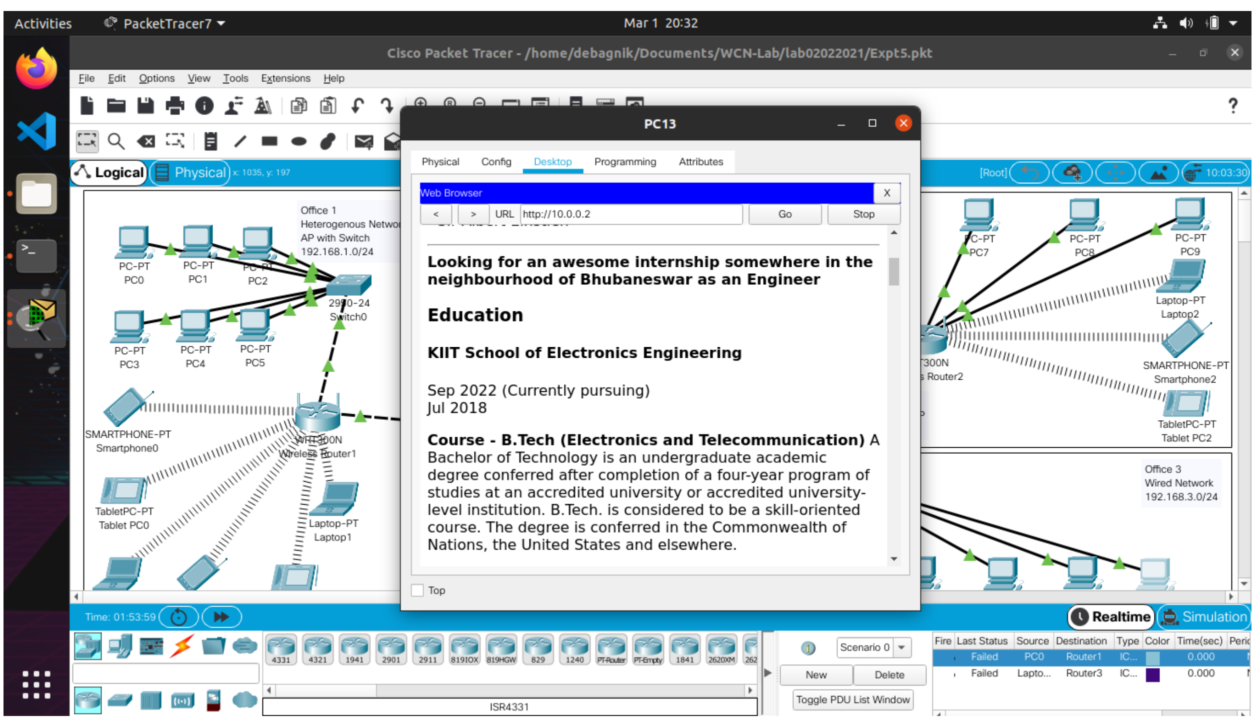


Fig 5.2: A web page hosted at server 10.0.0.2

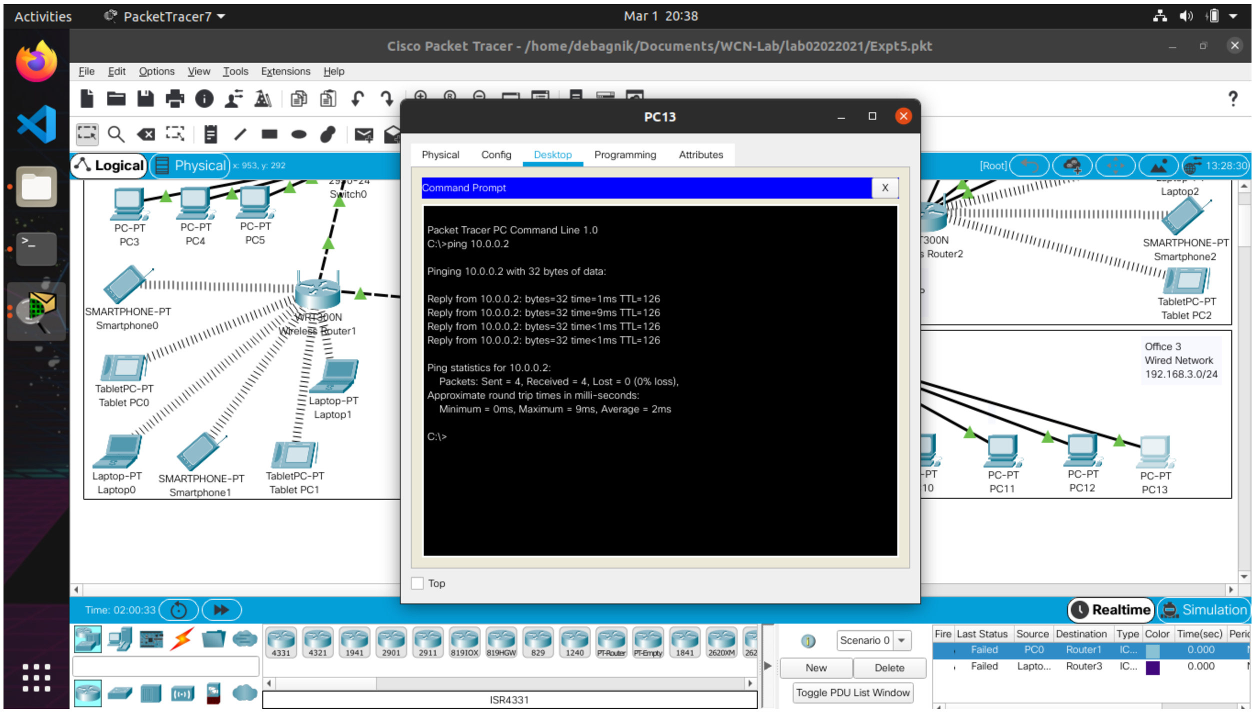


Fig 5.3: Pinging the server 10.0.0.2 with TTL 126

<u>Conclusion :-</u>

In this experiment we got a brief idea about how we can design a wireless network using CISCO Packet Tracer. We Designed, configured and simulated of wired and wireless (heterogeneous) network using CISCO networking devices. We also analyzed the traffic in the network. The result obtained is shown above.

Experiment Number	06A
Date of Experiment	23/02/2021
Date of Submission	09/03/2021
Name of student	Debagnik Kar
Roll Number	1804373
Section	ETC-06

Aim of the Experiment :-

Understand the cellular frequency reuse concept.

Software Requirement :-

- Java Runtime Environment 7
- Virtual Labs IIT-Kharagpur

Problem statement :-

- How many cochannel cells are there for N= 3, 7, 9 and 19 in the first tier? Compare with theoretical result.
- What happens to the system capacity when the value of N is increased?

Theory :-

Cellular Concept: In a cellular network, total area is subdivided into smaller areas called "cells". Each cell can cover a limited number of mobile subscribers within its boundaries. Each cell can have a base station with a number of RF channels. Frequencies used in a given cell area will be simultaneously reused at a different cell which is geographically separated. For example, a typical seven-cell pattern can be considered.

Co-Channel Cells:-

$$N = i^2 + ij + j^2$$

Where, i and j are non-negative integers.

To and the nearest co-channel neighbors of a particular cell,

Move 'i' cells along any chain of hexagons then,

Turn 60^o counter-clockwise and move 'j' cells.

Observation :-

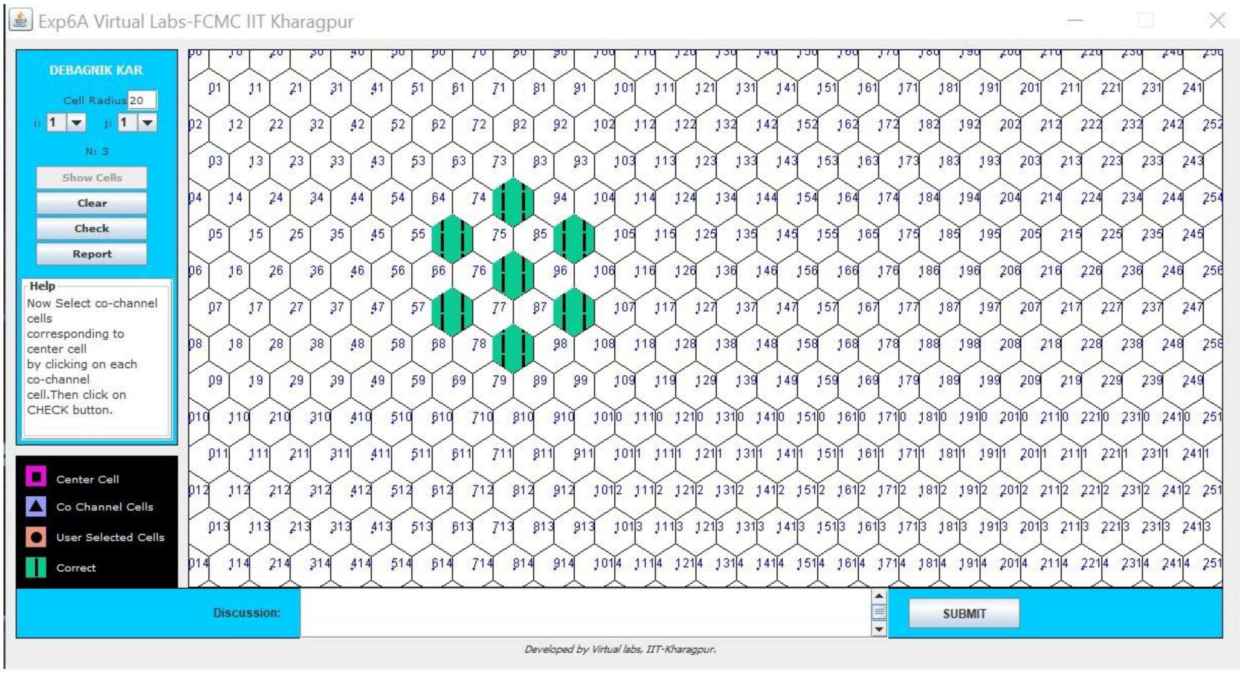


Fig 6.1: co-channel estimation at i=1, j=1

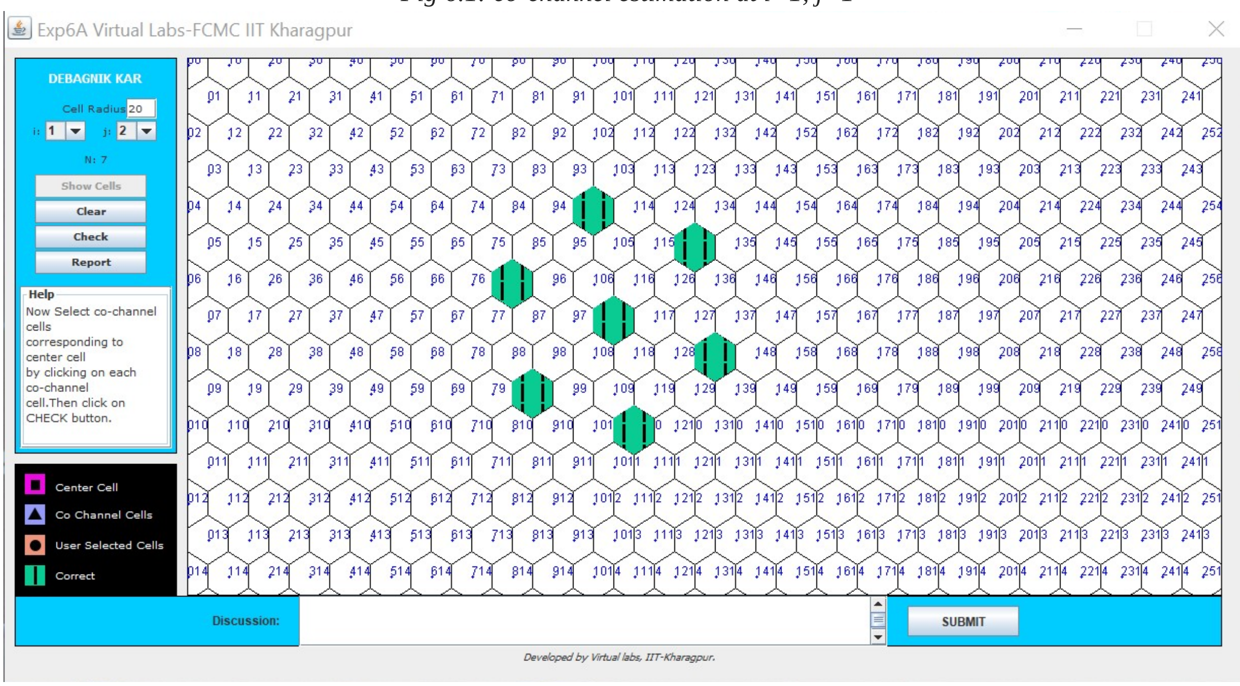


Fig 6.2: co-channel estimation at i=1, j=2

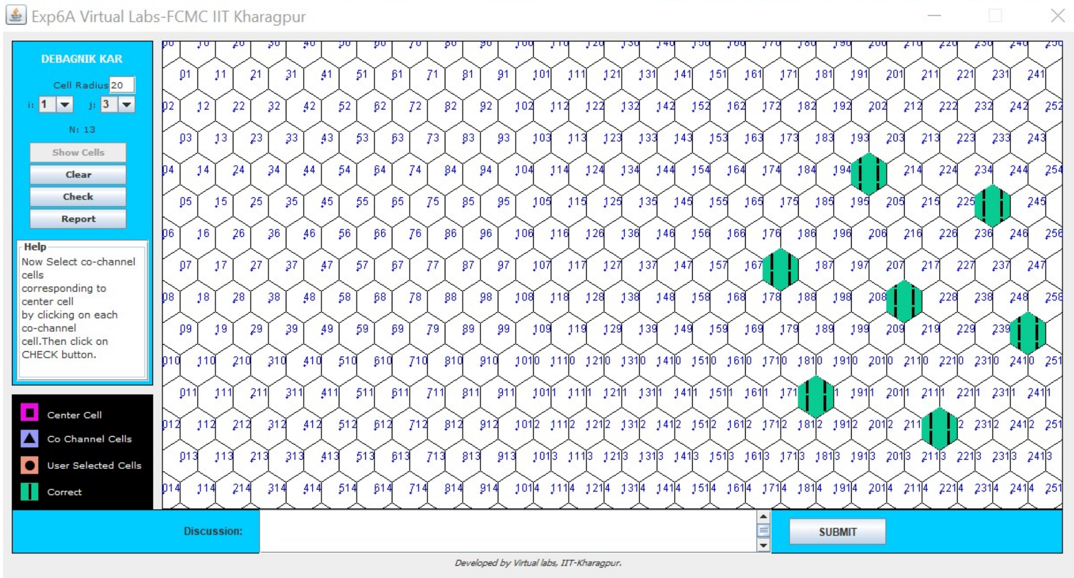


Fig 6.3: co-channel estimation at i=1, j=3

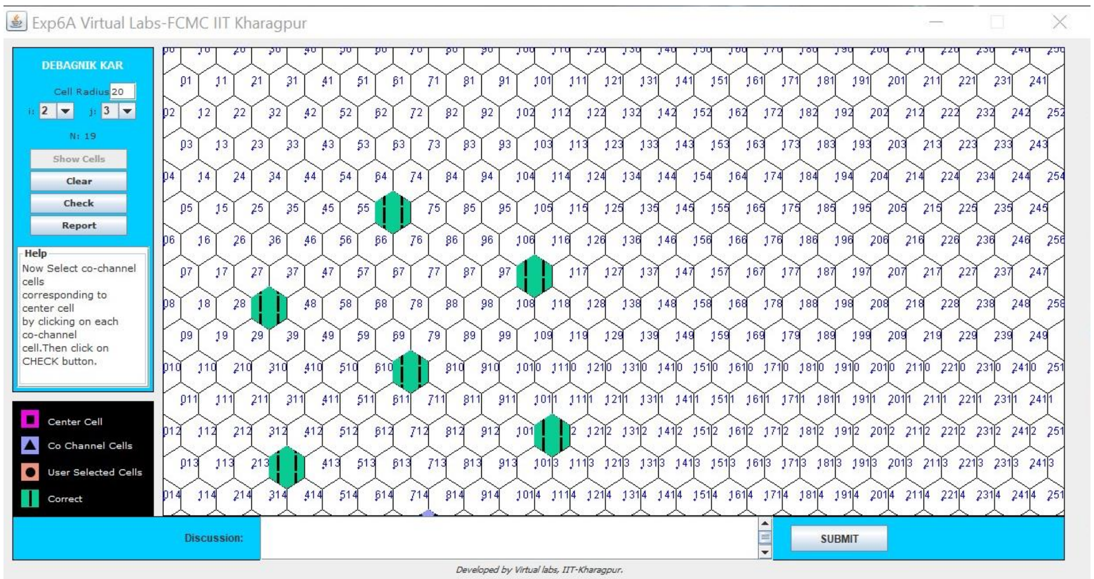


Fig 6.4: co-channel estimation at i=2, j=3

Results :-

N	i	j	Number of co-channel cells	Number of co-channel cells correctly identified
3	1	1	6	6
7	1	2	6	6
13	1	3	6	6
19	2	3	6	5

Experiment Number	6B
Date of Experiment	23/02/2021
Date of Submission	09/03/2021
Name of student	Debagnik Kar
Roll Number	1804373
Section	ETC-06

Aim of the Experiment :-

Understand the cellular frequency reuse concept.

Software Requirement :-

- Java Runtime Environment 7
- Virtual Labs IIT-Kharagpur

Problem statement :-

- What is the relationship between cluster size and cochannel reuse ratio?
- What happens to the system capacity with increase in cluster size?

Observation :-

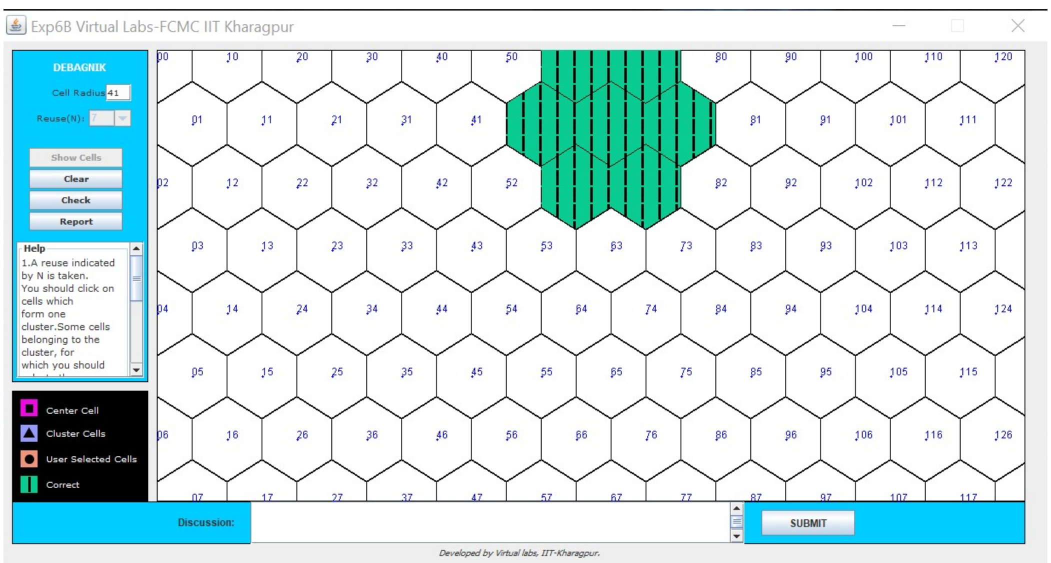


Fig 6.5: observation of clustering

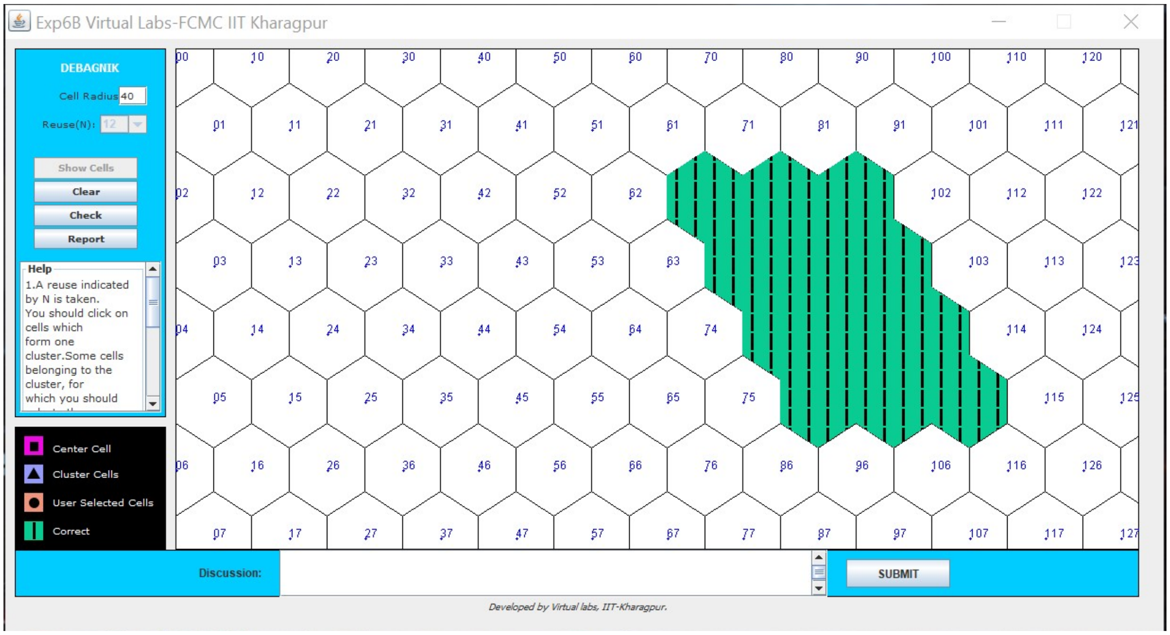


Fig 6.6: observation of clustering

Conclusion :-

In this experiment we learned about cellular frequency reuse concept and clustering . We observed the number of co-channel cells for different values of N (by changing the values of i and j) by performing the experiment in Virtual Labs IIT-Kharagpur . we also observed the cluster of cells for a given reuse(N) and it was seen that cluster size increased with the increase in reuse(N).

Experiment Number	07
Date of Experiment	02/03/2021
Date of Submission	09/03/2021
Name of student	Debagnik Kar
Roll Number	1804373
Section	ETC-06

Aim of the Experiment :-

Study the effect of handover (Mobility Management) threshold and margin on SINR and call drop probability and handover

Software Requirement :-

- Java Runtime Environment 7
- Virtual Labs IIT-Kharagpur

Theory:-

Handoff: In cellular communications, the handoff is the process by which an active call is transferred from one cell to another. When a mobile station is in motion and is moving away from the base transceiver station, into another cell which is covered by another base station, the call is required to be transferred. The process is called handoff.

Problem statement :-

- Set mobile speed to 50 mps and vary the reuse ratio to 1 and 3 and record the number of handoffs, outage duration and outage percentage. What can be observed from the table?

Observation :-

reuse	No. of Handoffs	mobile speed	outage	outage percentage
1	6	50 mps	11520	57.55
3	9	50 mps	1008	5.04
3	2	50 mps	0	0
3	1	50 mps	17500	77.78
7	9	100 mps	0	0

Reuse	Mobile Speed	Cell Radius	No. of Handoffs
3	100 mps	50 m	9
3	100 mps	100 m	15
3	100 mps	200 m	0

Conclusion :-

In this experiment we learned about Hands-off in cellular communication. We observed no. of Call Drops and No. of Handoffs by selecting the parameters (e.g.: Reuse, Environment, Beamwidth, Carrier frequency etc). We analyzed the effect of handover (Mobility Management) threshold and margin on SINR and call drop probability and handover in the above experiment. Also, we realized that High SNR Threshold doesn't depend on CDP.

Fading Channels &Mobile Communications

IIT Kharagpur

Date: 2/Mar/2021

Exp 8: Handoff

Name: DEBAGNIK

Input Parameters	
Reuse: 1 ,Model: Rune	Pt(dBm): 34
fc(GHz): 2.5	Beam Width(deg): 70
Rotate(deg): 30	Cell Radius(m): 50
hT(m): 10	hM(m): 1
Sigma(dB): 4	Vertical Tilt(deg): 12
SNR(dB): 5	Band Width(MHz): 5
Noise Figure(dB): 7	Noise Power(dBm): -100.01
Pr0(dBm): -95.01	Time Slot(s): 20

Exp. Results

SNR	No.Calldrops	No.Handoffs	Delta1	Delta2	Reading Time(ms)	Outage Time(ms)	% Outage	Alpha
5.0	6.0	6.0	3.0	3.0	20016.0	11520.0	57.55	0.1

Observation
Observation not entered

(Signature of DEBAGNIK)

(Signature of Faculty)

Fading Channels &Mobile Communications

IIT Kharagpur

Date: 2/Mar/2021

Exp 8: Handoff

Name: DEBAGNIK

Input Parameters	
Reuse: 3 ,Model: Rune	Pt(dBm): 34
fc(GHz): 2.5	Beam Width(deg): 70
Rotate(deg): 30	Cell Radius(m): 50
hT(m): 10	hM(m): 1
Sigma(dB): 4	Vertical Tilt(deg): 12
SNR(dB): 5	Band Width(MHz): 5
Noise Figure(dB): 7	Noise Power(dBm): -100.01
Pr0(dBm): -95.01	Time Slot(s): 20

Exp. Results

SNR	No.Calldrops	No.Handoffs	Delta1	Delta2	Reading Time(ms)	Outage Time(ms)	% Outage	Alpha
5.0	0.0	9.0	3.0	3.0	20016.0	1008.0	5.04	0.1

Observation
Observation not entered

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(Signature of Faculty)

Fading Channels &Mobile Communications

IIT Kharagpur

Date: 2/Mar/2021

Exp 8: Handoff

Name: DEBAGNIK

Input Parameters	
Reuse: 3 ,Model: Rune	Pt(dBm): 34
fc(GHz): 2.5	Beam Width(deg): 70
Rotate(deg): 30	Cell Radius(m): 100
hT(m): 10	hM(m): 1
Sigma(dB): 4	Vertical Tilt(deg): 12
SNR(dB): 5	Band Width(MHz): 5
Noise Figure(dB): 7	Noise Power(dBm): -100.01
Pr0(dBm): -95.01	Time Slot(s): 20

Exp. Results

SNR	No.Calldrops	No.Handoffs	Delta1	Delta2	Reading Time(ms)	Outage Time(ms)	% Outage	Alpha
5.0	0.0	2.0	3.0	3.0	20625.0	0.0	0.0	0.1

Observation
Observation not entered

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Fading Channels &Mobile Communications

IIT Kharagpur

Date: 2/Mar/2021

Exp 8: Handoff

Name: DEBAGNIK

Input Parameters	
Reuse: 3 ,Model: Rune	Pt(dBm): 34
fc(GHz): 2.5	Beam Width(deg): 70
Rotate(deg): 30	Cell Radius(m): 200
hT(m): 10	hM(m): 1
Sigma(dB): 4	Vertical Tilt(deg): 12
SNR(dB): 5	Band Width(MHz): 5
Noise Figure(dB): 7	Noise Power(dBm): -100.01
Pr0(dBm): -95.01	Time Slot(s): 20

Exp. Results

SNR	No.Calldrops	No.Handoffs	Delta1	Delta2	Reading Time(ms)	Outage Time(ms)	% Outage	Alpha
5.0	0.0	1.0	3.0	3.0	22500.0	17500.0	77.78	0.1
5.0	0.0	0.0	3.0	3.0	22500.0	0.0	0.0	0.1

Observation
Observation not entered

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Fading Channels &Mobile Communications

IIT Kharagpur

Date: 2/Mar/2021

Exp 8: Handoff

Name: DEBAGNIK

Input Parameters	
Reuse: 7 ,Model: Rune	Pt(dBm): 34
fc(GHz): 2.5	Beam Width(deg): 70
Rotate(deg): 30	Cell Radius(m): 50
hT(m): 10	hM(m): 1
Sigma(dB): 4	Vertical Tilt(deg): 12
SNR(dB): 5	Band Width(MHz): 5
Noise Figure(dB): 7	Noise Power(dBm): -100.01
Pr0(dBm): -95.01	Time Slot(s): 20

Exp. Results

SNR	No.Calldrops	No.Handoffs	Delta1	Delta2	Reading Time(ms)	Outage Time(ms)	% Outage	Alpha
5.0	0.0	9.0	3.0	3.0	20016.0	0.0	0.0	0.1

Observation
Observation not entered

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Fading Channels &Mobile Communications

IIT Kharagpur

Date: 9/Mar/2021

Exp 8: Handoff

Name: DEBAGNIK KAR

Input Parameters	
Reuse: 3 ,Model: Rune	Pt(dBm): 34
fc(GHz): 2.4	Beam Width(deg): 70
Rotate(deg): 30	Cell Radius(m): 100
hT(m): 10	hM(m): 1
Sigma(dB): 4	Vertical Tilt(deg): 12
SNR(dB): 5	Band Width(MHz): 5
Noise Figure(dB): 7	Noise Power(dBm): -100.01
Pr0(dBm): -95.01	Time Slot(s): 20

Exp. Results

SNR	No.Calldr ops	No.Hand offs	Delta1	Delta2	Reading Time(ms)	Outage Time(ms)	% Outage	Alpha
5.0	2.0	15.0	3.0	3.0	20016.0	1728.0	8.63	0.1

Observation
Observation not entered

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Fading Channels &Mobile Communications

IIT Kharagpur

Date: 9/Mar/2021

Exp 8: Handoff

Name: DEBAGNIK KAR

Input Parameters	
Reuse: 1 ,Model: Rune	Pt(dBm): 34
fc(GHz): 2.4	Beam Width(deg): 70
Rotate(deg): 30	Cell Radius(m): 500
hT(m): 10	hM(m): 1
Sigma(dB): 4	Vertical Tilt(deg): 12
SNR(dB): 5	Band Width(MHz): 5
Noise Figure(dB): 7	Noise Power(dBm): -100.01
Pr0(dBm): -95.01	Time Slot(s): 20

Exp. Results

SNR	No.Calldr ops	No.Hand offs	Delta1	Delta2	Reading Time(ms)	Outage Time(ms)	% Outage	Alpha
5.0	0.0	0.0	3.0	3.0	23064.0	23064.0	100.0	0.1

Observation
Observation not entered

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