# Networking Concept
# (Using Comnet III)

**Report by: Sayush Khadka**

## Abstract:

The coursework is divided into 2 parts namely Task A and Task B. Task A related with the network simulation process whereas Task B is based on technical report.

For Task A we must make a network system according to the given scenario. The network system must be designed for ABC bank. There are three LANs, they are Manchester LAN, Pokhara LAN, and Kathmandu LAN, and are in Manchester, Pokhara, and Kathmandu, respectively. The headquarters of the bank is in Manchester. And the bank is to set 2 ATM transaction network in Nepal (Pokhara and Kathmandu). Comnet III is used as an analysis tool to perform the task. The report generated from the simulation is further discussed in the form of a table, graph, and description of it.

Task B is a technical report which is more research based. Task B highlights on the internet. It occupies information on the history of internet, commercial expansion, features of the internet (advantages and disadvantages). Task B also covers information on internet architecture.

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# 1. Task A

## 1.1 Introduction:

A computer network can be defined as a system that help connect two or more computers in a network. Either cable or wireless media can be used to establish a network connection. In any network, hardware and software are utilized to connect computers and tools (Williams, 2021).

There are mainly 4 types of important computer networks:

i) PAN (Personal Area Network): A PAN (Personal Area Network) is a computer network designed to support a single user. The most popular components are a computer, a mobile phone, or a personal digital assistant (Williams, 2021).

ii) LAN (Local Area Network): A local area network (LAN) can be referred to as a collection of computers and peripheral devices connected in a small space, such as a school, home, or workplace. It is a well-known network for sharing files, printers, games, and other applications (Williams, 2021).

iii) WAN (Wide Area Network): The WAN is another big computer network that spans a large geographical area (Wide Area Network). A wide-area network (WAN) system might be a LAN link that connects to other LANs through phone lines and radio waves. Typically, it is limited to a particular firm or group (Williams, 2021).

iv) MAN (Metropolitan Area Network): A computer network that covers a city, a college campus, or a small area is known as a Metropolitan Area Network, or MAN. This network is substantially larger than a local area network (LAN), which is often limited to a single building or location. Depending on the layout, this type of network might run anywhere from a few miles to tens of miles (Williams, 2021).

In the given coursework or the task, an individual is supposed to make Network Simulation Model for a multinational bank according to the given scenario.

## 1.2 WAN Model:

The three LANs are Manchester LAN, Pokhara LAN, and Kathmandu LAN, and are in Manchester, Pokhara, and Kathmandu, respectively. Messages are sent to the Manchester Response Source from the Message Source in the Pokhara and Kathmandu LANs. Following then, the Manchester Response Source responds to the messages sent by the LANs in Pokhara and Kathmandu. All three LANs are connected to the WAN Cloud.

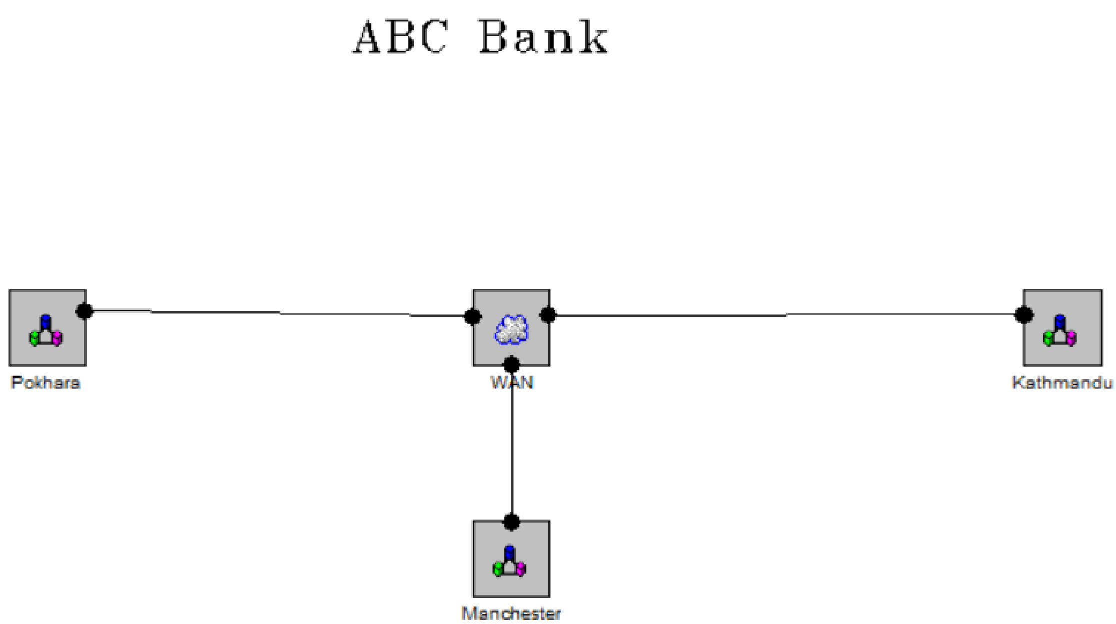


*Figure 1 WAN Model*

### 1.2.1 Manchester LAN:

Manchester LAN consists of a network device (router), an ethernet, a processing server and a response source. The message response is initiated when a message from the Pokhara or Kathmandu LAN reaches Manchester LAN. After that, the server sends the response to the ethernet, router, and access point.

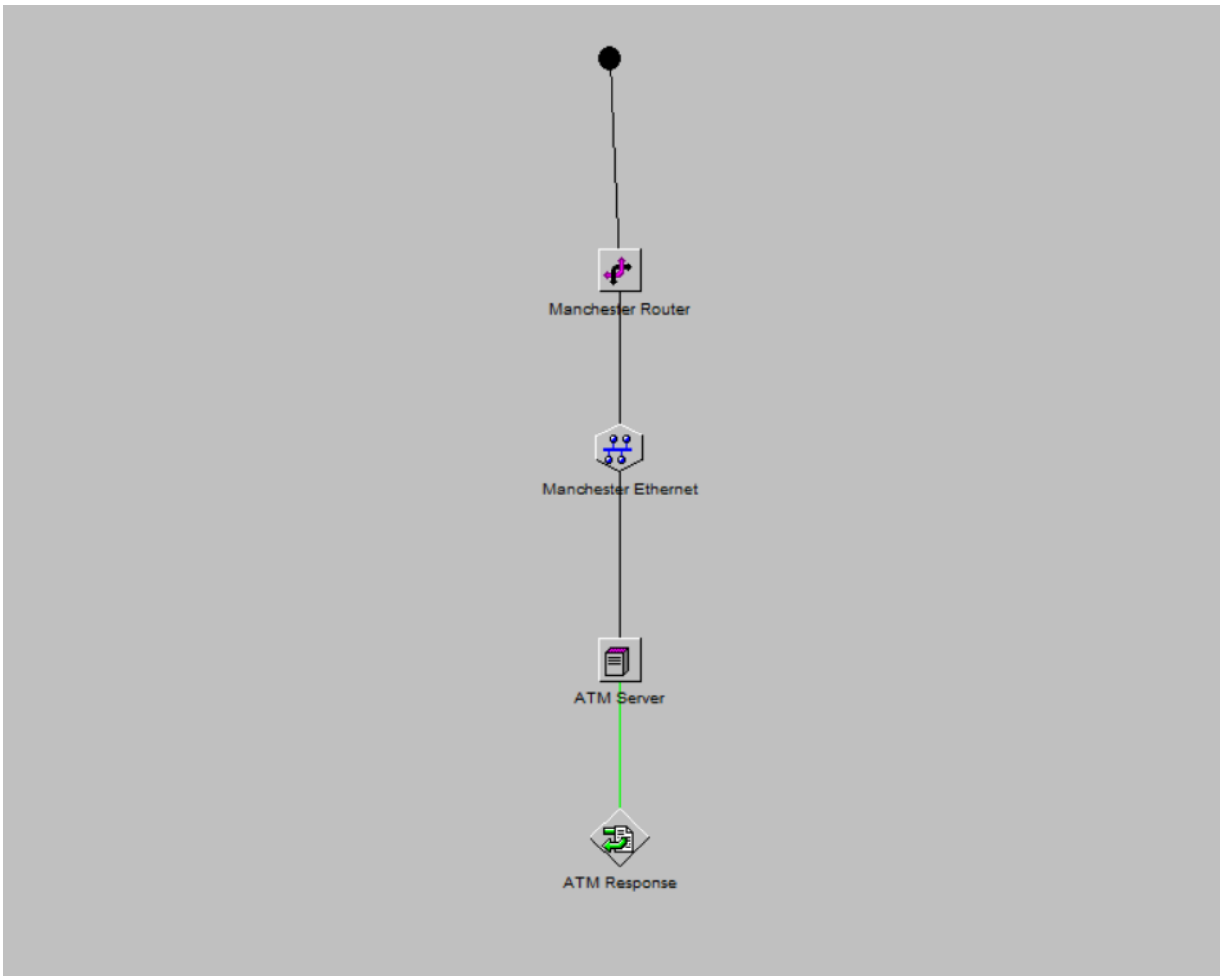


*Figure 2 Manchester LAN*

#### 1.2.1.1 Manchester Router (Network Device):

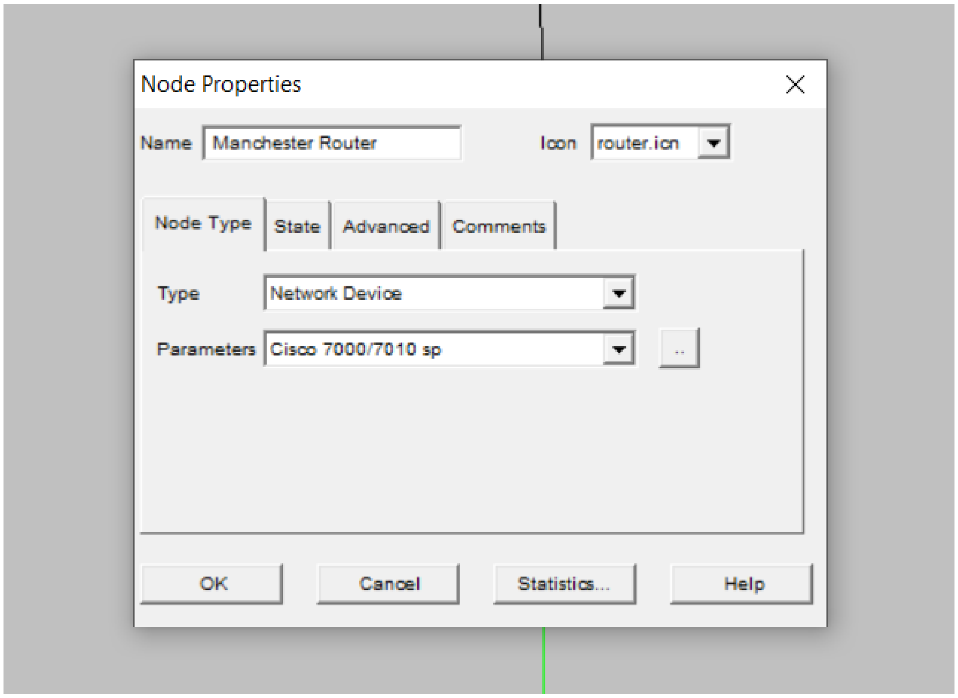


*Figure 3 Manchester Router*

Cisco 7000/7010 sp has been used as the network device (Router) as Manchester Router.

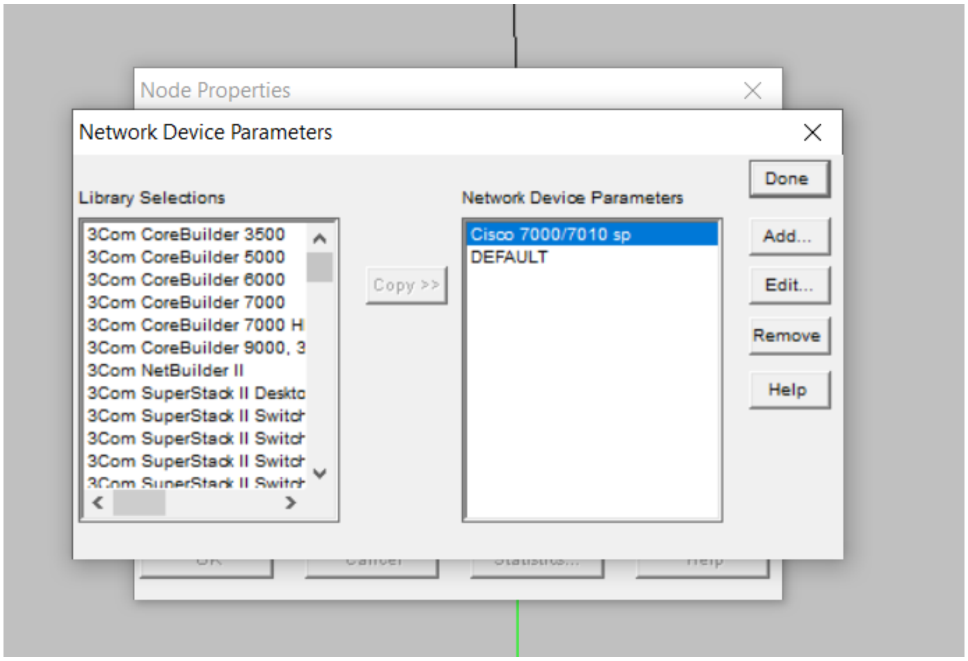


*Figure 4 Network Device Parameter (Manchester)*

#### 1.2.1.2 Manchester Ethernet:

The ethernet is set using 802.3 CSMA/CD 10BASET as the parameter.

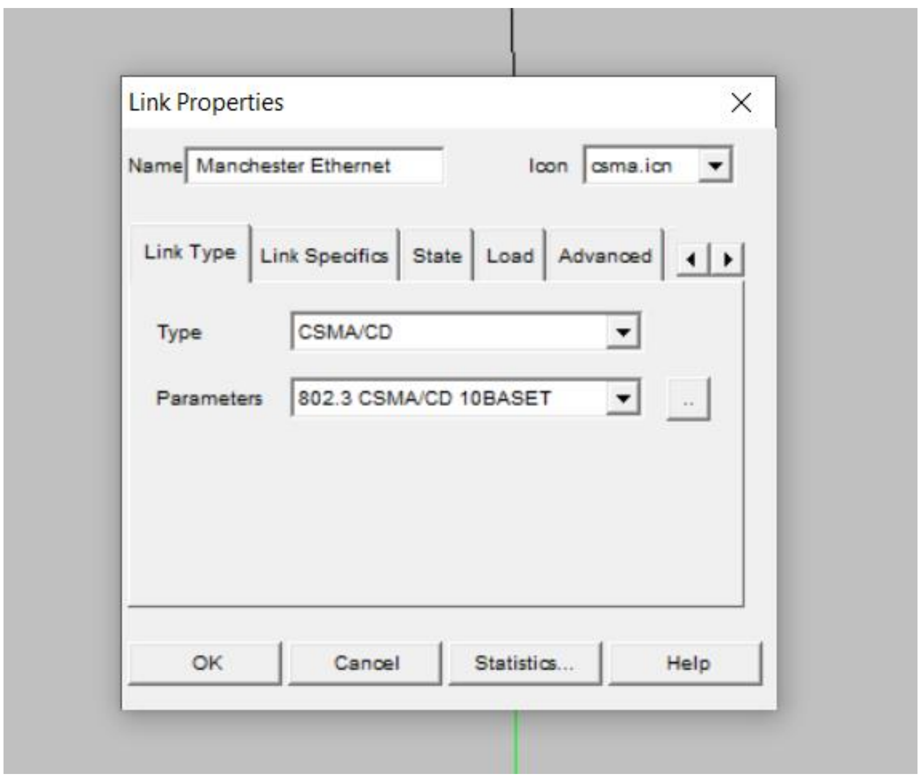


*Figure 5 Manchester Ethernet*

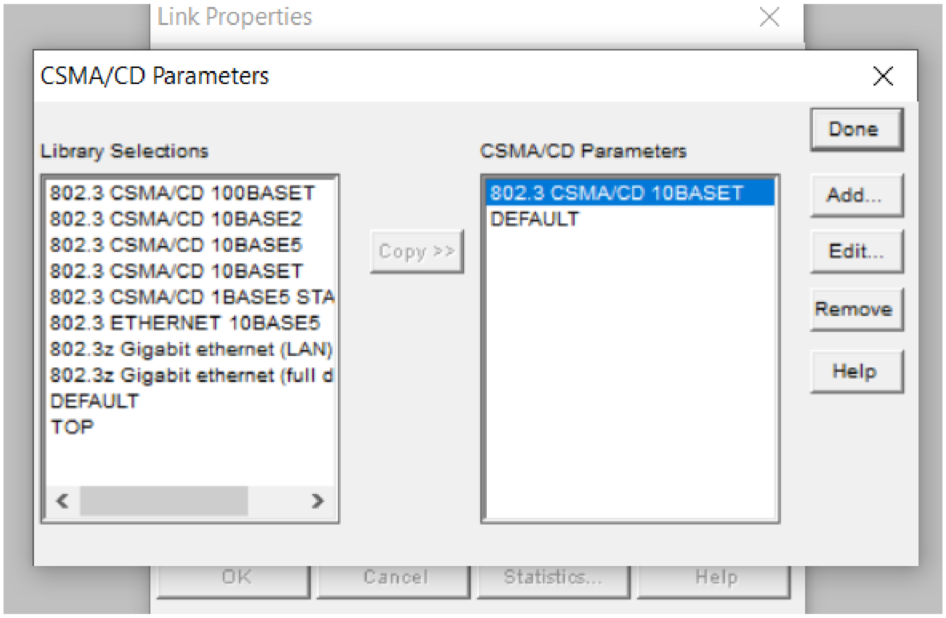

Figure 6 Manchester Ethernet parameter

#### 1.2.1.3 Manchester ATM Server (Processing Server):

Manchester ATM Server is the processing server. This server is responsible to generate message response. The server is a processing node with parameters as default.

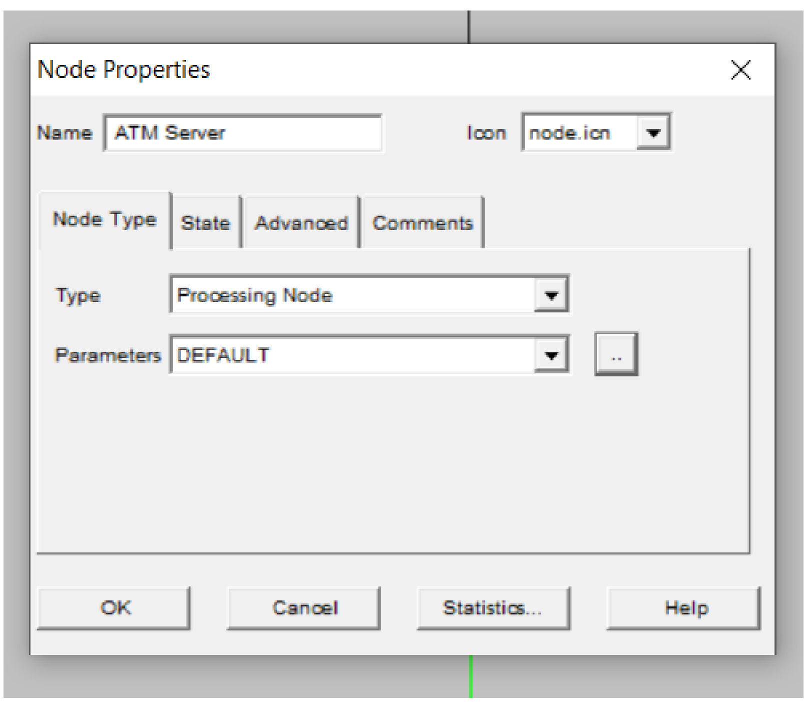

Figure 7 Manchester ATM Server

#### 1.2.1.4 Manchester ATM Response (Response Source):

Manchester ATM Response is the response source. The message list received from the requesting LAN is shown. The message property specifies that the message's size is determined using a uniform probability distribution.

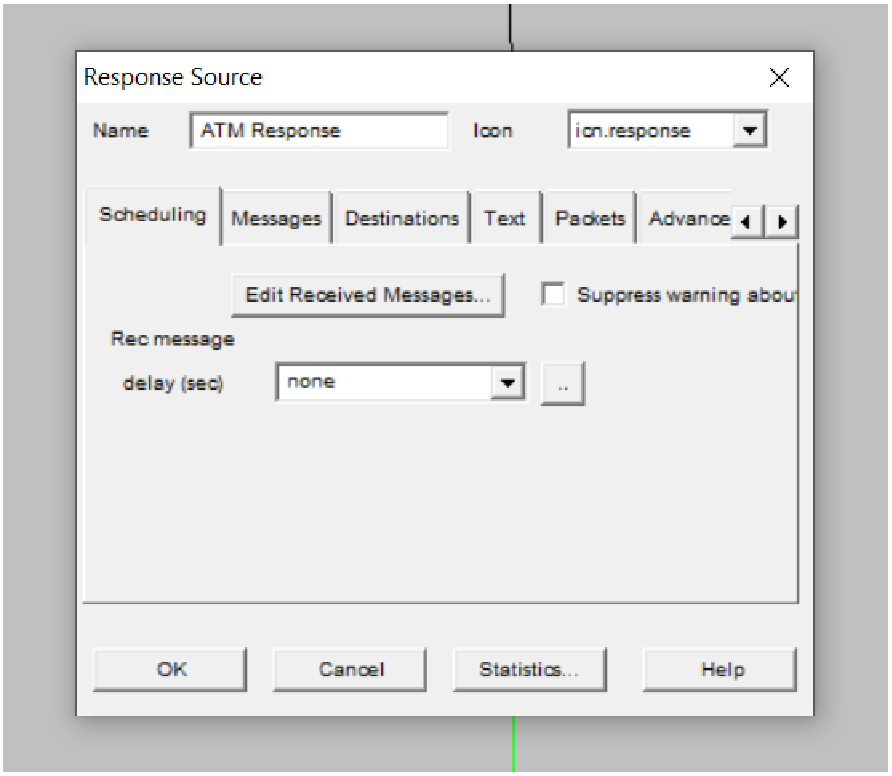


*Figure 8 Manchester ATM Response*

Received Message List from the other present LANs.

The received message list contains:

i) Kathmandu ATM Source

ii) Kathmandu Message Source

iii) Pokhara ATM Source

iv) Pokhara Message Sender

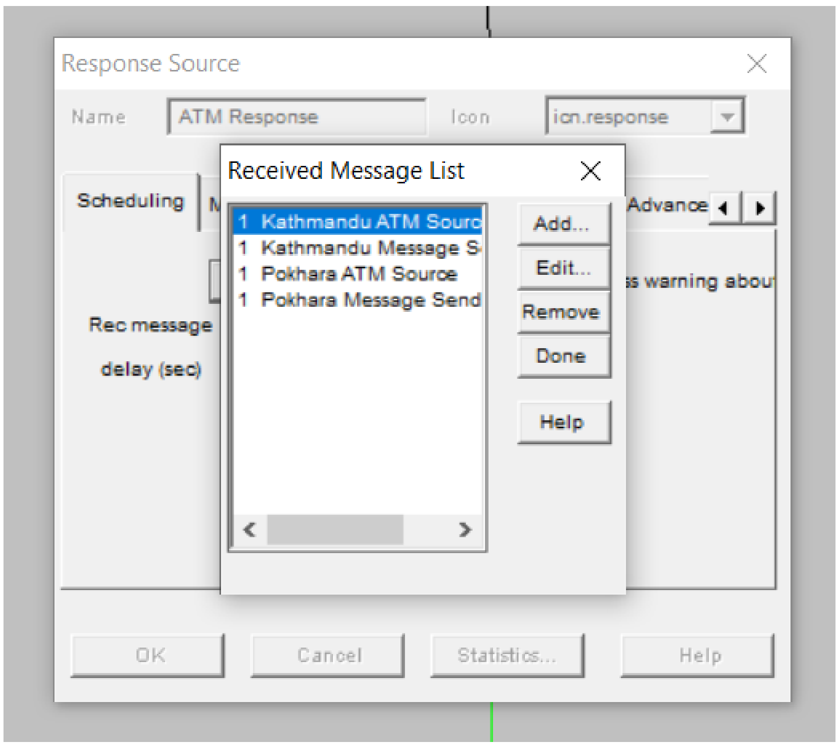


*Figure 9 Manchester ATM Response (Received Message List from other LANs)*

Message size calculation is done using Uniform Probability Distribution

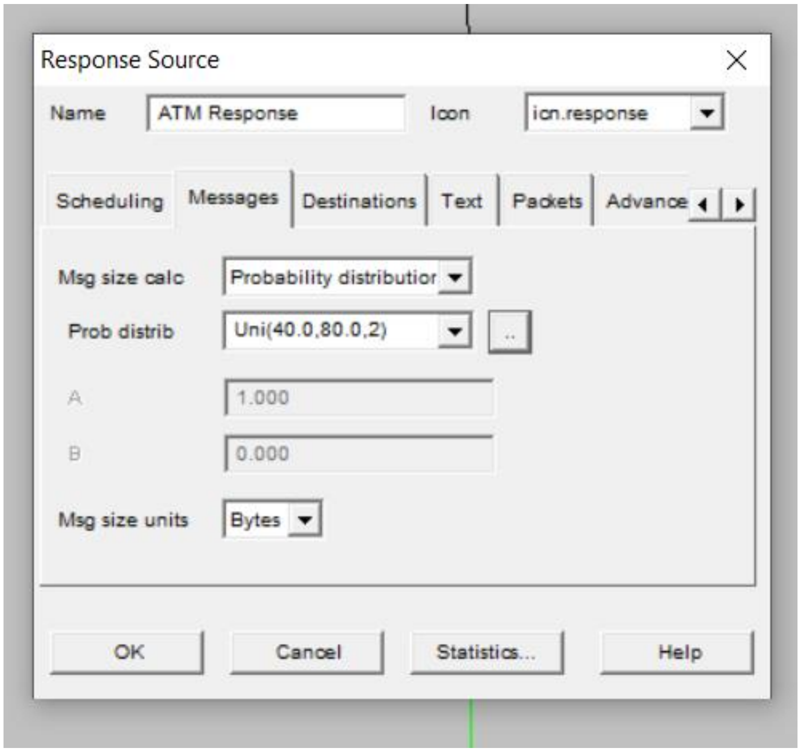

*Figure 10 Manchester ATM Response (Message Size calculation)*

The Minimum value given is 40 and the Maximum value given is 80 and Stream is 2 for the Uniform Probability Distribution.

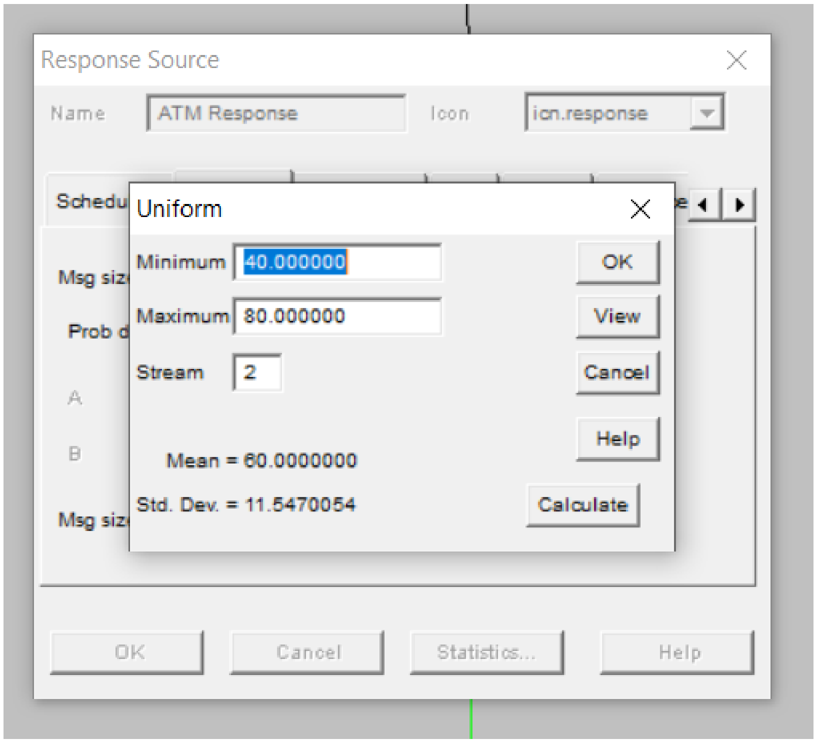

*Figure 11 Manchester ATM Response (Uniform values)*

The protocol used is TCP/IP – Microsoft V1.0.

The packetize(ms) is 10.

The priority set is 1 with Standard routing class.

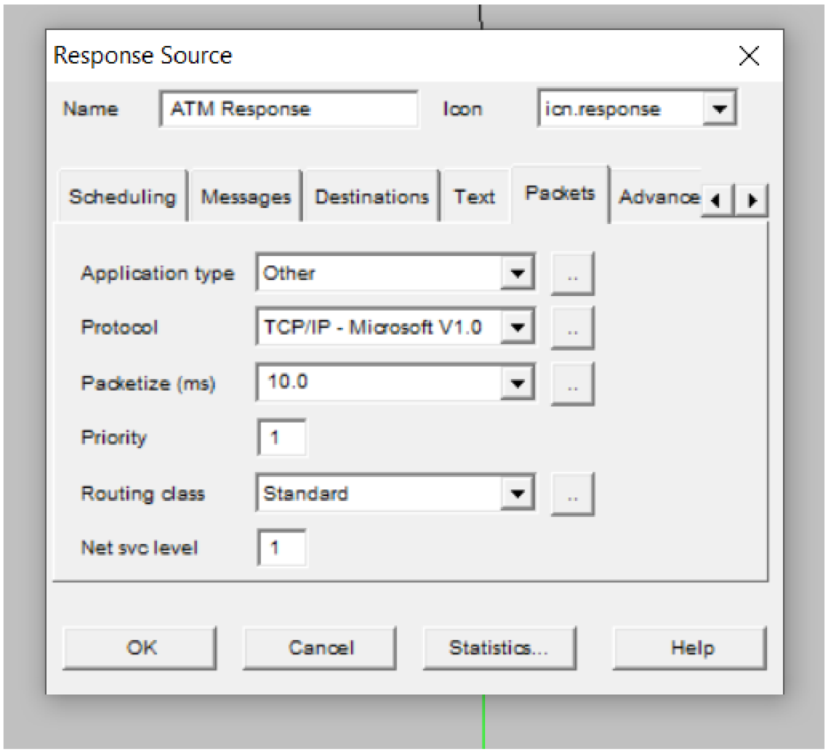


*Figure 12 Manchester ATM Response (Packets)*

### 1.2.2 WAN Cloud:

The LAN's data is routed across many Access Points and Virtual Circuits. Data is delivered to a Virtual Circuit (Pokhara - Manchester) and subsequently to the Manchester server through the path from the Pokhara LAN to the WAN via a Pokhara access point. Following that, the server responds through Virtual Circuit which is (Manchester-Pokhara). The Kathmandu LAN connects to the WAN through a Kathmandu access point, from which data is sent to the Manchester server via a Virtual Circuit (Kathmandu - Manchester). Following that, the server responds through Virtual Circuit which is (Manchester- Kathmandu).

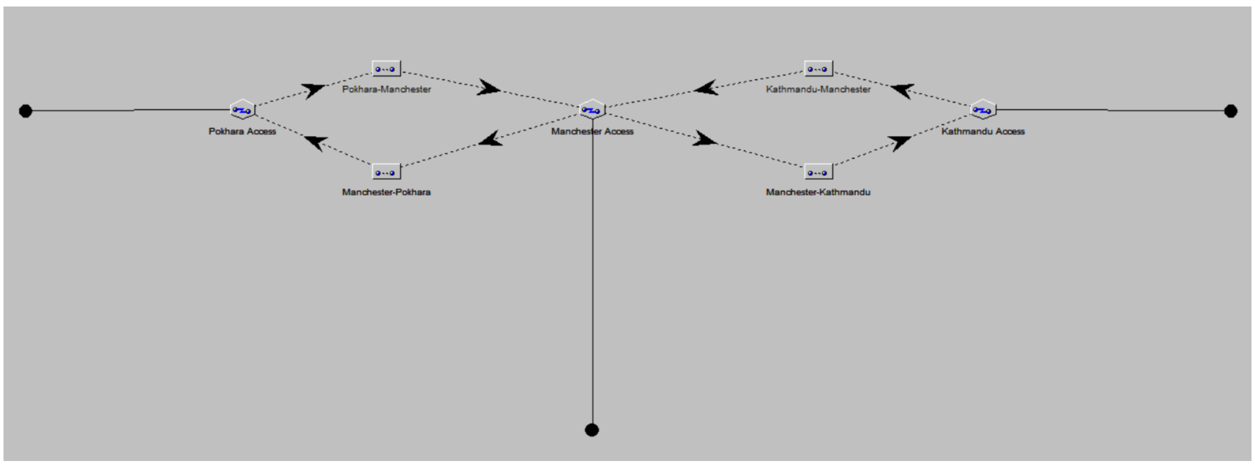


*Figure 13 WAN Cloud*

### 1.2.2.1 Access Link:

There are 3 access links in the WAN cloud. The access links are Manchester Access, Pokhara Access and Kathmandu Access. The Access links are given with a parameter of 9.6 kbps each.

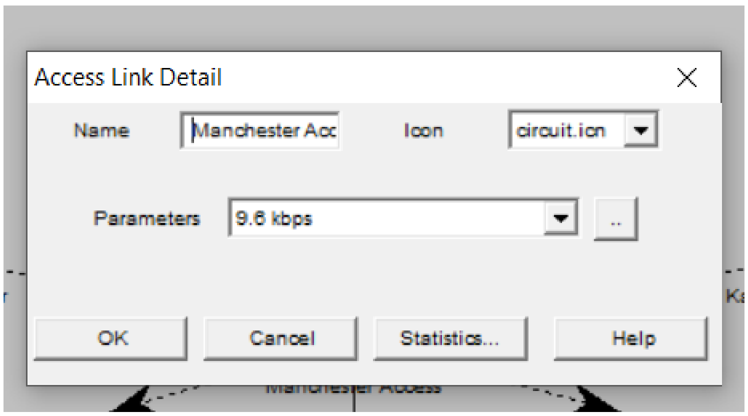

*Figure 14 Manchester Access*

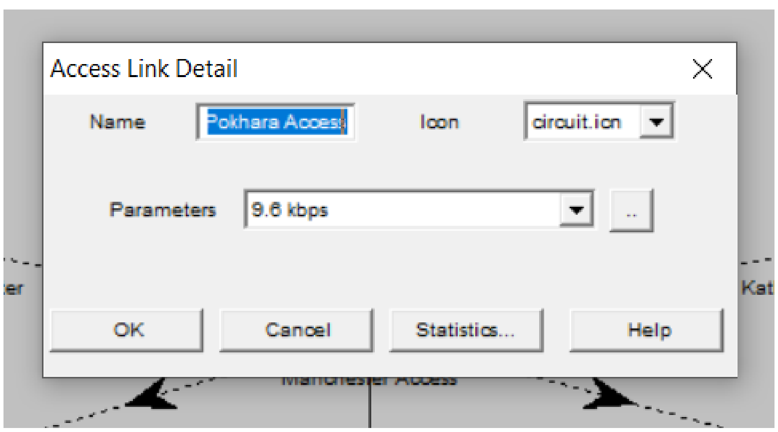

*Figure 15 Pokhara Access*

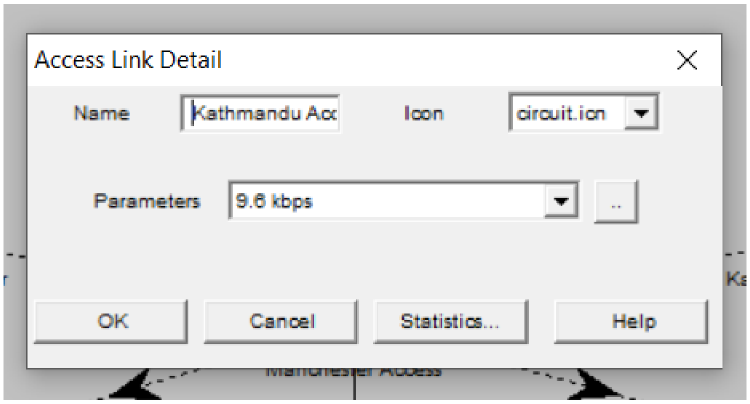

*Figure 16 Kathmandu Access*

#### 1.2.2.2 Virtual Circuit

A virtual circuit is a physical path and destination for data packets in a packet switching system. Intermediary nodes in a virtual circuit use routing instructions to complete the path in a precise manner, allowing system administrators to fulfil their goals (technopedia, 2019).

4 virtual circuits have been used of frame relay type and parameter of 56 kbps CIR to carry packets from Pokhara to Manchester through (Pokhara - Manchester) and from Manchester to Pokhara through (Manchester - Pokhara). Similarly, from Kathmandu to Manchester through (Kathmandu - Manchester) and back to Kathmandu from Manchester from (Kathmandu - Manchester).

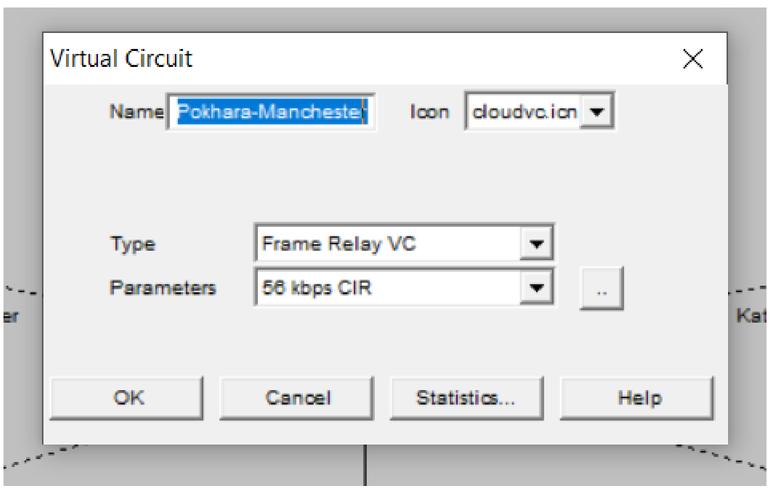

*Figure 17 Pokhara-Manchester Virtual Circuit*

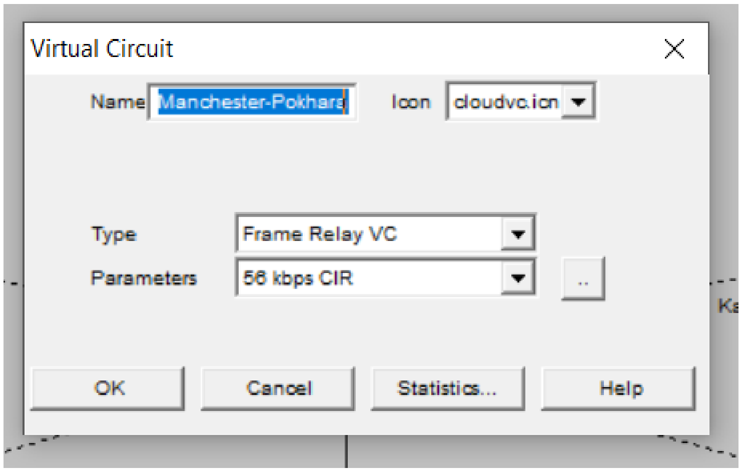


*Figure 18 Manchester-Pokhara Virtual Circuit*

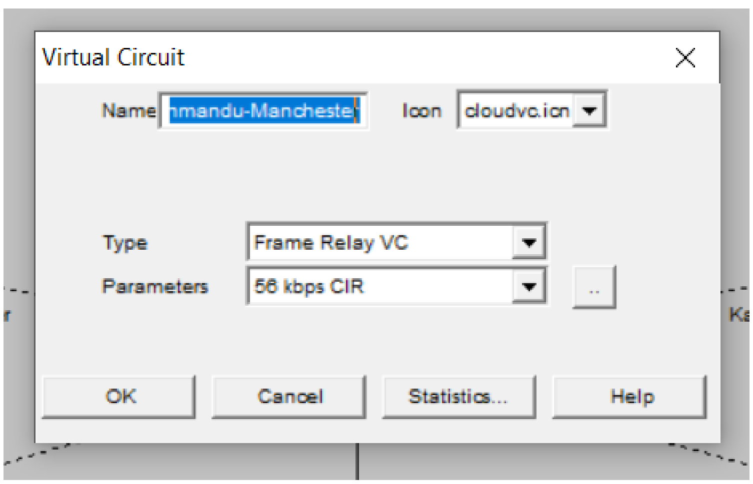


*Figure 19 Kathmandu-Manchester Virtual Circuit*

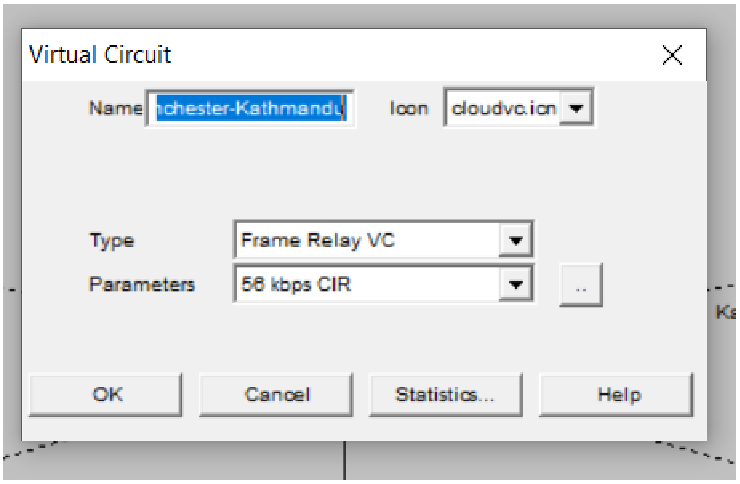

*Figure 20 Manchester-Kathmandu Virtual Circuit*

### 1.2.3 Pokhara and Kathmandu LAN:

The Pokhara and Kathmandu LAN both consists of 40 ATM transaction nodes and a single teller making it as 41 of total ATMs in each LAN. The LANs also consist of a router and a token ring each.

The LANs are connected to the WAN cloud through an access link. A router, token ring, a 40-machine ATM group, and a single teller machine, each with its own message source, make up the system. The message source is transmitted to a router, which delivers the signal to the WAN Cloud, where Manchester Server receives it and validates the message source before sending a response to the Pokhara or Kathmandu networks, respectively.

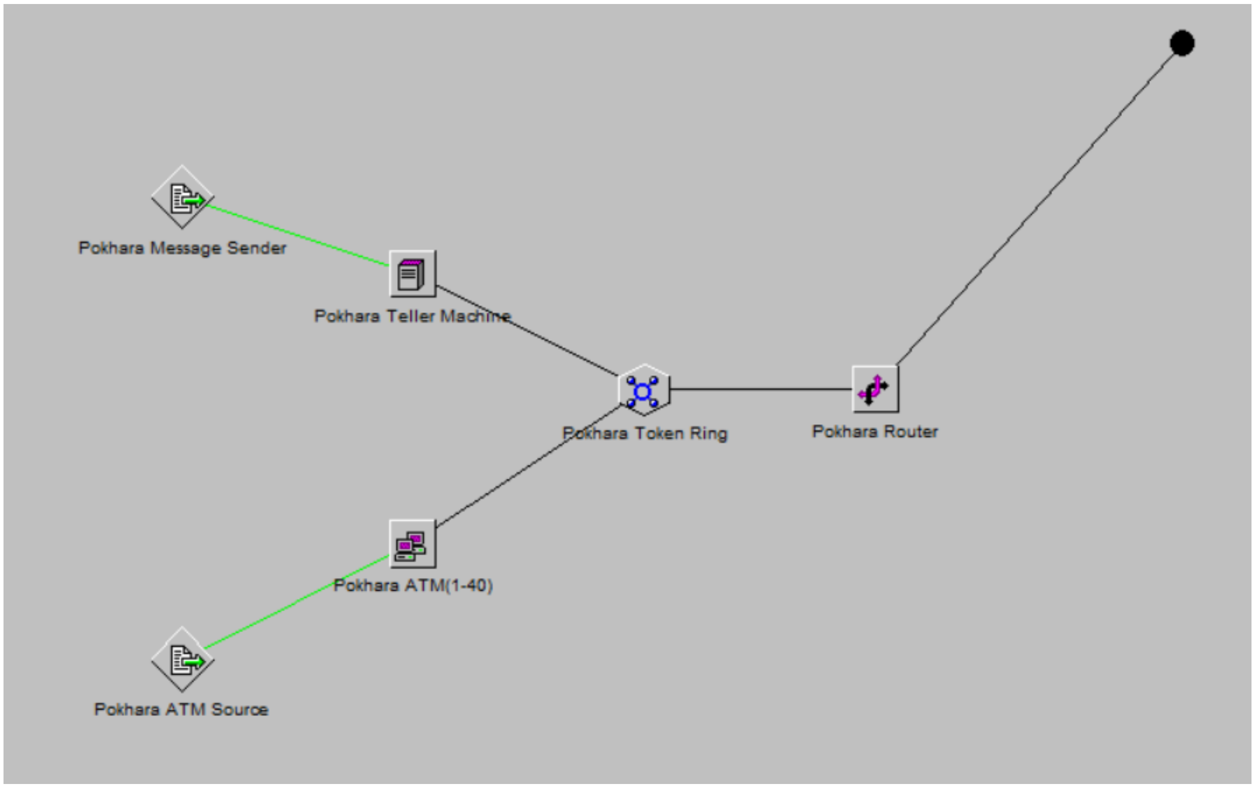


*Figure 21 Pokhara LAN*

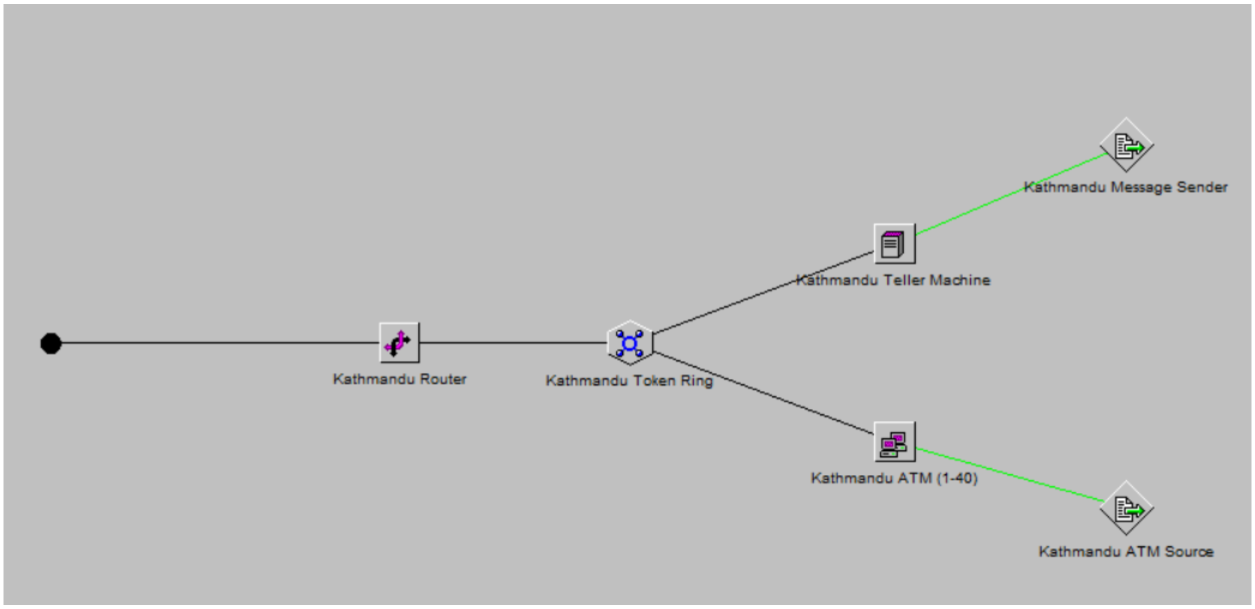

*Figure 22 Kathmandu LAN*

### 1.2.3.1 Pokhara and Kathmandu Router (Network Device):

Cisco 7000/7010 sp has been used as the network device (Router) as Pokhara and Kathmandu Router respectively.

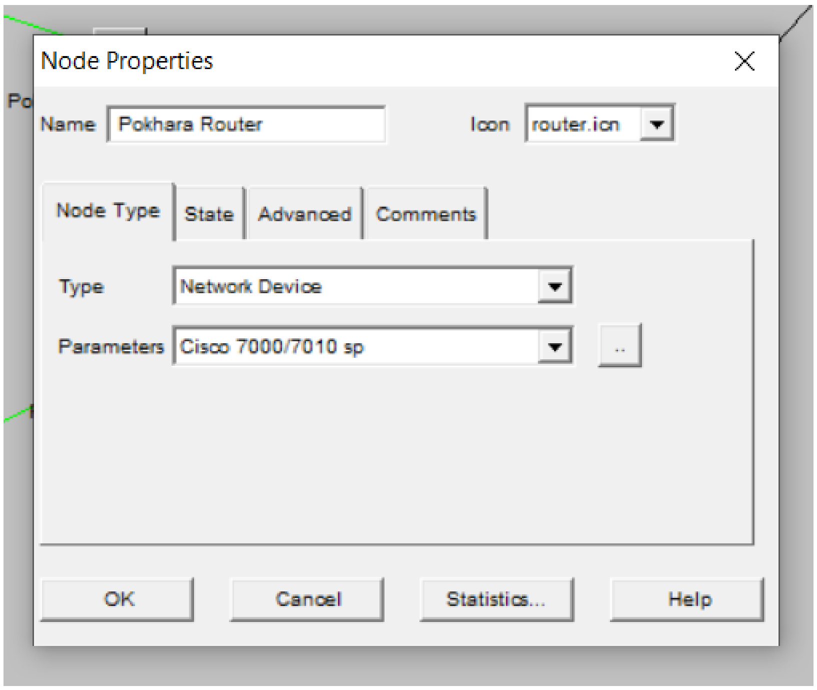


Figure 23 Pokhara Router

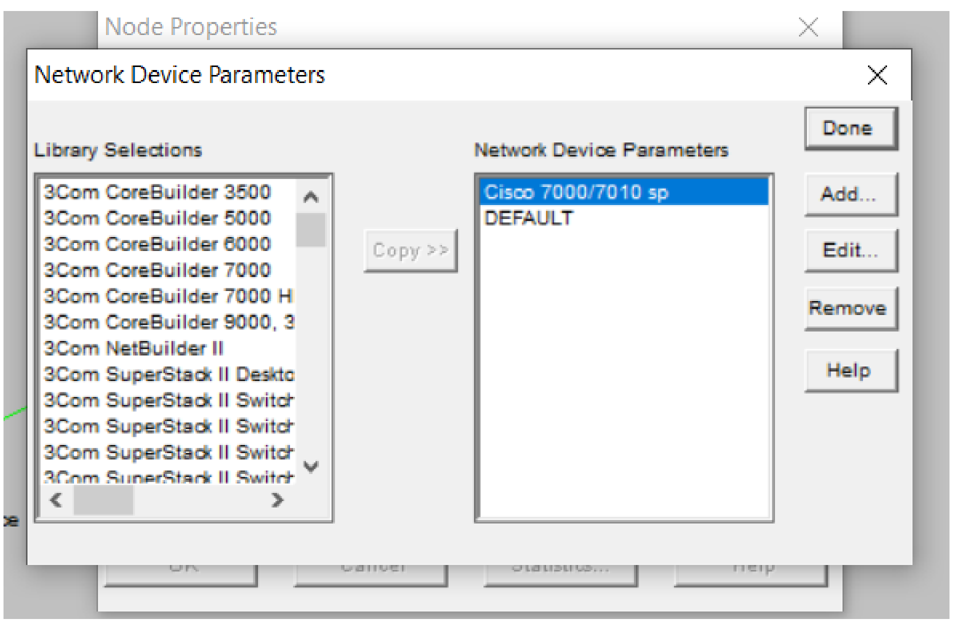


Figure 24 Network Device Parameter (Pokhara)

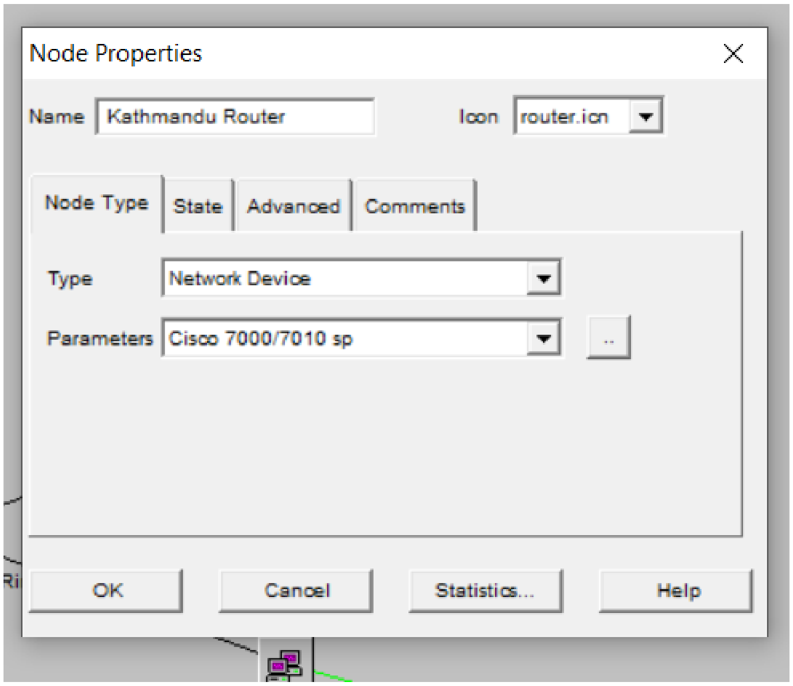

*Figure 25 Kathmandu Router*

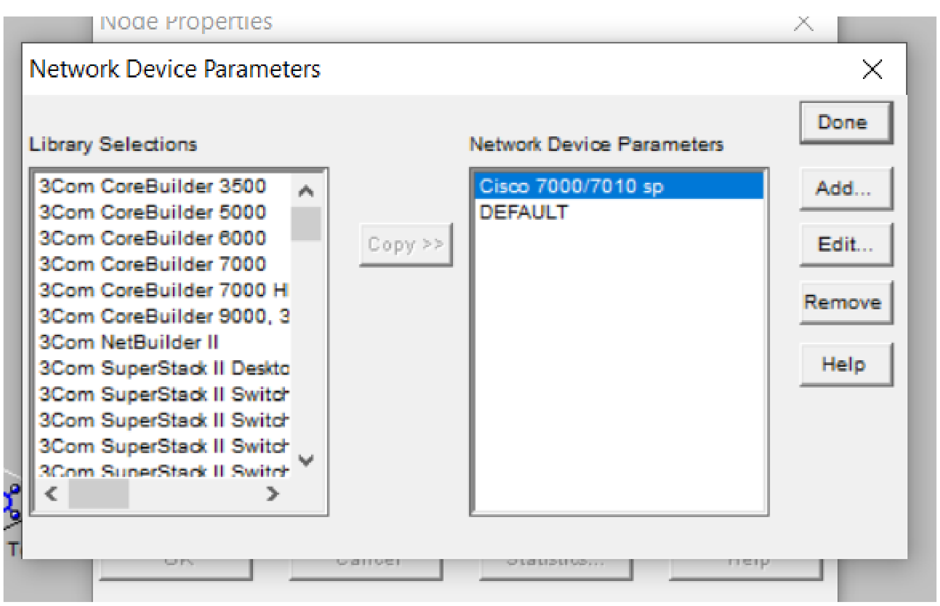

*Figure 26 Network Device Parameter (Kathmandu)*

### 1.2.3.2 Pokhara and Kathmandu Token Ring (Token Passing Ring):

In a local area network (LAN), token ring (IEEE 802.5) is a communication protocol in which all stations are connected in a ring topology and pass one or more tokens for channel acquisition (Moumita, 2019)

The Token Ring of the Pokhara and Kathmandu LAN Have been set to type Token Passing with the parameter of 802.5 16 Mbps.

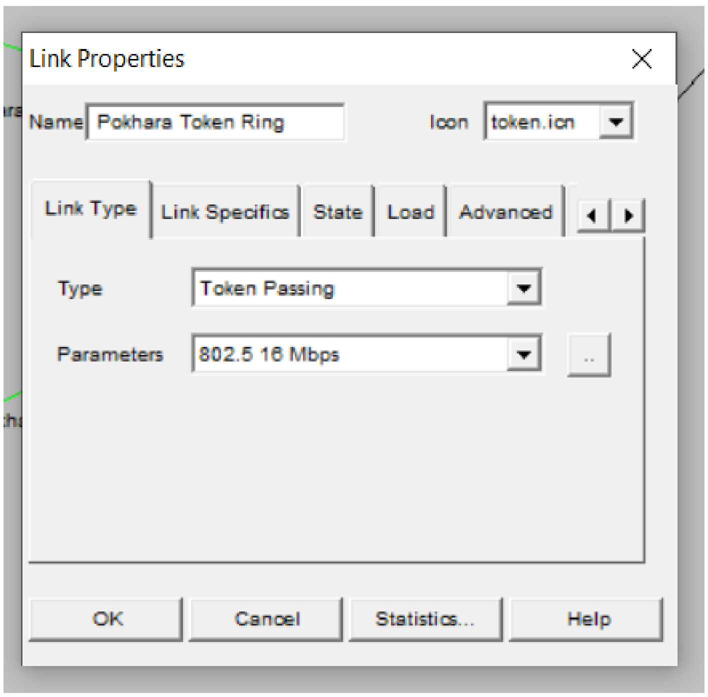


*Figure 27 Pokhara Token Ring*

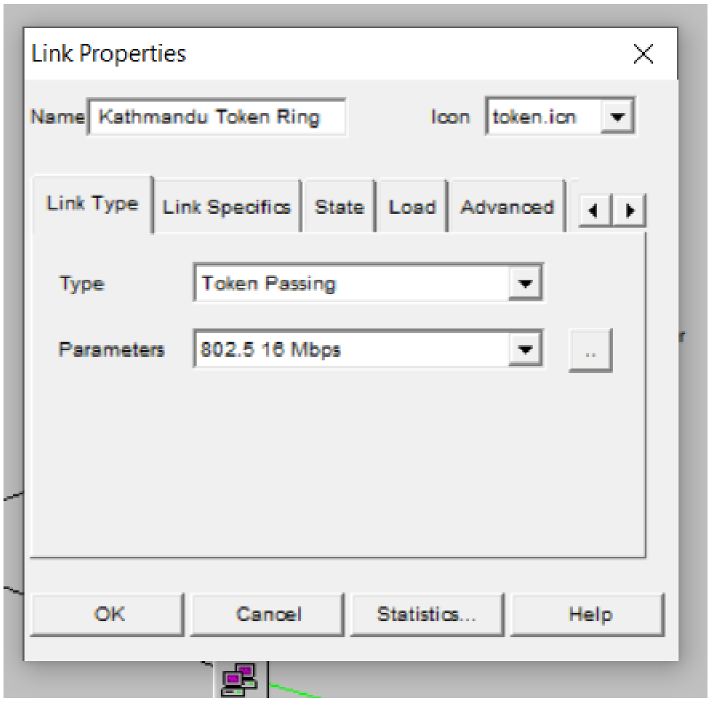

Figure 28 Kathmandu Token Ring

### 1.2.3.3 Pokhara and Kathmandu ATM (1-40) (Computer Group):

Pokhara ATM (1-40) and Kathmandu ATM (1-40) are the computer groups of Pokhara and Kathmandu respectively.

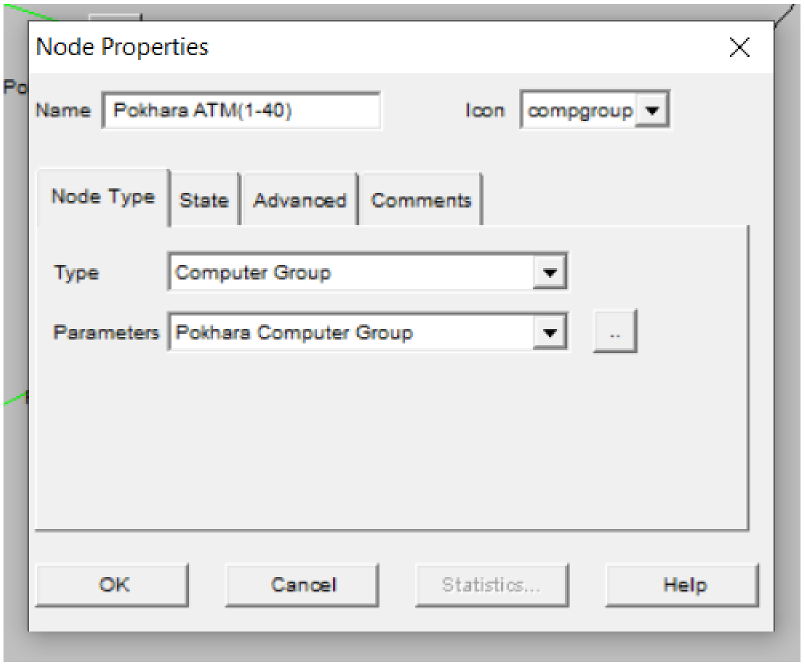


Figure 29 Pokhara ATM (1-40)

Computer Group Parameters is set as Pokhara Computer Group.

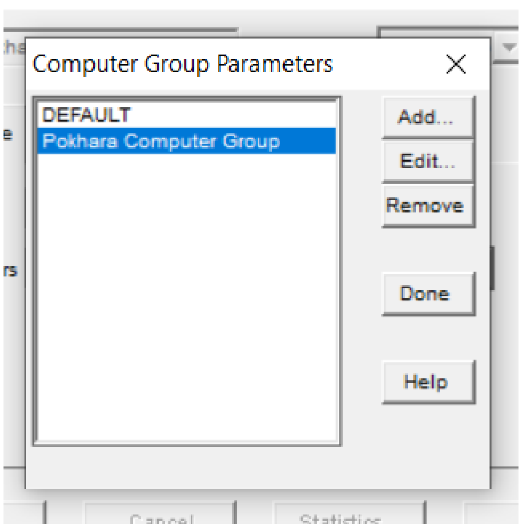


Figure 30 Pokhara ATM (Computer Group Parameter)

The number in group, of Computer Group Parameters is given with the value of 40.

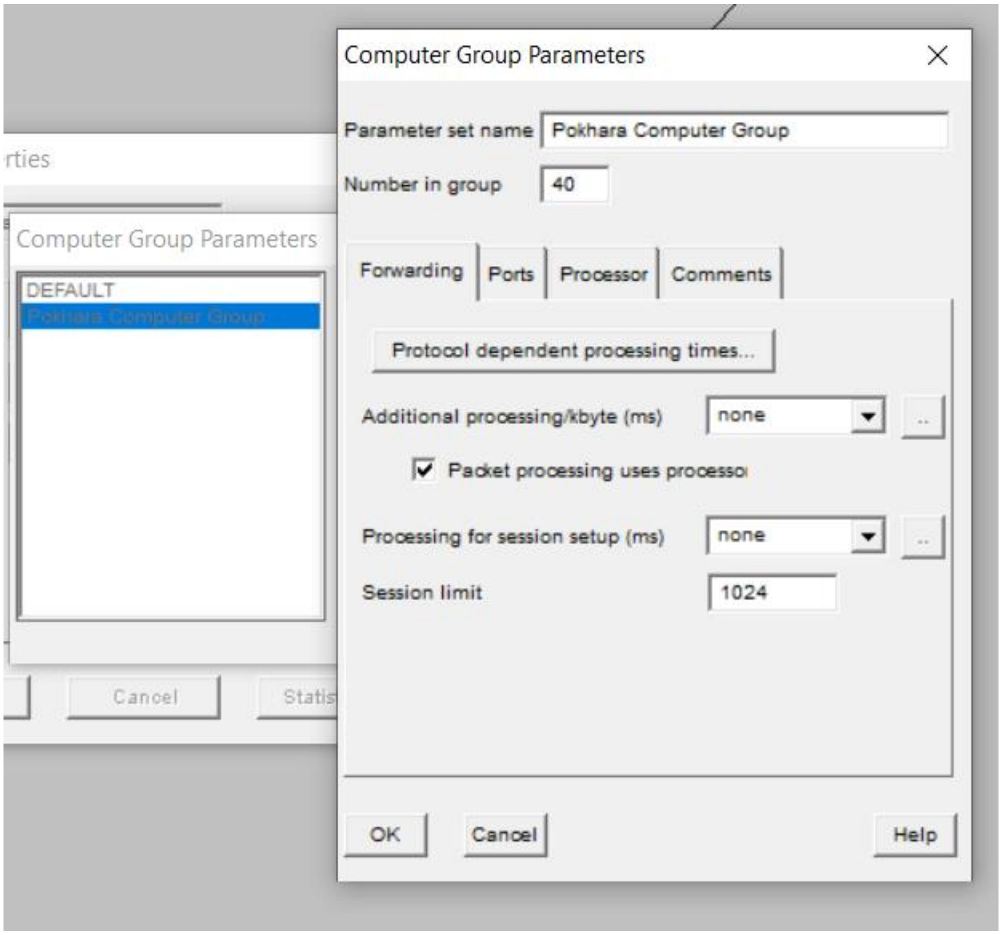


*Figure 31 Pokhara ATM (Number in group set to 40)*

The parameter of the Kathmandu ATM (1-40) is also Pokhara Computer Group as both the computer group which is Pokhara ATM (1-40) and Kathmandu ATM (1-40) requires same parameters.

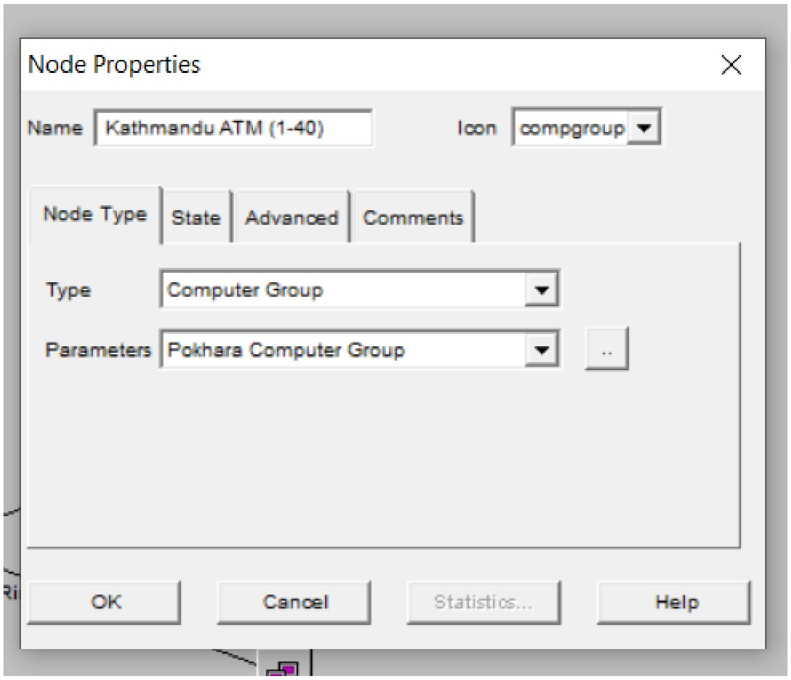


*Figure 32 Kathmandu ATM (1-40)*

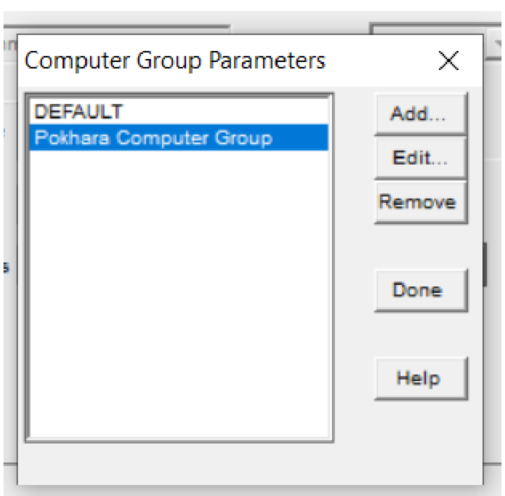


*Figure 33 Kathmandu ATM (Computer Group Parameter)*

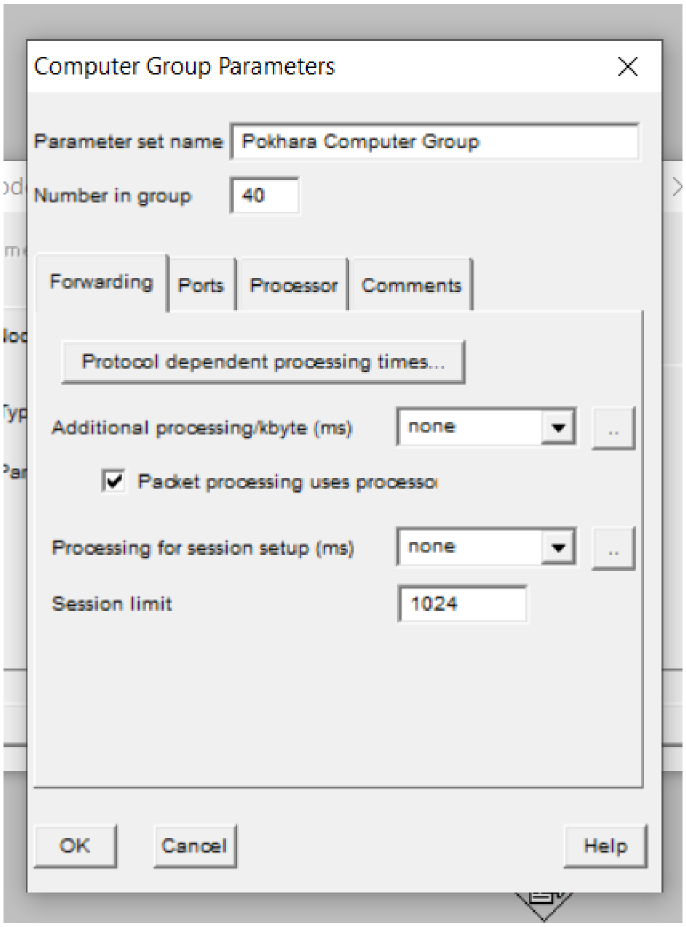


*Figure 34 Kathmandu ATM (Number in group set to 40)*

### 1.2.3.4 Pokhara and Kathmandu Teller Machine (Processing Node):

Each LAN has a processing node. Pokhara Teller Machine and Kathmandu Teller Machine for Pokhara LAN and Kathmandu LAN respectively.

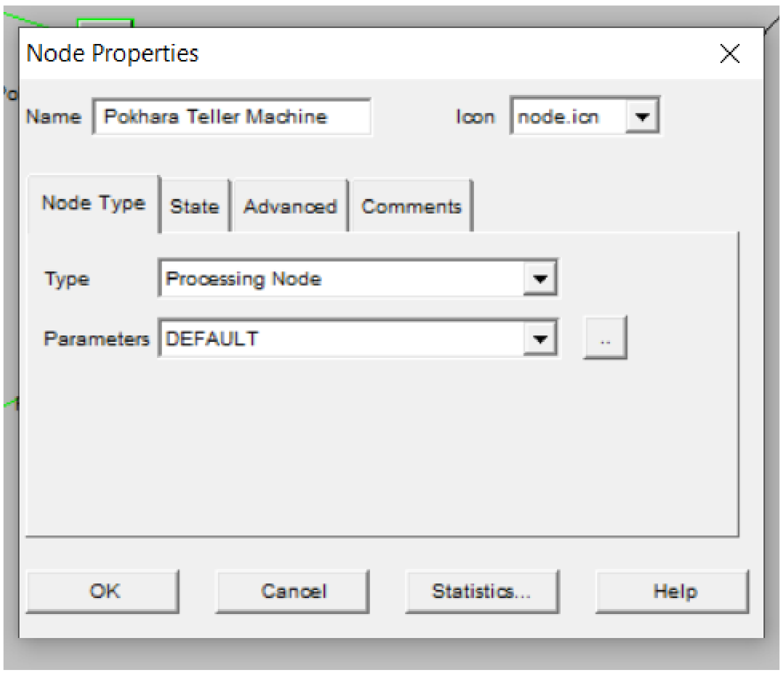


*Figure 35 Pokhara Teller Machine with parameters as default*

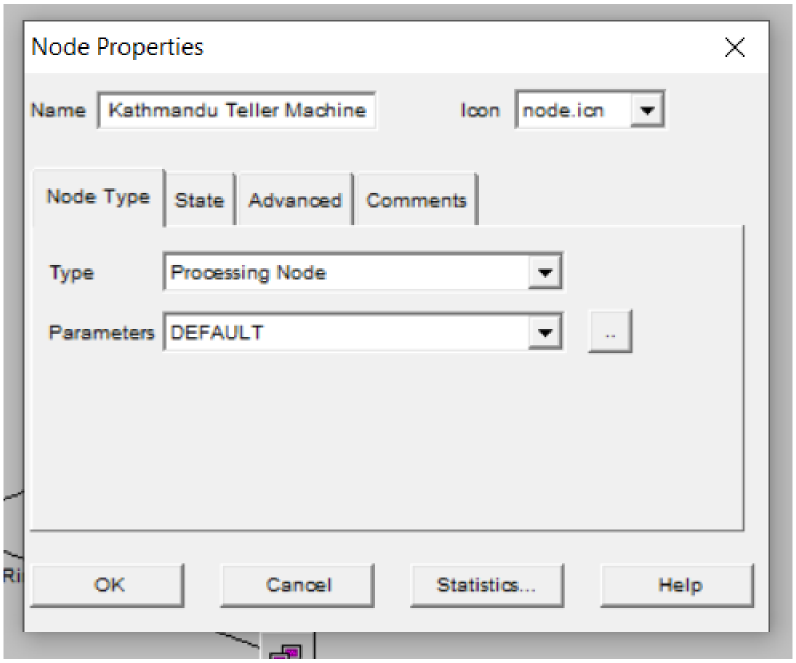

*Figure 36 Kathmandu Teller Machine with parameters as default*

### 1.2.3.5 Pokhara and Kathmandu ATM Source (Message Source):

The Scheduling properties given in the message source are:

i) Schedule by: Iteration Time

ii) Interarrival: Exponential

a) In Exponential

i) Mean: 0.5

ii) Stream: 3

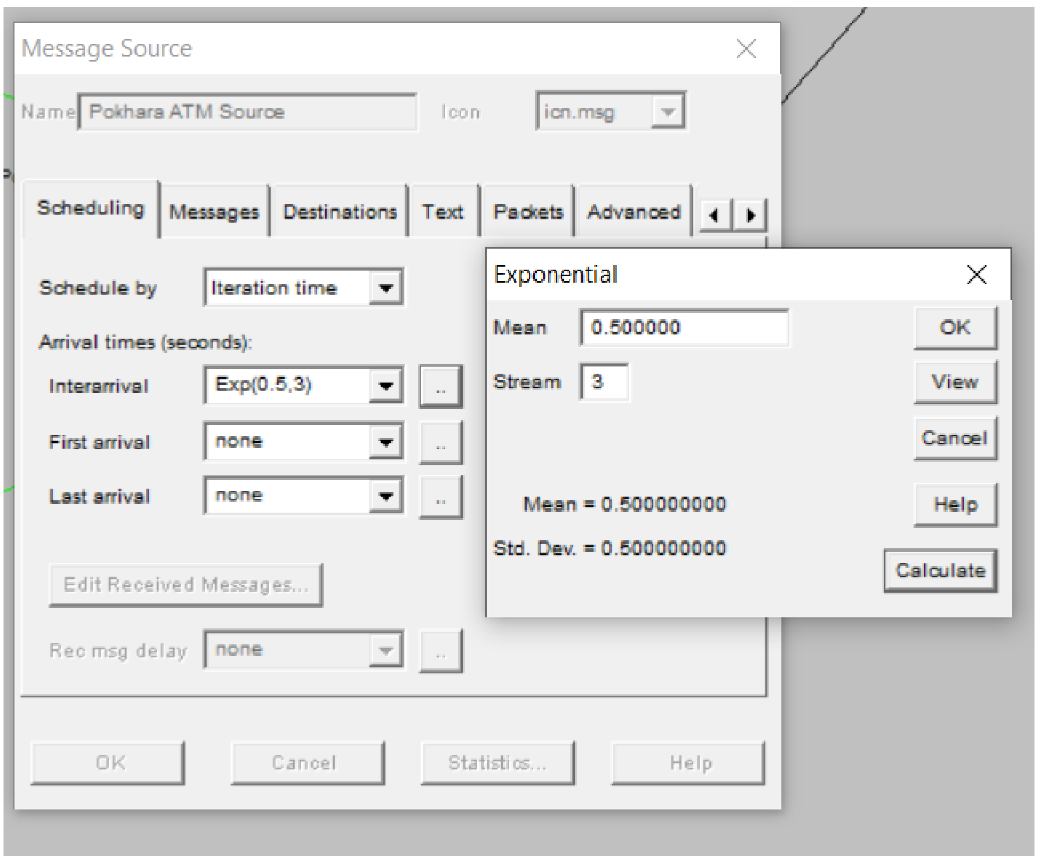


*Figure 37 Scheduling properties of Pokhara ATM Source*

The Messages properties given to the message source are:

i) Msg size calc: Probability Distribution

ii) Prob distribution: Unifrom

  a) In Unifrom

    i) Minimum: 60

    ii) Maximum: 100

    iii) Stream: 3

iii) Msg size units: Bytes

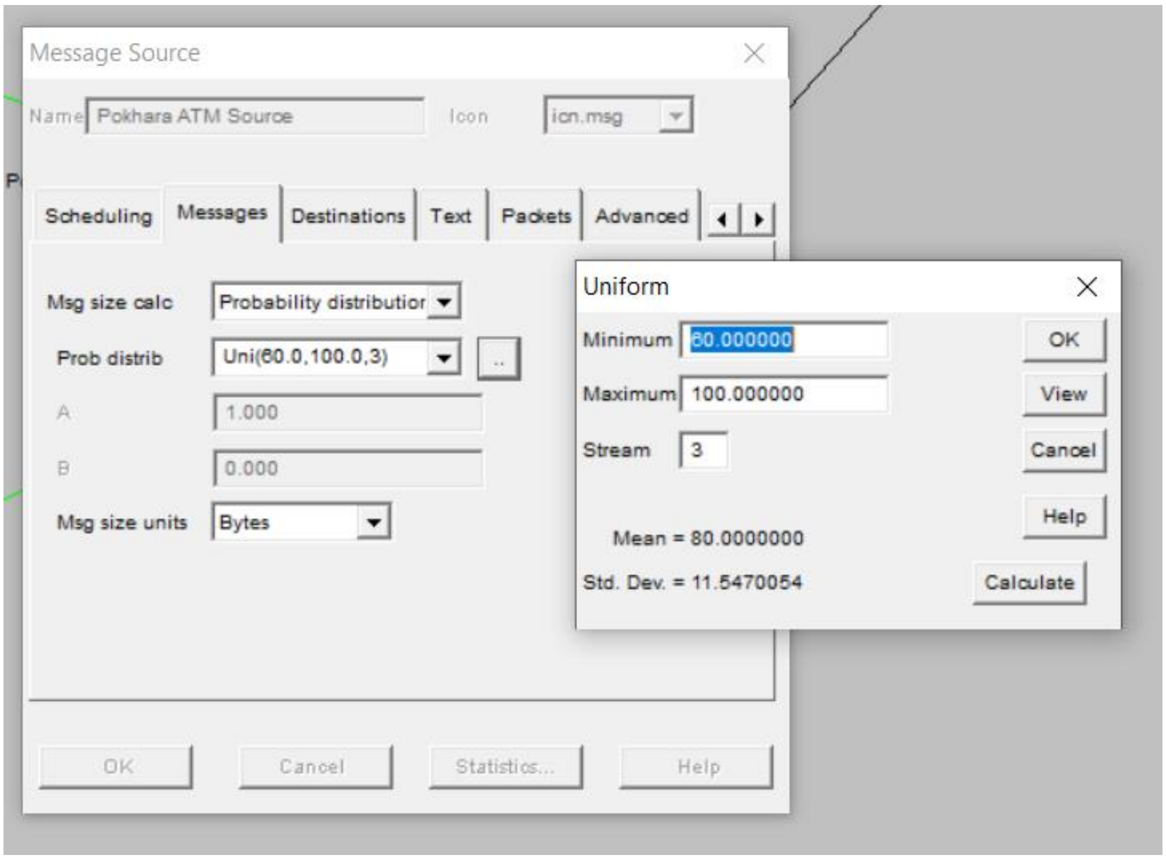


Figure 38 Messages properties of Pokhara ATM Source

The Destinations properties given to the message source are:

i) Destination Type: Random List

ii) In Destination List: Manchester.ATM Server

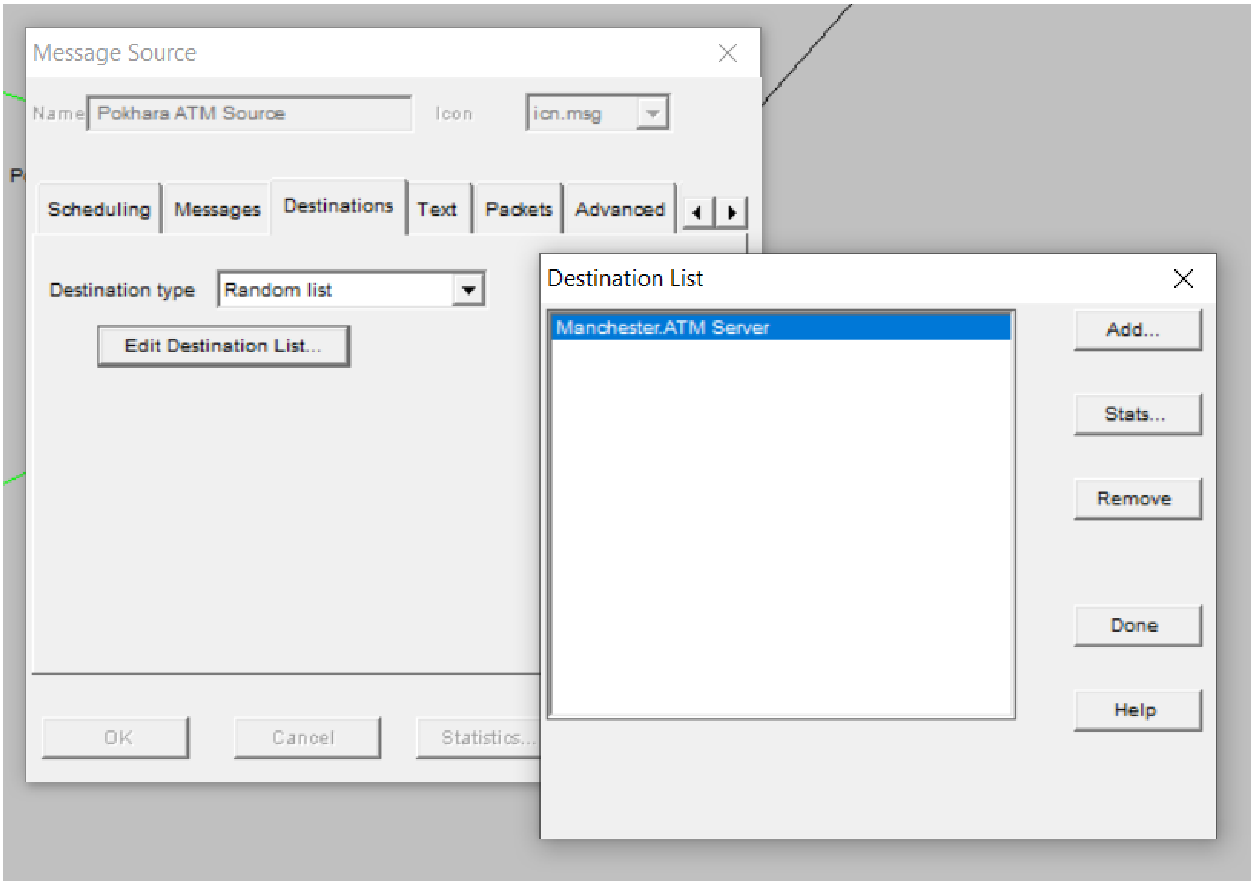


*Figure 39 Destination properties of Pokhara ATM Source*

The Packets properties for the message source are:

i) Protocol: TCP/IP – Microsoft V1.0

   a) Transport Protocol: TCP/IP – Microsoft V1.0

ii) Packetize(ms): 10

iii) Priority: 1

iv) Routing class: Standard

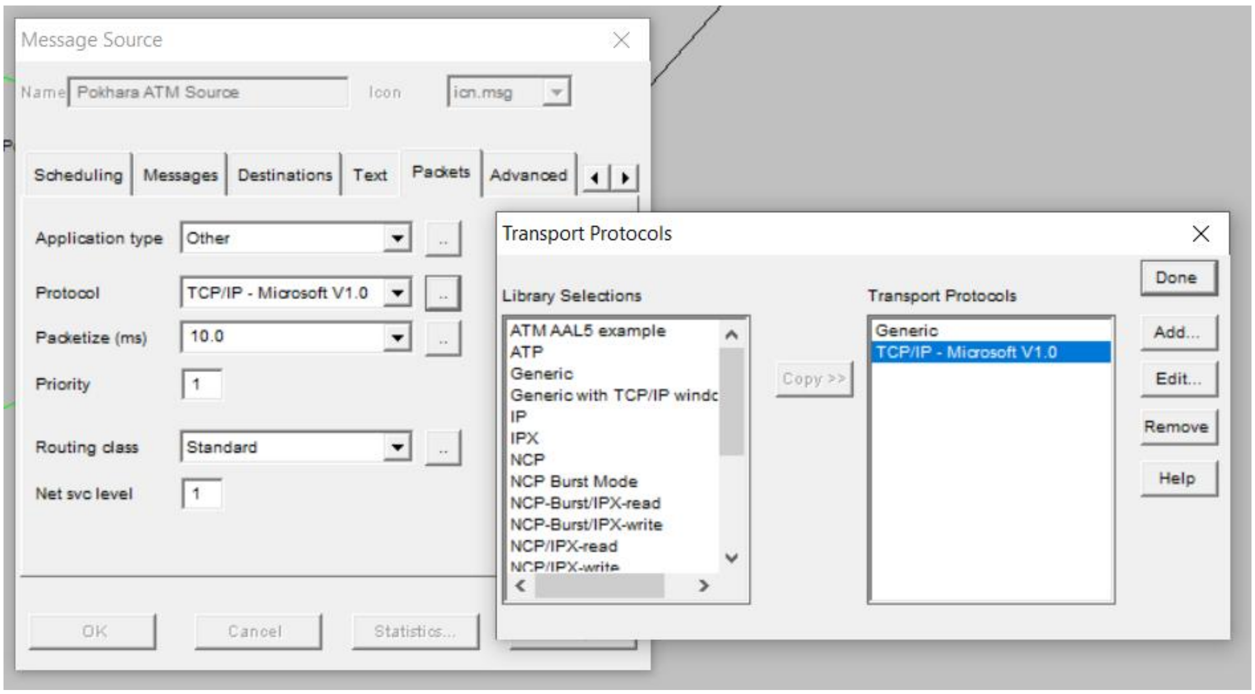


*Figure 40 Packets properties of Pokhara ATM Source*

The Scheduling, Messages, Destinations and Packets properties for Kathmandu ATM Source are same as the properties of the Pokhara ATM Source.

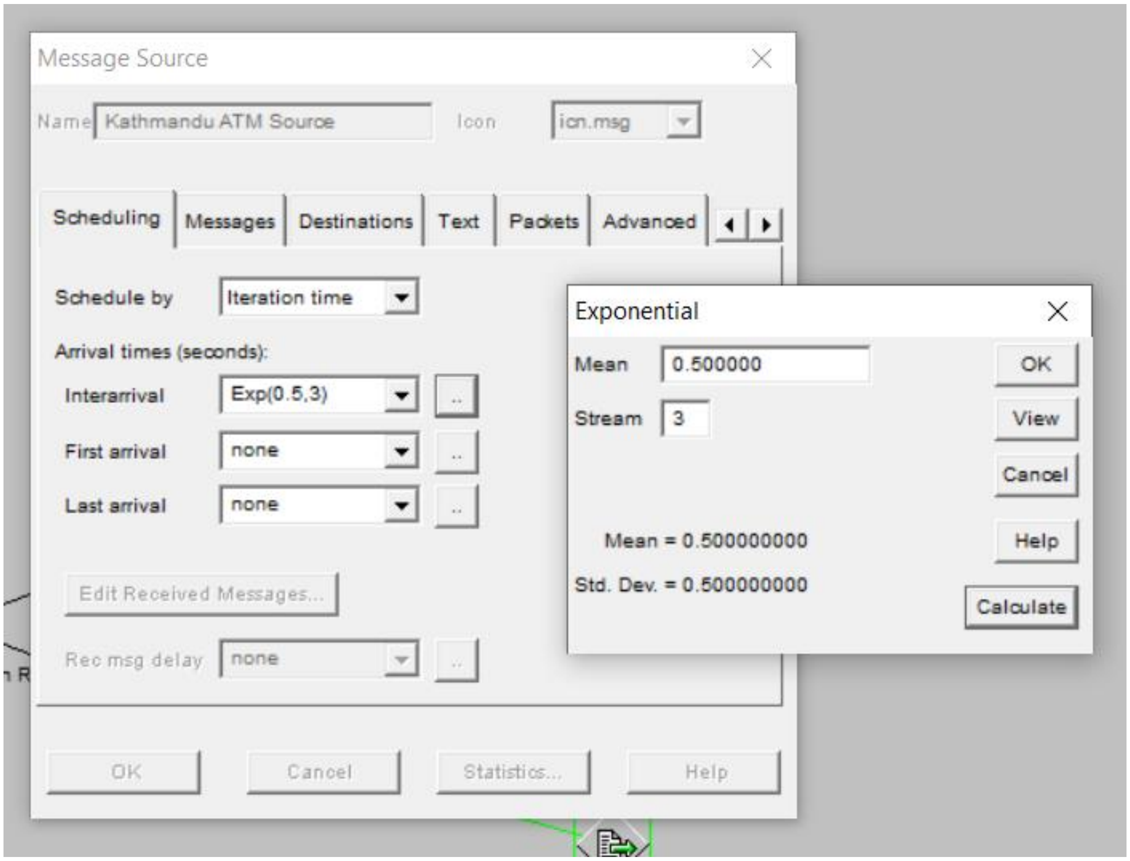


*Figure 41 Scheduling properties of Kathmandu ATM Source*

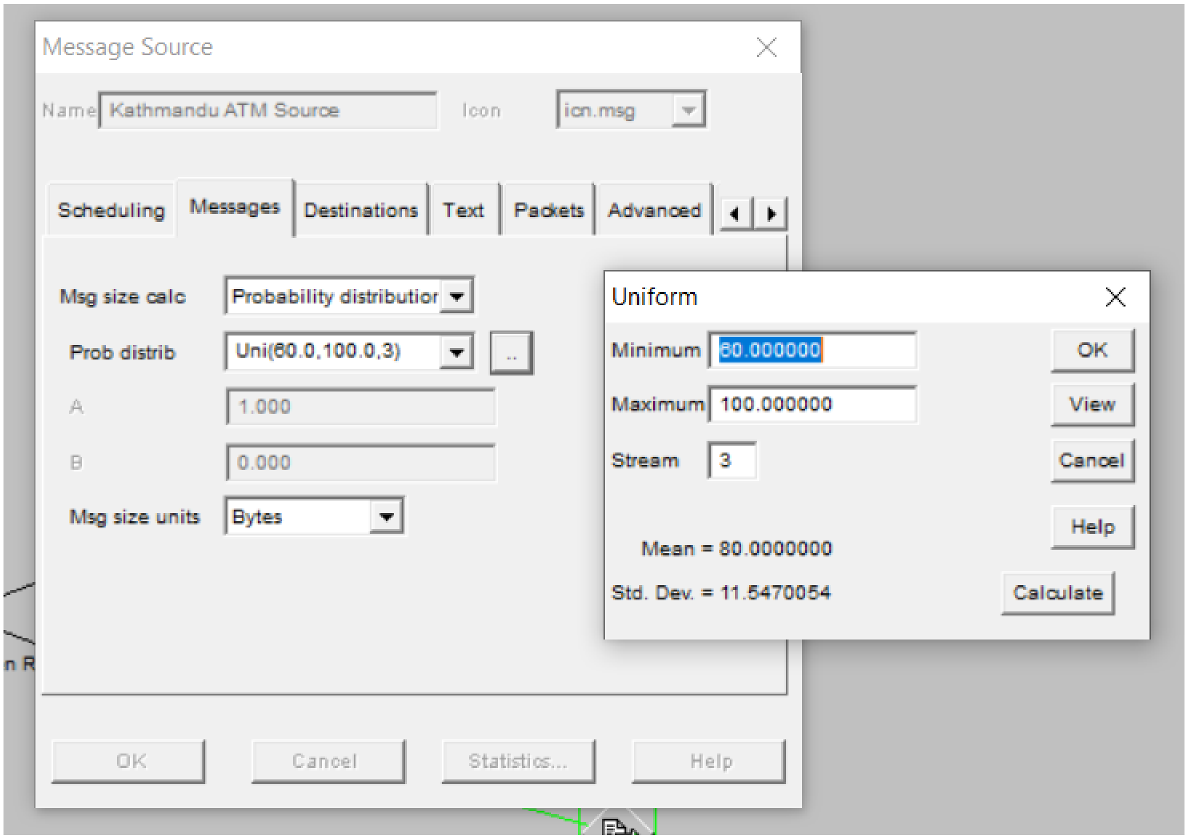

Figure 42 Messages properties of Kathmandu ATM Source

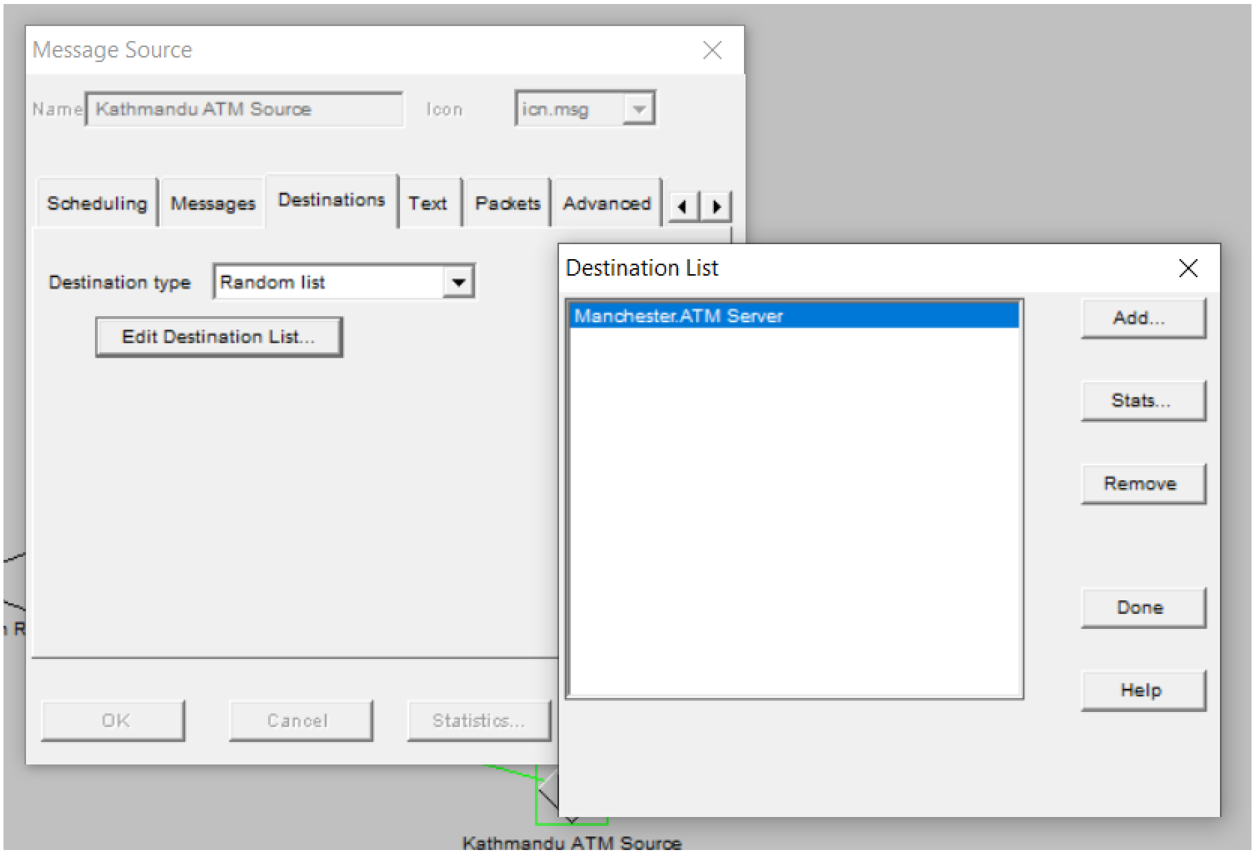


*Figure 43 Destination properties of Kathmandu ATM Source*

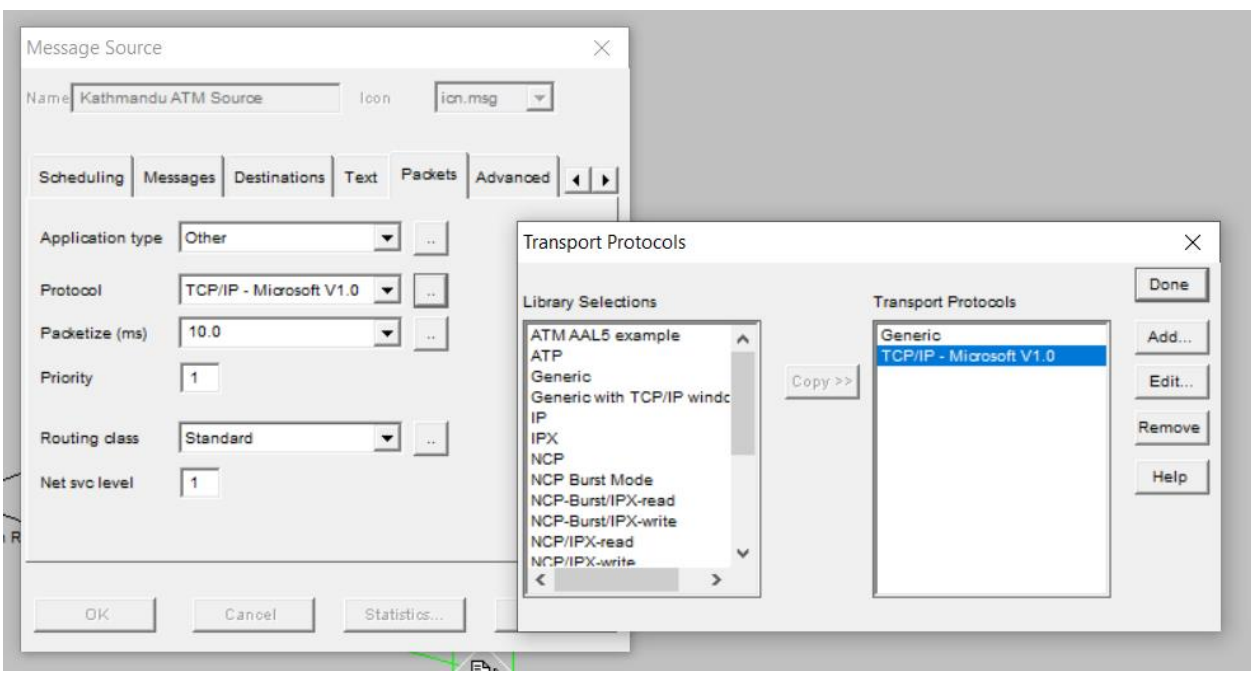


*Figure 44 Packets properties of Kathmandu ATM Source*

#### 1.2.3.6 Pokhara and Kathmandu Message Sender (Message Source):

The Scheduling properties given to the Pokhara, and Kathmandu Message Sender (Message Source) are:

i) Schedule by: Iteration Time

ii) Interarrival: Exponential

In Exponential:

a) Mean: 15

b) Stream: 0

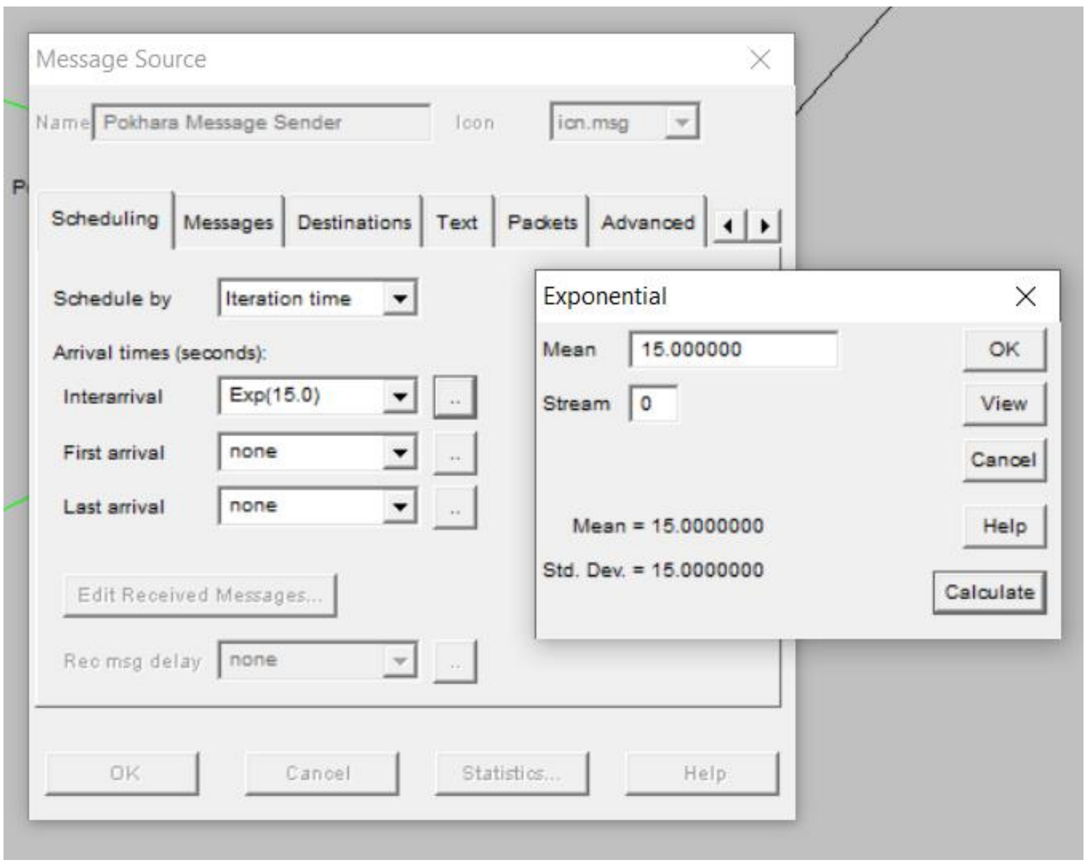

*Figure 45 Scheduling properties Pokhara Message Sender*

The Messages properties given to the Pokhara, and Kathmandu Message Sender (Message Source) are:

i) Msg size calc: Probability Distribution

ii) Prob Distribution: Uniform

In Unifrom

a) Minimum: 50

b) Maximum: 100

c) Stream: 0

iii) Msg size units: Bytes

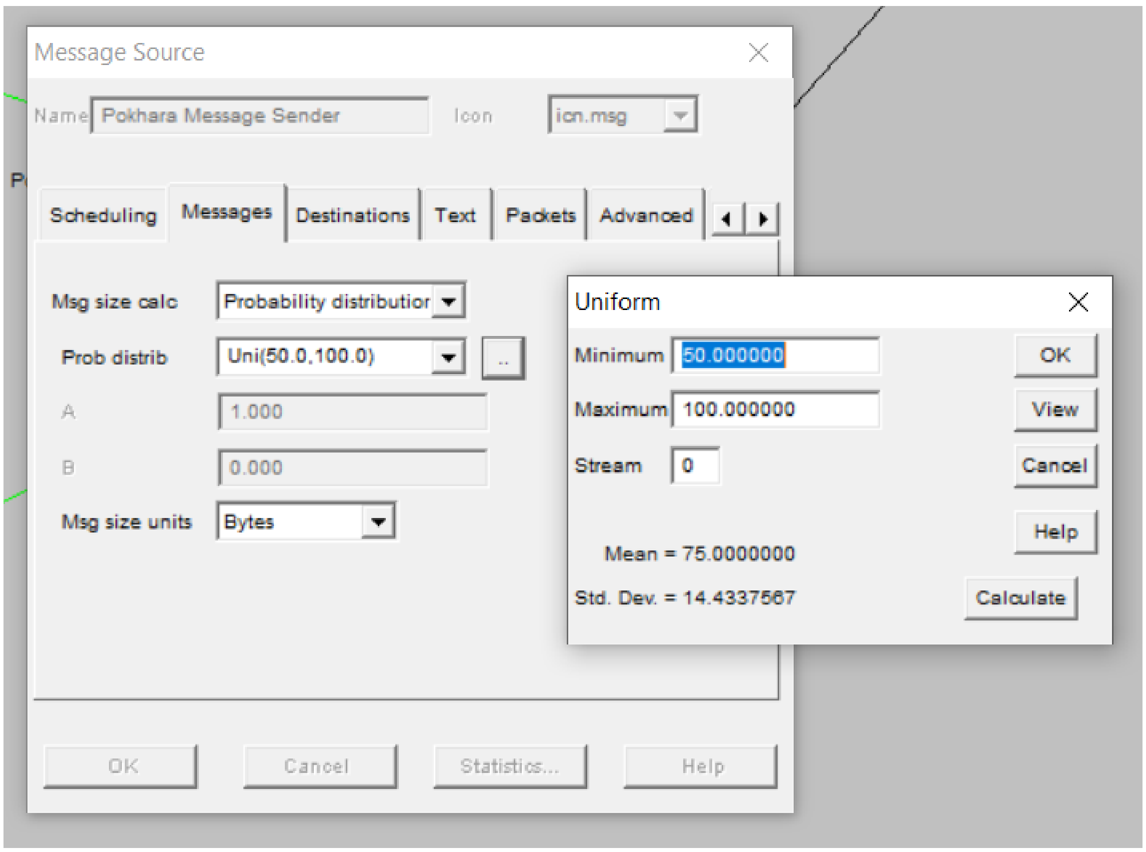


*Figure 46 Messages properties Pokhara Message Sender*

The Destinations properties given to the Pokhara, and Kathmandu Message Sender (Message Source) are:

i) Destination type: Random List

ii) Destination List: Manchester.ATM Server

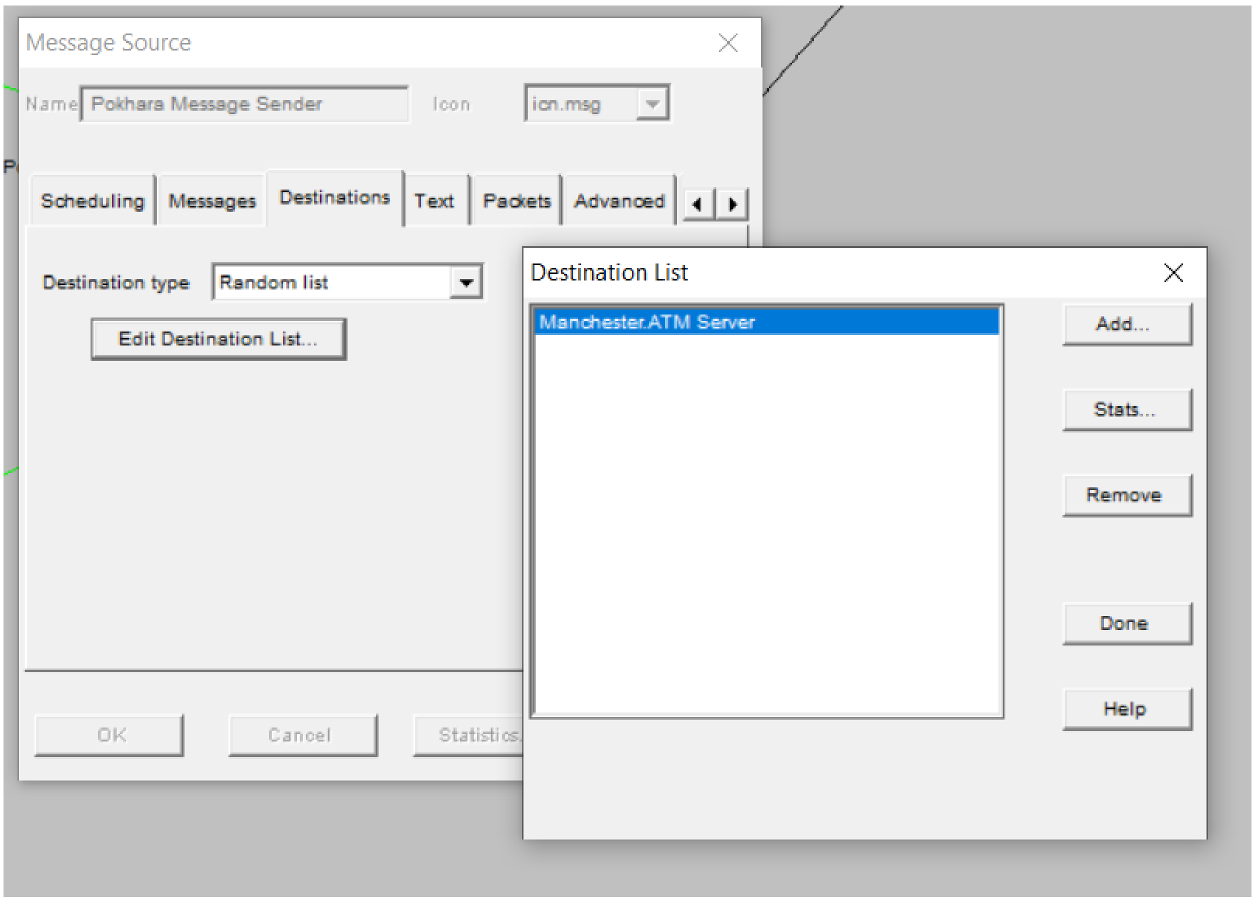


*Figure 47 Destination properties Pokhara Message Sender*

The Packets properties given to the Pokhara, and Kathmandu Message Sender (Message Source) are:

i) Protocol: TCP/IP – Microsoft V1.0

   a) Transport Protocols: TCP/IP – Microsoft V1.0

ii) Packetize(ms): 10

iii) Priority: 1

iv) Routing class: Standard

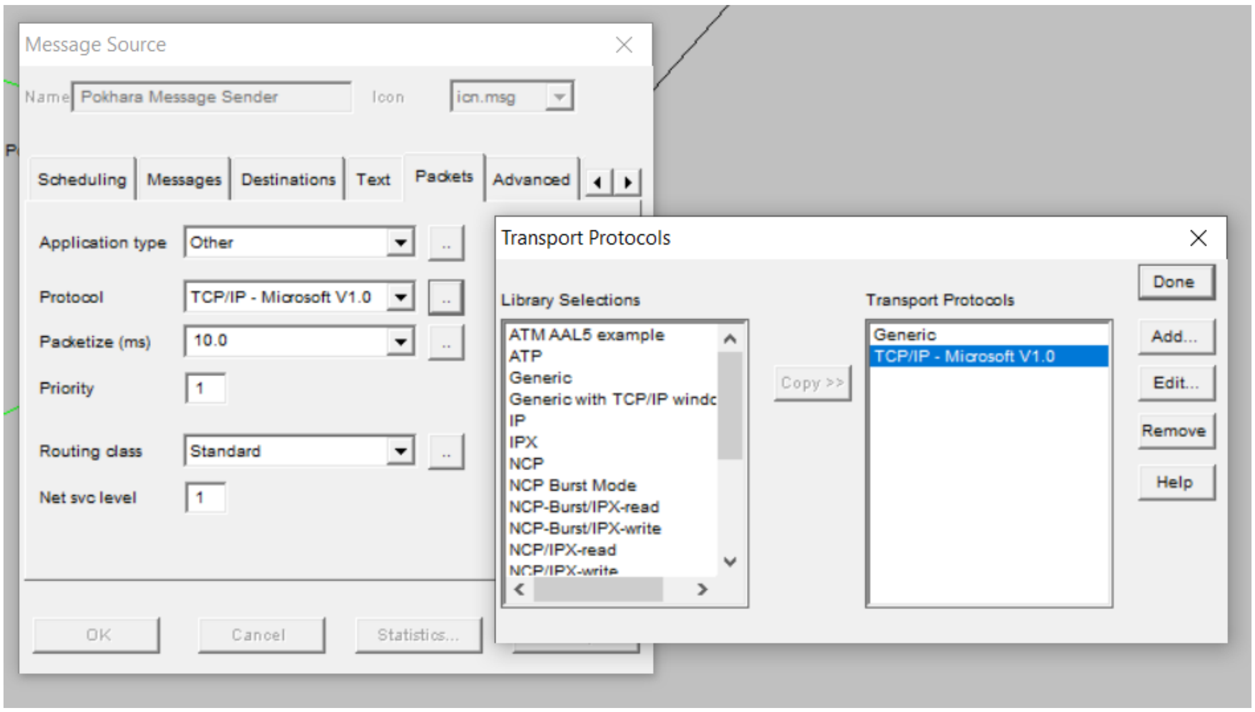


*Figure 48 Packets properties Pokhara Message Sender*

The Scheduling, Messages, Destinations and Packets properties for Kathmandu Message Sender are same as the properties of the Pokhara Message Sender.

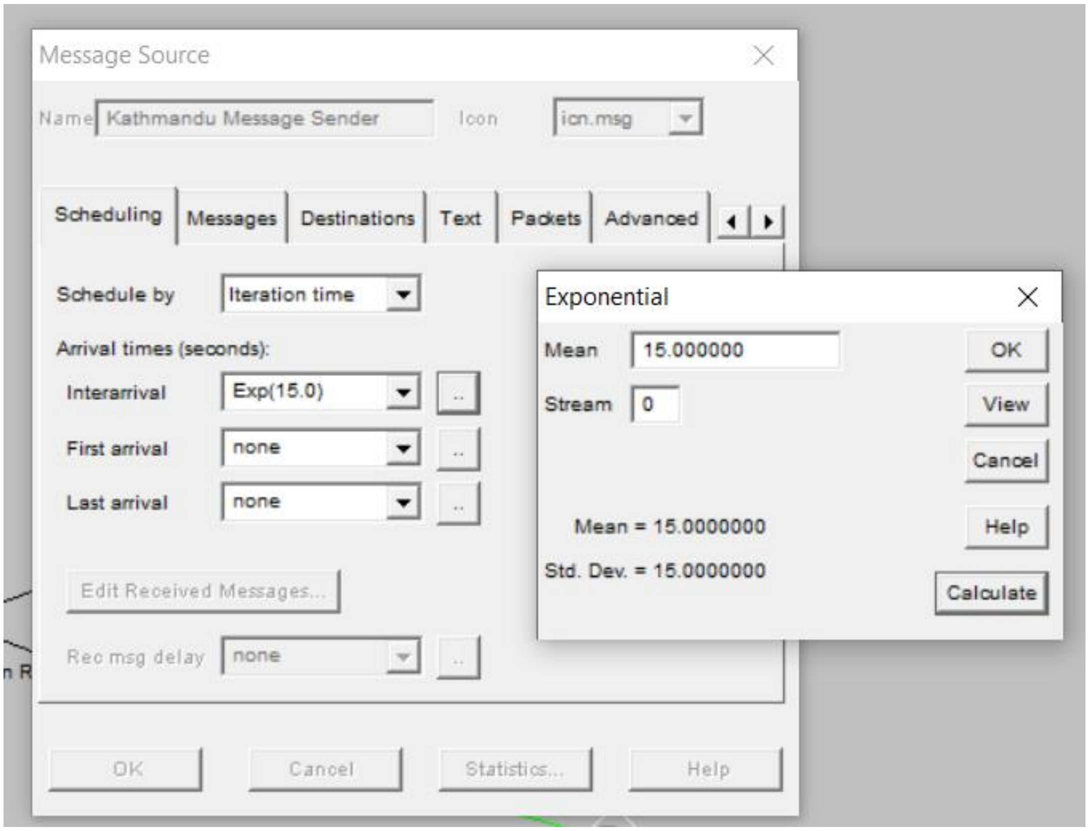

*Figure 49 Scheduling properties Kathmandu Message Sender*

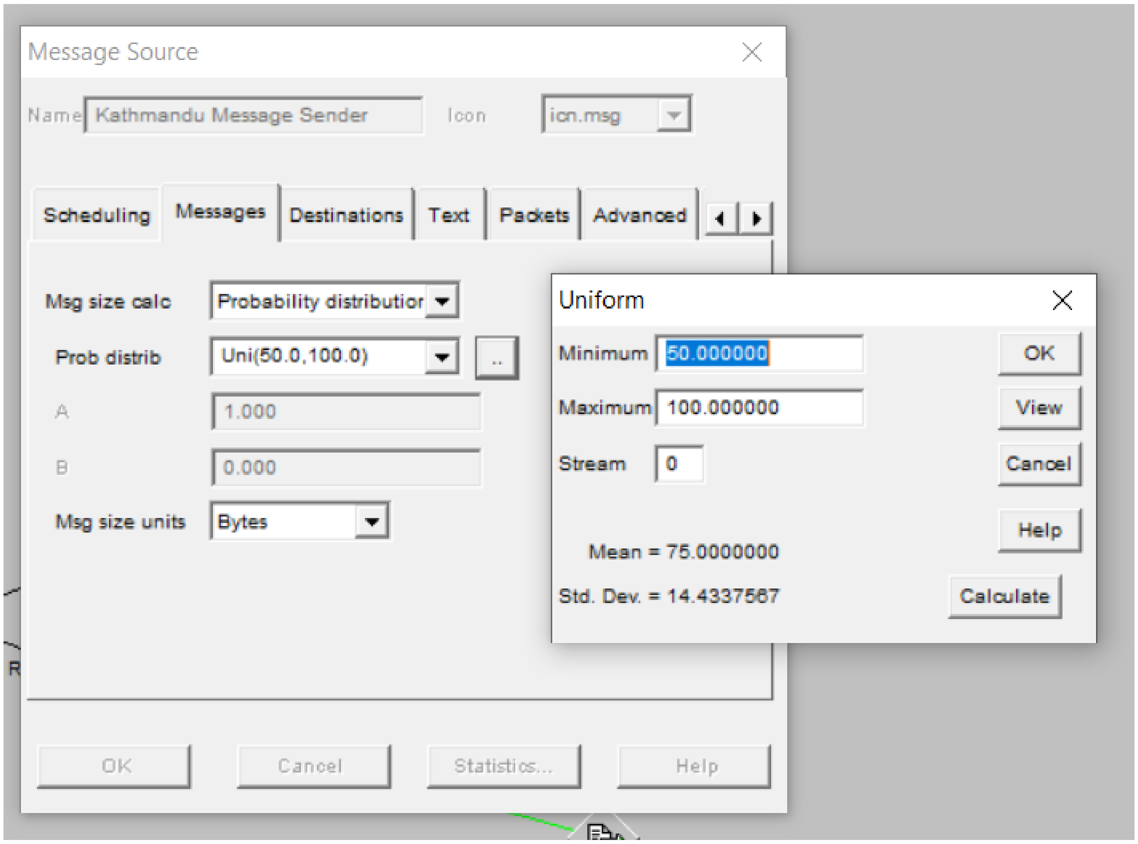


*Figure 50 Messages properties Kathmandu Message Sender*

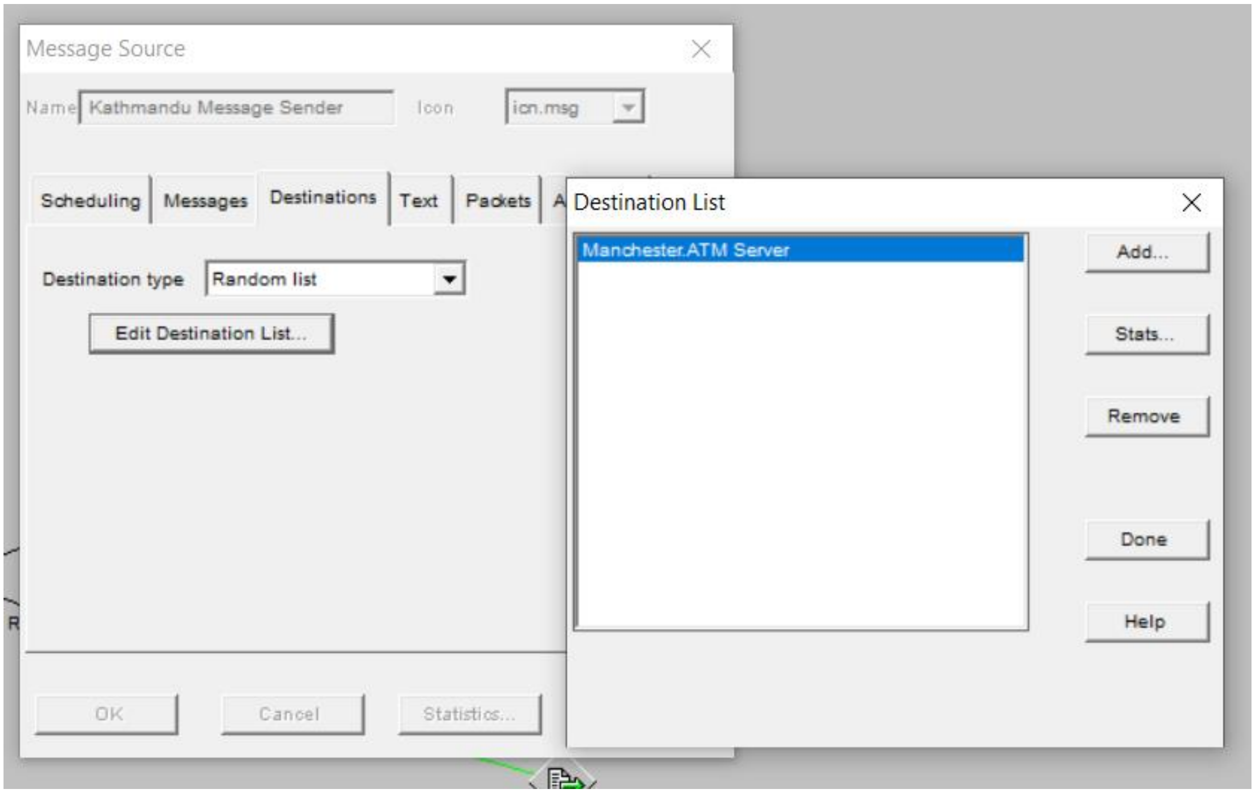


*Figure 51 Destination properties Kathmandu Message Sender*

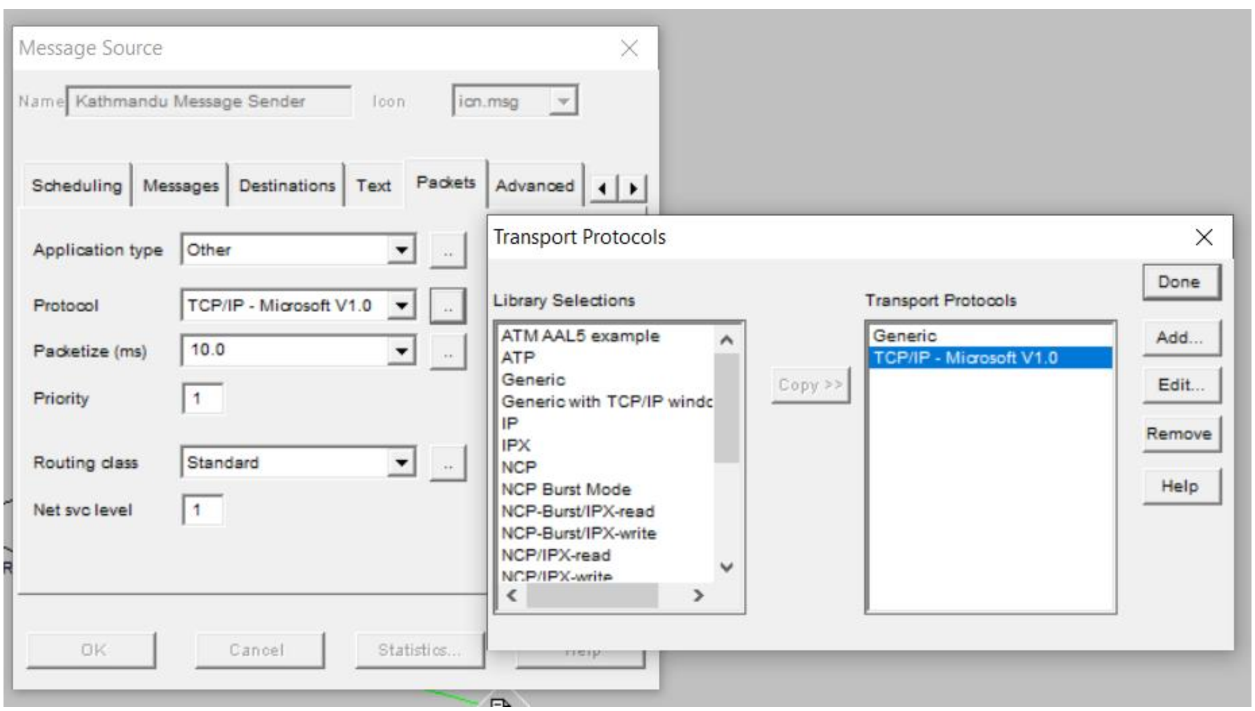


*Figure 52 Packets properties Kathmandu Message Sender*

### 1.3 Description of reports:

The designed model from Section A is tested by simulation with warmup length of 60 seconds simulation time of 120 seconds.

#### 1.3.1 Node reports: Received message counts for all nodes

| RECEIVER | COUNT | MESSAGE NAME |
|---|---|---|
| Manchester.ATM Server | 113 | Pokhara ATM Source |
| Manchester.ATM Server | 110 | Kathmandu ATM Source |

*Table 1 Received message counts for all nodes*

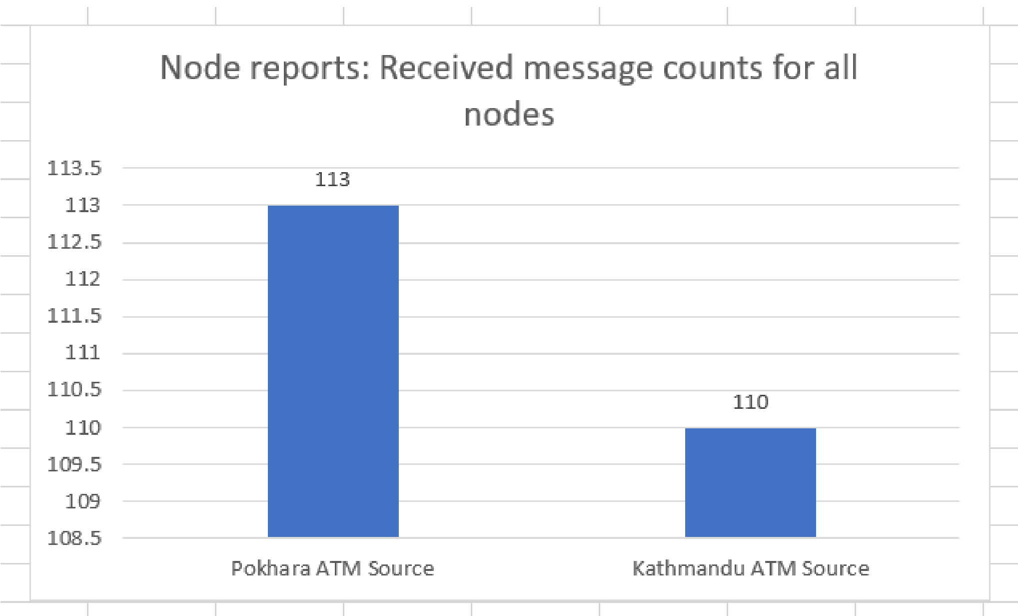


*Figure 53 Received message counts for all nodes*

The graph indicates that, the message count from message name Pokhara ATM Source and Kathmandu ATM Source has Manchester.ATM Server as the receiver. The count of Pokhara ATM Source is more than that of Kathmandu ATM Source during the simulation process which means the receiver received more message counts from the message name Pokhara ATM Source.

### 1.3.2 Link reports: Chanel utilization for all links

| LINK | FRAMES | | TRANSMISSION DELAY (MS) | | | % |
|---|---|---|---|---|---|---|
| | DELIVERED | RST/ERR | AVERAGE | STD DEV | MAXIMUM | UTIL |
| Pokhara.Pokhara Token | 11966 | 0 | 0.036 | 0.012 | 0.082 | 0.3549 |
| Kathmandu.Kathmandu To | 11989 | 0 | 0.036 | 0.012 | 0.082 | 0.3562 |
| Manchester.Manchester | 4860 | 0 | 0.065 | 0.013 | 0.136 | 0.2447 |

*Table 2 Link reports: Chanel utilization for all links*

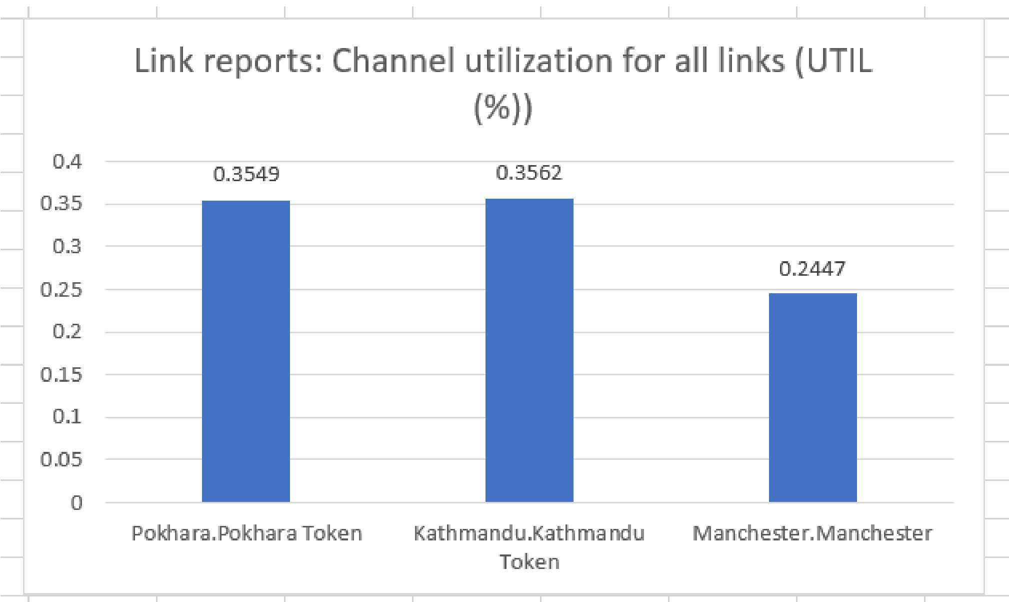


*Figure 54 Link reports: Channel utilization for all links*

The above report is of channel utilization. The Pokhara.Pokhara Token Ring is used up to 0.3549%, the Kathmandu.Kathmandu Token Ring is used up to 0.3562% and the Manchester.Manchester Ethernet is used up to 0.2447%. Similarly, the amount of frame delivered is 11966, 11989 and 4860 for Pokhara.Pokhara Token Ring, Kathmandu.Kathmandu Token Ring and Manchester.Manchester Ethernet respectively.

### 1.3.3 WAN cloud reports: Frame Delay by VC, Frame count by VC, and access link stats

#### 1.3.3.1 WAN cloud reports: Frame Delay by VC

| CLOUD: | FRAME DELAY (MS) | | | BURST SIZE (kb) | |
|---|---|---|---|---|---|
| VC | AVG | STD | MAX | AVG | MAX |
| WAN | | | | | |
| Pokhara-Manchester | 60159 | 17306 | 90032 | 5 | 10 |
| Manchester-Pokhara | 97 | 0 | 97 | 2 | 5 |
| Kathmandu-Manchester | 60157 | 17334 | 90089 | 5 | 11 |
| Manchester-Kathmandu | 97 | 0 | 97 | 2 | 5 |

*Table 3 WAN cloud reports: Frame Delay by VC*

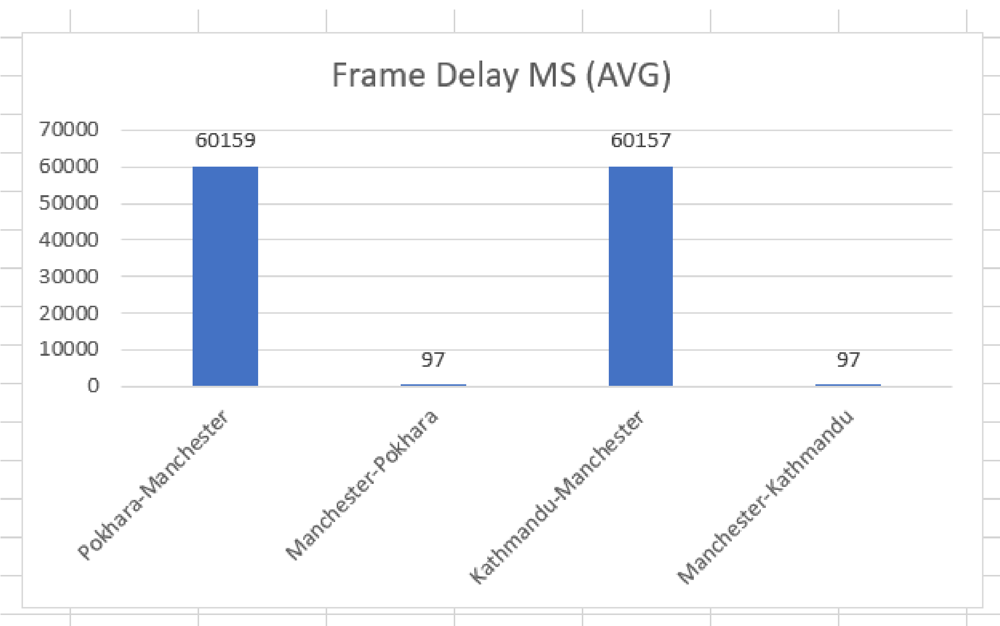


*Figure 55 Frame Delay MS (AVG)*

The Frame Delay by VC Report in a WAN cloud displays information for each virtual circuit's frame delay and burst size. All frames successfully transmitted by the WAN cloud are included in the frame delay data. Burst is the term used when many frames come at the same time. The average, standard deviation, and maximum frame delays for a link layer frame transiting the WAN cloud are all measured in milliseconds.

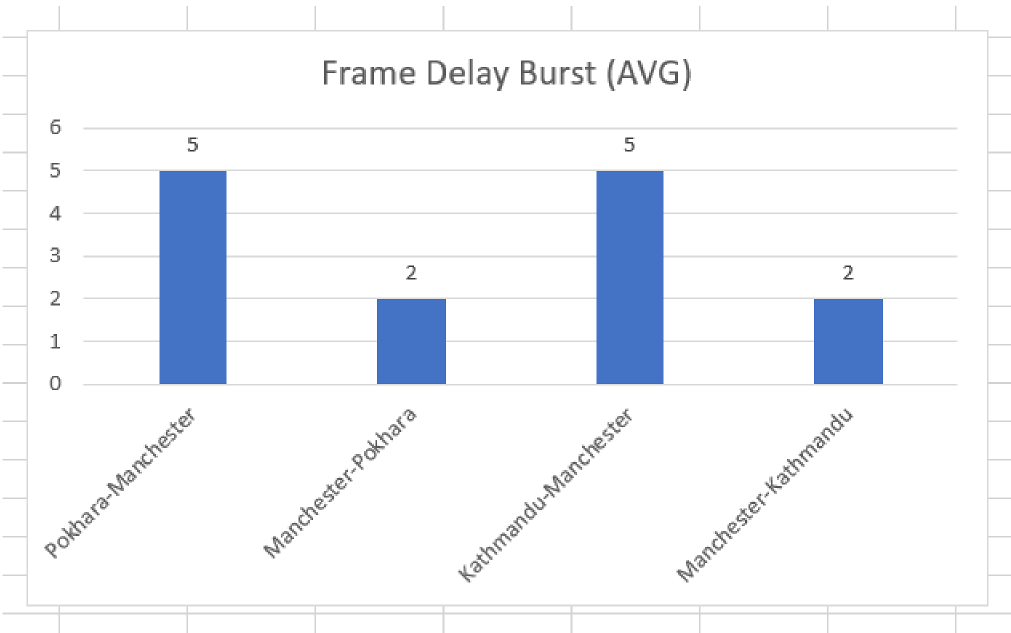


*Figure 56 Frame Delay Burst (AVG)*

Packets transported across the virtual circuit have an average and maximum burst size in kilobits.

#### 1.3.3.2 WAN cloud reports: Frame Counts by VC

| CLOUD: | FRAMES / KILOBITS | | | |
|---|---|---|---|---|
| **VC: FRAMES KILOBITS** | **ACCEPTED** | | **DROPPED** | |
| | **NORMAL** | **DE** | **NORMAL** | **DE** |
| WAN (TOTAL KILOBITS TRANSMITTED = 1696 ) | | | | |
| Pokhara-Manchest Frm | 1213 | 0 | 0 | 0 |
| Kb | 460 | 0 | 0 | 0 |
| Manchester-Pokha Frm | 1212 | 0 | 0 | 0 |
| Kb | 388 | 0 | 0 | 0 |
| Kathmandu-Manche Frm | 1217 | 0 | 0 | 0 |
| Kb | 458 | 0 | 0 | 0 |
| Manchester-Kathm Frm | 1217 | 0 | 0 | 0 |
| Kb | 389 | 0 | 0 | 0 |

*Table 4 WAN cloud reports: Frame Counts by VC*

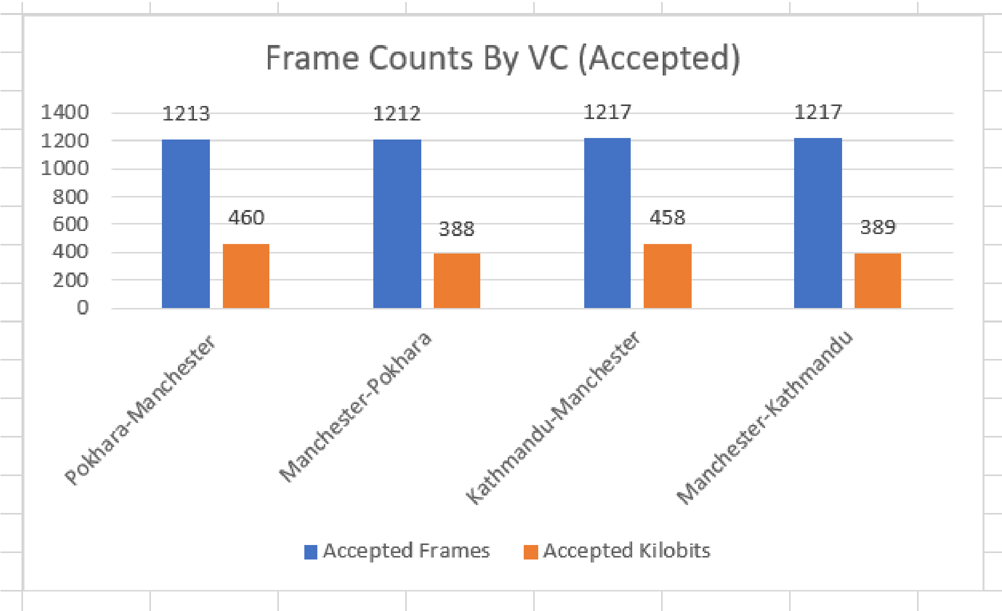


*Figure 57  WAN cloud reports: Frame Counts by VC*

Frame Counts by VC provides detailed information on each circuit, such as the number of frames accepted or dropped, as well as the number of kilobits accepted or dropped. According to the above table, the total number of kilobits successfully transmitted through the cloud is 1696. For each virtual circuit there are 2 rows of data which are frame and kilobit.

### 1.3.3.3 WAN cloud reports: Access link stats

| CLOUD: | FRAMES | | BUFFER (BYTES) | | | % UTIL |
|---|---|---|---|---|---|---|
| **ACCESS LINK (ENTRY) (EXIT)** | **ACCEPTED** | **DROPPED** | **MAX** | **AVG** | **STD** | |
| WAN | | | | | | |
| Manchester Acces Entry | 2429 | 0 | N/A | N/A | N/A | 87.74 |
| Exit | 4841 | 0 | 172587 | 114915 | 33254 | 100.00 |
| Pokhara Access Entry | 2417 | 0 | N/A | N/A | N/A | 100.00 |
| Exit | 1212 | 0 | 40 | 18 | 20 | 43.76 |
| Kathmandu Access Entry | 2425 | 0 | N/A | N/A | N/A | 100.00 |
| Exit | 1217 | 0 | 40 | 18 | 20 | 43.95 |

*Table 5 WAN cloud reports: Access link stats*

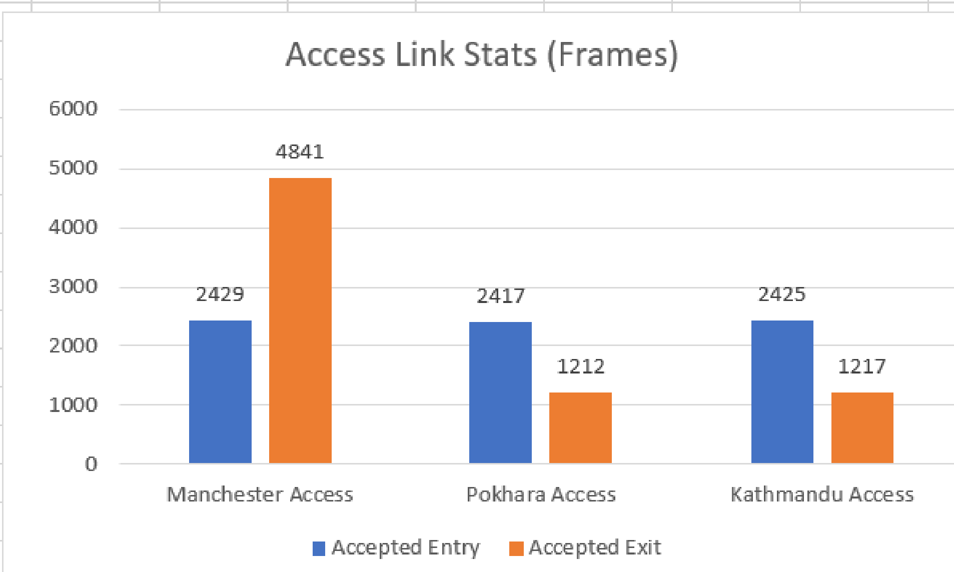


*Figure 58 WAN cloud reports: Access link stats*

The Access Link Statistics report profiles each access link in a WAN cloud. For each access connection, the entry and exit links are presented in two rows.

Frames accepted refers to the number of frames accepted by the WAN cloud's entry and exit access link. Frames lost, on the other hand, refers to the number of frames lost through the WAN cloud's entry and exit access link.

### 1.3.4 Message and Report response: Message delay for all nodes

| ORIGIN / MSG SRC NAME: DESTINATION LIST | MESSAGES ASSEMBLED | MESSAGE DELAY | | |
|---|---|---|---|---|
| | | AVERAGE | STD DEV | MAXIMUM |
| Pokhara.Pokhara ATM((1-40)) / src Pokhara ATM Source: Manchester.ATM Serve | 17 | 117.20039 S | 36140.339 MS | 177.90295 S |
| Pokhara.Pokhara Teller Machine / src Pokhara Message Sender: Manchester.ATM Serve | 0 | 0.000 MS | 0.000 MS | 0.000 MS |
| Kathmandu.Kathmandu ATM ((1-40)) / src Kathmandu ATM Source: Manchester.ATM Serve | 17 | 118.51851 S | 35018.643 MS | 177.49400 S |
| Kathmandu.Kathmandu Teller Machine / src Kathmandu Message Sender: Manchester.ATM Serve | 0 | 0.000 MS | 0.000 MS | 0.000 MS |
| Manchester.ATM Server / src ATM Response: ECHO | 0 | 0.000 MS | 0.000 MS | 0.000 MS |

*Table 6 Message and Report response: Message delay for all nodes*

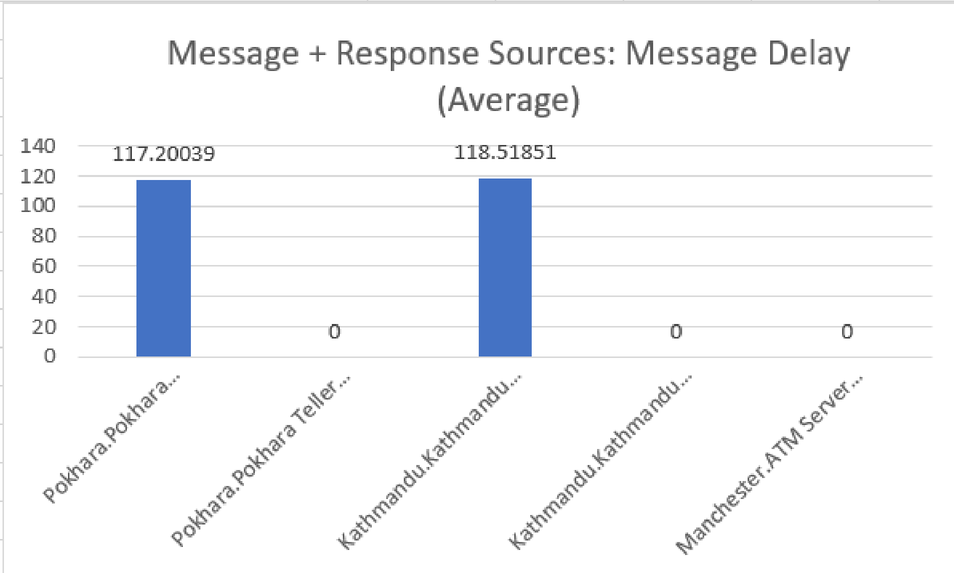


*Figure 59 Message and Report response: Message delay for all nodes*

The origin, message source name, and destination are all listed in the above table. The report has number of messages assembled. Message delay includes the average, standard deviation, and maximum time taken, which focuses on the time taken from a source to a response to answer back to the source.

## 1.4 Conclusion for Task A:

Task A was completed with a lot of hard work with implementation of the given scenario in a network system. Guidance of the teacher was very helpful in completing the task. In completion of the task, we now have the overview of the network system and confidently build similar network simulation for other scenarios.

The task wasn’t only limited with designed and implementing the scenario of the network. Furthermore, a report had to be made to explain the done work in Comnet III. In this part a lot of research work has been carried. The teacher helped a lot in not only performing the task but also understanding the purpose of the task. And, in understanding the analysing the final report of network simulation model.

## 2. Task B:

### 2.1 Introduction:

The task is related with the discussion and highlighting on the knowledge about internet in a technical report. The description or the report is based on the history of the internet, commercial expansion and advantages and disadvantages of the internet. Further discussion or report is on internet architecture and topic on privacy and the internet.

So, what really is the internet? To begin with, the Internet is a system architecture that enables various computer networks all over the world to interact, changing communications and business. The Internet, often described as a "network of networks," was created in the 1970s in the United States but did not become generally recognized until the early 1990s. Around 4.5 billion people, or more than half of the world's population, are predicted to have access to the Internet by 2020 (Kahn, 2021).

## 2.2 Aims and objectives:

i) To learn about internet: To have a strong based knowledge on the internet and its various aspects.

ii) History of internet: To research and learn the history of internet.

iii) Expansion on commercial basis: To have a detailed overview on the commercial expansion of the internet.

iv) Features of internet: To discuss on the advantages and disadvantages of the internet.

v) Internet Architecture: This aspect covers the internet architecture design.

vi) Privacy and the internet: The effect of internet in the life of an individual and pros and cons on privacy of the individual.

## 2.3 Background:

The information explains about the internet and its history. The content expresses, the inter relation of the internet and technology with mankind and it is assisting nature and vice versa of it. The content below consists of the research-based work that has been done.

### 2.1.1 Internet:

#### 2.1.1.1 History:

For a technology as enormous and ever-changing as the internet, it's difficult to ascribe its development to a single person. Hundreds of pioneering scientists, programmers, and engineers worked on the internet, each generating new features and technologies that eventually merged to create the modern-day "information superhighway." Many scientists foresaw the creation of global information networks long before the technology to do so existed. Nikola Tesla proposed a "global wireless system" in the early 1900s, while visionary thinkers like Paul Otlet and Vannevar Bush proposed automated, searchable book and media storage systems in the 1930s and 1940s (Andrews, 2013).

J.C.R. Licklider of MIT popularized the concept of a computer "Intergalactic Network" in the early 1960s, but it wasn't until then that the first working internet schematics appeared. Soon after, computer scientists developed the concept of "packet switching," a method for effectively moving electronic data that would later become one of the internet's most significant building blocks (Andrews, 2013).

The Advanced Research Projects Agency Network (ARPANET) was the first operational prototype of the Internet, and it was built in the late 1960s. ARPANET used packet switching to allow several computers to communicate on a single network, which was originally funded by the US Department of Defence (Andrews, 2013).

The first message delivered via ARPAnet was a "node-to-node" dialogue between two computers on October 29, 1969. (The first computer, the size of a small house, was housed at UCLA, while the second was located at Stanford.) Even though the message—"LOGIN"—was quick and basic, it caused the ARPA network to crash just the first two letters of the memo were received by the Stanford computer (Andrews, 2013).

In the 1970s, academicians Robert Kahn and Vinton Cerf developed the Transmission Control Protocol and Internet Protocol, or TCP/IP, a communications paradigm that specified principles for how data might be transferred between several networks. ARPANET transitioned to TCP/IP on January 1, 1983, and researchers began constructing the "network of networks" that would become the modern Internet. The World Wide Web, created by computer scientist Tim Berners-Lee in 1990, gave the online world a more recognizable structure. While it is sometimes confused with the internet, the web is just the most common means of accessing information online through websites and hyperlinks (Andrews, 2013).

The web aided in the public's comprehension of the internet and was a crucial step in the creation of the huge treasure trove of knowledge that most of us now have access to daily (Andrews, 2013).

#### 2.1.1.2 Commercial Expansion:

The web was spurred forward by market-based, decentralized, and autonomous decision-making. The paper includes proposals for legislation governing the commercialization of more government-managed technologies, as well as the market's future.

A. Motivation:

The term "commercial expansion of the Internet" refers to three nearly simultaneous events: the National Science Foundation's (NSF) removal of restrictions on commercial use of the Internet, the browser wars sparked by Netscape's founding, and the rapid entry of tens of thousands of businesses into commercial ventures using TCP/IP-based technologies. The National Science Foundation (NSF) has been working for years to transition the Internet from government-funded laboratories and universities to the commercial sector. In that sense, the article examines the Internet access market and one set of companies, the Internet Service Providers (ISPs). Depending on the user's facilities, whether it be a company or a private residence, connection can be dial-up to a local number or 1-800 number at varying speeds, or direct access to the user's server via one of multiple high-speed access methods (Greenstein, 2001).

Because of commercialization, many of the anticipated technological and operational challenges did not materialize. Entrepreneurs quickly recognized that the Internet connection market was commercially feasible. This happened because of a variety of economic variables. After making minimal changes to standard operating procedures obtained from academia, ISPs began providing commercial service. Privatizing Internet access made it easier to adapt Internet access technology to a wide variety of locations, situations, and users. The most prevalent business model, it found out, could be applied at a small scale, resulting in low demand (Greenstein, 2001).

B. Challenges During Technology Transfer:

Many studies of technology commercialization emphasize the importance of the setting in which technology is developed. Rather than technology coming out of nowhere, learning processes and adaptation behaviour impact them. Users and suppliers routinely tailor technology to fulfil short-term demands, depending on shifting price schedules or idiosyncratic preferences, resulting in technological outcomes that can only be described in terms of these unique conditions and causes. These concerns reoccur in investigations of technology that is subject to government oversight. A server to monitor traffic and act as a gatekeeper, a router to direct traffic between the Internet and PCs in a LAN or call centre, and a link to the NSF's Internet backbone or data exchange point were all required for a small business. A small group of persons, generally students or IT professionals, oversaw these. The financial limits were not realistic of what may be met with commercial operations and competitive pressures because of the Internet's commercialization, and the agreements did not collect income on a regular basis (Greenstein, 2001).

Finally, classical research anticipates that transforming Internet access to corporate use would provide technological, financial, and structural challenges (Greenstein, 2001).

C. In the Internet Access Industry. There Is No Competition:

An Internet service provider (ISP) is a for-profit business that offers Internet access, maintains it for a charge, and develops associated services as needed by customers. While this is occasionally all they do, they usually offer a lot more for business users. Simple responsibilities like filtering are occasionally assigned to ISPs. Managing and creating e-mail accounts, databases, and web sites are all part of the job. Some ISPs classify this activity as consulting and charge separately for it; others do not classify it as anything other than standard Internet access service operation and do not charge extra for it (Greenstein, 2001).

By the turn of the century, the ISP sector had evolved an amazing structure. One firm, America On-Line, served over half of the US market, while a swarm of other Internet service providers (ISPs) supplied millions of households and businesses around the country. Thousands of Internet service providers also provided connectivity to specific geographic areas, such as a single city or province. Small ISPs accounted for almost a quarter of all residential Internet usage and a lesser share of commercial Internet usage (Greenstein, 2001).

#### 2.1.1.3 Advantages and Disadvantages:

A. Advantages:

i) Connectivity, communication, and sharing: Receiving a letter from someone else may take days, weeks, or even months in the past. Thanks to the Internet, you can now send an e-mail to anyone in the world in less than a minute. Other communication options, like as chat and VOIP, allow you to quickly speak with anybody on the planet (Hope, 2019).

ii) Online Banking: Online businesses have resulted in online money transfers, which are now possible thanks to the online banking system. The online banking services have made it possible to receive or transfer money, open accounts, and provide loans (Prasanna, 2021).

iii) Abundant of Information: The Internet is a useful data source. Search engines like Bing, Google, and Yahoo address financial themes, government legislation and services, market information, economic affairs, technology information, educational and academic concerns, new ideas, and technical support in depth (Prasanna, 2021).

iv) Cloud computing and cloud storage: PCs and other Internet-enabled devices connect to cloud computing and storage services over the Internet. Cloud computing allows a device to connect to more powerful computers, such as supercomputers, to do complex processes while performing other tasks. Users may access their files from any place thanks to cloud storage, which synchronizes data across all Internet-connected devices (Hope, 2019).

B. Disadvantages:

i) Anti-Social: Because of the extensive use of the internet, people's communication abilities have decreased in recent years. Digital communication is more appealing to people than face-to-face interaction (Roomi, 2021).

ii) Loss of Personal Information: With using social networking websites or online banking services, users supply personal information such as their email address, bank account numbers, credit card numbers, and phone numbers. This information can be easily accessed by a software expert or a hacker, exposing personal information (Singhal, 2021).

iii) Not reliable: The information on the internet is not always correct. It's conceivable that internet information is inaccurate or overstated. Some content exists solely to trick visitors (Roomi, 2021).

iv) Health issues: Sitting for lengthy periods of time is widely known to cause weight gain. Surfing the internet, playing video games, and social networking on a regular basis can contribute to weight gain and an unhealthy physique (Singhal, 2021).

### 2.1.2 Internet Architecture

The Internet architecture is commonly referred to as the TCP/IP architecture after the two main protocols that it employs. The ARPANET, an early packet-switched network, influenced the creation of the Internet. The Internet and the ARPANET were both financed by the Advanced Research Projects Agency (ARPA), one of the Department of defence's research and development funding bodies. The Internet and the ARPANET existed before the OSI reference model, and the information gained from their development influenced the OSI reference model significantly (Larry L. Peterson, 2011).

While the seven-layer OSI model may be extended to the Internet with little effort, the four-layer model is more widely used. At the most basic level, a wide range of network protocols labelled NET1, NET2, and so on are accessible. These protocols are implemented using a mix of hardware (such as a network adapter) and software (e.g., a network device driver). The second layer is made up of only one protocol: the Internet Protocol (IP) (IP). This is the protocol that enables many networking technologies to be linked together to form a logical internetwork. The User Datagram Protocol (UDP) and the Transmission Control Protocol (TCP) are the two core protocols of the third layer (UDP). TCP and UDP provide extra logical channels to application applications (Larry L. Peterson, 2011).

HTTP, FTP, Telnet (remote login), and the Simple Mail Transfer Protocol (SMTP) are examples of application protocols that operate on top of the transport layer and allow popular programs to connect with one another. To understand the difference between an application layer protocol and an application, consider all the many World Wide Web browsers that are or have been available (e.g., Firefox, Safari, Netscape, Mosaic, Internet Explorer). There is a slew of other web server implementations available as well. You may use any of these application programs to access a certain website on the Internet since they all follow the same application layer protocol (Larry L. Peterson, 2011).

The levels between the Internet architecture and the seven-layer OSI architecture are widely agreed upon. The application layer is layer 7, the transport layer is layer 4, the

IP (internetworking or simple network) layer is layer 3, and the link or subnet layer underneath IP is layer 2 (Larry L. Peterson, 2011).

### 2.1.3 Privacy and the Internet:

Cyberspace privacy issues are a hot topic of debate across the world. Citizens all around the globe are concerned that the most personal aspects of their daily life are being watched, searched, recorded, maintained, and frequently misinterpreted when taken out of context as reading and writing, health care and shopping, and gossip become more common in cyberspace. For many, the greatest threats to privacy are posed by the architecture of e-commerce, which is based on the collection and exchange of personal data in unprecedented ways (Dennis, n.d.).

## 2.4 Conclusion:

Internet in simple terms can be considered as the network of networks. With the advancement in internet, there had, has and will have different advantages and the drawbacks too. This all leads to sustaining human life with new technologies which is an endless era where every new discovery of the internet gets better and better. From the first operational prototype of the Internet, The Advanced Research Projects Agency Network (ARPANET), which was built in the late 1960s; till date has had a huge difference and impact on every aspect of human life. In present day, people live in a time frame where money is transferred digitally with the help of an application and the internet. Every task of human life gets easier and convenient with the advancement of the internet. What leads the future direction is the advancement and the hunger to achieve better than the present and the past. There are a lot of things to be achieved and solved with the enthusiastic behaviour of humans to achieve greater goals in the field of technology and internet which will indeed help to enrich the advancement of the internet to meet the requirement of that present day time.

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# 4. Appendix

## 4.1 Appendix – A (Glossary)

UCLA – University of California, Los Angeles

NSF - The National Science Foundation

VOIP – Voice over Internet Protocol

ARPA - Advanced Research Projects Agency

UDP - User Datagram Protocol

Cyberspace - the fictitious setting in which computer network communication occurs

## 4.2 Appendix – B (Screen copies of Simulation result of Task A)

CourseWork

NODES: RECEIVED MESSAGE COUNTS

REPLICATION 1 FROM 60.0 TO 180.0 SECONDS

| RECEIVER | COUNT | MESSAGE NAME |
|---|---|---|
| Manchester.ATM Server | 113 | Pokhara ATM Source |
| Manchester.ATM Server | 110 | Kathmandu ATM Source |

This screen copy shows the Nodes: Received Message Counts

CourseWork

LINKS: CHANNEL UTILIZATION

REPLICATION 1 FROM 60.0 TO 180.0 SECONDS

| | FRAMES | | TRANSMISSION DELAY (MS) | | | % |
|---|---|---|---|---|---|---|
| LINK | DELIVERED | RST/ERR | AVERAGE | STD DEV | MAXIMUM | UTIL |
| Pokhara.Pokhara Token | 11966 | 0 | 0.036 | 0.012 | 0.082 | 0.3549 |
| Kathmandu.Kathmandu To | 11989 | 0 | 0.036 | 0.012 | 0.082 | 0.3562 |
| Manchester.Manchester | 4860 | 0 | 0.065 | 0.013 | 0.136 | 0.2447 |

This screen copy shows the Link: Channel Utilization

CourseWork

WAN CLOUDS: FRAME DELAY BY VC

REPLICATION 1 FROM 60.0 TO 180.0 SECONDS

| CLOUD: VC | FRAME DELAY (MS) AVG | STD | MAX | BURST SIZE (kb) AVG | MAX |
|---|---|---|---|---|---|
| WAN | | | | | |
| Pokhara-Manchester | 60159 | 17306 | 90032 | 5 | 10 |
| Manchester-Pokhara | 97 | 0 | 97 | 2 | 5 |
| Kathmandu-Manchester | 60157 | 17334 | 90089 | 5 | 11 |
| Manchester-Kathmandu | 97 | 0 | 97 | 2 | 5 |

This screen copy shows Wan Clouds: Frame Delay By VC

CourseWork

WAN CLOUDS: FRAME COUNTS BY VC

REPLICATION 1 FROM 60.0 TO 180.0 SECONDS

| CLOUD: VC: FRAMES KILOBITS | | FRAMES / KILOBITS ACCEPTED NORMAL | DE | DROPPED NORMAL | DE |
|---|---|---|---|---|---|
| WAN | | (TOTAL KILOBITS TRANSMITTED = | | 1696 ) | |
| Pokhara-Manchest | Frm | 1213 | 0 | 0 | 0 |
| | kb | 460 | 0 | 0 | 0 |
| Manchester-Pokha | Frm | 1212 | 0 | 0 | 0 |
| | kb | 388 | 0 | 0 | 0 |
| Kathmandu-Manche | Frm | 1217 | 0 | 0 | 0 |
| | kb | 458 | 0 | 0 | 0 |
| Manchester-Kathm | Frm | 1217 | 0 | 0 | 0 |
| | kb | 389 | 0 | 0 | 0 |

This screen copy shows Wan Clouds: Frame Counts By VC

CourseWork

WAN CLOUDS: ACCESS LINK STATS

REPLICATION 1 FROM 60.0 TO 180.0 SECONDS

| CLOUD: ACCESS LINK | (ENTRY) (EXIT) | FRAMES ACCEPTED | FRAMES DROPPED | BUFFER (BYTES) MAX | BUFFER (BYTES) AVG | BUFFER (BYTES) STD | % UTIL |
|---|---|---|---|---|---|---|---|
| WAN | | | | | | | |
| Manchester Acces | Entry | 2429 | 0 | N/A | N/A | N/A | 87.74 |
| | Exit | 4841 | 0 | 172587 | 114915 | 33254 | 100.00 |
| Pokhara Access | Entry | 2417 | 0 | N/A | N/A | N/A | 100.00 |
| | Exit | 1212 | 0 | 40 | 18 | 20 | 43.76 |
| Kathmandu Access | Entry | 2425 | 0 | N/A | N/A | N/A | 100.00 |
| | Exit | 1217 | 0 | 40 | 18 | 20 | 43.95 |

This screen copy shows Wan clouds: Access link stats

CourseWork

MESSAGE + RESPONSE SOURCES: MESSAGE DELAY

REPLICATION 1 FROM 60.0 TO 180.0 SECONDS

| ORIGIN / MSG SRC NAME: DESTINATION LIST | MESSAGES ASSEMBLED | MESSAGE DELAY AVERAGE | STD DEV | MAXIMUM |
|---|---|---|---|---|
| Pokhara.Pokhara ATM((1-40)) / src Pokhara ATM Source: | | | | |
| Manchester.ATM Serve | 17 | 117.20039 S | 36140.339 MS | 177.90295 S |
| Pokhara.Pokhara Teller Machine / src Pokhara Message Sender: | | | | |
| Manchester.ATM Serve | 0 | 0.000 MS | 0.000 MS | 0.000 MS |
| Kathmandu.Kathmandu ATM ((1-40)) / src Kathmandu ATM Source: | | | | |
| Manchester.ATM Serve | 17 | 118.51851 S | 35018.643 MS | 177.49400 S |
| Kathmandu.Kathmandu Teller Machine / src Kathmandu Message Sender: | | | | |
| Manchester.ATM Serve | 0 | 0.000 MS | 0.000 MS | 0.000 MS |
| Manchester.ATM Server / src ATM Response: | | | | |
| ECHO | 0 | 0.000 MS | 0.000 MS | 0.000 MS |

This screen copy shows Message + Response Source: Message Delay

```
                    CourseWork

   MESSAGE + RESPONSE SOURCES: MESSAGE DELIVERED

      REPLICATION 1 FROM 60.0 TO 180.0 SECONDS

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

Pokhara.Pokhara ATM((1-40)) / src Pokhara ATM Source:
  Manchester.ATM Serve        113   117.40456 S   34524.072 MS  177.81935 S
Pokhara.Pokhara Teller Machine / src Pokhara Message Sender:
  Manchester.ATM Serve          0       0.000 MS      0.000 MS      0.000 MS
Kathmandu.Kathmandu ATM ((1-40)) / src Kathmandu ATM Source:
  Manchester.ATM Serve        110   117.81080 S   34127.375 MS  177.88275 S
Kathmandu.Kathmandu Teller Machine / src Kathmandu Message Sender:
  Manchester.ATM Serve          0       0.000 MS      0.000 MS      0.000 MS
Manchester.ATM Server / src ATM Response:
  ECHO                          0       0.000 MS      0.000 MS      0.000 MS
```

This screen copy shows Message + Response Sources: Message Delivered

## 4.3 Appendix – C (Additional research Content of Task B)

Additional information on commercialization of the internet:

Internet connectivity was malleable as a technology and a medium of trade. This is because TCP/IP, the Internet's backbone, isn't a single innovation that has grown through time and space. Instead, it's embedded in hardware that uses a set of communication technologies, protocols, and standards to connect computers. This technology achieves economic value when combined with other inventions, investments, and equipment. While commercialization did result in a rearrangement of Internet access to meet corporate clients, this did not prevent diffusion or the early rise in demand. The ability to adjust Internet access technology to a wide range of locales, situations, and people was made possible by privatizing Internet access. On a modest scale, and hence with low demand, the dominant business model proved to be feasible. This meant that the technology could be sold in areas with low population density, either as part of a national branded service or as a regionally targeted business. As a result, privatization gave ownership of the technology to a new set of decision-makers with new ideas about how to employ it. Attempts to adapt the technology for new objectives, new locations, new market circumstances, new applications, and collaboration with other lines of business were conceivable because of the low cost of testing. Many of these attempts failed, while many others succeeded (Greenstein, 2001).

The National Science Foundation was lucky in a manner. It enabled the commercialization of the Internet access sector at an ideal time, as the World Wide Web expanded into a tremendous new technical potential. This revelation encouraged deeper investigation to capitalize on the new potential, which turned out to thrive under market-driven, decentralized decision-making (Greenstein, 2001).