LONDON METROPOLITAN UNIVERSITY

Module Code & Module Title

CS5001NT Network and Operating System

Assessment Weightage & Type

30% Individual Coursework

Year and Semester

2019-20 Autumn / 2019-20 Spring

Student Name: Girija Tamang

London Met ID: 18030995

College ID: NP05CP4S190007

Assignment Due Date: 02-Jan-2020

Assignment Submission Date: 02-Jan-2020

Word Count (Where Required): 6596

I confirm that I understand my coursework needs to be submitted online via Google Classroom under the relevant module page before the deadline in order for my assignment to be accepted and marked. I am fully aware that late submissions will be treated as non-submission and a marks of zero will be awarded.

Acknowledgement

I would like to express my special thanks of gratitude to my module teacher Pratik Karki as well as IIC College to provide me the golden opportunity to do this wonderful project on the topic Simulation and Research, which helped me in doing a lot of research and I come to know about so many new things.

Secondly, I would also like a thank my friend and Mr. Pratik Karki whose valuable guidance and kind supervision given to me throughout the course shaped me to complete assignment. It helped me to increase my knowledge and skills.

Abstract

This is the individual Assessment of Network and Operating System module. This coursework is divided into two parts as tasked A and task B. Task A is based on network stimulation model where I have to develop a WAN model for IBN Bank which connects different LANS of Nepal and Edinburgh. I must implement the scenario given to generate proper report of wan model. Task B is based for technical report on GSM technologies which includes mobile communication and cellular technologies. Task B report should also cover the wireless technologies and its impact on daily lives.

Contents

Tables of Figures

Tables of Table

Task A

1. Introduction of Task A

As per the scenario, I have done all the task of part A where I have created the WAN model and LAN models. All the models relate to the help of Cloud and Access point. The Edinburgh LAN Model includes the Edinburgh Router, the Edinburgh Server, the Edinburgh Token Ring, the Edinburgh Response Source and the access point, all of which are connected. There is a Biratnagar router, Biratnagar token ring connected with Biratnagar Atm and Biratnagar Atm Group and Biratnagar ATM is connected to Biratnagar Atm message source and Biratnagar Atm group is connected through Biratnagar Atm group message. All these things are linked to each other with access point inside the Biratnagar Lan Model. Inside the Lalitpur Lan Model there is an access point connected to Lalitpur Router, Lalitpur Token Ring connected with Lalitpur Atm and Lalitpur connects with Lalitpur Atm message and Lalitpur Atm group connects with Lalitpur ATM group message in token ring.

All LAN is configured using IEEE 802.5 16 Mbps token passing standard. The routing protocol used is TCP-IP Microsoft V1.0 with 10 ms Packetize time. Each LANs are connected to the frame relay cloud through a cisco 7010sp, V10.0 router. There are four Virtual Circuits and three points to point link where the Edinburgh point to point link connects with Lalitpur and Biratnagar point to point link and vice-versa and the access points are connected to all three points to point link in wan cloud. the WAN cloud has a transmission rate of 56 Kbps and the links in the WAN cloud have a transmission rate of 64 Kbps using sliding window burst type. This task was done with the help of COMNET ||| application.

Aims and Objectives

- The main aim is to create the WAN model for IBN Bank where the parameters must be set according to the given scenario.
- Creation of the different LAN topology within the WAN Model and join connect them with the help of wan cloud.
- The implementation of the scenario is done with the proper explanation of the figures and the reports of the nodes are also shown along with bar graph and table.
- After the development of proper wan model, we conclude the overall report with the screenshots that are provided with a proper explanation in the appendix.

2. WAN Model

A wide area network (WAN) is a geographically distributed private telecommunications network that interconnects multiple local area networks (LANs). WANs are often used by large corporations or organizations to promote the sharing of data, and WANs have been implemented in a wide range of industries corporation with facilities at multiple locations (Rouse, 2009).

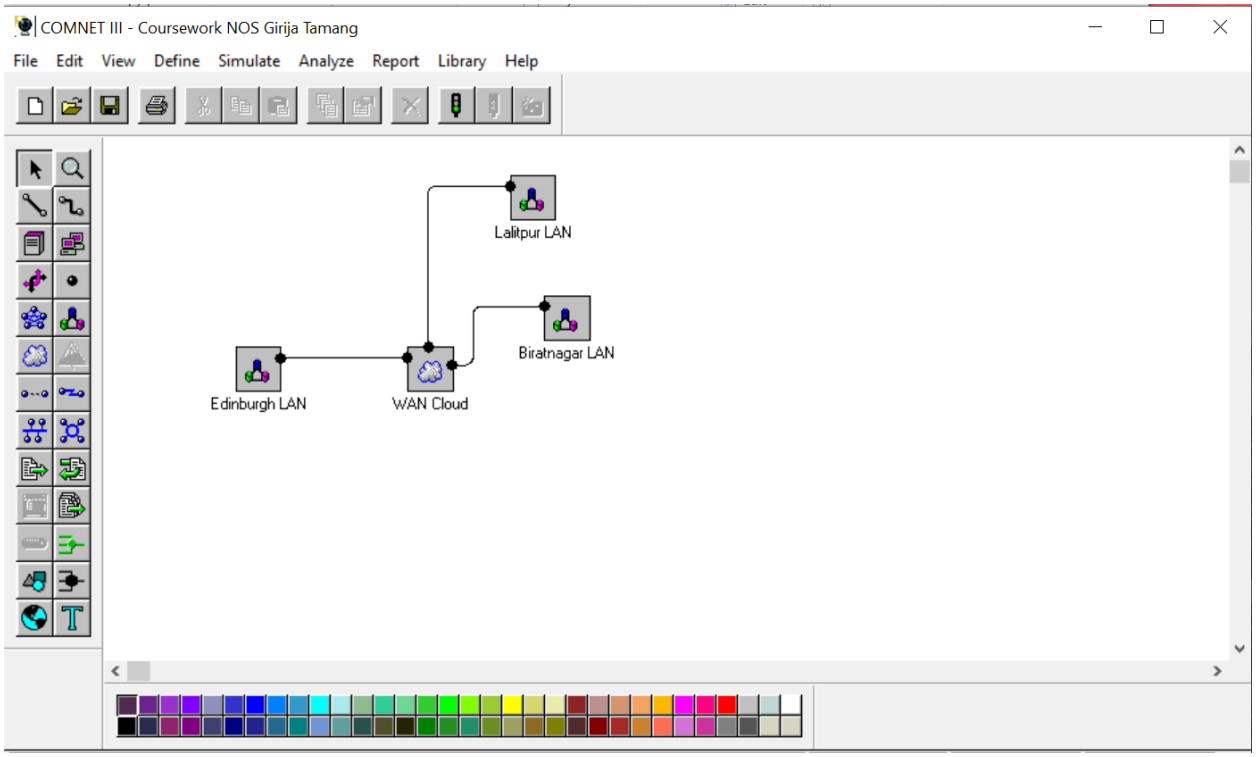

Figure 1: WAN Model.

In this model, there are total of three different LANs in this topology, namely Edinburgh, Biratnagar and Lalitpur. The wan cloud is used to connect all the LAN through access point. This model is developed for a Mythical company namely IBN bank which is willing to setup two ATM transaction network in Nepal.

3. Edinburgh LAN

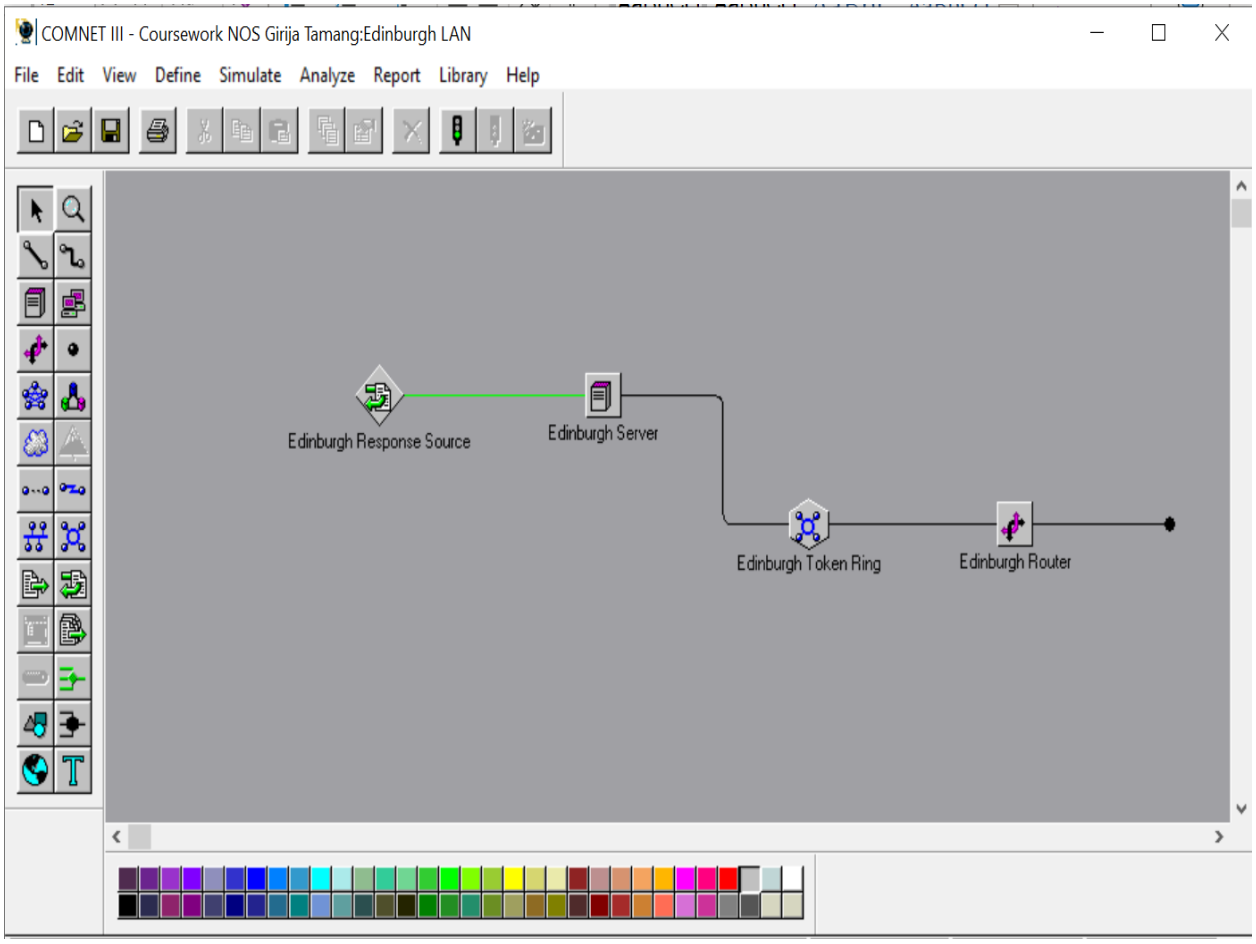

Figure 2: Edinburgh Lan Model

This LAN has a token ring, server, router and one message response source linked with each other. The Edinburgh LAN is configured using IEEE 802.5 16 Mbps token passing standard with an ATM processing server. This LAN is connected to the frame relay cloud through a cisco 7010sp, Edinburgh Router (V10.0 router) which is linked to access point.

3.1 Edinburgh Token Ring

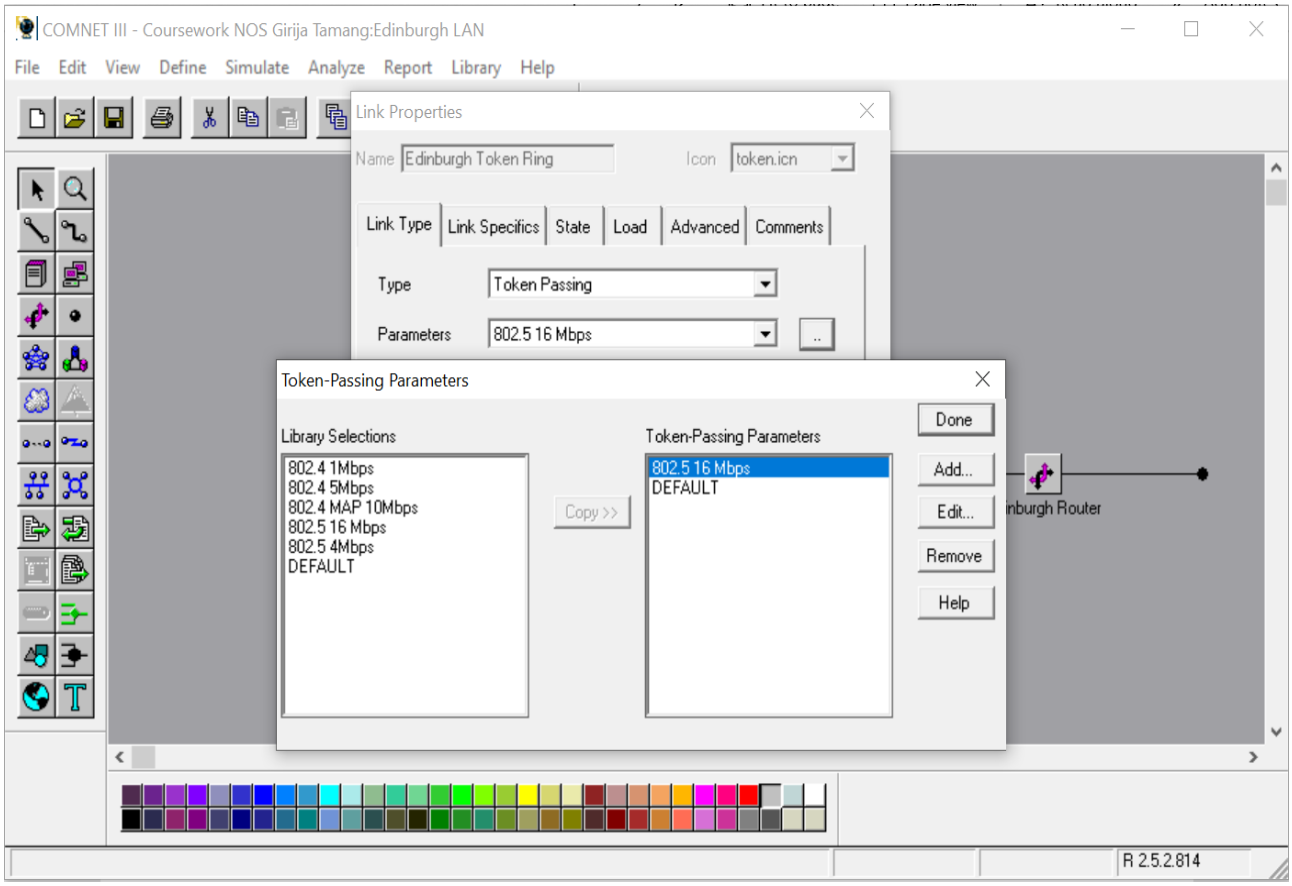

Figure 3: Edinburgh Token Ring.

A Token Passing Link is created with the name Edinburgh Token Ring where parameters are set to 802.5 16 Mbps and its Type is Token Passing, and all the other settings are set as default.

3.2 Edinburgh Router

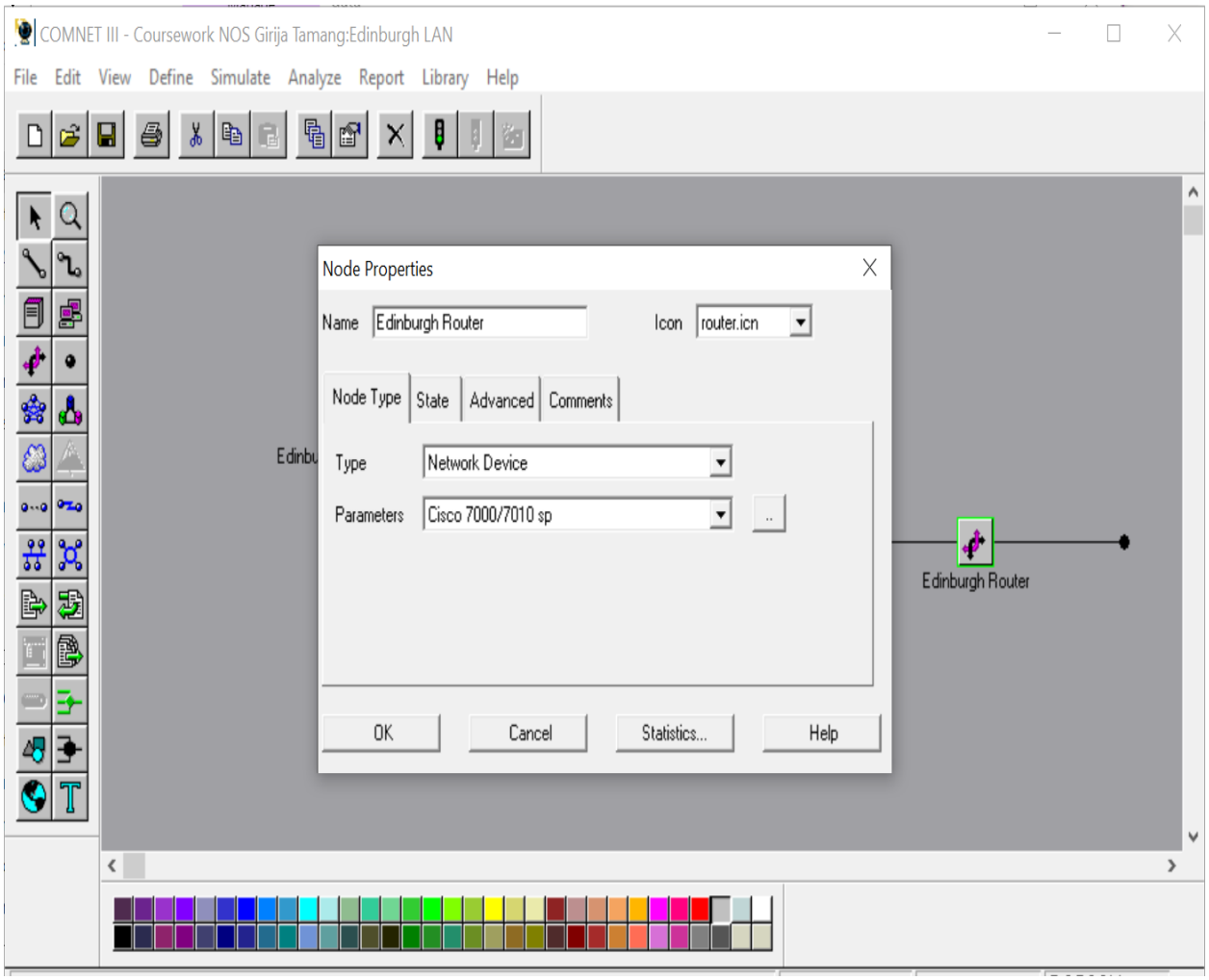

Figure 4: Edinburgh Router.

A network device node is created with the name Edinburgh Router and connected to other links. The router parameters are changed to Cisco 7000/7010 sp and the rest settings are as default.

3.3 Edinburgh Server

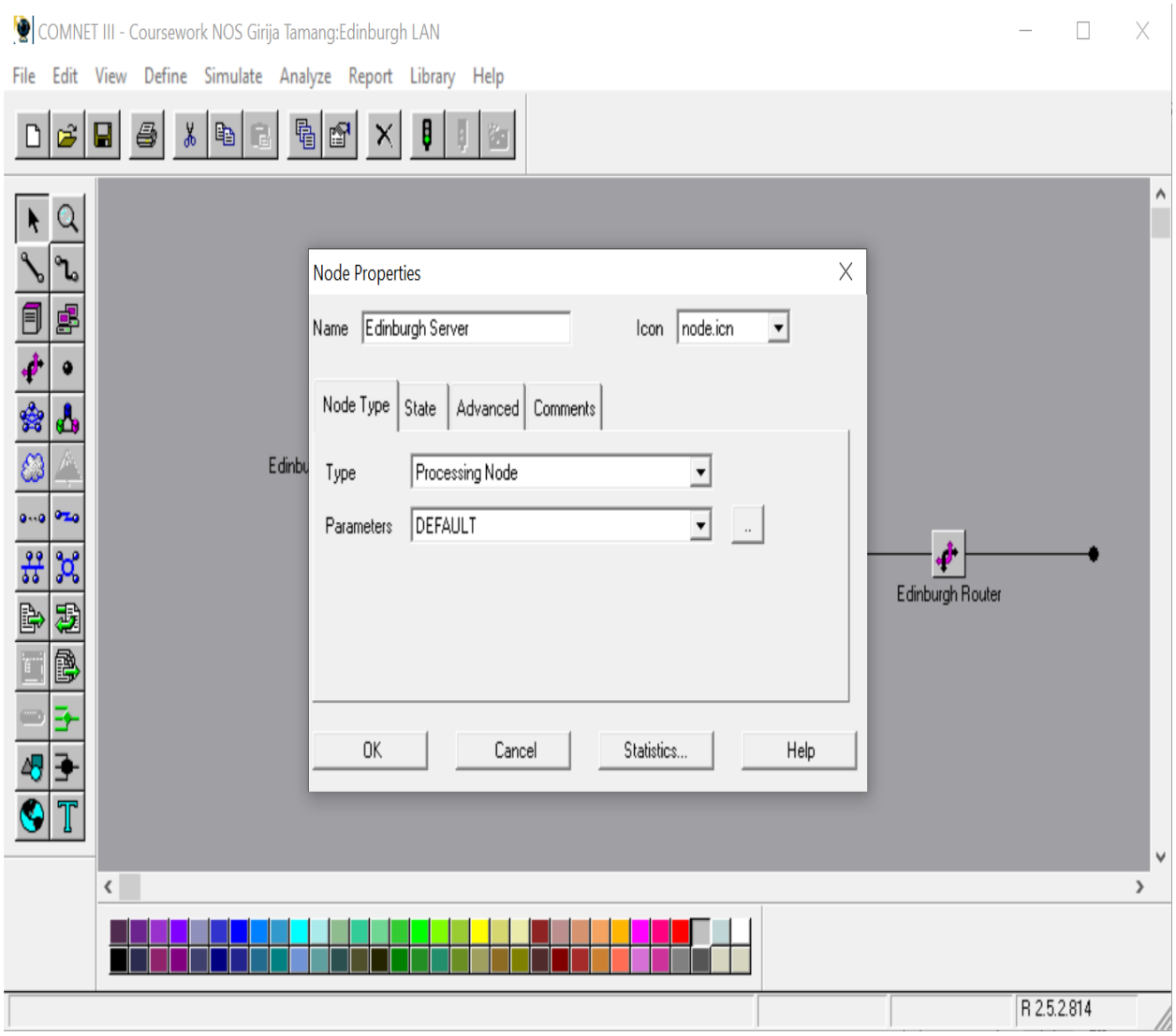

Figure 5: Edinburgh Server.

Processing node (Server) is created in working area. The name of the server is set as Edinburgh Server and other setting are set as default.

3.4 Edinburgh Response Source

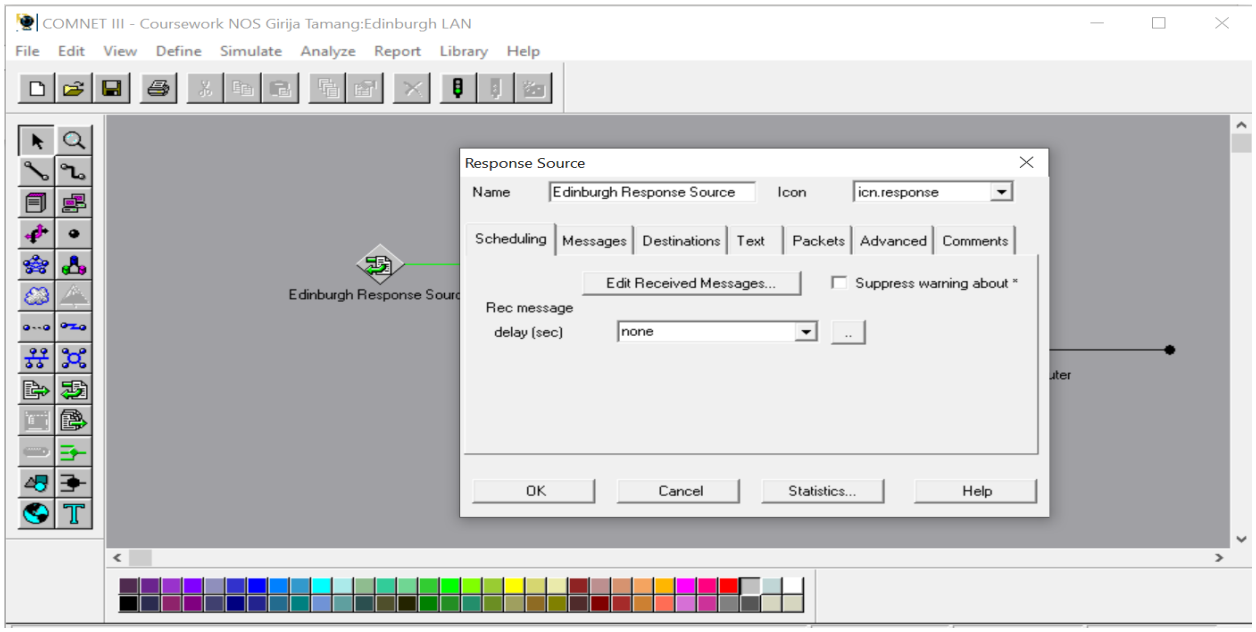

Figure 6: Edinburgh Response Source

A response source is created with the name Edinburgh Response Source where various changes are done and attach to Edinburgh server.

3.4.1 Scheduling

In scheduling the received messages are changed and the response from Lalitpur ATM Group Msg Source, Lalitpur ATM Msg Source, Biratnagar ATM Group Msg Source, Biratnagar ATM Msg Source are added to message response source of Edinburgh LAN.

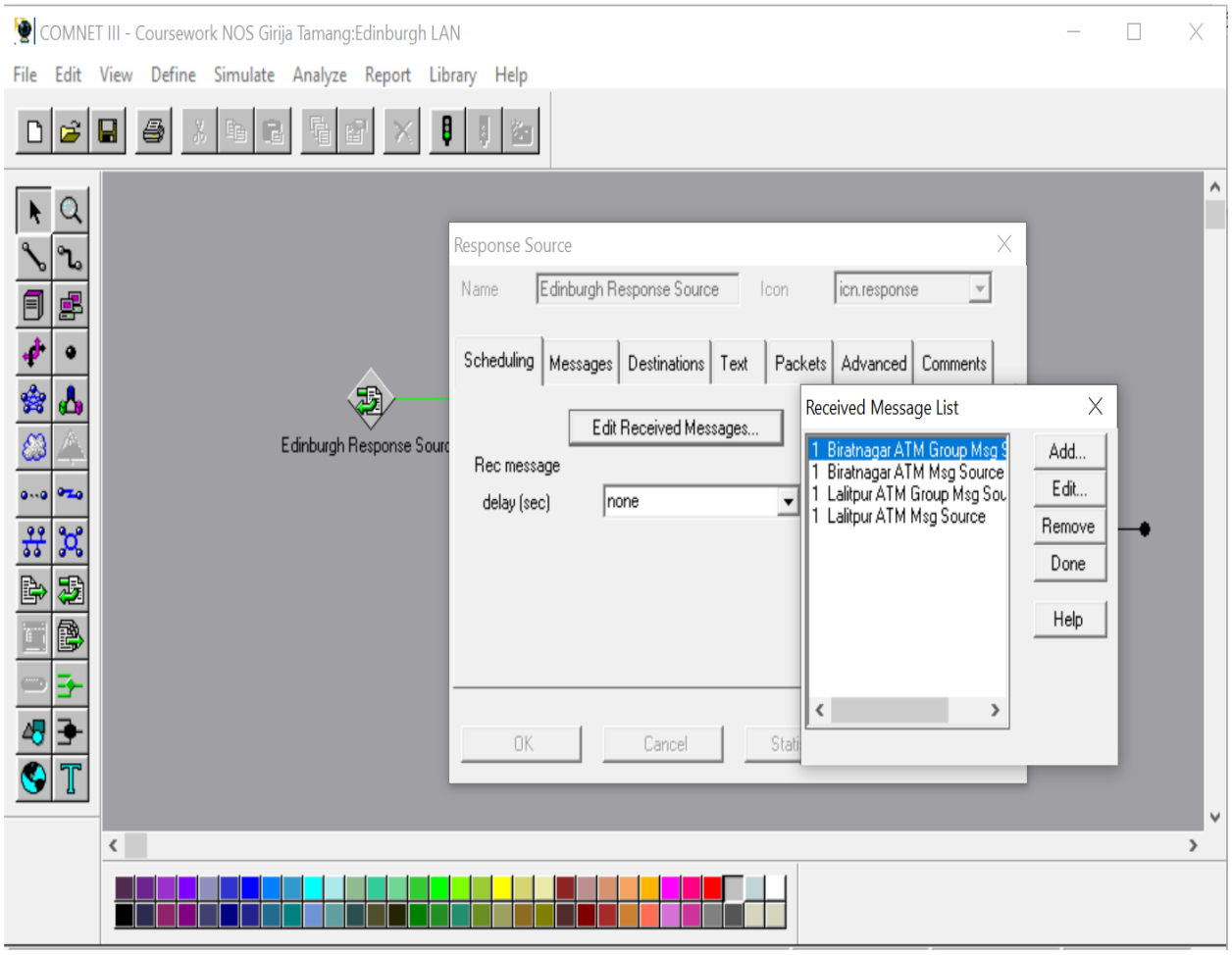

Figure 7: Scheduling of Edinburgh Server Response.

3.4.2 Message

The response message size of Edinburgh LAN measures with a uniform distribution of probability and the size with stream 2 is uniformly distributed over the range of 50 to 100 bytes.

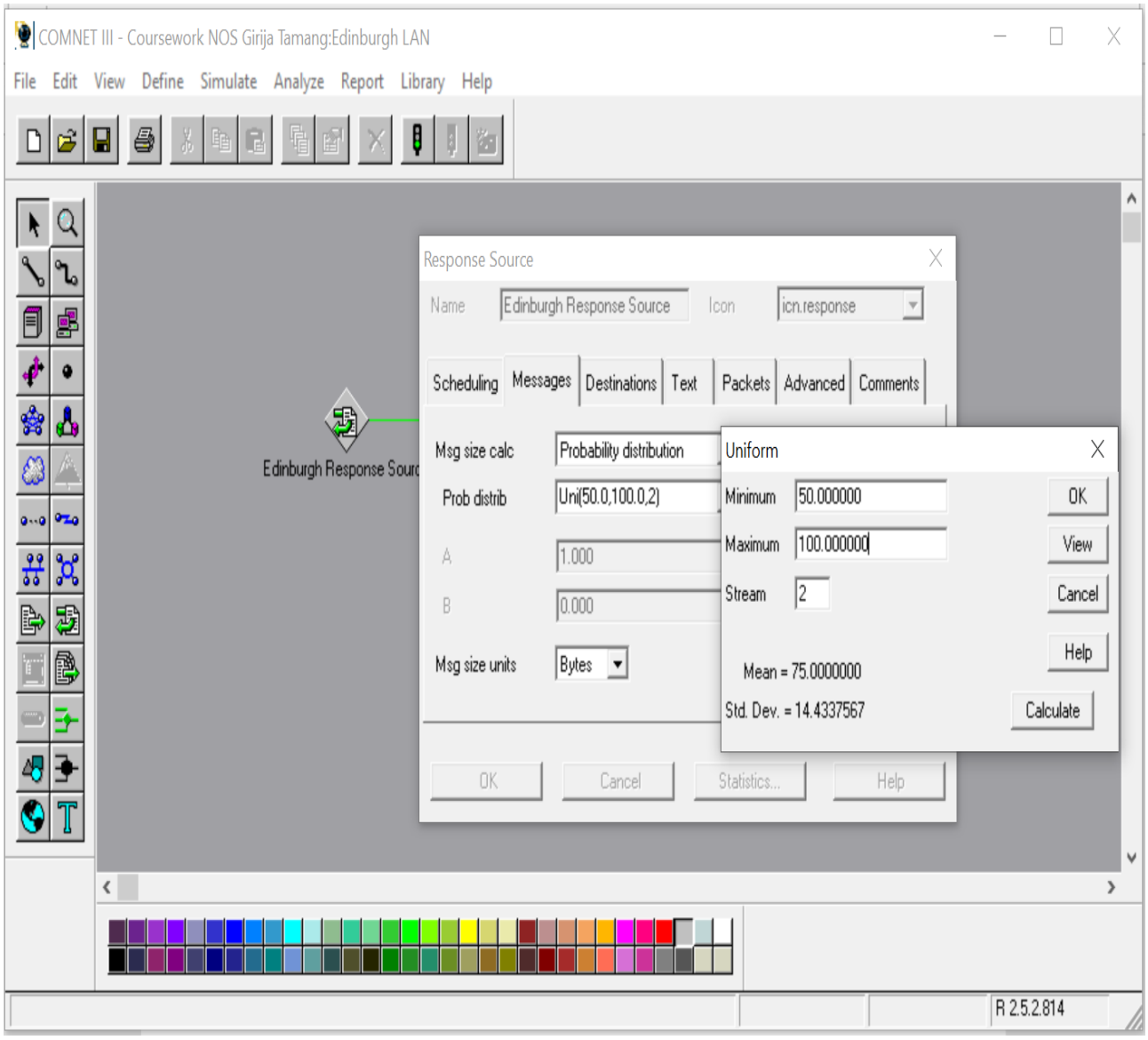

Figure 8: Messages of Edinburgh Server Response.

3.4.3 Packet

In Packets, The Protocol format is set to TCP/IP – MicrosoftV1.0 and the packetize is set to 10.0 ms where routing class is set to Standard with a hop count of 65535 with IGRP metric weight (k1) = 1.

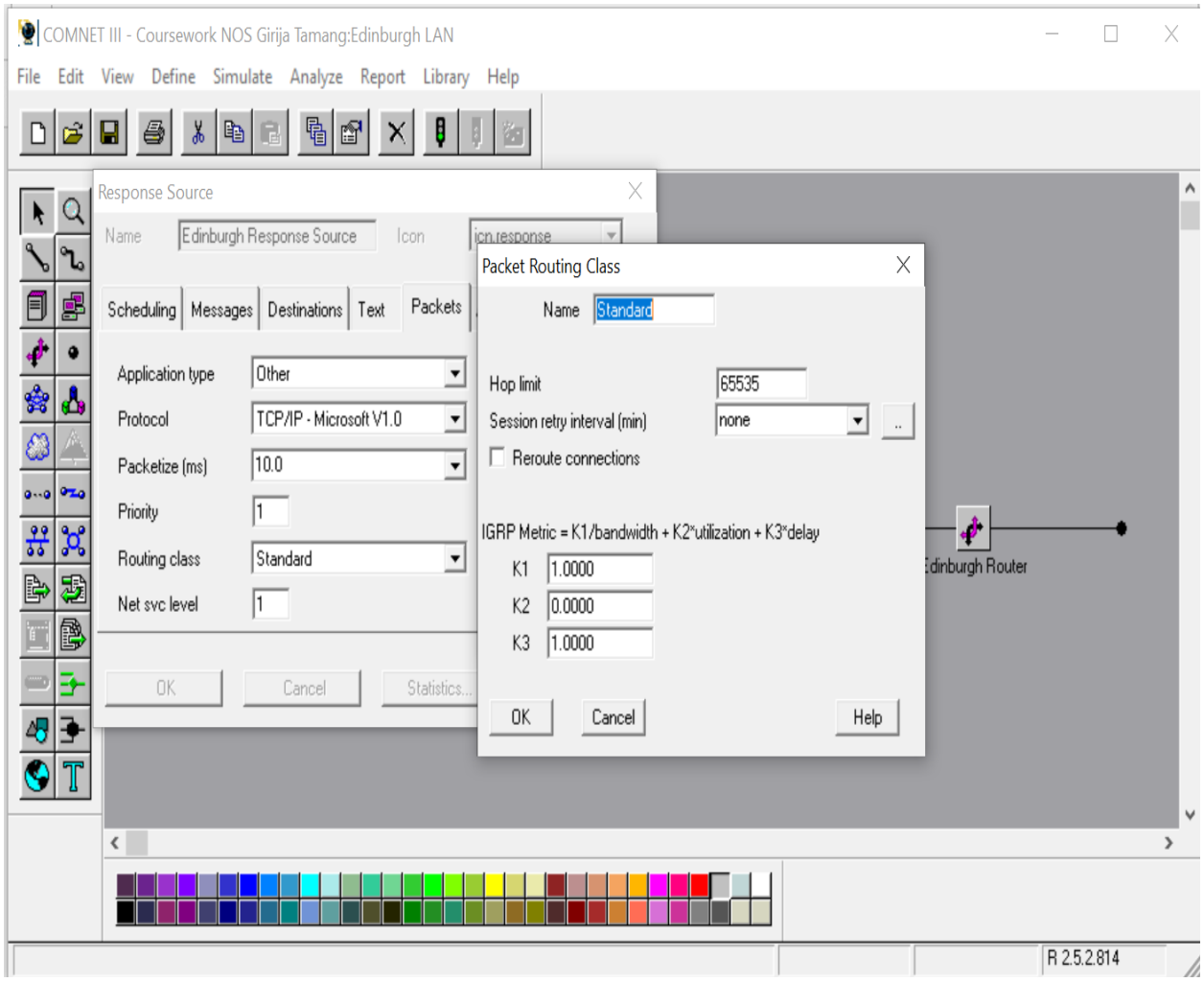

Figure 9: Packets of Edinburgh Sever Response

4. Biratnagar LAN

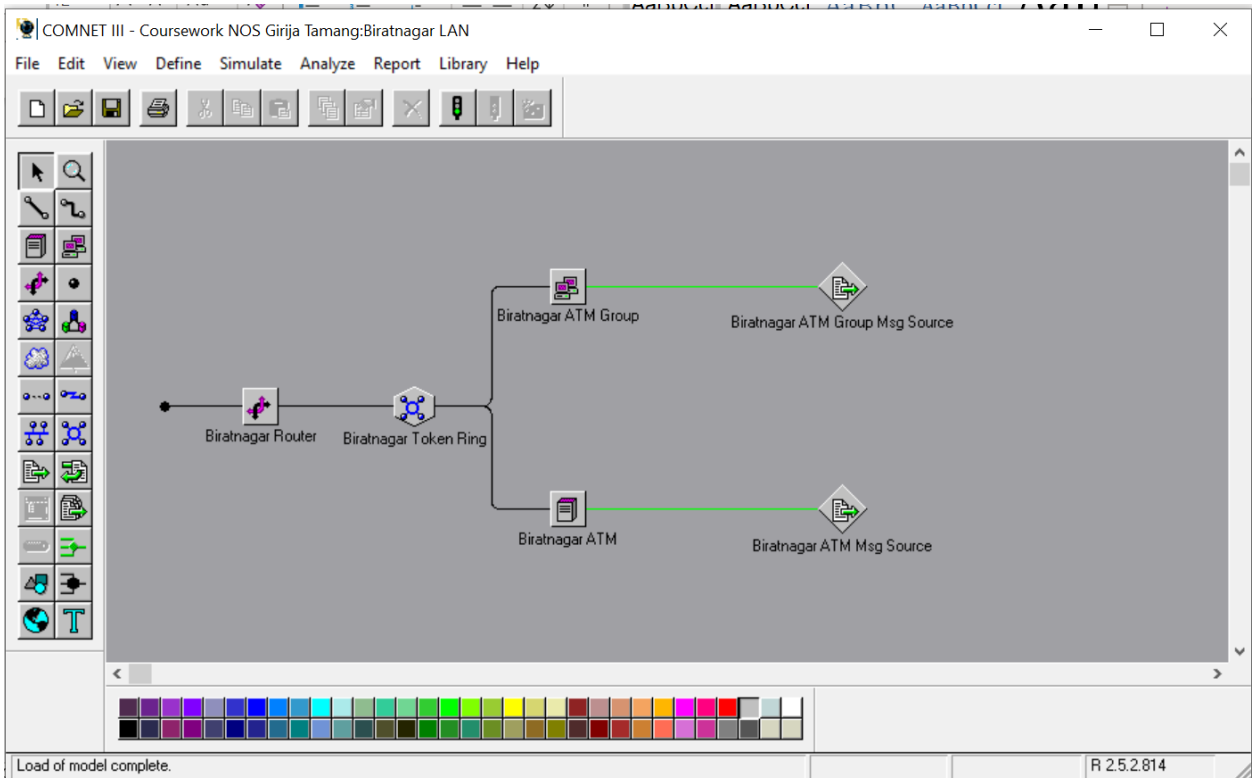

Figure 10: Biratnagar LAN Model

This model consists of a token ring, a processing node, two message sources, a group of PCs and one router which are connect to access point. The Biratnagar LAN is configured using IEEE 802.5 16 Mbps token passing standard connected with the frame relay cloud through a cisco 7010sp, Biratnagar Router (V10.0 router). This LAN consists of 50 ATM transaction nodes plus one single teller giving a total of 51 ATMs in transection network.

4.1 Network Device: Router

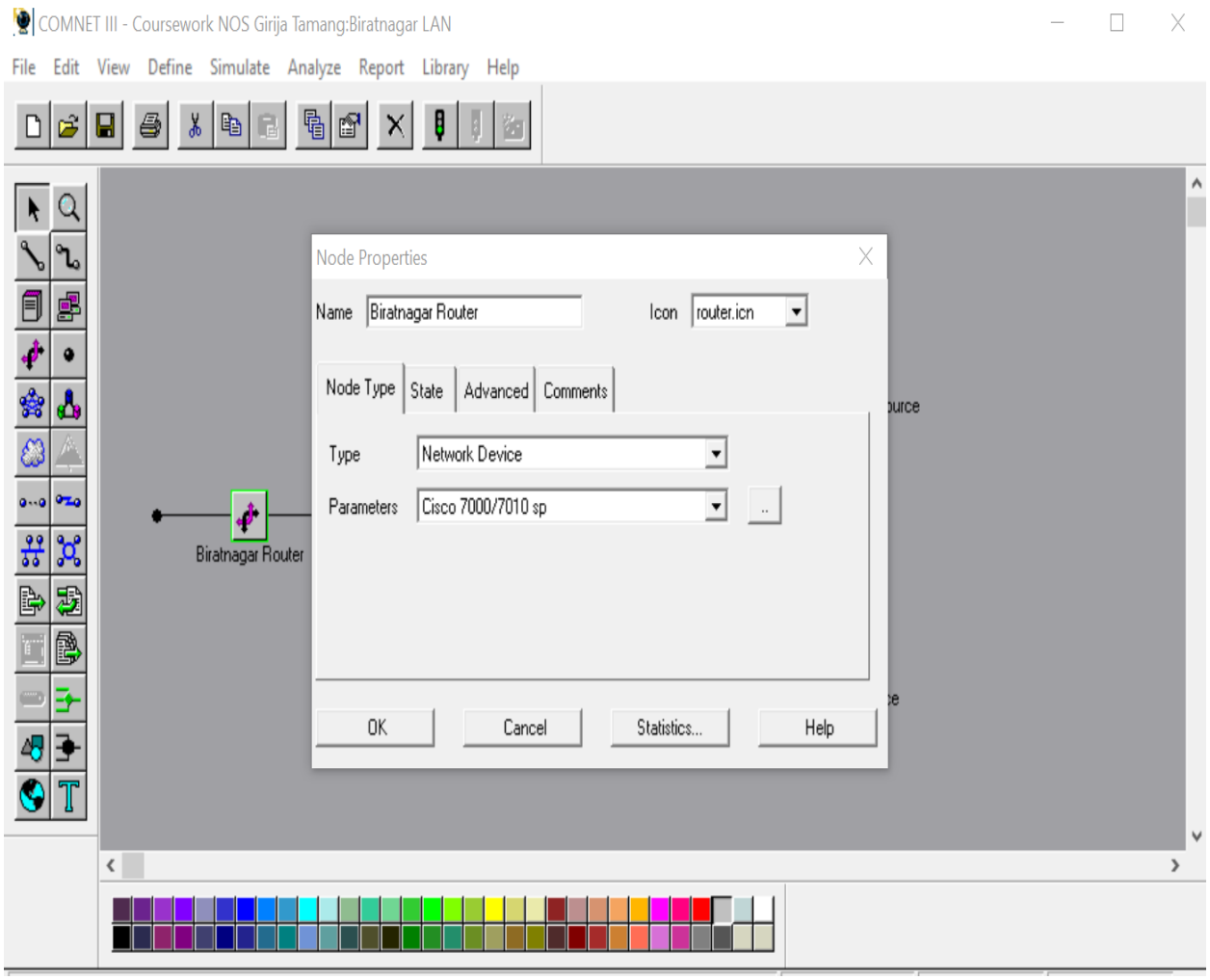

Figure 11: Biratnagar LAN Router.

A network device node is created with name Biratnagar Router and connected to access point and token passing link. The router parameters are changed to Cisco 7000/7010 sp and the rest settings are as default.

4.2 Token Passing Link

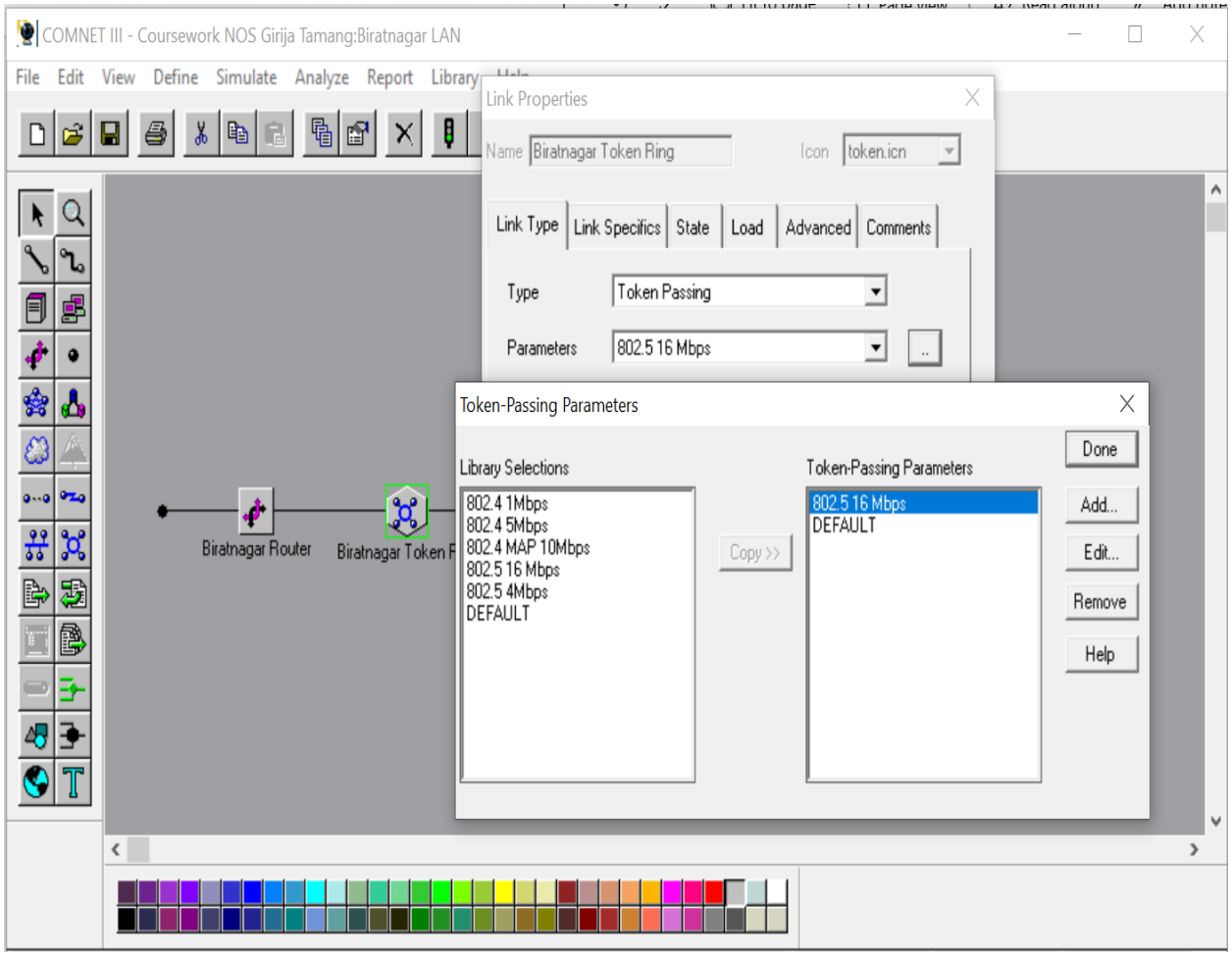

Figure 12: Biratnagar Token Passing Link

A Token Passing Link is created with the name Biratnagar Token Ring where parameters are set to 802.5 16 Mbps and its Type is Token Passing, and all the other settings are set as default.

4.3 Processing Node

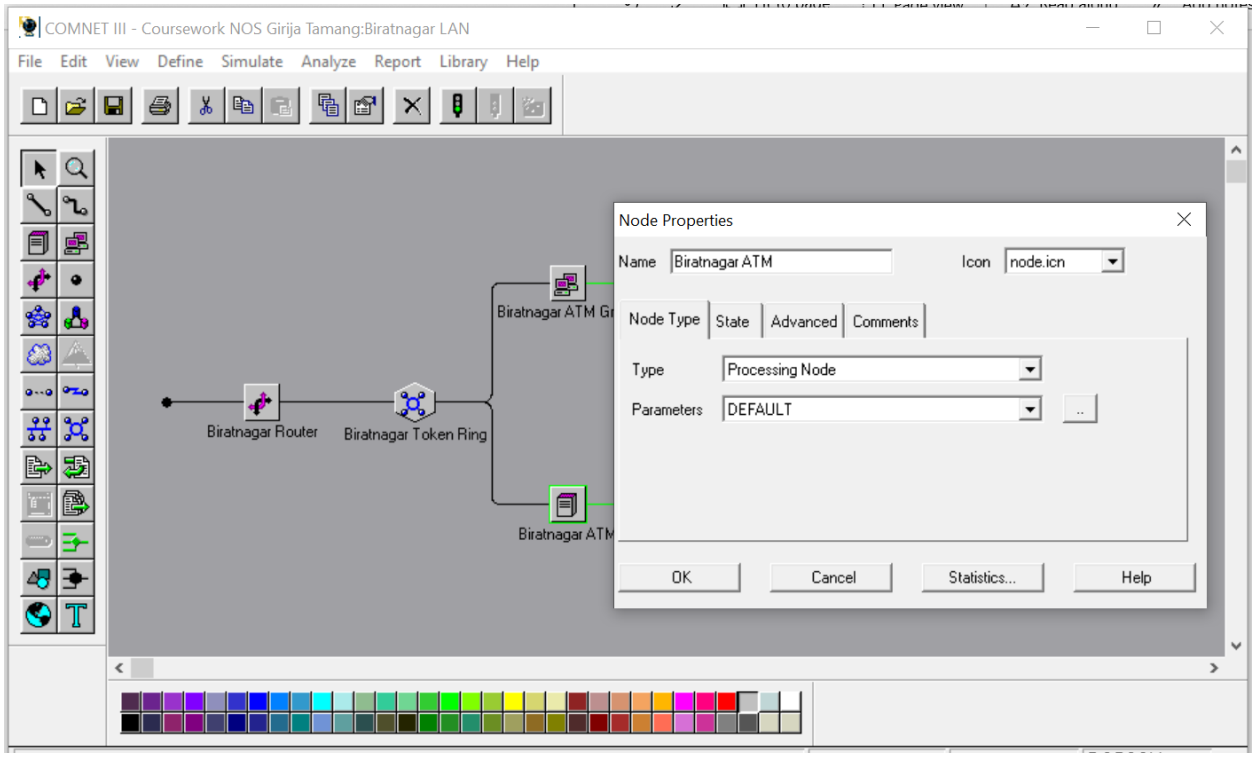

Figure 13 : Biratnagar ATM

A processing node is created, joined with token passing link, and its name is changed to Biratnagar ATM and the other settings are left as default.

4.4 Computer Group

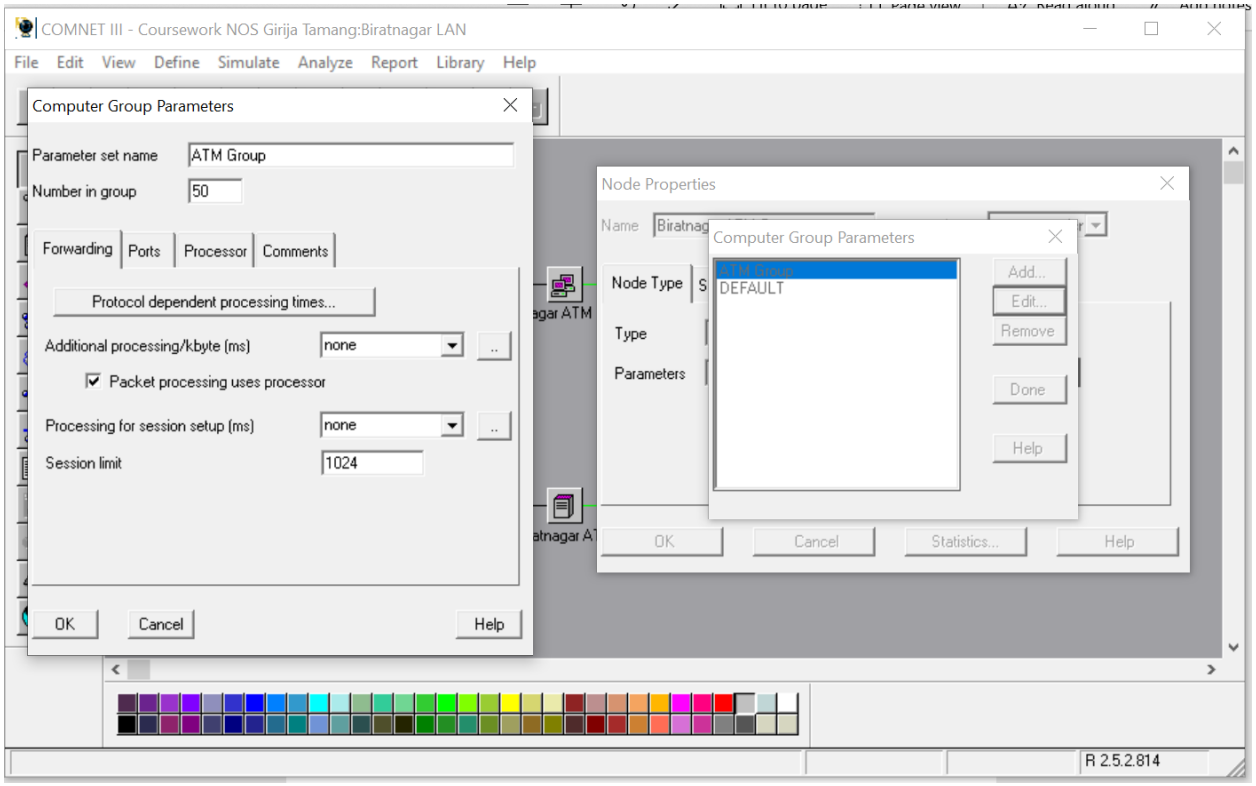

Figure 14: Biratnagar ATM Group.

A computer group is created with the name Biratnagar ATM group where the parameter is set as ATM Group and Number of computer group is set to 50 in ATM Group.

4.5 Biratnagar ATM Message Source.

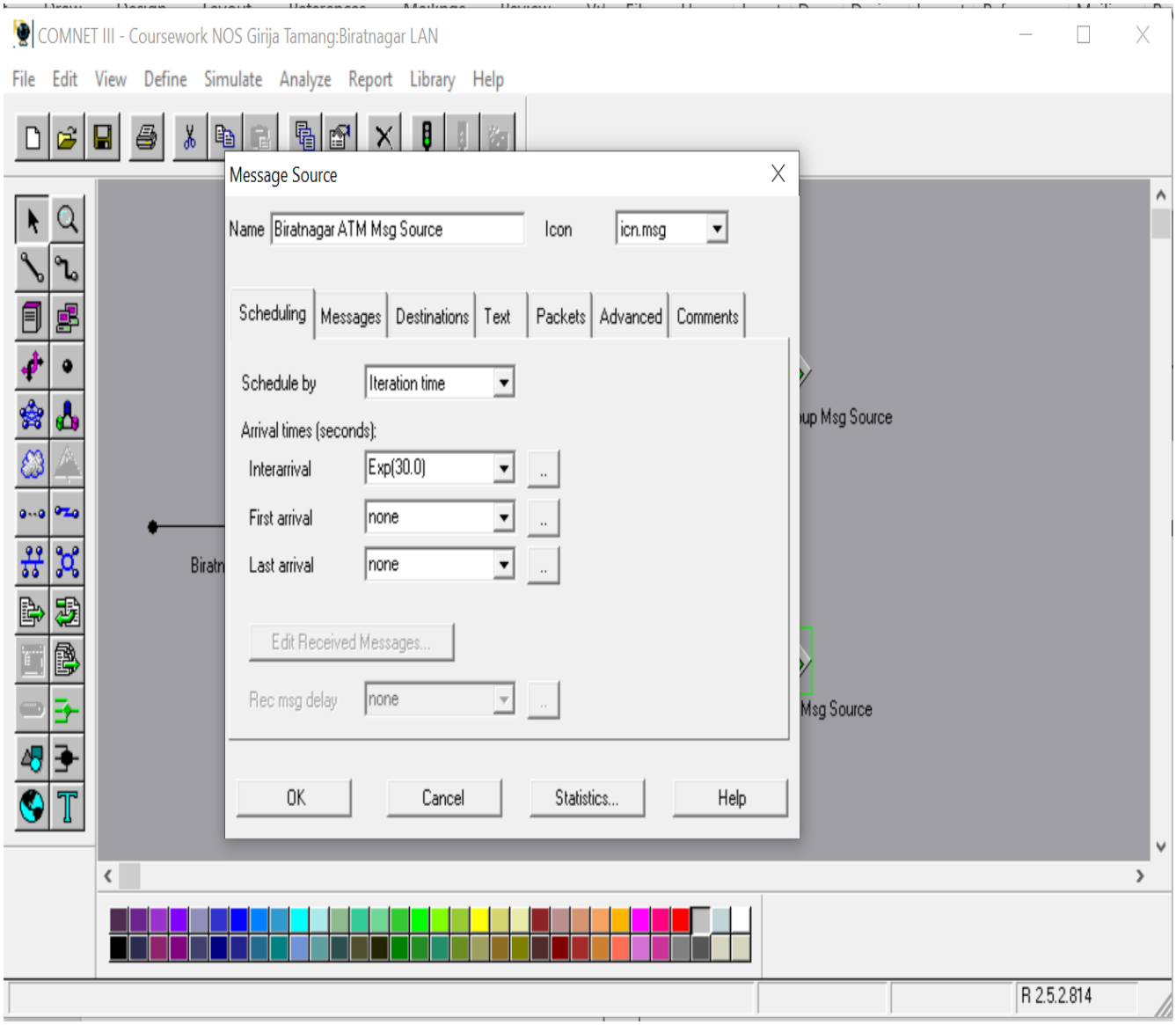

Figure 15: Biratnagar ATM Message Source.

A message source is created with the name Biratnagar ATM Msg Source where various changes are done and attached to processing node (Biratnagar ATM).

4.5.1 Scheduling

In scheduling, the interarrival of message is set as exponential where Mean is set to 30 and the Stream of 0.

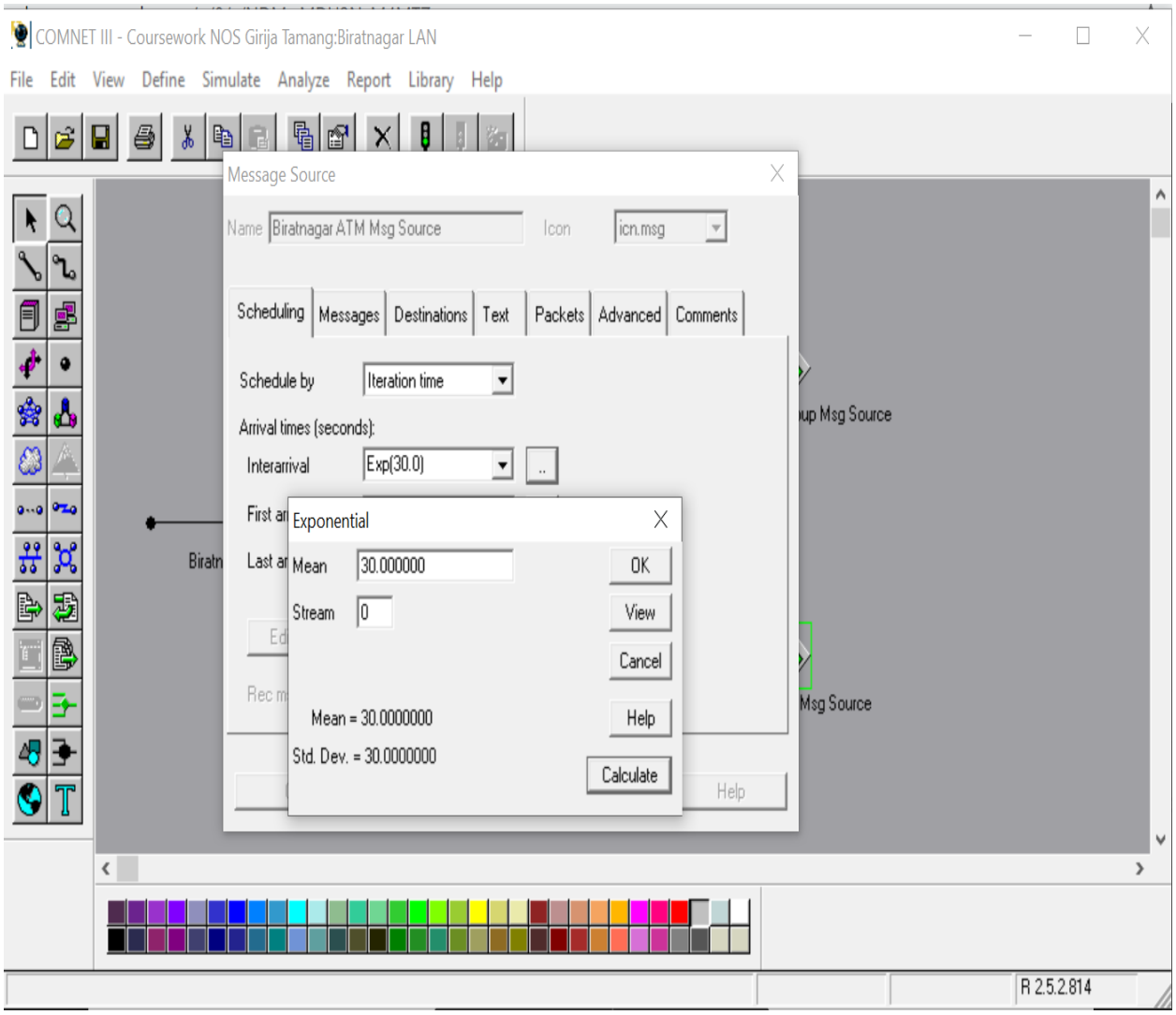

Figure 16: Scheduling of Biratnagar ATM Message Source.

4.5.2 Message

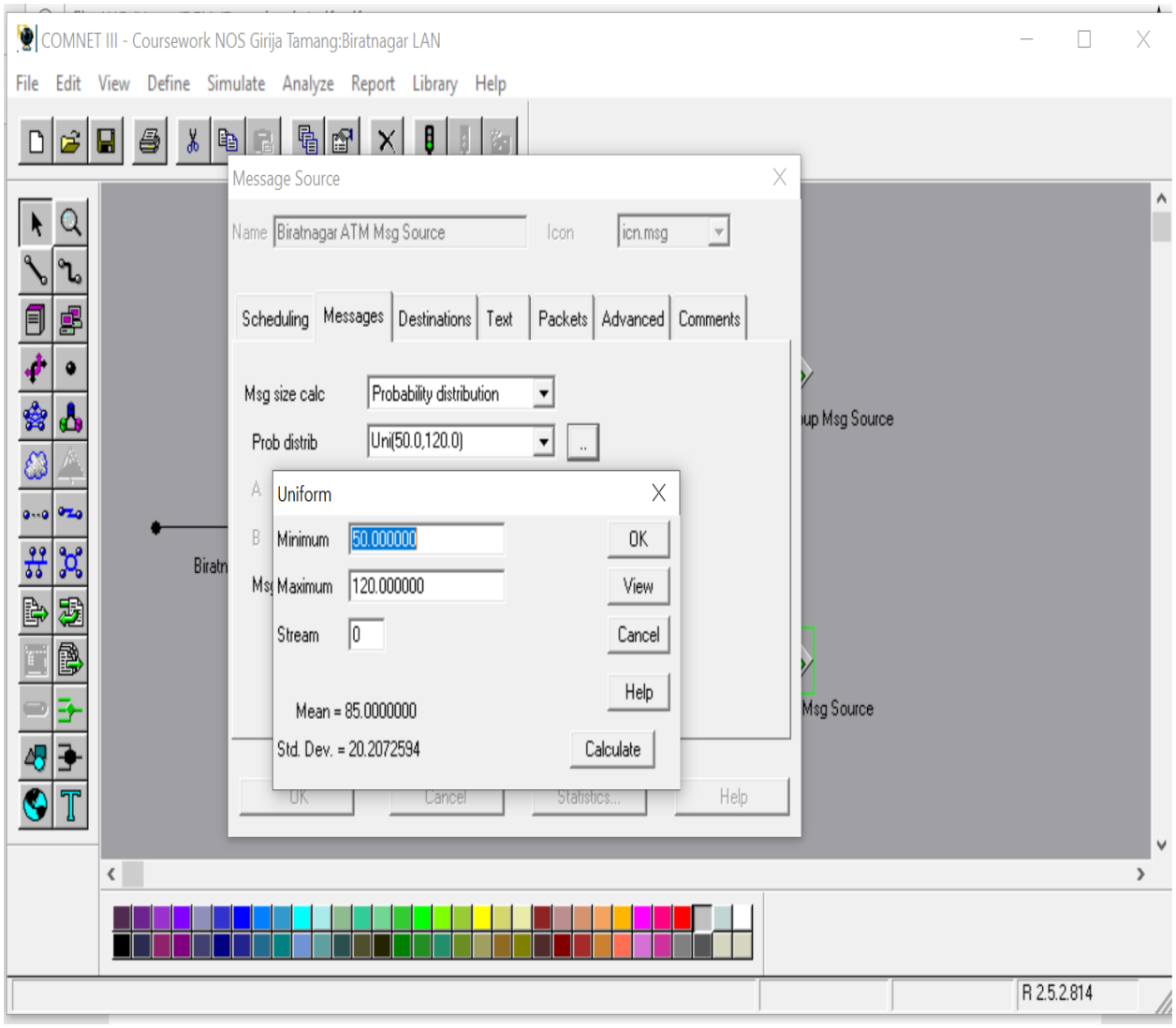

Figure 17: Messages of Biratnagar ATM Message Source.

The message source size of Biratnagar ATM measures with a uniform distribution of probability and the size with stream 0 is uniformly distributed over the range of 50 to 120 bytes.

4.5.3 Destinations

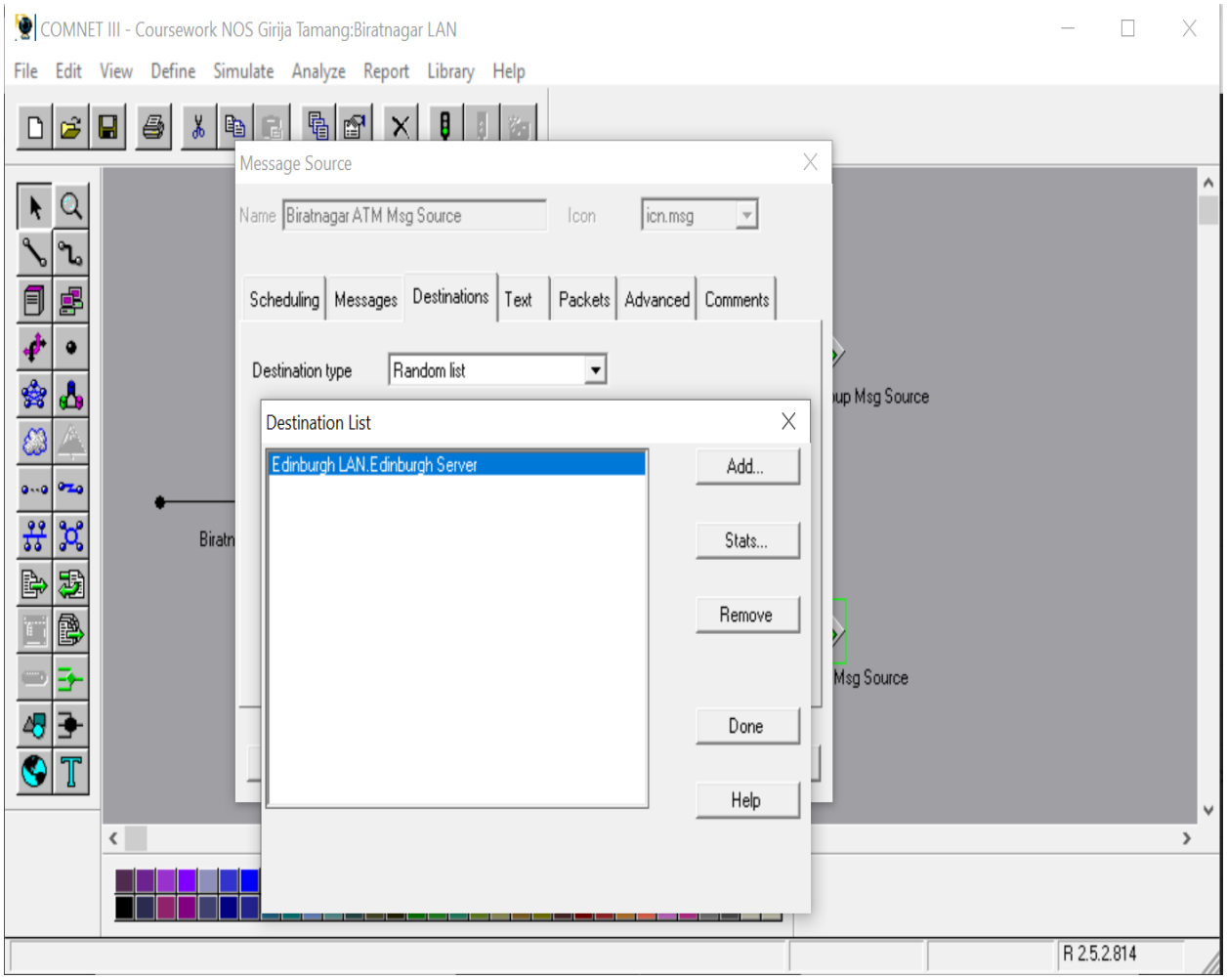

Figure 18: Destination of Biratnagar Atm Message Source.

Here, the destination type is set to Random List and the destination list is set as Edinburgh LAN.Edinburgh Server.

4.5.4 Packets

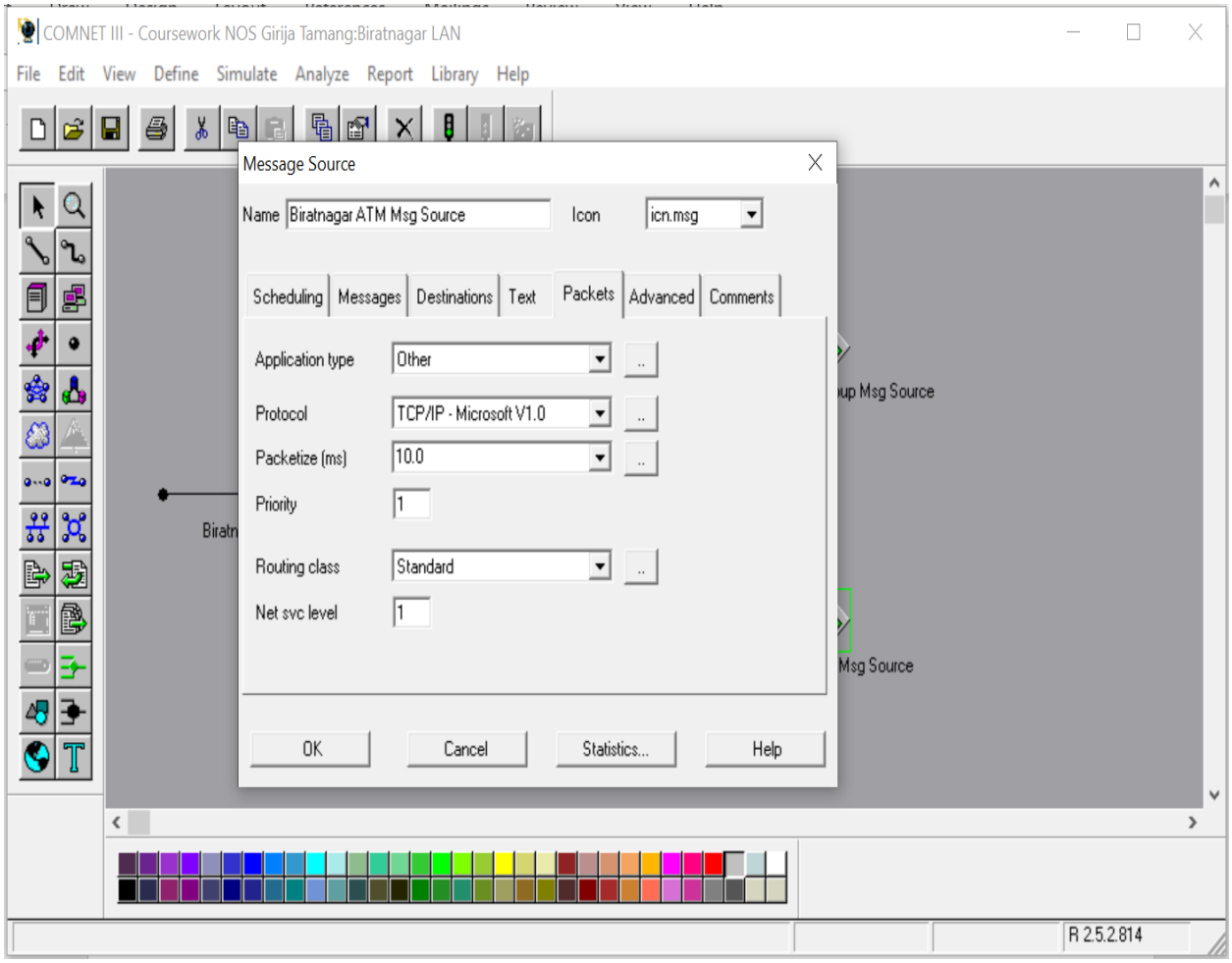

Figure 19: Packets of Biratnagar ATM Message Source.

The Protocol format is set to TCP/IP – MicrosoftV1.0 and the packetize is set to 10.0 ms where routing class is set to Standard with a hop count of 65535 with IGRP metric weight (k1) = 1.

4.6 Biratnagar ATM Group Message Source

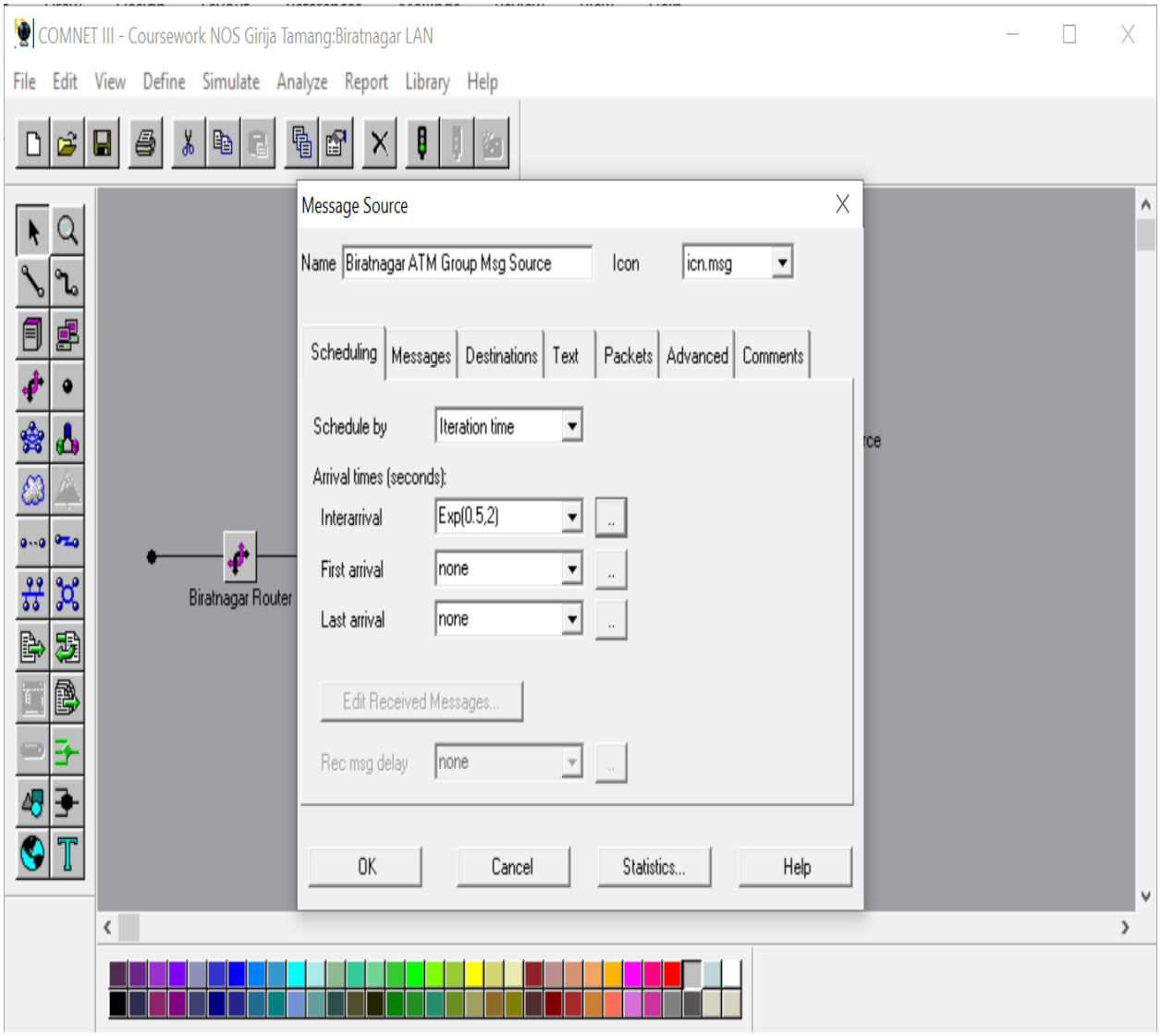

Figure 20: Biratnagar ATM Group Message Source.

A message source is created with the name Biratnagar ATM Group Msg Source where various changes are done and attached to Biratnagar ATM Group.

4.6.1 Scheduling

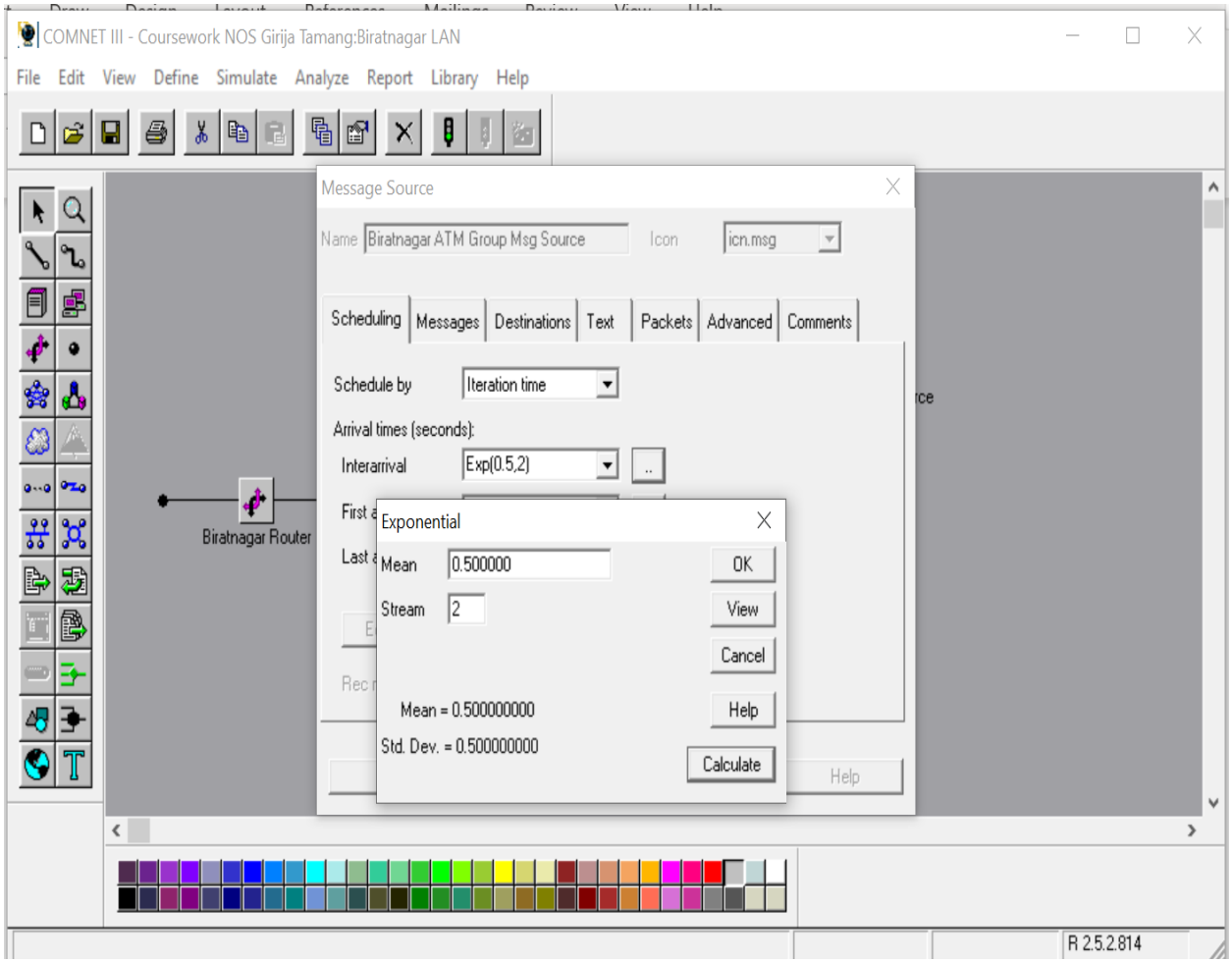

Figure 21: Scheduling of Biratnagar ATM Group Msg Source.

The Interarrival is set as Exponential where the Mean is set as 0.5 along with the Stream of 2.

4.6.2 Message

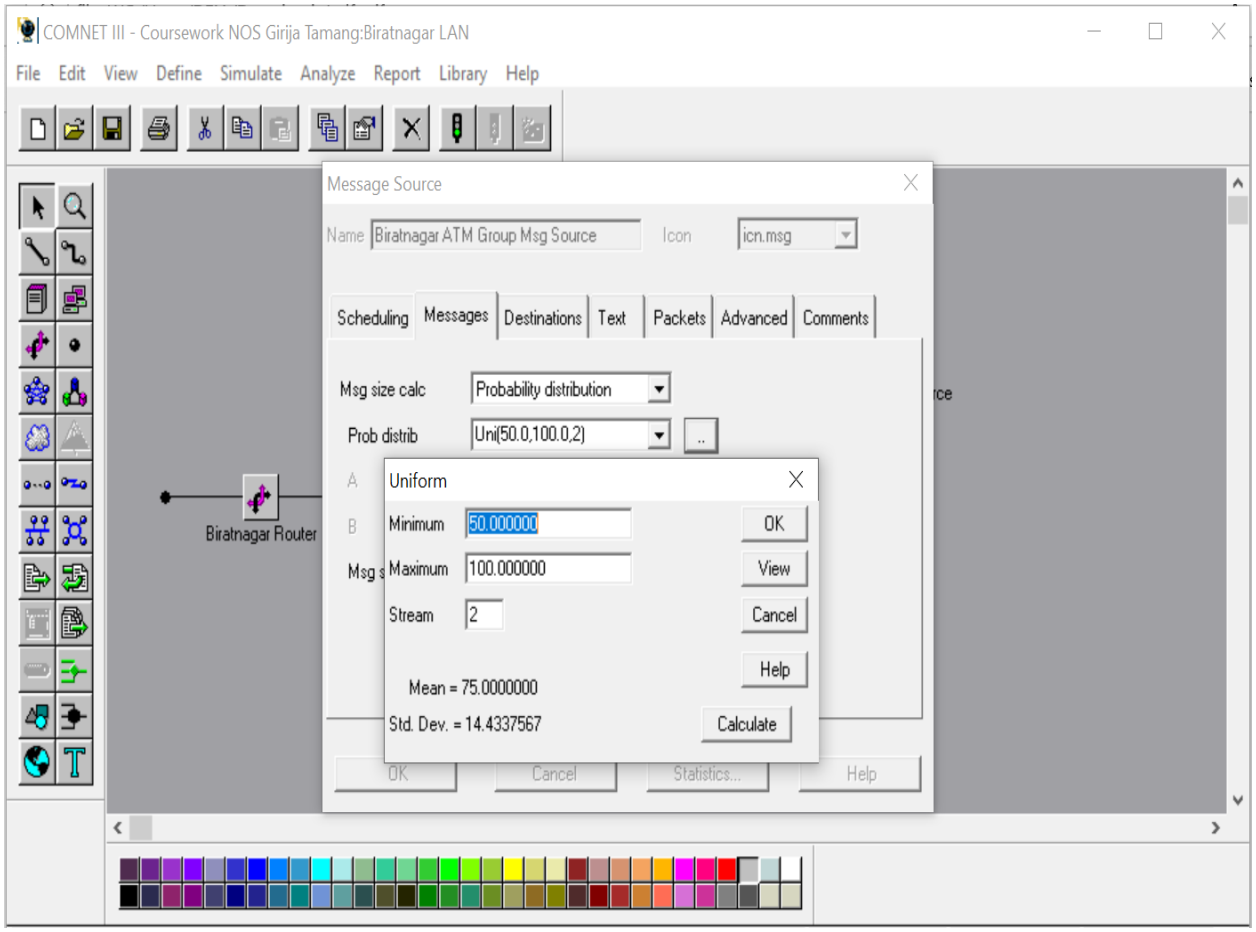

Figure 22: Message Source of Biratnagar ATM Group.

The message source size of Biratnagar ATM Group measures with a uniform Distribution of Probability and the size with stream 2 is Uniformly Distributed over the range of 50 to 100 bytes.

4.6.3 Destinations

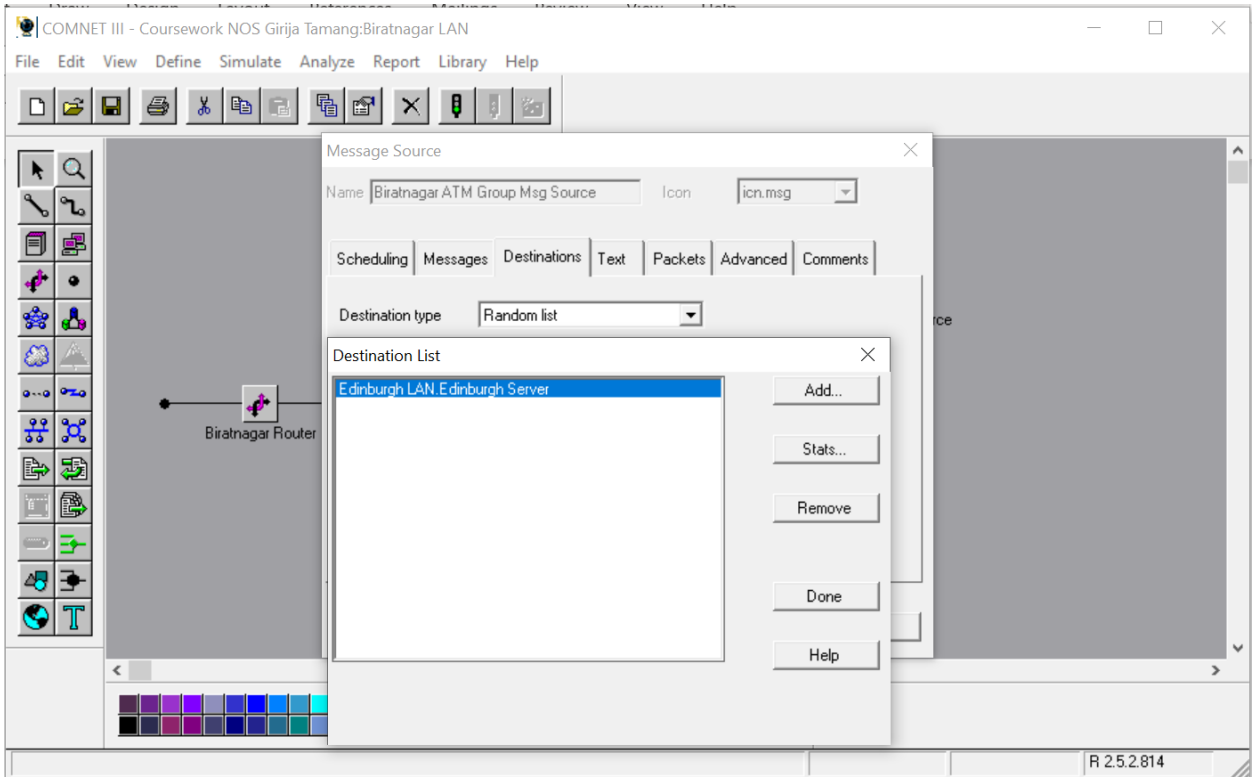

Figure 23: Destinations of Biratnagar ATM Message Source.

Here, the destination type is set to Random List and the destination list is set as Edinburgh LAN.Edinburgh Server.

4.6.4 Packets

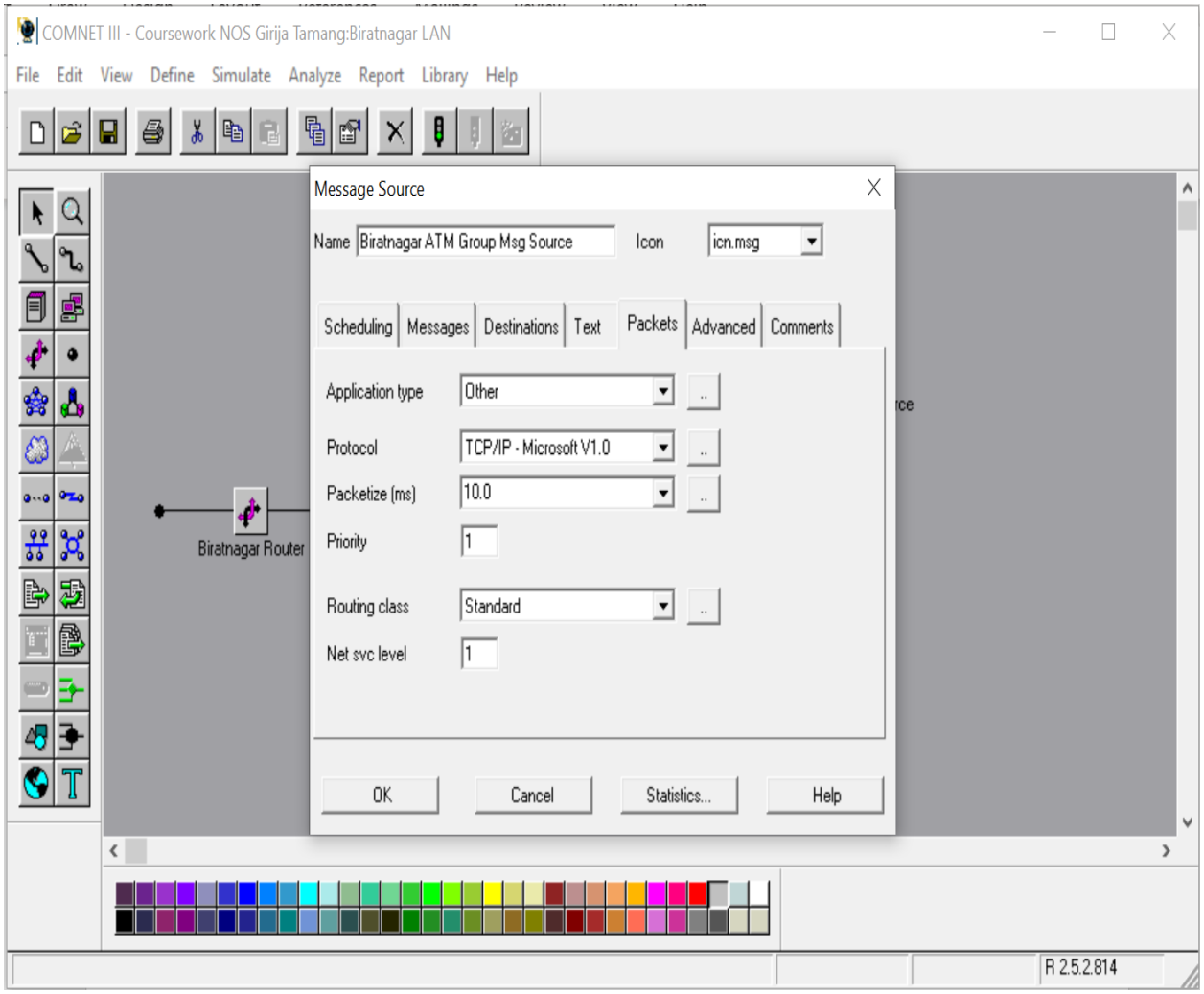

Figure 24: Packets of Biratnagar ATM Group Message Source.

The Protocol format is set to TCP/IP – MicrosoftV1.0 and the packetize is set to 10.0 ms where routing class is set to Standard with a hop count of 65535 with IGRP metric weight (k1) = 1.

5. Lalitpur LAN

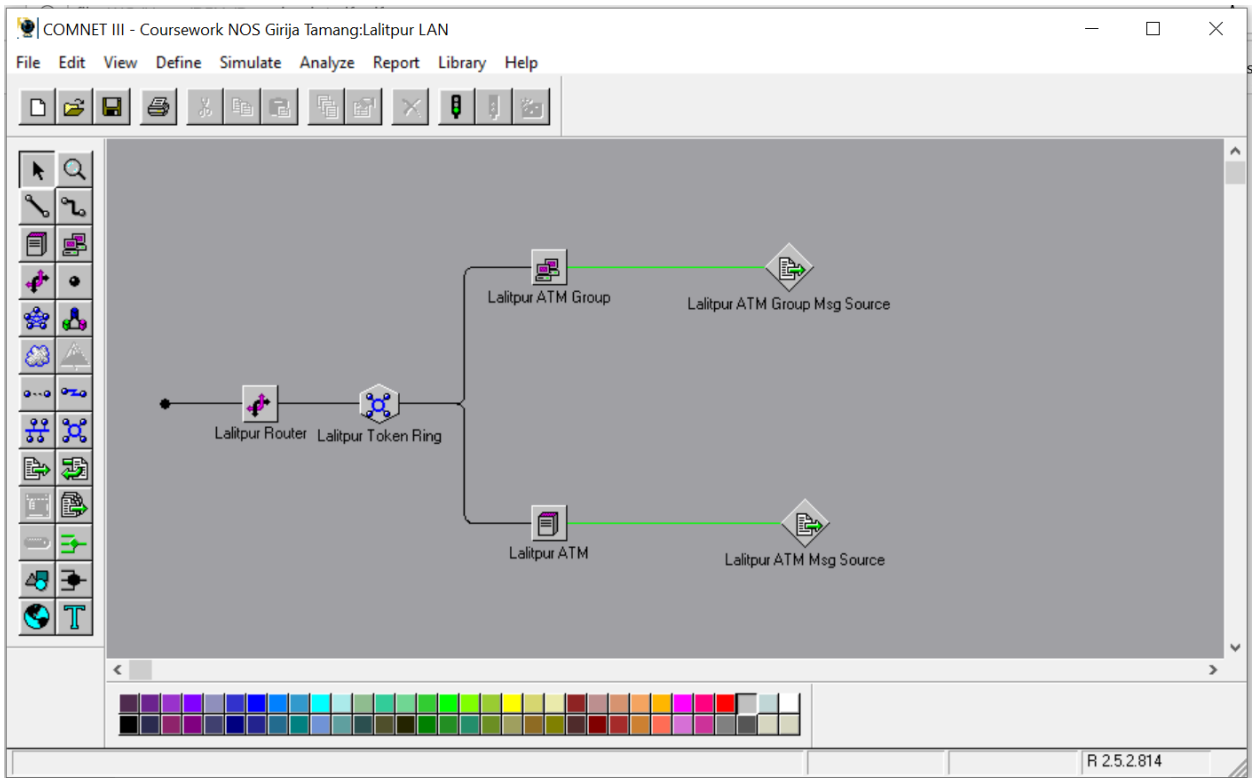

Figure 25: Lalitpur LAN Model.

This model consists of a token ring, a processing node, two message sources, a group of PCs and one router. The Lalitpur LAN is configured using IEEE 802.5 16 Mbps token passing standard connected with the frame relay cloud through a cisco 7010sp, Biratnagar Router (V10.0 router) which is linked to access point. This LAN consists of 50 ATM transaction nodes plus one single teller giving a total of 51 ATMs in transection network.

5.1 Lalitpur Router

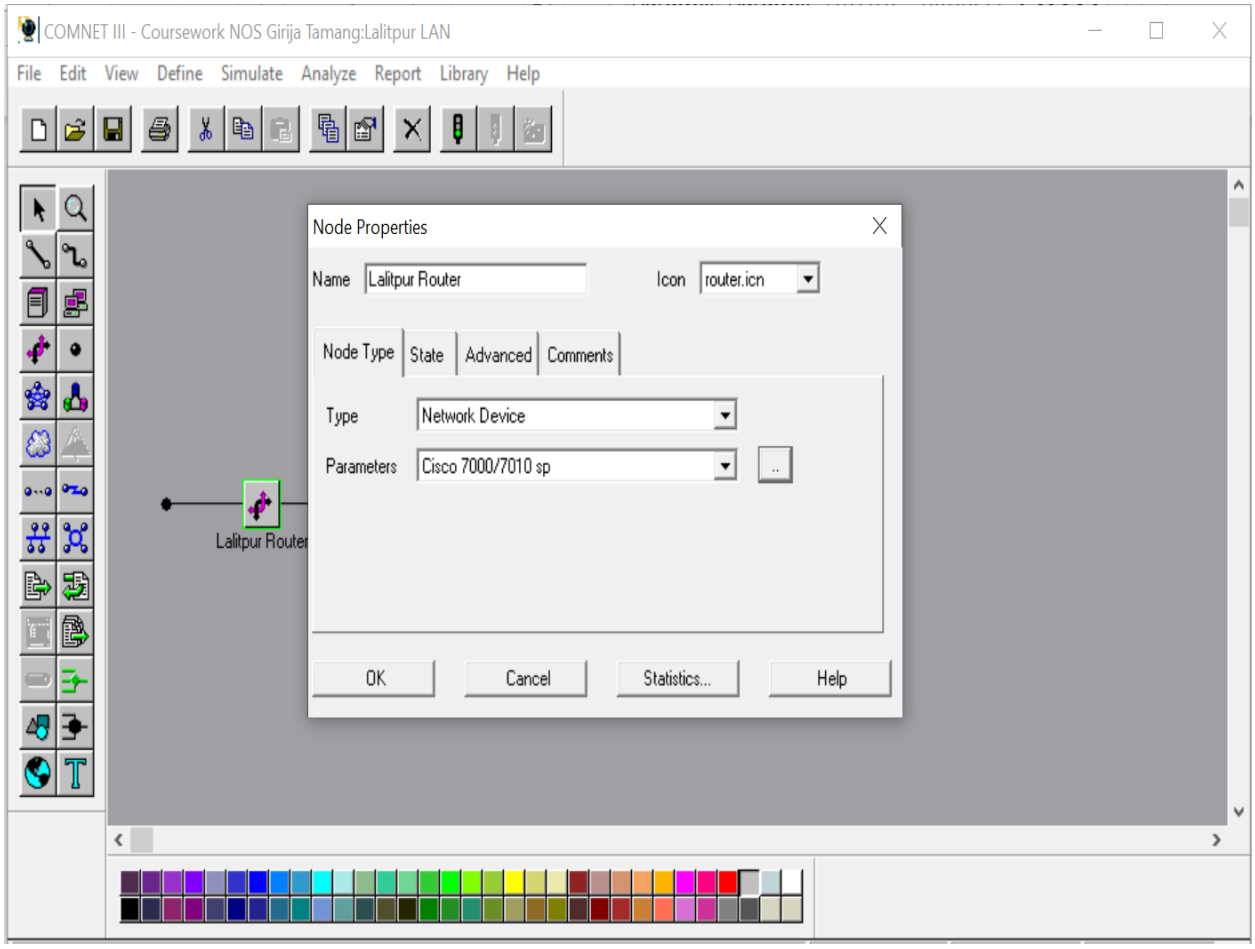

Figure 26: Lalitpur Router.

A network device node is created with the name Lalitpur Router and connected to access point and token passing link. The router parameters are changed to Cisco 7000/7010 sp and the rest settings are as default.

5.2 Lalitpur Token Ring

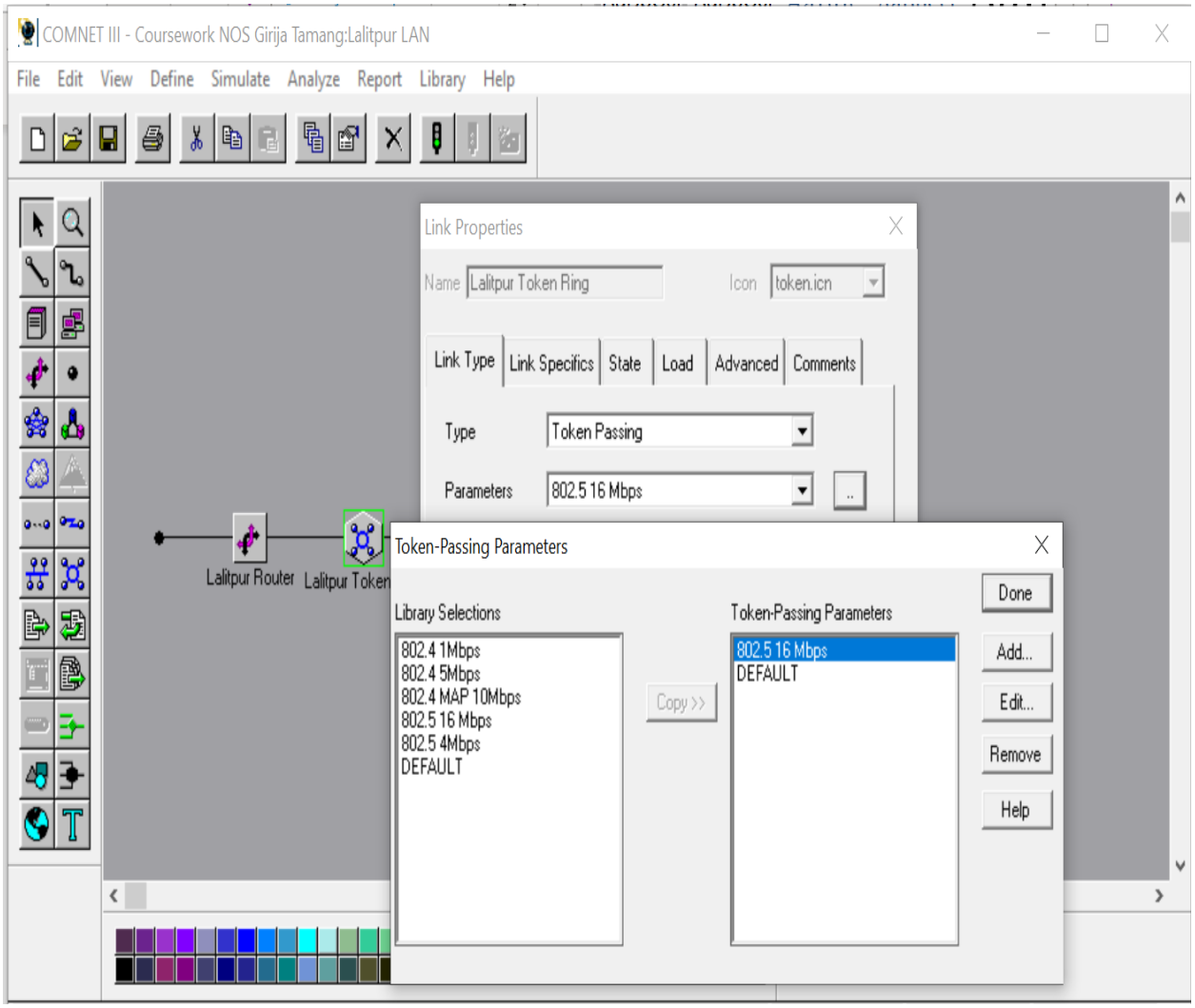

Figure 27:Lalitpur Token Ring.

A Token Passing Link is created with the name Lalitpur Token Ring where parameters are set to 802.5 16 Mbps and its Type is Token Passing, and all the other settings are set as default.

5.3 Lalitpur Processing Node

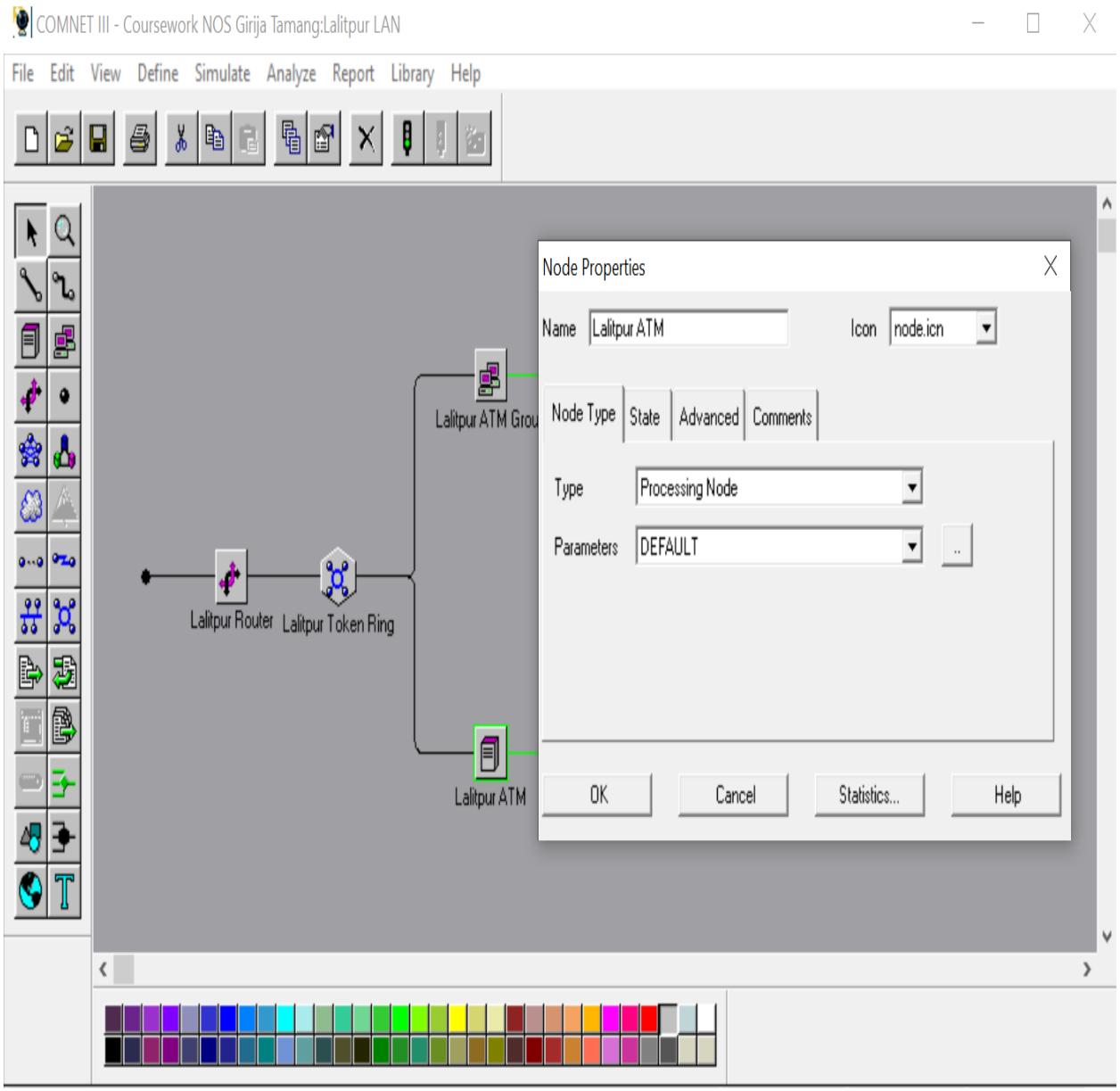

Figure 28: Lalitpur ATM.

A processing node is created, joined with token passing link, and its name is changed to Lalitpur ATM and the other settings are left as default.

5.4 Lalitpur ATM Group

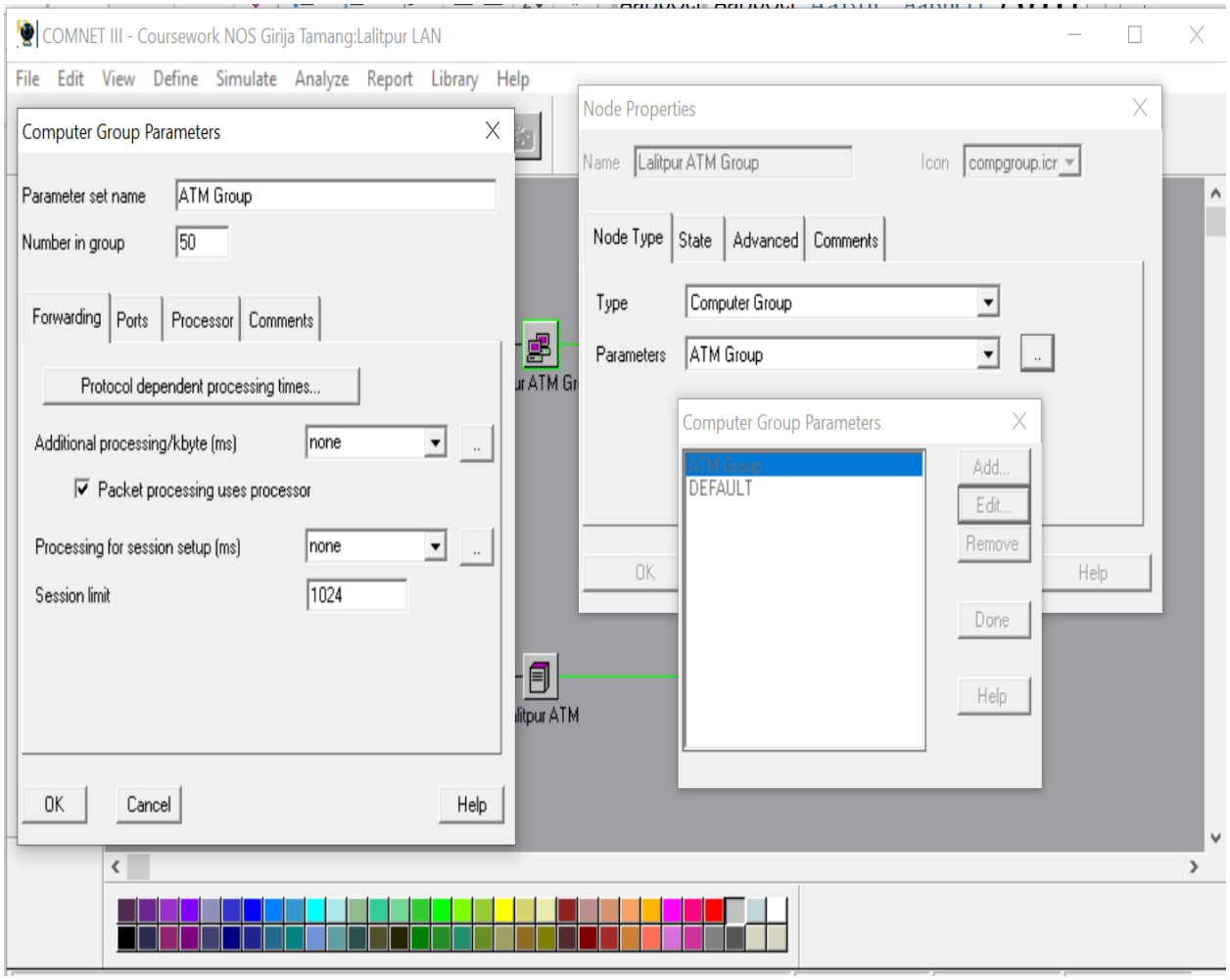

Figure 29:Lalitpur ATM Group.

A computer group is created with the name Lalitpur ATM group where the parameter is set as ATM Group and Number of computer group is set to 50 in ATM Group.

5.5 Lalitpur ATM Message Source

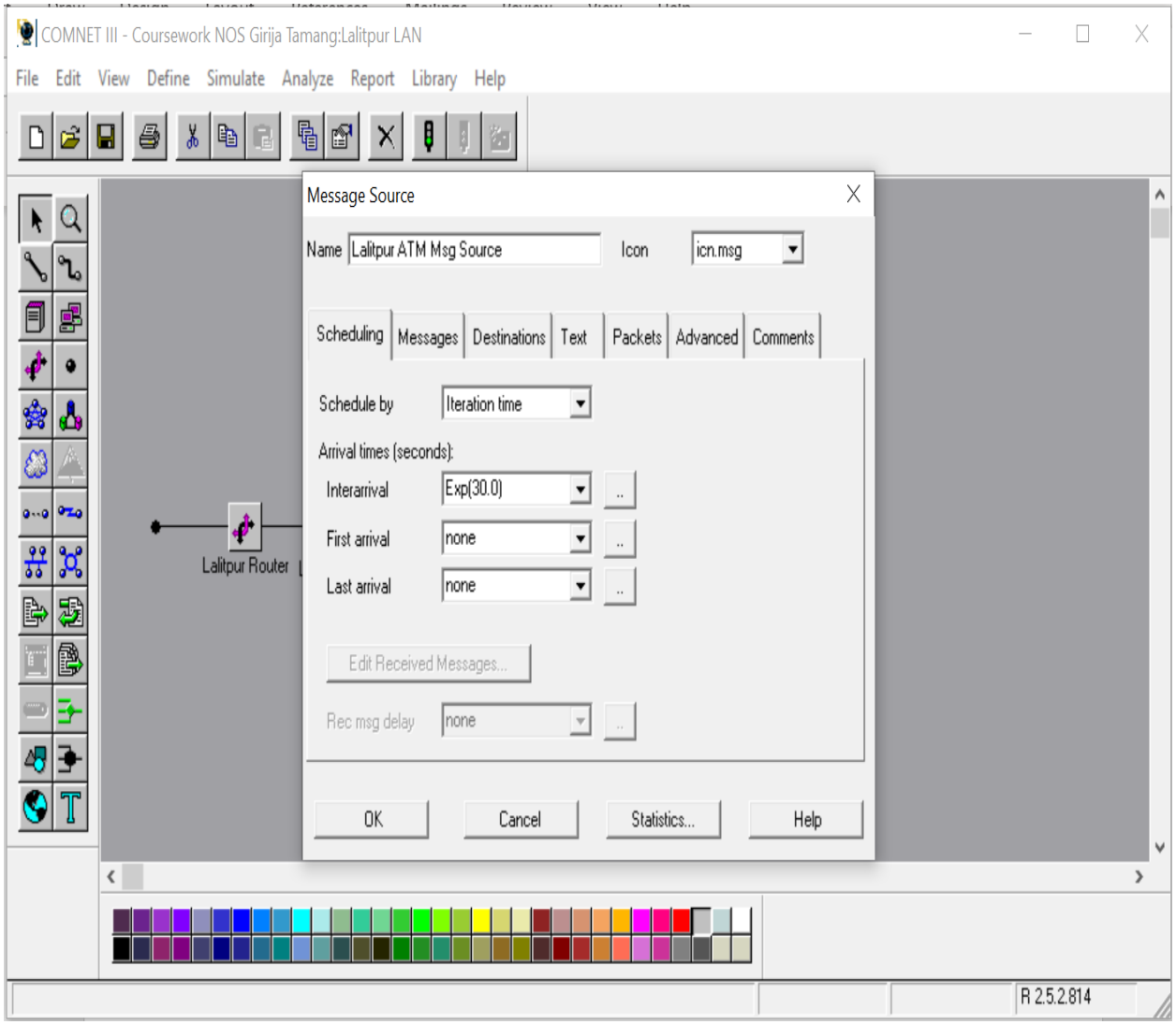

Figure 30: Lalitpur ATM Message Source.

A message source is created with the name Lalitpur ATM Msg Source where various changes are done and attached to processing node (Lalitpur ATM).

5.5.1 Scheduling

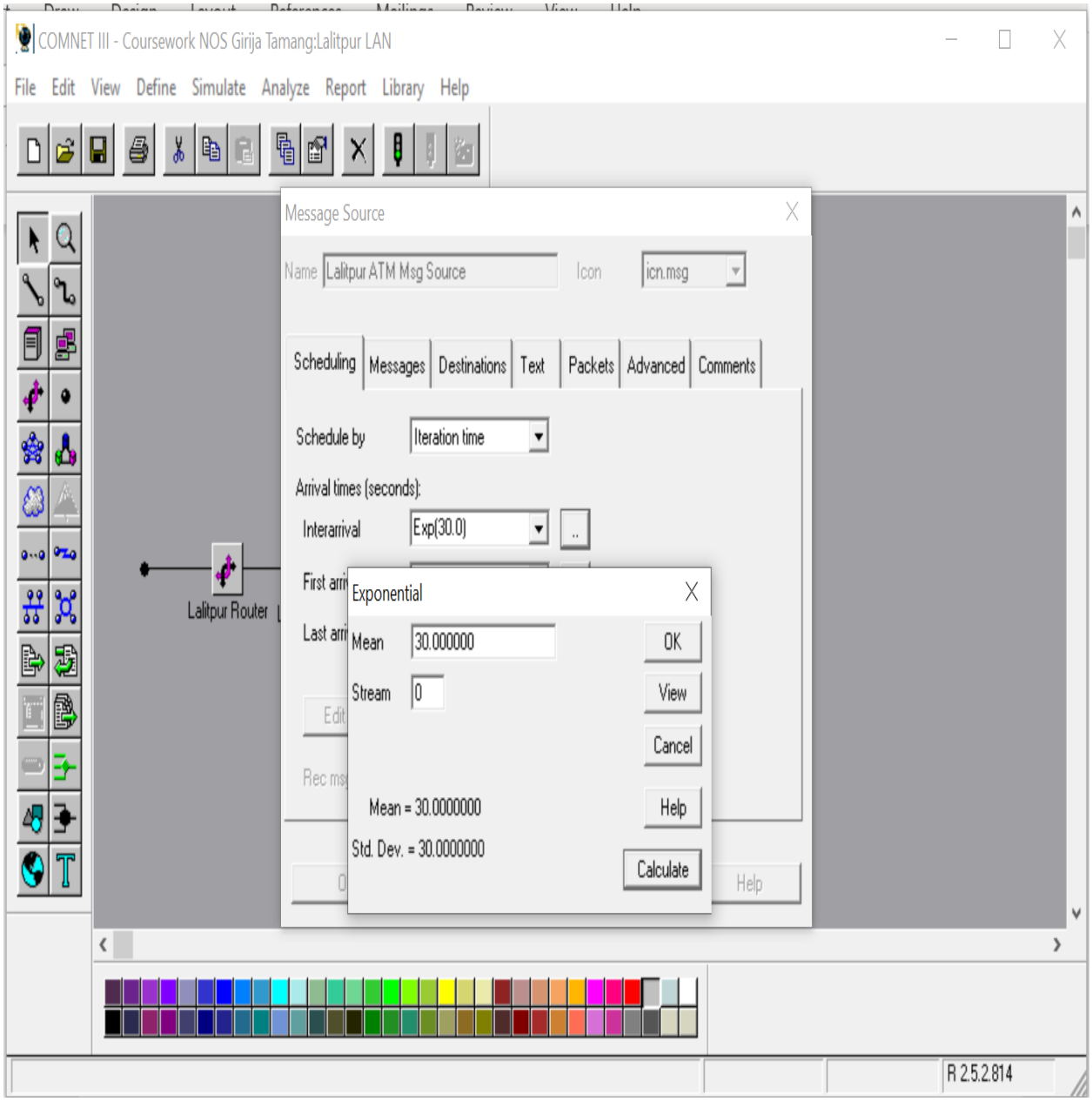

Figure 31:Scheduling of Lalitpur ATM Message Source.

In scheduling, the interarrival of message is set as exponential where Mean is set to 30 and the Stream of 0.

5.5.2 Message

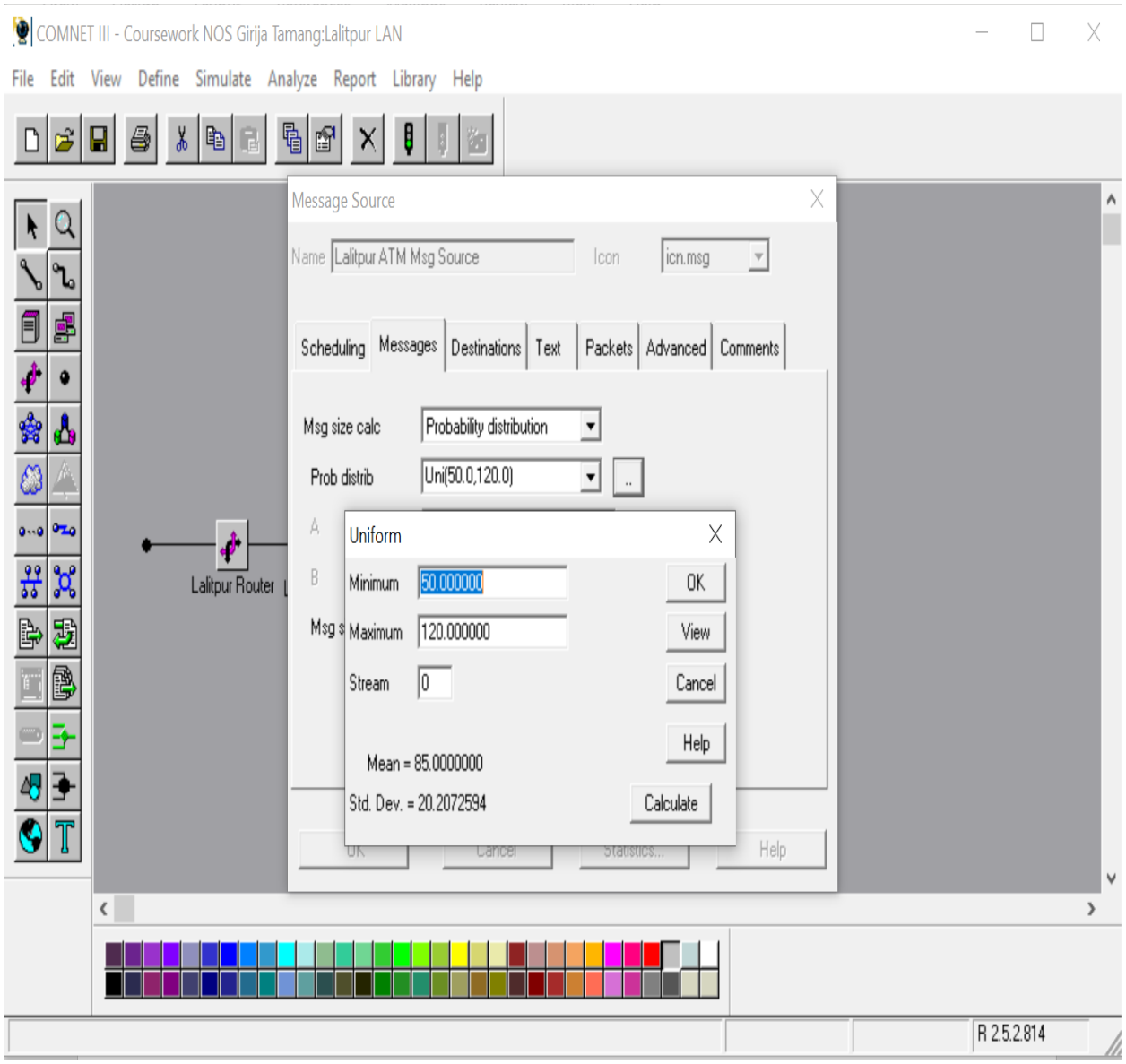

Figure 32: Messages of Lalitpur ATM Message Source.

The message source size of Lalitpur ATM measures with a uniform distribution of probability and the size with stream 0 is uniformly distributed over the range of 50 to 120 bytes.

5.5.3 Destinations

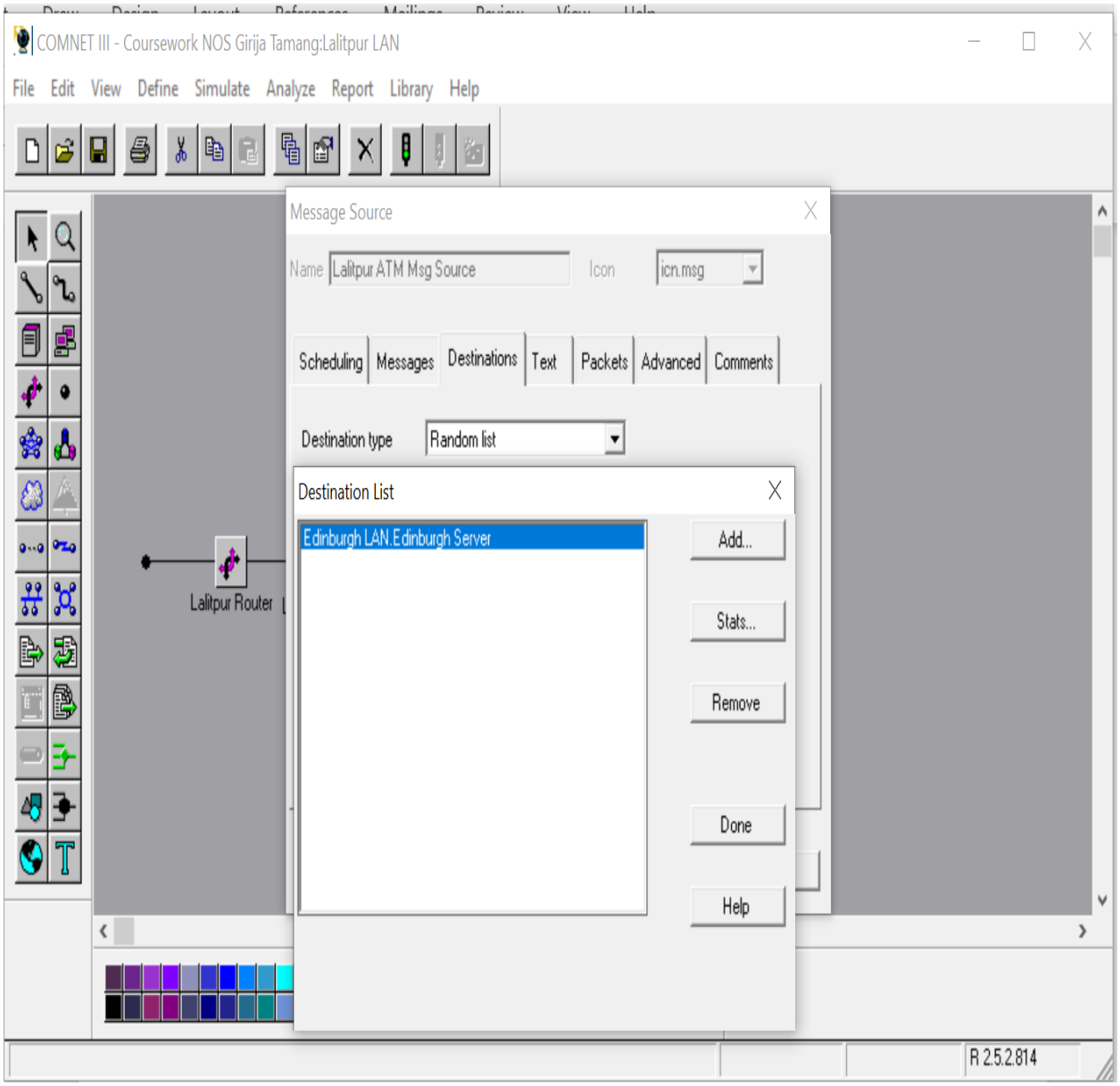

Figure 33: Destination of Lalitpur ATM Message Source.

Here, the destination type is set to Random List and the destination list is set as Edinburgh LAN.Edinburgh Server.

5.5.4 Packets

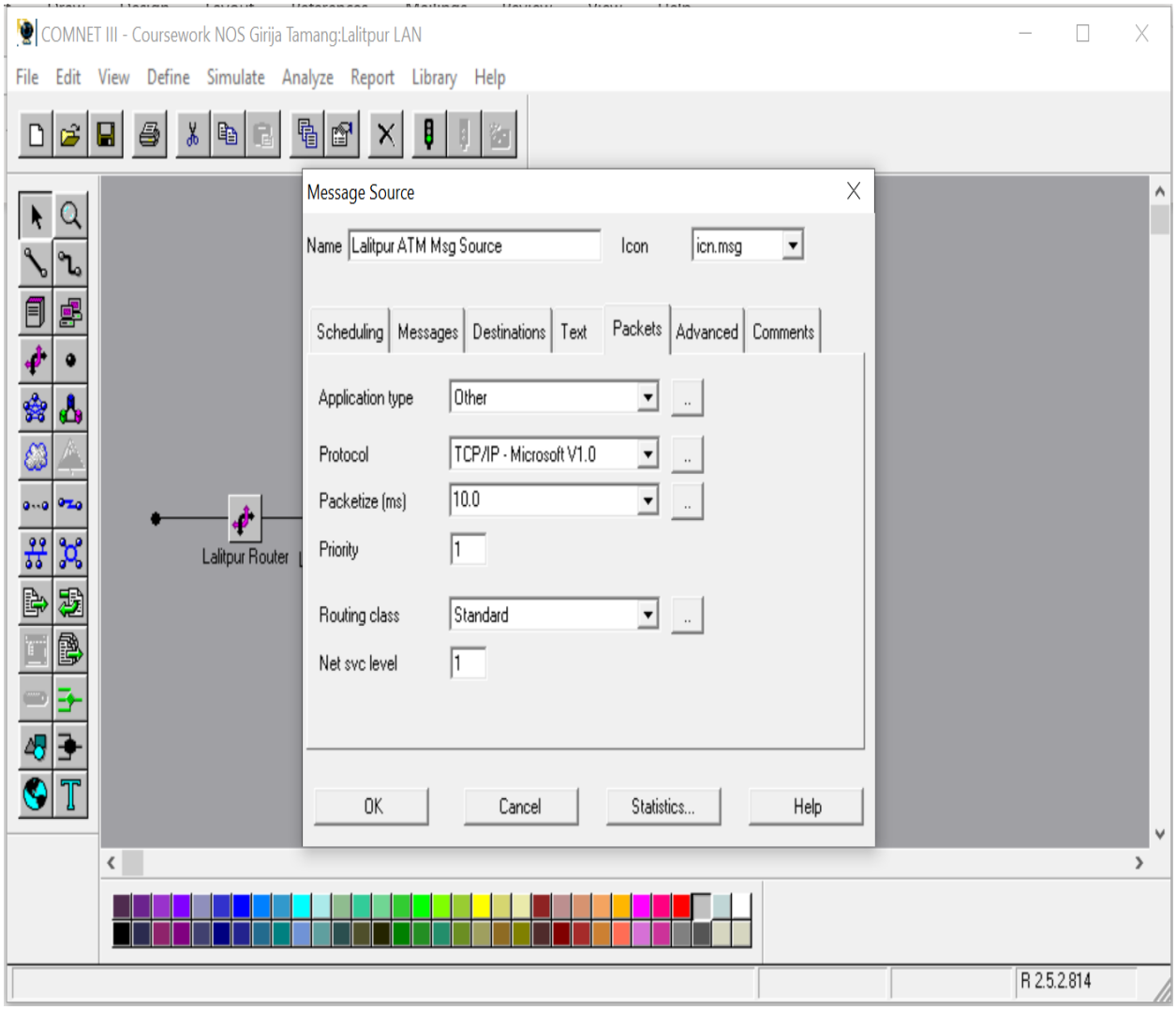

Figure 34: Packets for Lalitpur ATM Message Source.

The Protocol format is set to TCP/IP – MicrosoftV1.0 and the packetize is set to 10.0 ms where routing class is set to Standard with a hop count of 65535 with IGRP metric weight (k1) = 1.

5.6 Lalitpur Atm Group Message Source

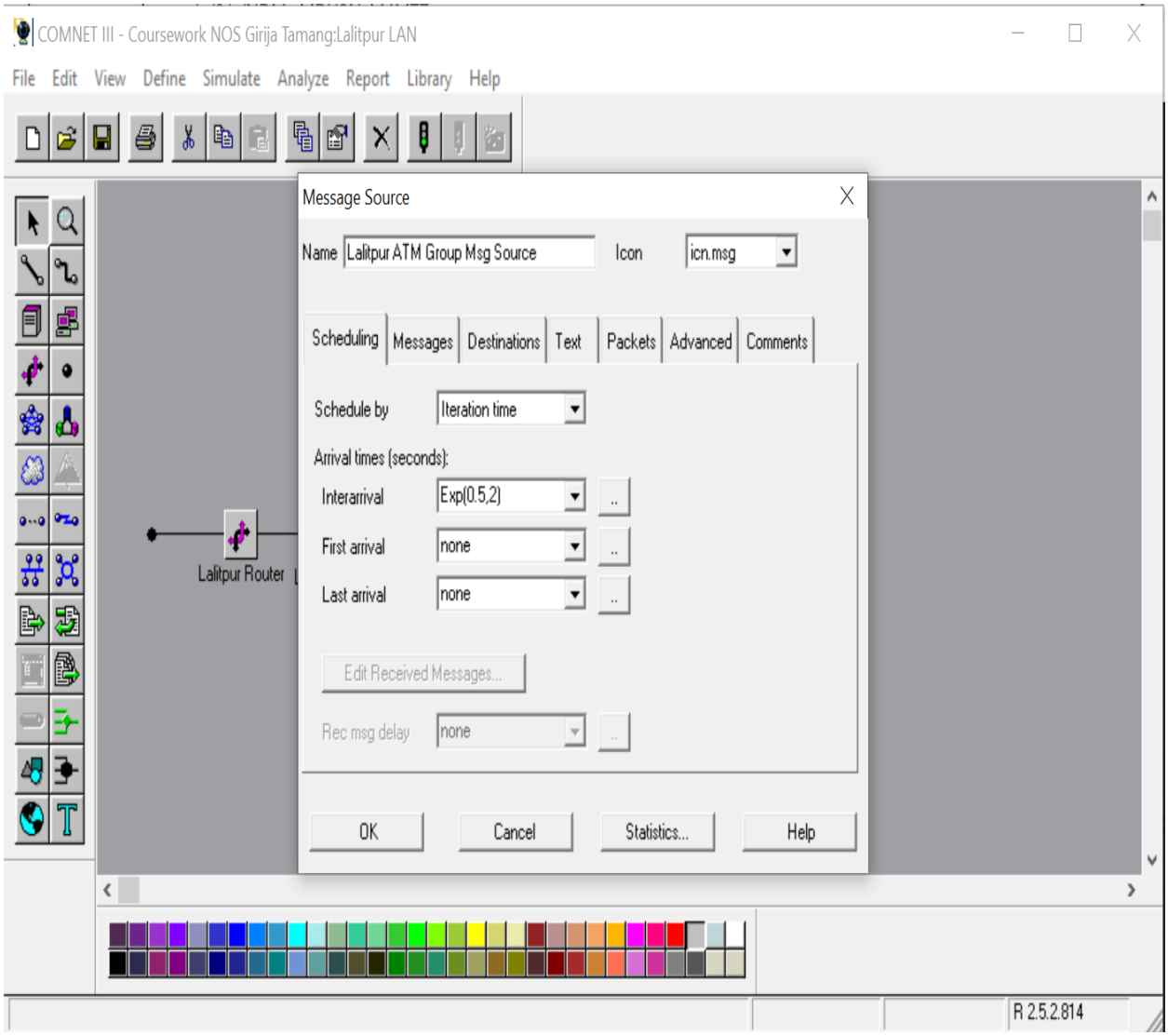

Figure 35: Lalitpur ATM Group Message Source.

A message source is created with the name Lalitpur ATM Group Msg Source where various changes are done and attached to Lalitpur ATM Group.

5.6.1 Scheduling

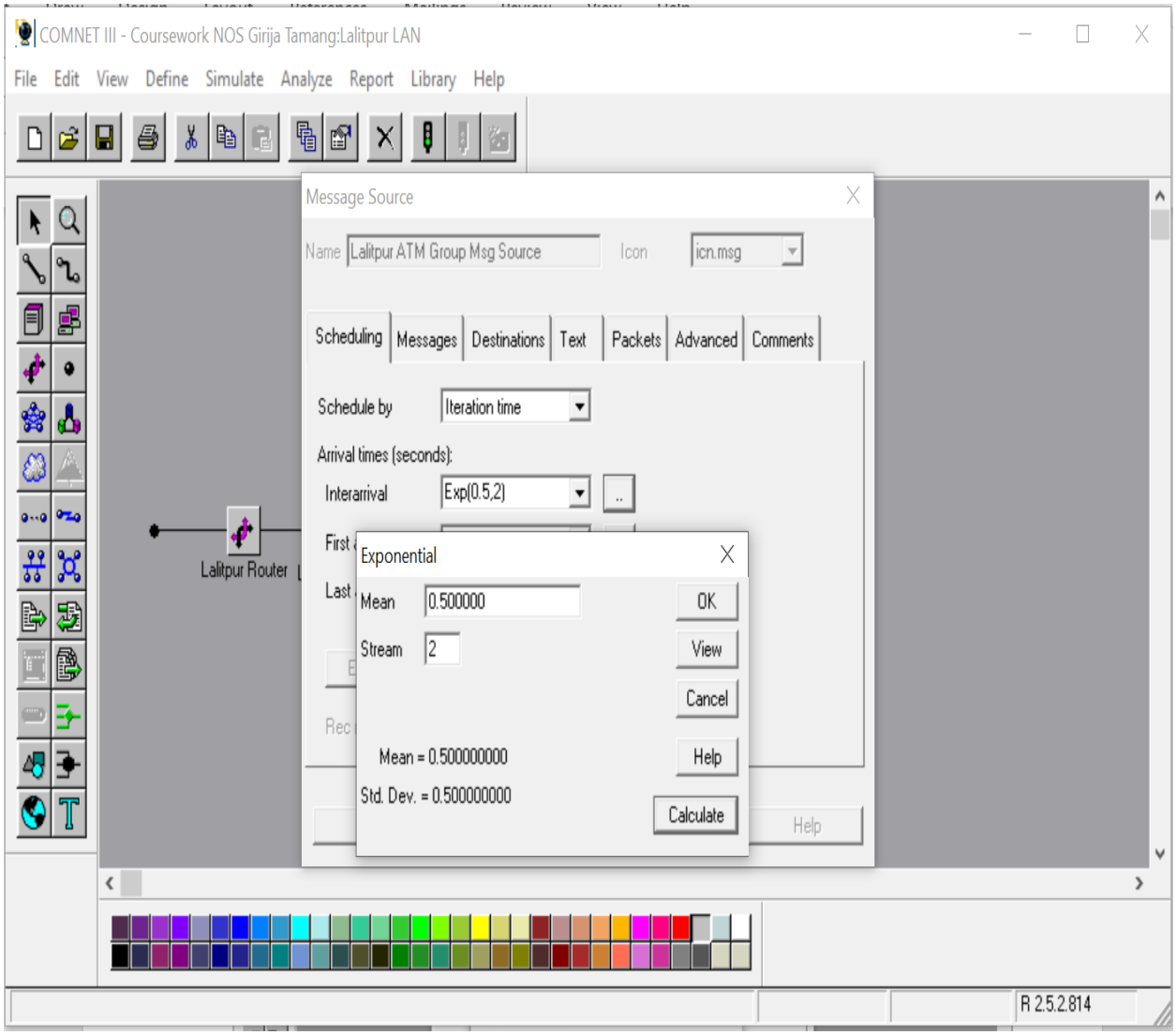

Figure 36:Scheduling Lalitpur ATM Group Message Source.

The Interarrival is set as Exponential where the Mean is set as 0.5 along with the Stream of 2.

5.6.2 Message

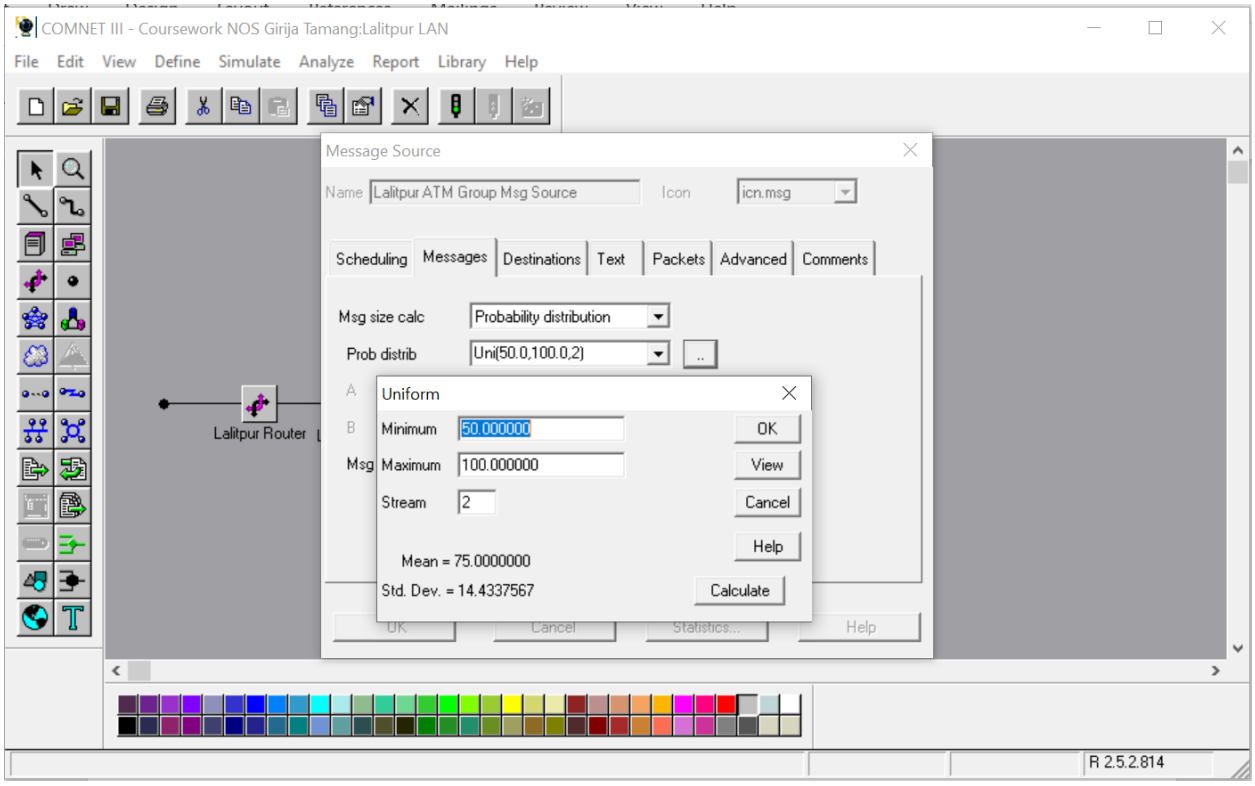

Figure 37: Message of Lalitpur ATM Group Message Source.

The message source size of Lalitpur ATM Group measures with a uniform Distribution of Probability and the size with stream 2 is uniformly distributed over the range of 50 to 100 bytes.

5.6.3 Destinations

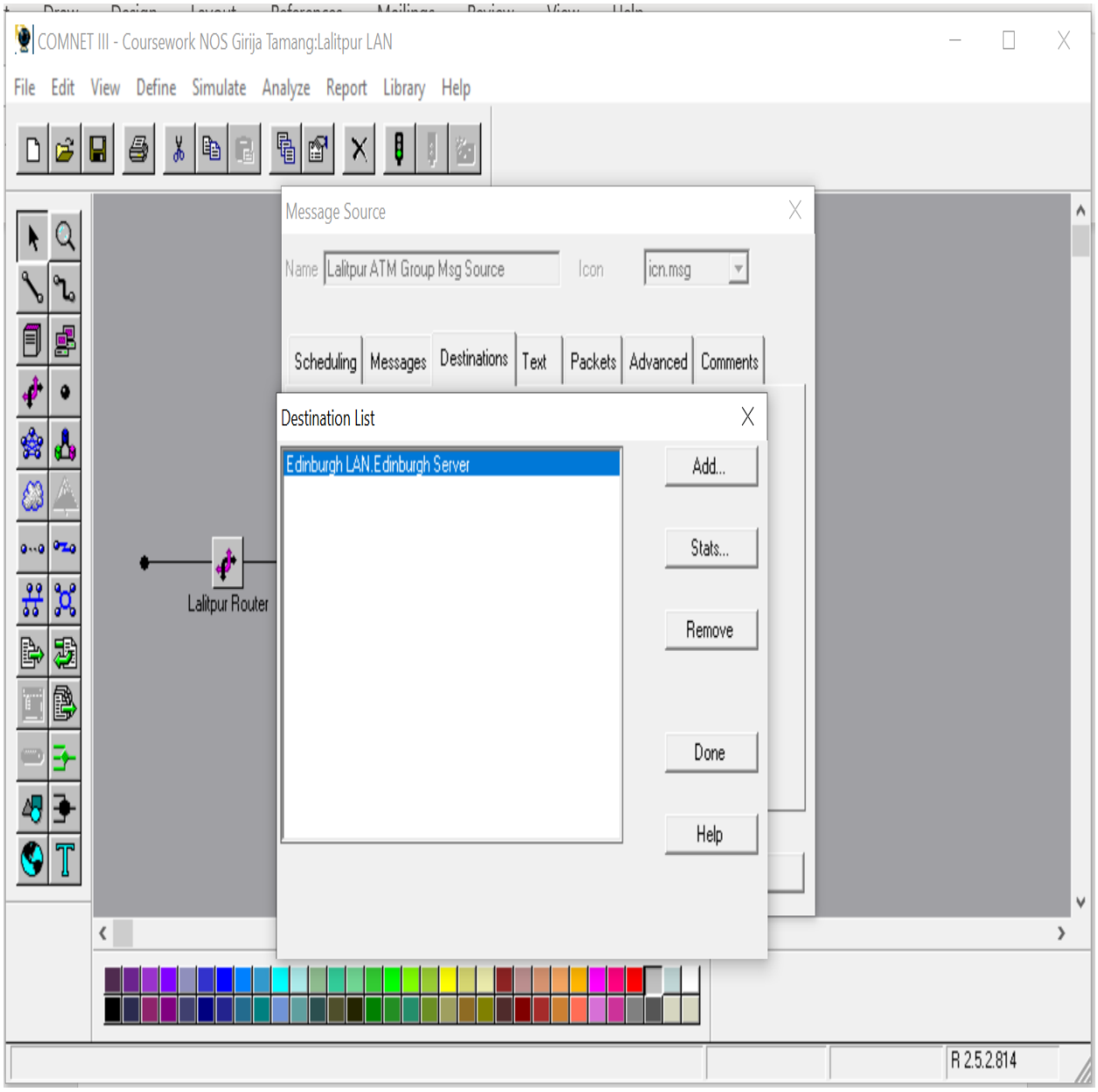

Figure 38: Destination of Lalitpur ATM Group Message Source.

Here, the destination type is set to Random List and the destination list is set as Edinburgh LAN.Edinburgh Server.

5.6.4 Packets

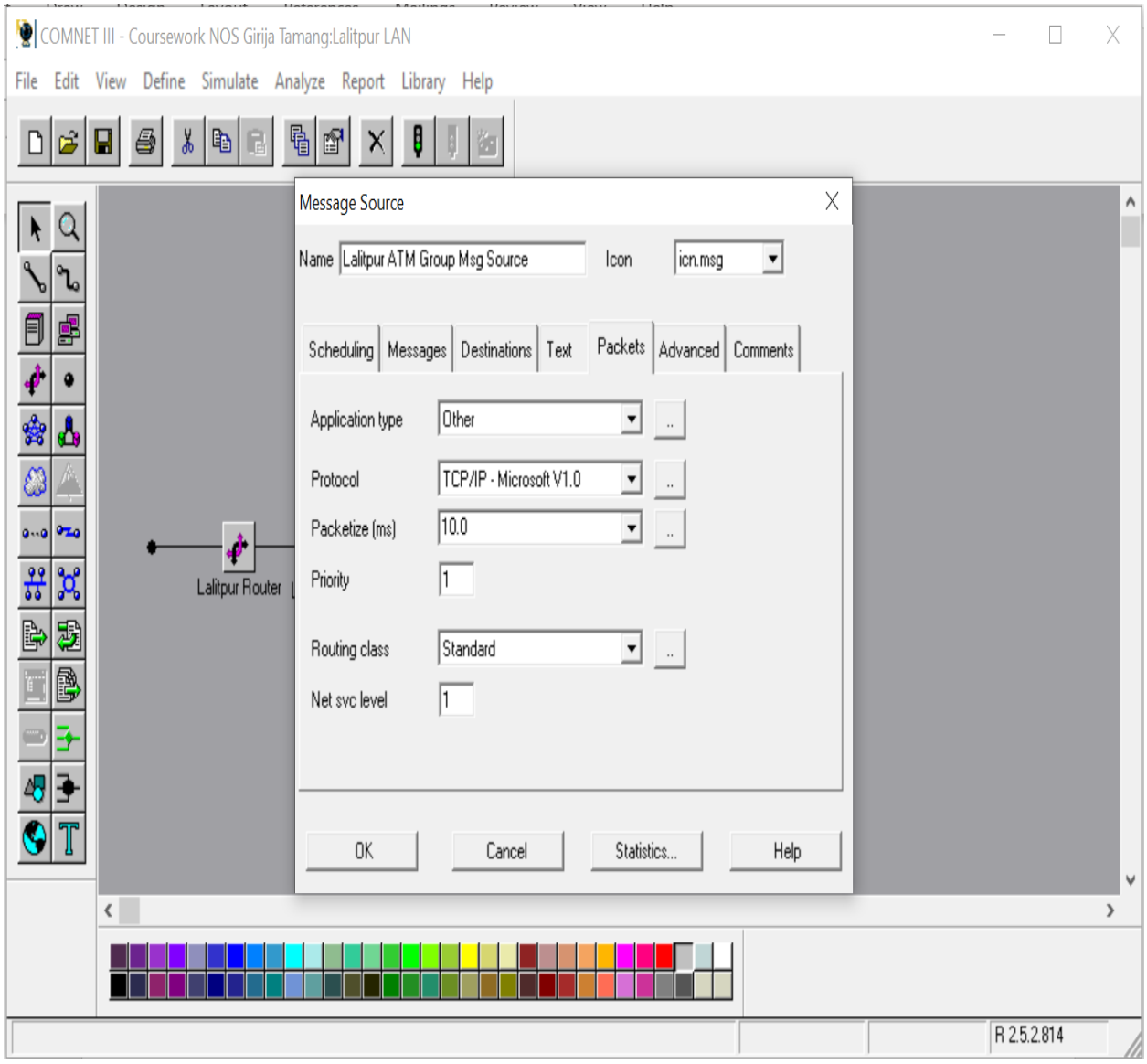

Figure 39: Packets of Lalitpur ATM Group Message Source.

The Protocol format is set to TCP/IP – MicrosoftV1.0 and the packetize is set to 10.0 ms where routing class is set to Standard with a hop count of 65535 with IGRP metric weight (k1) = 1.

6. WAN Cloud

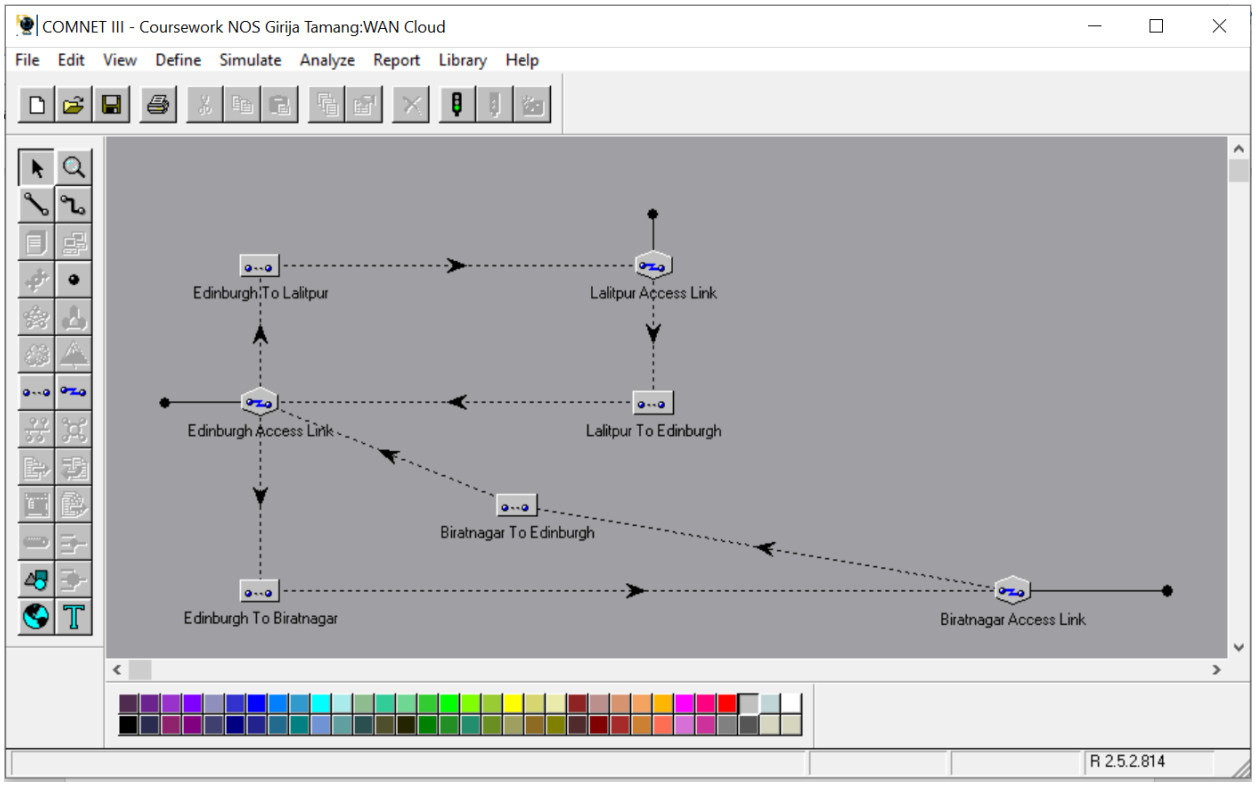

Figure 40: WAN Cloud Model.

This model is formed with the help of 4 Virtual circuits and 3 points to point link. In this cloud virtual circuits are created for the data transmitted. A logical path between nodes through where data flows in virtual circuit. The WAN cloud has a transmission rate of 56 Kbps and the links in the WAN cloud have a transmission rate of 64Kbps using sliding window burst type.

6.1 ACCESS LINK

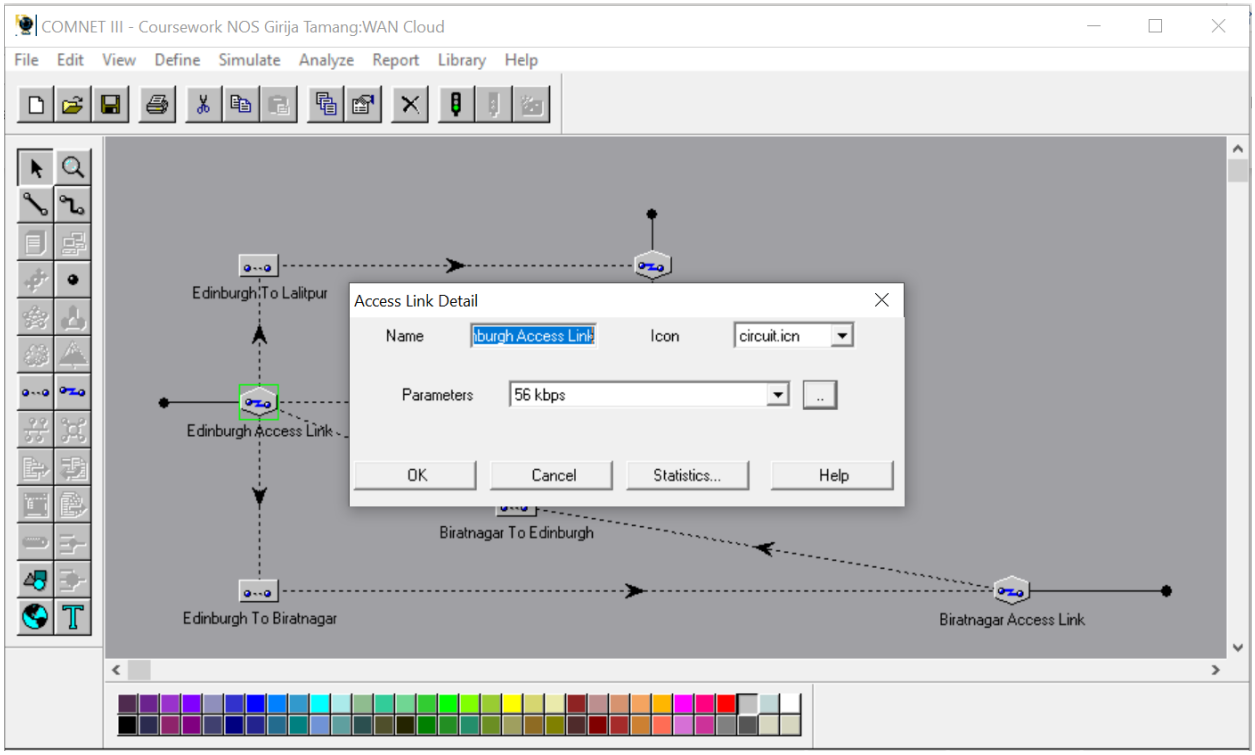

Figure 41 : Cloud Access Link.

All the parameters of the point to point link are set to 56 kbps.

6.2 VIRTUAL CIRCUIT

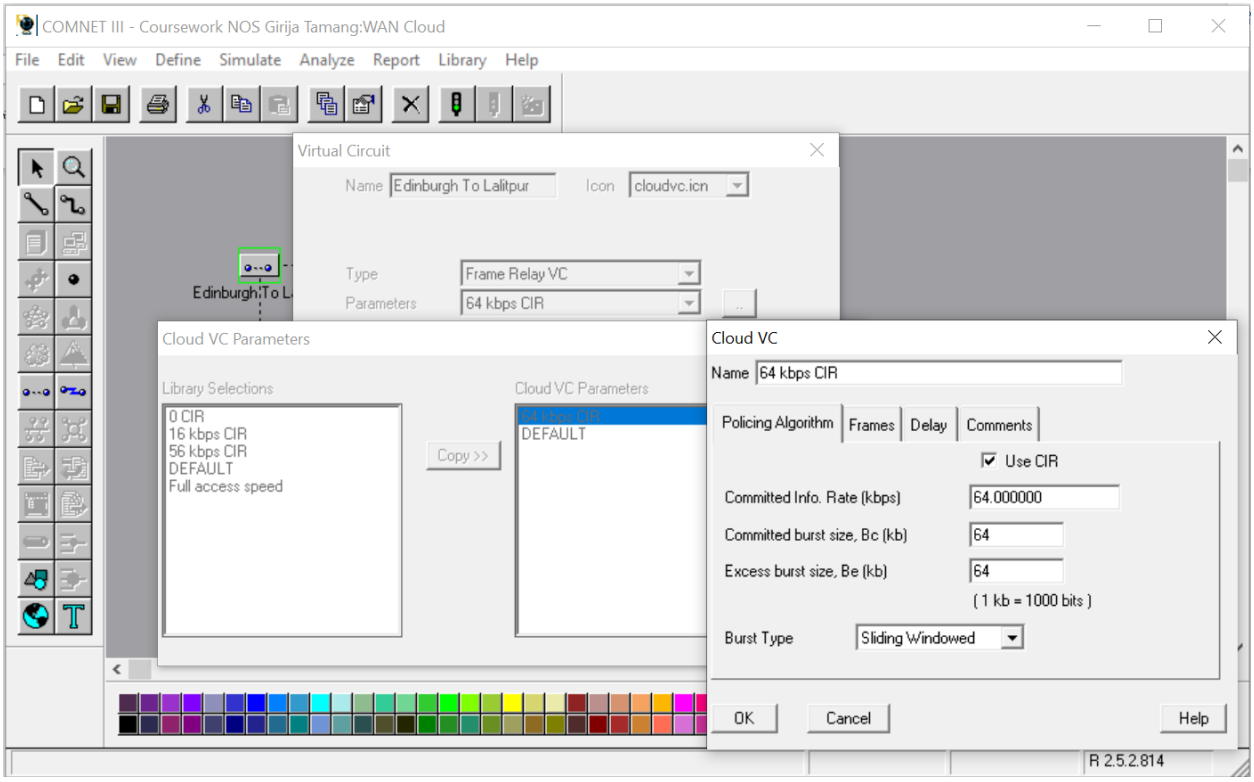

Figure 42: Cloud Virtual Circuit.

All the parameters of the Virtual Circuit are set to 64 kbps CIR with burst type of sliding windowed.

7. Description of Report

Simulation is required to test a WAN model designed of IBN Bank with a warm-up time of 120 seconds, a simulation time of 60 seconds and a replication number 1.

7.1 NODE REPORT: RECEIVED MESSAGE COUNT

Receiver	Count	Message Name
Edinburgh LAN.Edinburgh Server	709	Lalitpur ATM Group Msg Source
Edinburgh LAN.Edinburgh Server	696	Biratnagar ATM Group Msg Source

Table 1: Nodes: Received Message Counts.

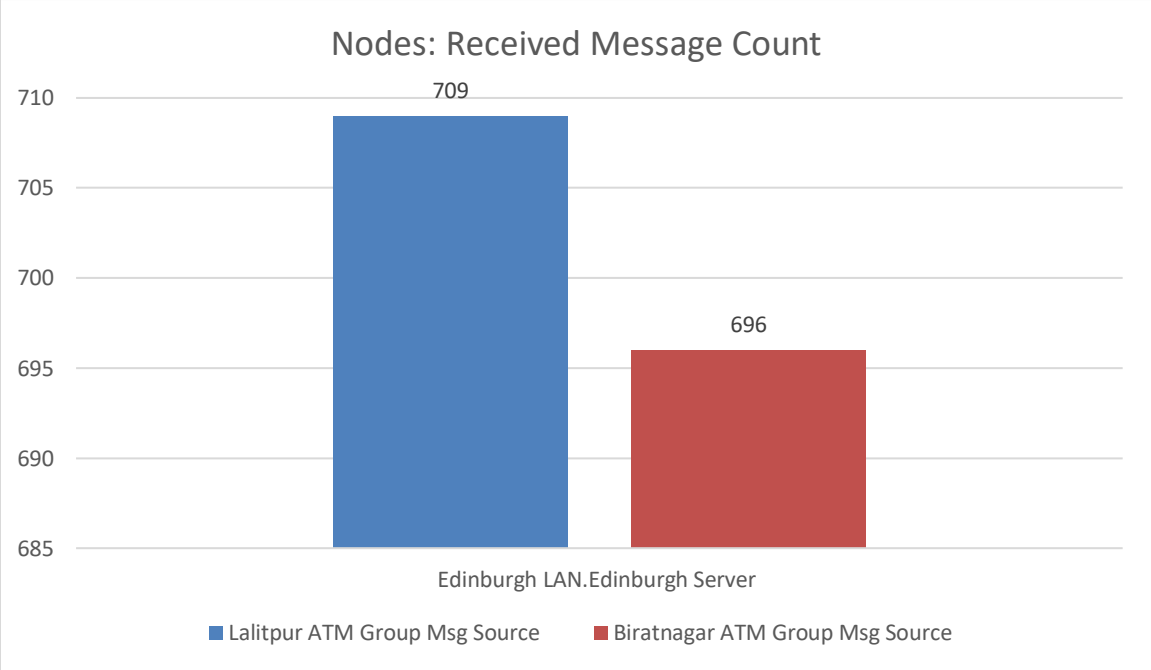

Figure 43:Nodes: Received Message Counts.

The above figure is for the received message counts for nodes. In the above table, the message count for Lalitpur ATM Group Msg Source and Biratnagar ATM Group Msg Source are 709 and 696 respectively. In the chart of received message count

the information of table is plotted exactly where message count for Lalitpur message group is 709 and Biratnagar message group is 696.

7.2 LINK REPORT: CHANNEL UTILIZATION

	FRAMES		TRANSMISSION DELAY		(MS)	%
LINK	DELIVERD	RST/ER	AVERAGE	STD DEV	MAXIMM	UTIL
Lalitpur LAN.Lalitpur	11735	0	0.039	0.015	0.089	0.7557
Biratnagar LAN.Biratnagar	11811	0	0.039	0.015	0.092	0.7608
Edinburgh LAN.Edinburgh	12128	0	0.036	0.012	0.082	0.7340

Table 2: Channel Utilization

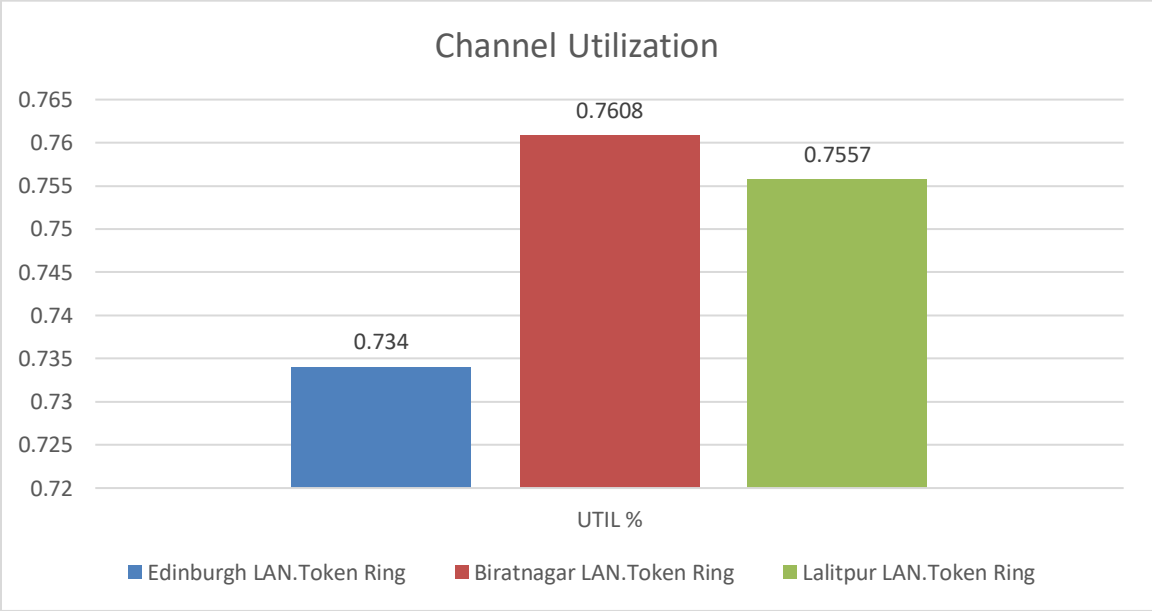

Figure 44: Channel Utilizations.

In this chart of channel utilization, the information of table is plotted exactly where channel utilization % of Lalitpur LAN token ring is 0.7557, Biratnagar LAN token ring is 0.7608 and Edinburgh LAN token ring is 0.734.

7.3 WAN CLOUD REPORT: FRAME DELAY

CLOUD	FRAME DELAY (MS)			BURST SIZE	
VC	AVG	STD	MAX	AVG	MAX
Edinburgh To Lalitpur	25	0	25	21	25
Lalitpur To Edinburgh	75089	8671	90002	56	57
Edinburgh To Biratnagar	25	0	25	21	26
Biratnagar To Edinburgh	74909	8602	90003	56	57

Table 3: Frame Delay By VC.

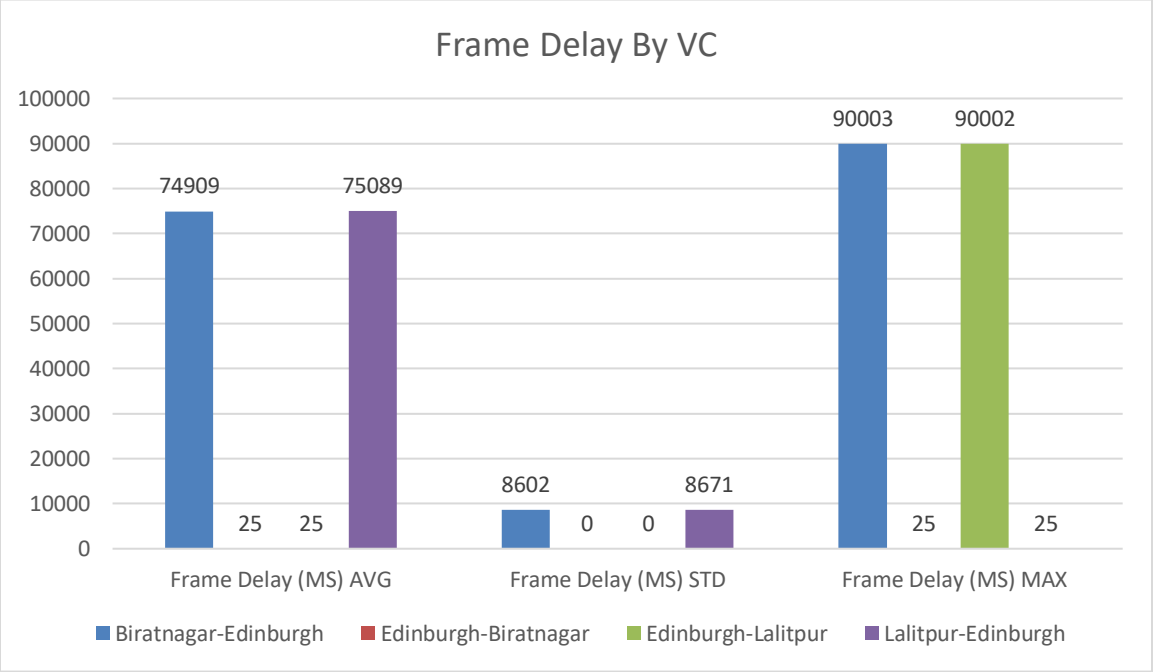

Figure 45: Frame Delay By VC.

In the above figure, the virtual circuit of WAN in frame delay is shown. Biratnagar-Edinburgh, Edinburgh-Biratnagar, Lalitpur-Edinburgh and Edinburgh-Lalitpur has frame delay value maximum 90003 MS, 25 MS, 90002 MS and 25 MS with Frame Avg 74909 MS, 25 MS, 75089 MS and 25 MS respectively.

7.4 WAN CLOUD REPORT: FRAME COUNT

CLOUD:					
VC: FRAMES KILOBITS		ACCEPTED		DROPPED	
		NORMAL	DE	NORMAL	DE
Edinburgh-Lalitpur	Frm	3028	0	0	0
	kb	969	0	0	0
Lalitpur- Edinburgh	Frm	3025	0	0	0
	Kb	1390	0	0	0
Edinburg - Biratnagar	Frm	3037	0	0	0
	kb	972	0	0	0
Biratnagar-Edinburgh	Frm	3038	0	0	0
	kb	1388	0	0	0

Table 4: Frame Count by VC.

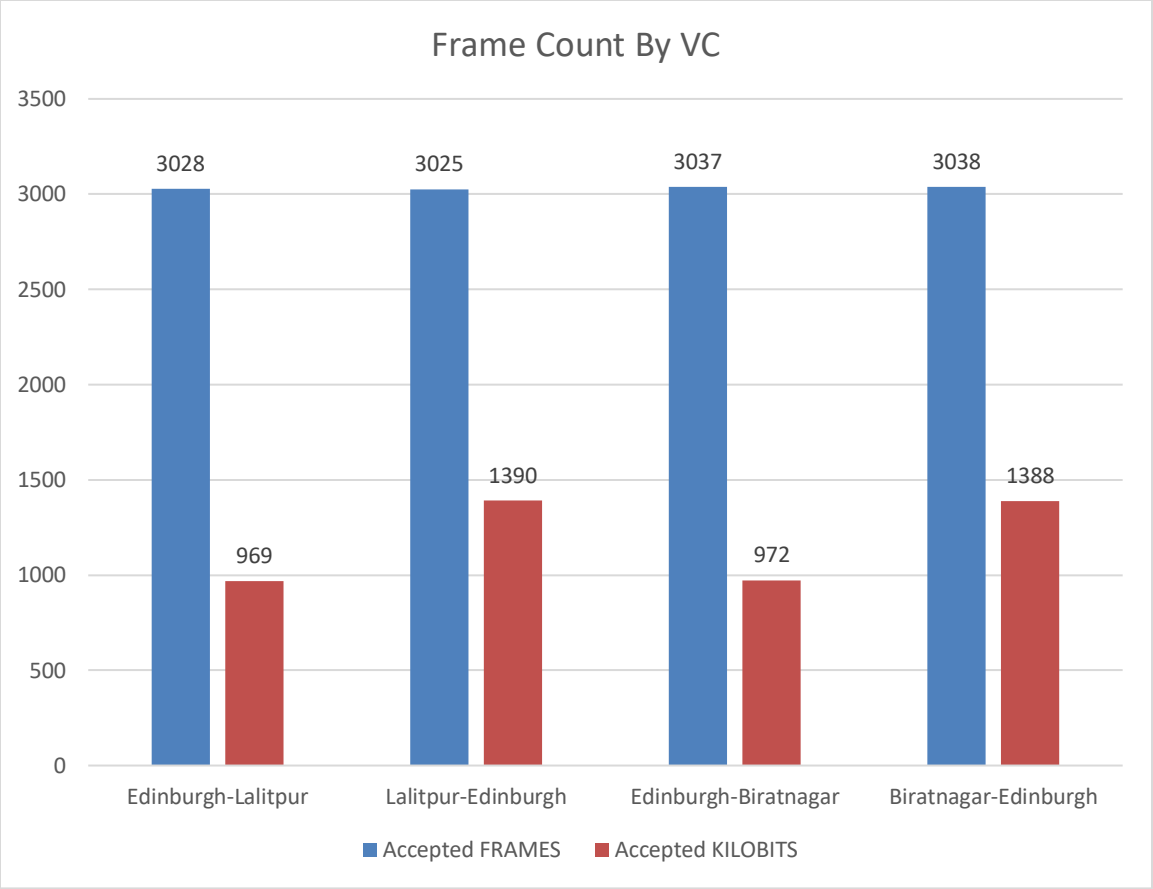

Figure 46: Frame Count By VC.

The above figure shows the frame counts by vc. This table and chart show Edinburgh to Lalitpur, Lalitpur to Edinburgh, Edinburgh to Biratnagar, Biratnagar to Edinburgh where accepted frames are 3028,3025,3037,3038 and accepted kilobits are 969, 1390, 972 and 1388 respectively.

7.5 WAN CLOUD REPORT: ACESS LINK STATS

CLOUD		FRAMES		BUFFER(BYTES)			% UTIL
ACCESS LINK	ENTRY/EXIT	ACCEPTED	DROPPED	MAX	AVG	STD	
Edinburgh Access	Entry	6066	0	N/A	N/A	N/A	75.10
	Exit	12082	0	1043038	869065	100516	100.00
Lalitpur Access	Entry	6058	0	N/A	N/A	N/A	100.00
	Exit	3028	0	80	15	19	37.49
Biratnagar Access	Entry	6024	0	N/A	N/A	N/A	100.00
	Exit	3038	0	80	15	19	37.60

Table 5: Access Link Stats.

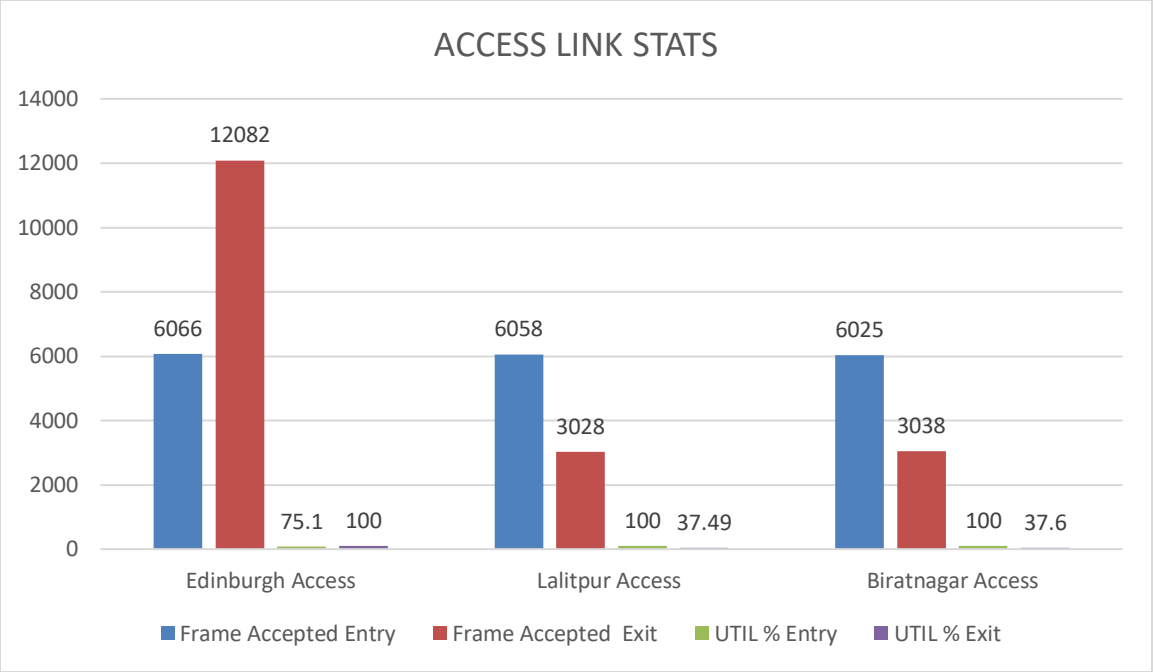

Figure 47: Access Link Stats.

In the above table and chart the access link stats is shown where frame accepted entry are 6066, 6058, 6025 and frame accepted exit are 12082,3028,3038 for Edinburgh Access, Lalitpur Access and Biratnagar Access respectively. The utilization percentage of Edinburgh Access, Lalitpur Access and Biratnagar Access for entry are 75.1,100 and 100 and for exit are 100,37.49 and 37.6 percentage respectively.

7.6 MESSAGE AND REPORT RESPONSE: MESSAGE DELAY FOR ALL NODES

ORIGIN / MSG SRC NAME: DESTINATION LIST	MESSAGE		MESSAGE DELAY STD DEV (MS)	MAXIMUM (MS)
	ASSEMBLED	AVERAGE (MS)		
LalitpurLAN.Lalitpur ATM Group / src Lalitpur ATM Group Msg Source: Edinburgh LAN.Edinburgh	258	143.85198	16529.863	173.17171
Lalitpur LAN.Lalitpur ATM / src Lalitpur ATM Msg Source: Edinburgh LAN.Edinburgh	0	0.000	0.000	0.00
Biratnagar LAN.Biratnagar ATM Group / src Biratnagar ATM Group Msg Source: Edinburgh LAN.Edinburgh	224	143.19133	16148.599	172.14799
Biratnagar LAN.Biratnagar ATM / src Biratnagar ATM Msg Source: Edinburgh LAN.Edinburgh	0	0.000	0.000	0.000
Edinburgh LAN.Edinburgh Server / src Edinburgh Response Source: ECHO	0	0.000	0.000	0.000

Table 6: Message Delay.

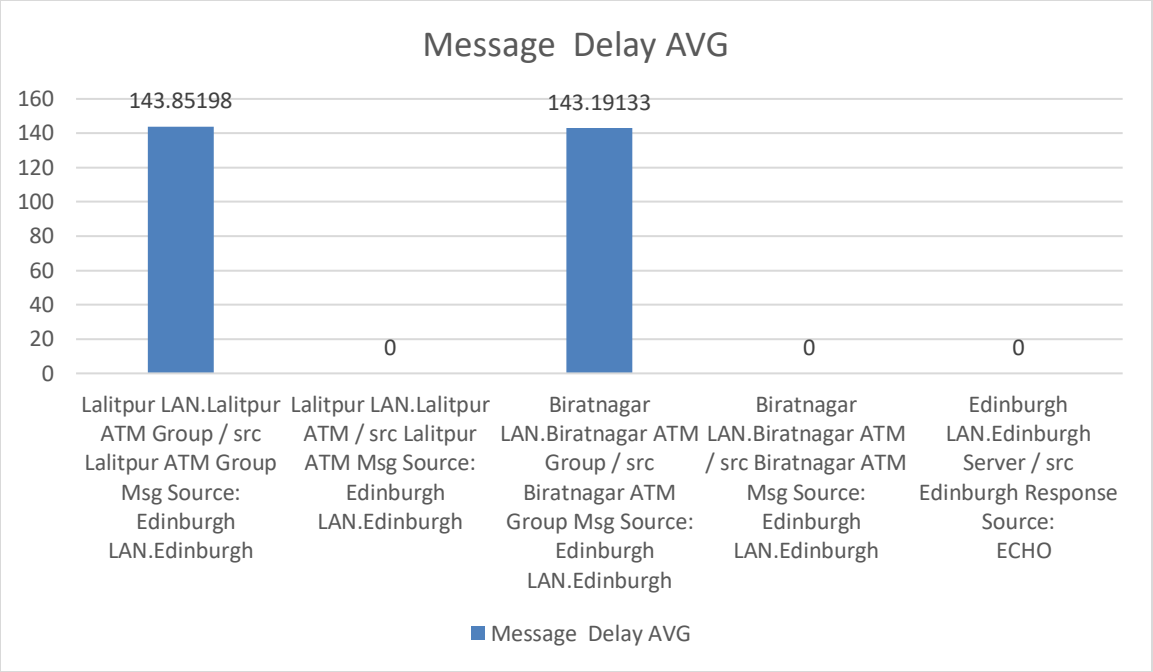

Figure 48: Message Delay.

The above figure shows the information about messages assembled along with the message source name and destination list. The message assembled avg for Biratnagar Atm group source and Lalitpur Atm group source are 143.19133 and 143.85198.

8. Conclusion

This is the coursework of Network and Operating system module where I have developed a wan model in COMNET III. I have given a scenario for doing task A where I have made WAN model for the IBN bank. This coursework is based on a network simulation model, so it helps me to gain basic knowledge on network topology and how it works. It was hard to understand the scenario at first, but I was able to solve the scenario after some analysis and research. Another big issue was to implement the scenario on COMNET tool as per the question, but I was able to complete this task after a hard effort and study. I had generated the stimulation report with the various values and the tables and figures are generated with proper explanation. A lot of research work as well as understanding the network simulation helps me to learn new things.

Task B

1. INTRODUCTION

This report is designed to provide with an overview of basic concepts of GSM technologies which includes mobile communication and cellular technologies. It also describes how gsm technology is developed and evolution of new technology according to time. Likewise, this report describes briefly about the wireless and cellular technologies specification and its advantages and disadvantages on people's lifestyles. The aims and objectives of developing this report are as follows:

1. To provide basic concept of GSM technologies.
2. Describe about evolution of mobile communication.
3. Describe Advantages and disadvantages of mobile communication.
4. To provide basic concept on cellular technologies.
5. Explain briefly about 1G,2G,3G, Lite.
6. Explain briefly about wireless communication.
7. Explain briefly about Technologies used by wireless communication.

Global System for Mobile Communications (GSM) is the well-known wireless cellular communication technology used for public communication. The GSM standard was developed to set protocols for digital cellular networks of the second generation (2G). It initially began as a circuit switching network, but after the introduction of General Packet Radio Service (GPRS) technology, packet switching was also implemented. The frequency ranges that are commonly used are 900 MHz and 1800 MHz. Approximately 80 percent of mobile phones around the world are currently using the Global Mobile Communications System (GSM) (TutorialsPoint, 2010). This technology has more than three billion users.

2. Mobile Communication

The use of technology that allows us to communicate with others at various locations without using any physical connection (wires or cables) is mobile communication. Mobile communication facilitates our lives, saving time and effort. If we're concerned about mobile communications systems, we can rely on many of today's cellular networks like 2 G, 3 G, 4 G, WiMAX, Wibro, EDGE, GPRS and many more. Mobile communication enables voice and multimedia information to be transmitted through a computer or mobile device without any physical or fixed connection (FreeWimaxInfo, 2010).

2.1 History of Mobile Communications

In the mid-1860s, James Clerk Maxwell, a Scottish mathematician, developed a pair of equations whose solution predicted electromagnetic waves propagating at the speed of light. It took 20 years for this prediction to be verified in the laboratory, and another 20 years for the first mobile application to take place. In September 1899, in the era of practical mobile radio communication, Guglielmo Marconi introduced his historic radiotelegraph transmissions from the ship in New York Harbor to the Twin Lights in Highlands New Jersey. Marconi had introduced filtering within a year to create separable channels, allowing multiple simultaneous transmissions in the same region. He was able to cross the Atlantic with a radio transmission within three years, and radio telegraphy was soon used on many ocean-going vessels (most notably, it was used to report the Titanic sinking in 1912). Analog (voice) communication was used as early as 1905, but early work was primarily driven by military applications, and an experimental ship-to-shore radiotelephone system was not introduced until 1919. Commercial radiotelephony was introduced in 1929 for passengers on the Atlantic boats. By that time, radios were small and rugged enough to be mounted in automobiles, and in 1928 the first "land mobile" radio system was put into service by the Detroit police. In 1934, there were 194 municipal police forces and 58 radio stations serving over 5000 police cars mounted with radio. Mobile radio's era had begun (Arokiamary, 2009).

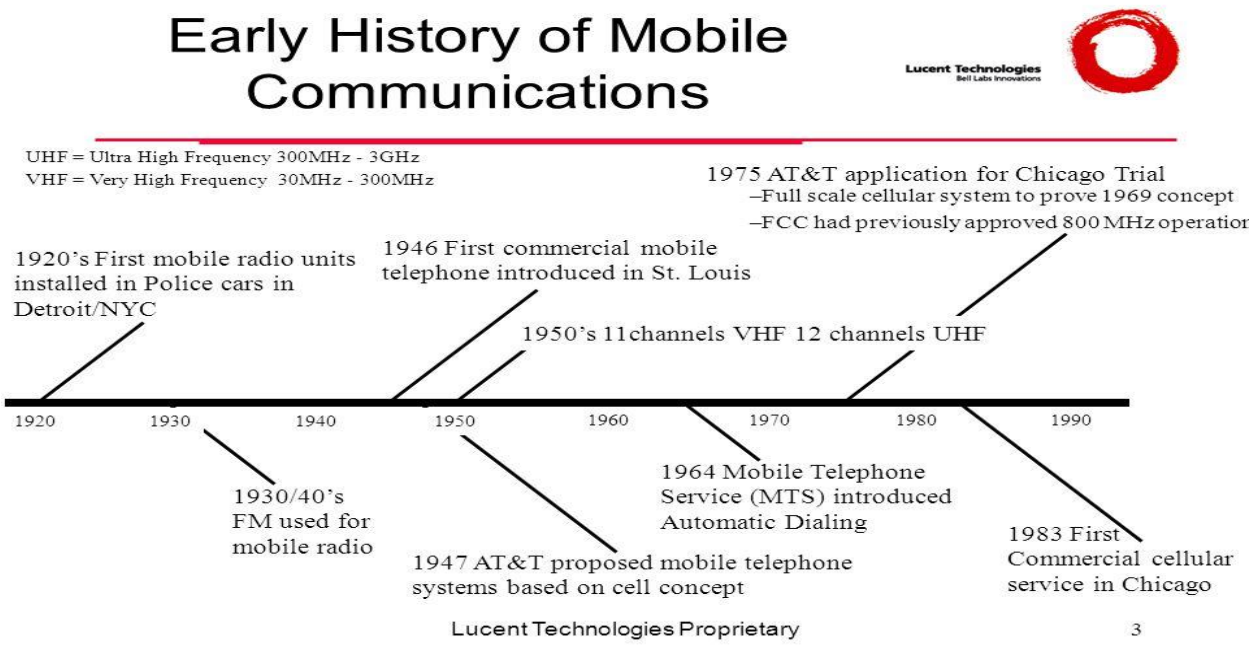

Figure 49: Early History of Mobile Communications.

2.2 Cellular Radio

Cellular Radio is the use of technology to transmit and receive voice or data to a telephone network using low-powered radio transmission. The word radio can be defined as modulation and signal radiation. Therefore, a transmitter and an antenna are used to modulate and radiate the modulated signal within the radio spectrum. By reusing the same frequencies several times over, cellular radio makes better use of the small frequency spectrum available for wireless radio. Reuse of frequencies is achieved by dividing a wide geographical area across the world into several small, nominally hexagonal zones, known as cells. The transmitting power level of each base station is limited to restrict the coverage area of that base station. Frequencies are assigned in such a way that only a few cells away can be used for different voice transmissions at the same frequency. We may describe mobile or cellular radio as a communication system consisting of a combination of radio transmission and the Public Switched Telephone Network (PSTN) to allow telephone communication to and from mobile subscribers within a given area (Thakur, 2012).

2.3 Advantages and Disadvantages of Mobile Communication

Advantages of Mobile Communication are:

- Flexibility: Wireless connectivity makes it possible for individuals to communicate with each other regardless of location. To send and receive messages, there is no need to be in an office or telephone booth.
- Easy Installation: Wireless networks are easy to install compared to messy wired counterparts and easy to maintain. This will help with the growth of the network and hundreds to thousands of customers.
- Network planning: Due to the wireless software configuration of frequency, power, and other parameters, wireless network planning is very easy to compare with wired networks.
- Cost efficiency: There is no need for any physical infrastructure (wires or cables) or maintenance practices in wireless communication. The cost is therefore reduced (Root, 2013).

Disadvantages of Mobile Communication are:

- Wireless signals can be easily hacked, hampering confidentiality. To stop this, wireless networks use protection algorithms (AES, WEP, WAP2) and modulation techniques (FHSS, DSSS).
- The previous wireless networks have been slower. Wireless LANs with advanced standards such as IEEE 802.11ac and 802.11ad with the same performance as traditional ethernet-based LANs are available nowadays.
- At the beginning of the installation, wireless networks require careful radio frequency planning.
- Wireless communication is subject to interruption. There are different techniques for the receiver and modulation that make the wireless system robust against any type of interference (Root, 2013).

3. CELLULAR TECHNOLOGIES

Mobile technology is what mobile phone networks are built on, and it is the technology that gave mobile phones the name "cell phones." Cellular technology simply refers to having several small interconnected transmitters as opposed to one large one. Cellular technology enables mobile communication because they use a complex two-way radio system between the mobile unit and the wireless network. It uses radio frequencies (radio channels) to serve a large number of simultaneous conversations over and over a market with minimal interference. Cellular technology used in the manufacture of cell phones is supported by mobile network devices used to integrate cell phones into a public telephone network where millions of people can communicate (Mishra, 2010).

3.1 GSM

GSM stands for the Global Mobile Communication System. The concept of GSM emerged from Bell Laboratories ' mobile cellular radio system in the early 1970s. GSM is an open and digital cellular technology used on the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands for the transmission of mobile voice and data services. GSM system was developed as a digital system using time division multiple access (TDMA) technique for communication purposes. A GSM digitizes and reduces data, then sends it down through a network of two different streams of client data, each in its own specific time slot. The digital system is capable of delivering 64 kbps to 120 Mbps of data rates (Fendelman, 2015).

3.2 1G, 2G, 3G AND LTE

1G

These were the first mobile phones to be used, which were introduced in 1982 and completed in the early 1990s. It was used for voice services and was based on technology called the Advanced Mobile Phone System (AMPS). The AMPS module was modulated frequency and used frequency (FDMA) with 30 KHz channel range and 824-894 MHz frequency band. It introduces mobile technologies such as Mobile Telephone System (MTS), Advanced Mobile Telephone System (AMTS), Improved Mobile Telephone Service (IMTS), and

Push to Talk (PTT). It has low capacity, unreliable hand-off, poor voice connections, and no security at all since voice calls were played back in radio towers, making those calls susceptible to unwanted third-party eavesdropping.

2G

2 G refers to the second generation based on GSM, which emerged in the late 1980s. It uses digital signals for the transmission of voice. The technology has focused primarily on digital signals and services to deliver low-speed text and picture messages (in kbps). It uses the bandwidth of 30 to 200 KHz. Next to 2 G, the 2.5 G system uses the packet switched and the circuit switched domain which provides up to 144 kbps of data rate. e.g. GPRS, CDMA and EDGE (Fendelman, 2015).

3G

3 G is based on GSM and was launched in 2000. The objective of this technology was to provide high-speed data. Using packet switching, the original technology has been upgraded to enable data up to 14 Mbps and more. It uses a Wide Band Wireless Network, which increases clarity. It also offers data services, access to television/video, and new services such as Global Roaming. It operates within a range of 2100MHz and has a bandwidth of 15-20MHz used for high-speed internet, video chat services (Fendelman, 2015).

4G

4G offers a 100Mbps download rate. 4 G provides the same features as 3G and additional services, such as Multi-Media Newspapers, to watch T.V programs more clearly and to send data much faster than previous generations. LTE (Long Term Evolution) is considered 4 G technology. 4 G is being developed to meet the QoS and rate requirements set out in upcoming applications such as wireless broadband access, Multimedia Messaging Service (MMS), video chat, mobile TV, HDTV content, Digital Video Broadcasting (DVB), minimal voice and data services and other services that use bandwidth (Pershing, 2013).

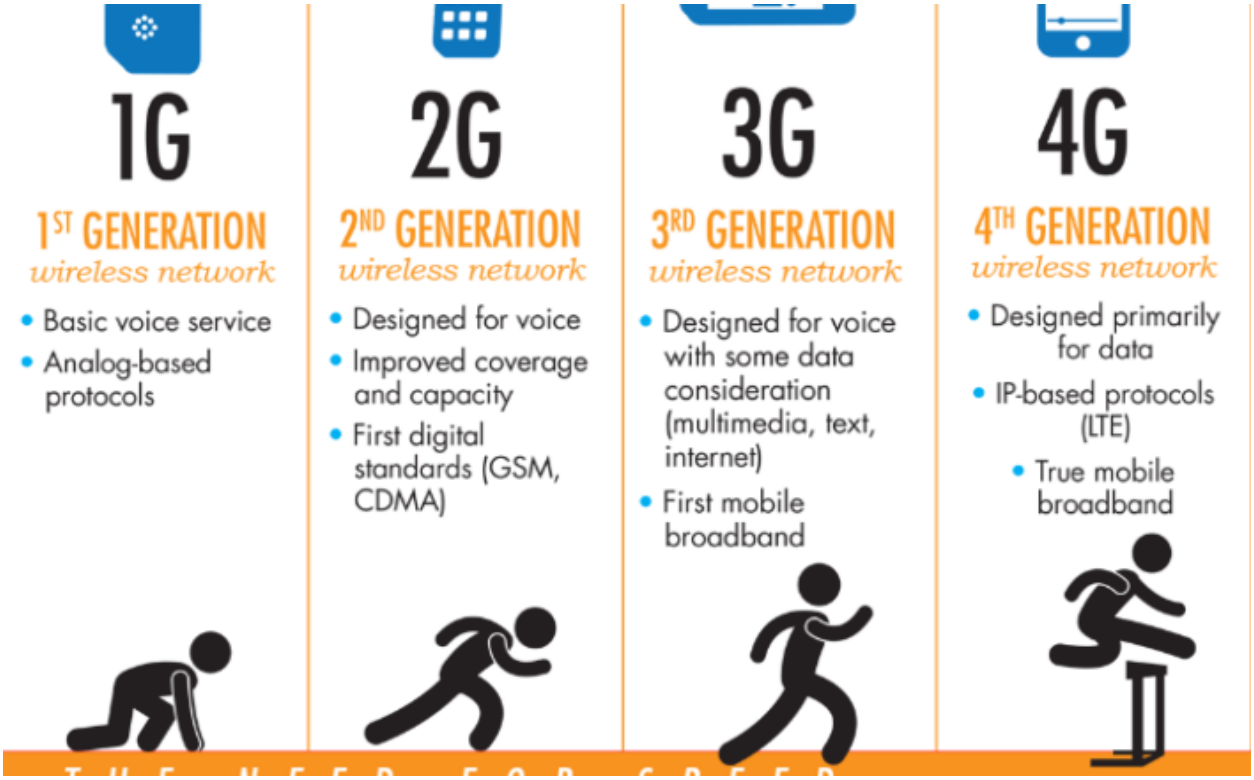

Figure 50: 1G,2G,3G,4G

4. Wireless Communication

Wireless communication is a broad term that encompasses all procedures and ways of connecting and interacting through wireless communication technologies and devices between two or more devices using a wireless signal (TutorialsPoint, 2010).

4.1 WAP

Wireless Application Protocol (WAP) is a networking protocol used by most cellular wireless networks for wireless data access. Using plain text and very simple black and white images, WAP allows wireless devices to access specific pages from the Internet. WAP improves the interoperability of wireless standards and enables instant communication between wireless interactive devices (mobile phones) and the Internet (GeeksforGeeks, 2015).

4.2 GPRS

General Packet Radio Service (GPRS) is a 3G and 2G cellular communication system packet-based mobile data service on the global mobile communication

system (GSM). Higher data rates allow users to participate in video conferences and interact with multimedia websites and similar applications using mobile handheld devices. Networks based on the Internet Protocol (IP) such as global internet or private/corporate intranets and X.25 networks are provided in the current versions of GPRS (JavaTPoint, 2011).

4.3 EDGE

Enhanced Data Rate for Global Evolution (EDGE) introduces a new modulation strategy as well as protocol improvements for transmitting packets over the radio. It is a high-speed wireless data system that can deliver up to 384kbps of the data through all GSM networks. This pace now allows the distribution of multimedia and other broadband services to mobile phones and computer users. The EDGE standard is still based on the GSM standard, but the general packet radio system (GPRS) and high-speed circuit switching data (HSCSD) systems are more precisely improvements. Considered an evolutionary protocol for Universal Mobile Telecommunications Service (UMTS), it became available commercially in 2001 (Garden, 2015).

4.4 UMTS

UMTS (Universal Mobile Telecommunications Service) is a third generation (3 G) broadband, packet-based transmission of text, digital voice, video, and multimedia at data rates of up to 2 megabits per second (Mbps). When UMTS is fully available, users of computers and telephones can be securely connected to the Internet everywhere they go and have the same collection of capabilities as they wander. Through integrating terrestrial wireless and satellite communications, users will have access. UMTS defines a full network system that includes the radio access network (UMTS Terrestrial Radio Access Network or UTRAN), the core network (Mobile Application Part or MAP) and user authentication through SIM cards (Rouse, 2013).

5. Conclusion

Mobile communication is a broad term that incorporates all procedures and forms of connecting and communicating between two or more devices using a wireless signal through wireless communication technologies and devices. The mobile telephony industry is growing rapidly and has become the backbone of business success and productivity and a part of modern lifestyles around the world.

In this report work I have tried to give and overview of the GSM system which also includes mobile communication and cellular technologies. The GSM is standard that ensures interoperability without stifling competition and innovation among the suppliers to the benefit of the public both in terms of cost and service quality. The features and benefits expected in GSM systems include superior speech quality, low terminal, operating and service costs, high level of security, international roaming support for low-power hand-held terminals and a variety of new services and network facilities. GSM has a network management subsystem that detects and resolves problems, keeps the information up to date, and detects good and bad network performance.

References

Arokiamary, V., 2009. *Cellular and Mobile Communication.* 5th ed. Tamilnadu: Technical Publication Pune.

Fendelman, A., 2015. *Lifewire.* [Online] Available at: https://www.lifewire.com/1g-vs-2g-vs-2-5g-vs-3g-vs-4g-578681 [Accessed 26 December 2019].

Fendelman, A., 2015. *What Is GSM in Cellular Networking?.* [Online] Available at: https://www.lifewire.com/definition-of-gsm-578670 [Accessed 31 December 2019].

FreeWimaxInfo, 2010. *Mobile Communication Technologies – Mobile Communication.* [Online] Available at: http://freewimaxinfo.com/mobile-communication-technologies.html [Accessed 28 December 2019].

Garden, T., 2015. *Techwalla-Edge Network.* [Online] Available at: https://www.techwalla.com/articles/what-is-the-edge-network [Accessed 30 December 2019].

GeeksforGeeks, 2015. *Wireless Application Protocol.* [Online] Available at: https://www.geeksforgeeks.org/wireless-application-protocol/ [Accessed 30 December 2019].

JavaTPoint, 2011. *GPRS: General Packet Radio Service.* [Online] Available at: https://www.javatpoint.com/gprs-full-form [Accessed 30 December 2019].

Mishra, R. A., 2010. *Cellular Technologies for Emerging Markets: 2G, 3G and Beyond.* 4th ed. NewDelhi: Aptata Book Publisher P ltd..

Pershing, B., 2013. *WHAT ARE 1G, 2G, 3G, 4G, AND 5G TECHNOLOGIES.* [Online] Available at: https://www.meee-services.com/what-are-1g-2g-3g-4g-and-5g-

technologies-and-what-are-their-differences/
[Accessed 2019 December 2019].

Root, G. N., 2013. *Advantages & Disadvantages of Mobile Communication Technology.* [Online]
Available at: https://www.techwalla.com/articles/advantages-disadvantages-of-mobile-communication-technology
[Accessed 29 December 2019].

Rouse, M., 2009. *SearchNetworking.* [Online]
Available at: https://searchnetworking.techtarget.com/definition/WAN-wide-area-network
[Accessed 28 December 2019].

Rouse, M., 2013. *SearchMobileComputing.* [Online]
Available at: https://searchmobilecomputing.techtarget.com/definition/UMTS
[Accessed 29 December 2019].

Thakur, D., 2012. *EcomputerNotes.* [Online]
Available at: http://ecomputernotes.com/computernetworkingnotes/services-and-applications/cellular-radio-definition
[Accessed 28 December 2019].

TutorialsPoint, 2010. *Wireless Communication - Overview.* [Online]
Available at: https://www.tutorialspoint.com/wireless_communication/wireless_communication_overview.htm
[Accessed 29 December 2019].

Appendix

Nodes: Received Message Counts

```
Compuware COMNET III  Release 2.5.2.814  Wed Jan 01 10:10:56 2020   PAGE     1

                          Coursework NOS Girija Tamang

                        NODES: RECEIVED MESSAGE COUNTS

                    REPLICATION 1 FROM 120.0 TO 180.0 SECONDS

      RECEIVER             COUNT                  MESSAGE NAME
_____________________  _________  ____________________________________________

Edinburgh LAN.Edinburg       709    Lalitpur ATM Group Msg Source
Edinburgh LAN.Edinburg       696    Biratnagar ATM Group Msg Source
```

The message count is shown along with the message name and the receiver.

Links: Channel Utilization

```
Compuware COMNET III  Release 2.5.2.814  Wed Jan 01 10:10:56 2020   PAGE     2

                          Coursework NOS Girija Tamang

                          LINKS: CHANNEL UTILIZATION

                    REPLICATION 1 FROM 120.0 TO 180.0 SECONDS

                            FRAMES          TRANSMISSION DELAY (MS)       %
LINK                     DELIVERED RST/ERR  AVERAGE    STD DEV    MAXIMUM   UTIL
_____________________  _________ ______  _________  _________  _________  _____

Lalitpur LAN.Lalitpur      11735      0      0.039      0.015      0.089 0.7557
Biratnagar LAN.Biratna     11811      0      0.039      0.015      0.092 0.7608
Edinburgh LAN.Edinburg     12128      0      0.036      0.012      0.082 0.7340
```

The links, % utilization, frames delivered, along with transmission delay are shown above of the wan model which we developed in comnet for coursework.

Frame delay by VC

```
Compuware COMNET III  Release 2.5.2.814  Wed Jan 01 10:10:56 2020   PAGE     3

                        Coursework NOS Girija Tamang

                      WAN CLOUDS: FRAME DELAY BY VC

                  REPLICATION 1 FROM 120.0 TO 180.0 SECONDS

CLOUD:                        FRAME DELAY (MS)              BURST SIZE (kb)
  VC                        AVG      STD      MAX          AVG           MAX
_____________________    _______  _______  _______    _____________  _____________

WAN Cloud
  Edinburgh To Lalitpu        25        0       25              21             25
  Lalitpur To Edinburg     75089     8671    90002              56             57
  Edinburgh To Biratna        25        0       25              21             26
  Biratnagar To Edinbu     74909     8602    90003              56             57
```

The average, standard and maximum frame delay and average, maximum burst size of the wan cloud is given.

Frame Counts By VC

```
Compuware COMNET III  Release 2.5.2.814  Wed Jan 01 10:10:56 2020   PAGE     4

                        Coursework NOS Girija Tamang

                      WAN CLOUDS: FRAME COUNTS BY VC

                  REPLICATION 1 FROM 120.0 TO 180.0 SECONDS

CLOUD:                                    FRAMES / KILOBITS
  VC:  FRAMES                   ACCEPTED                      DROPPED
       KILOBITS              NORMAL          DE           NORMAL          DE
_____________________    _____________  _____________  _____________  _____________

WAN Cloud               (TOTAL KILOBITS TRANSMITTED =         4718 )
  Edinburgh To Lal Frm           3028              0              0              0
                   kb             969              0              0              0
  Lalitpur To Edin Frm           3025              0              0              0
                   kb             1390             0              0              0
  Edinburgh To Bir Frm           3037              0              0              0
                   kb             972              0              0              0
  Biratnagar To Ed Frm           3038              0              0              0
                   kb             1388             0              0              0
```

The accepted and dropped frames/kilobits of the wan cloud is given above.

Access Links Stats

```
Compuware COMNET III  Release 2.5.2.814  Wed Jan 01 10:10:56 2020   PAGE     5

                          Coursework NOS Girija Tamang

                        WAN CLOUDS: ACCESS LINK STATS

                   REPLICATION 1 FROM 120.0 TO 180.0 SECONDS

CLOUD:                                FRAMES            BUFFER (BYTES)       % UTIL
  ACCESS LINK  (ENTRY)      ACCEPTED    DROPPED    MAX      AVG      STD
               (EXIT)
_____________________________ __________  _________  _______  _______  _______  ______

WAN Cloud
  Edinburgh Access Entry         6066          0    N/A      N/A      N/A     75.10
                   Exit         12082          0 1043038   869065   100516   100.00
  Lalitpur Access  Entry         6058          0    N/A      N/A      N/A     100.00
                   Exit          3028          0      80       15       19    37.49
  Biratnagar Acces Entry         6024          0    N/A      N/A      N/A     100.00
                   Exit          3038          0      80       15       19    37.60
```

The accepted and dropped frames along with the entry and exit point and the average, maximum, standard buffer and % of utilization is shown above.

Message Delay

```
                        Coursework NOS Girija Tamang

                  MESSAGE + RESPONSE SOURCES: MESSAGE DELAY

                  REPLICATION 1 FROM 120.0 TO 180.0 SECONDS

ORIGIN / MSG SRC NAME:  MESSAGES                MESSAGE DELAY
  DESTINATION LIST      ASSEMBLED      AVERAGE       STD DEV       MAXIMUM
_____________________   _________   ____________  ____________  ____________

Lalitpur LAN.Lalitpur ATM Group / src Lalitpur ATM Group Msg Source:
  Edinburgh LAN.Edinbu        258   143.85198 S   16529.863 MS  173.17171 S
Lalitpur LAN.Lalitpur ATM / src Lalitpur ATM Msg Source:
  Edinburgh LAN.Edinbu          0       0.000 MS      0.000 MS      0.000 MS
Biratnagar LAN.Biratnagar ATM Group / src Biratnagar ATM Group Msg Source:
  Edinburgh LAN.Edinbu        244   143.19133 S   16148.599 MS  172.14799 S
Biratnagar LAN.Biratnagar ATM / src Biratnagar ATM Msg Source:
  Edinburgh LAN.Edinbu          0       0.000 MS      0.000 MS      0.000 MS
Edinburgh LAN.Edinburgh Server / src Edinburgh Response Source:
  ECHO                          0       0.000 MS      0.000 MS      0.000 MS
```

The messages assembled, average, std and dev message delay and maximum value of message source name along with destination list are shown.