Computer Networks Lab

(Project Report)

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Abstract

This project is to design a suitable network system for companies within a city. The aim was to design a network that is cost-efficient and provides reliable, manageable communication. To improve network design, the technology we used was creating multiple LANs using normal devices and connecting them with routers serial connections. The network can also become better by using routing and other protocols. So, we have used such protocols and fewer devices to reduce the cost. We used Cisco-Packet Tracer to design our network.

Contents

Introduction

In the modern world, communication and exchange of information is essential. To stay connected we have several forms of communication and connection. such a connection is formed between several companies in our project to depict how a cost efficient network can be designed to get a company started and connected to other companies in its vicinity or even at a distant location.

The designed network handles and exchanges traffic between three companies namely; Company X, Company Y and Company Z. The aforementioned companies have been assigned the IPs 44.186.96.0/19 (CMP X), 50.152.0.0/15 (CMP Y and 210.98.169.64/26 (CMP Z).

Given the Design requirement of our companies, we needed to subnet our given network addresses for successful, sensibly utilized and uninterrupted communication. To make inter LAN communication successful we required Serial Communication between the routers. For this purpose, routers, serial communication 199.210.121.160/28 was also sub-netted. The details of the work are described below.

Requirement Analysis

- Our main requirement is to design a network that holds up for three different companies and supports inter-company communication.
- Since we bear the expenses of network design, we have to design a network that is cost-efficient.

Network Design and Structure

Our project is required to make three companies with the following details:

- CMP X with five rooms and one PC in each room
- CMP Y with three rooms and three PCs in each room
- CMP Z with two rooms and four PCs in each room

CMP X utilizes five switches configured over two routers. This is because CMP X has five rooms and one router can only support up to four connections.

CMP Y utilizes three switches configured over one router

CMP X utilizes two switches configured over one router

For the best demonstration of this network structure. We decided to use one switch per room. We further decided to connect routers in such a way that each router would have four connections. Two routers have two serial connections each and two routers have only one serial connection each. This makes for a network that is inexpensive, provides easier management and ensures network flexibility.

Network Topology

The topology which we will be using in this project is a hybrid topology in which the client devices are connected to their respective switches which is a star topology and these switches are further connected to the routers in a star topology again and finally the routers are connected in a bus topology.

We used Ethernet which is the most widespread wired local area network protocol in this project. The connection between different LANs is realized through serial connections.

Network Specifications

We used Copper straight-through wire to connect the PCs with the switches and the switches to the routers. We used Serial DCE and Serial DTE wires to connect the routers and RIPv2 protocol for their configuration. This is because we made use of subnetting for dividing our network and RIPv2 is a classless, distance vector routing protocol. As it is a classless routing protocol, it includes the subnet mask with the network addresses in its routing updates. As with other classless routing protocols, RIPv2 supports CIDR supernets. All the terminals and the interfaces (ports) are administratively shut down by default until they are configured. This prevents unnecessary errors and potential damage to the equipment.

Network Scenario

The network has been designed in the following way:

Company X

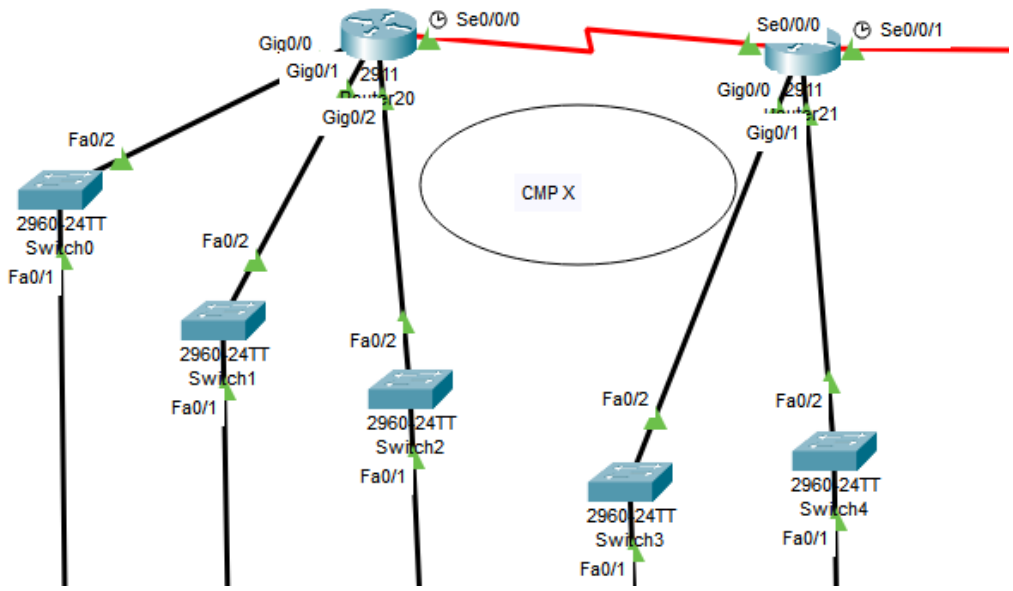


Figure 1 CMP X

Company Y

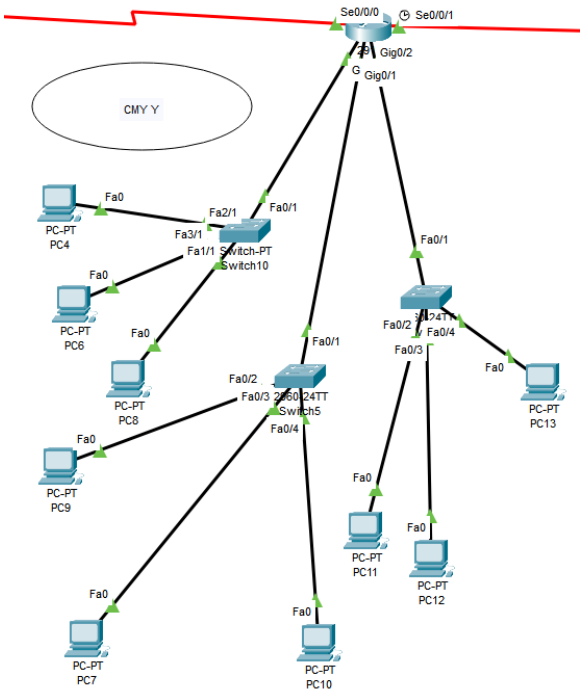


Figure 2 CMP Y

Company Z

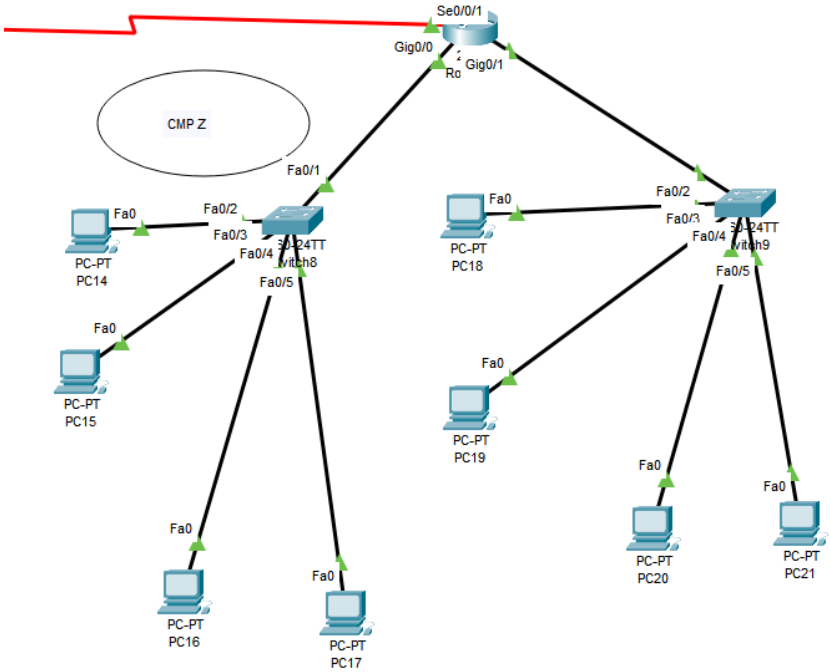


Figure 3 CMP Z

Complete Network Design

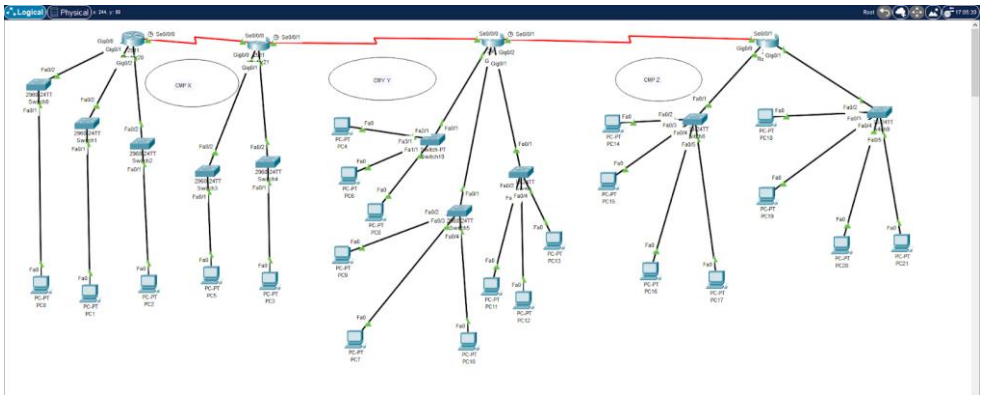


Figure 4 Complete Network Design

Configuration of Subnets

The sub-netting of each network is as follows:

Company X

Given: 144.186.96.0/19

We need five networks. Which means we will have to borrow three host bits

144.186.96.0/22.

New Subnet Mask -> 255.255.11111100.0 → 255.255.252.0

Calculations

1) 144.186.96.0 -> 144.186.011 000 00

2) 144.186.100.0 -> 144.186.011 001 00

3) 144.186.104.0 -> 144.186.011 010 00

4) 144.186.108.0 -> 144.186.011 011 00

5) 144.186.112.0 -> 144.186.011 100 00

Ranges

Subnet	Network Address	Valid Host	Broadcast Address

1.	144.186.96.0	144.186.96.1 - 144.186.99.254	144.186.99.255
2.	144.186.100.0	144.186.100.1 - 144.186.103.254	144.186.103.255
3.	144.186.104.0	144.186.104.1 - 144.186.107.254	144.186.107.255
4.	144.186.108.0	144.186.108.1 - 144.186.111.254	144.186.111.255
5.	144.186.112.0	144.186.112.1 - 144.186.115.254	144.186.115.255

Company Y

Given: 50.152.0.0/15

We need 3 networks. Which means we will have to borrow two host bits 50.152.0.0/17.

New Subnet Mask -> 255.10011000.0.0 → 255.255.128.0

Calculations

1) 50.152.0.0 -> 50.10011000.00000000.0

2) 50.152.128.0 -> 50.10011000.10000000.0

3) 50.153.0.0 -> 50.10011001.00000000.0

Ranges

Subnet	Network Address	Valid Host	Broadcast Address
1.	50.152.0.0	50.152.0.1 - 50.152.127.254	50.152.127.255
2.	50.152.128.0	50.152.128.1 - 50.152.255.254	50.152.255.255
3.	50.153.0.0	50.153.0.1 - 50.153.0.128	50.153.0.129

Company Z

Given: 210.98.169.64/26

We need 2 networks. Which means we will have to borrow one host bit 210.98.169.64/27

New Subnet Mask -> 255.255.255.11100000 → 255.255.255.224

Calculations

1) 210.98.169.64 -> 210.98.169.01000000

2) 210.98.169.96 -> 210.98.169.01100000

Ranges

Subnet	Network Address	Valid Host	Broadcast Address
1.	210.98.169.64	210.98.169.65 - 210.98.169.94	210.98.169.95
2.	210.98.169.96	210.98.169.97 - 210.98.169.126	210.98.169.127

Routers Serial Communication

Given: 199.210.121.160/28.

We need 4 networks. Which means we will have to borrow two host bits 199.210.121.160/30.

New Subnet Mask -> 255.255.255.11111100 → 255.255.255.252

Calculations

1) 199.210.121.160 -> 199.210.121.11000000

2) 199.210.121.164 -> 199.210.121.11000100

3) 199.210.121.168 -> 199.210.121.11001000

4) 199.210.121.172 -> 199.210.121.11001100

Ranges

Subnet	Network Address	Valid Host	Broadcast Address
1.	199.210.121.160	199.210.121.161 - 199.210.121.162	199.210.121.163
2.	199.210.121.164	199.210.121.165 - 199.210.121.166	199.210.121.167
3.	199.210.121.168	199.210.121.169 - 199.210.121.170	199.210.121.171
4.	199.210.121.172	199.210.121.173 - 199.210.121.174	199.210.121.175

Configuration of LANs

Configuration of PCs

All the PCs in the networks were assigned static IP addresses.

Company X

Name	IP address	Subnet	Gateway
PC-PT PC0	144.186.96.1	255.255.252.0	144.186.96.2
PC-PT PC1	144.186.100.1	255.255.252.0	144.186.100.2
PC-PT PC2	144.186.104.1	255.255.252.0	144.186.104.2
PC-PT PC3	144.186.112.1	255.255.252.0	144.186.112.2
PC-PT PC5	144.186.108.1	255.255.252.0	144.186.108.2

Company Y

Name	IP address	Subnet	Gateway
PC-PT PC8	50.152.0.1	255.255.128.0	50.152.0.4
PC-PT PC4	50.152.0.2	255.255.128.0	50.152.0.4
PC-PT PC6	50.152.0.3	255.255.128.0	50.152.0.4
PC-PT PC9	50.152.128.1	255.255.252.0	50.152.128.4
PC-PT PC7	50.152.128.2	255.255.252.0	50.152.128.4
PC-PT PC10	50.152.128.3	255.255.252.0	50.152.128.4

PC-PT PC11	50.153.0.1	255.255.128.0	50.153.0.4
PC-PT PC12	50.153.0.2	255.255.128.0	50.153.0.4
PC-PT PC13	50.153.0.3	255.255.128.0	50.153.0.4

Company Z

Name	IP address	Subnet	Gateway
PC-PT PC14	210.98.169.65	255.255.255.224	210.98.169.69
PC-PT PC15	210.98.169.66	255.255.255.224	210.98.169.69
PC-PT PC16	210.98.169.67	255.255.255.224	210.98.169.69
PC-PT PC17	210.98.169.68	255.255.255.224	210.98.169.69
PC-PT PC18	210.98.169.97	255.255.255.224	210.98.169.101
PC-PT PC19	210.98.169.98	255.255.255.224	210.98.169.101
PC-PT PC20	210.98.169.99	255.255.255.224	210.98.169.101
PC-PT PC21	210.98.169.100	255.255.255.224	210.98.169.101

Configuration of Gateways

Company X

Name	Gateway Address
Switch0	144.186.96.2
Switch1	144.186.100.2
Switch2	144.186.104.2

Switch3	144.186.112.2
Switch4	144.186.108.2

Company Y

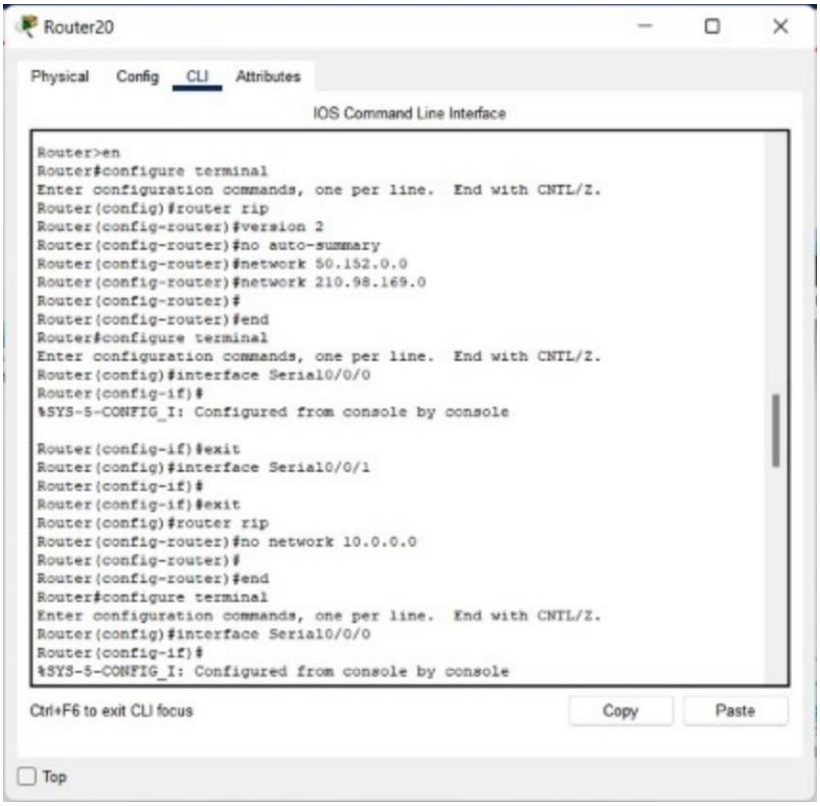
Name	Gateway Address
Switch10	50.152.0.4
Switch5	50.152.128.4
Switch6	50.153.0.4

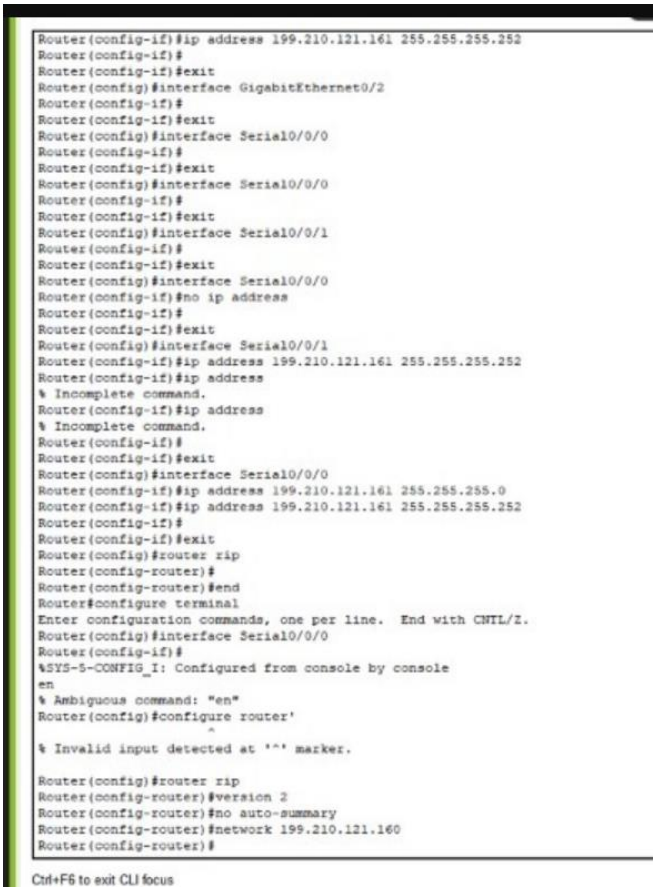
Company Z

Name	Gateway Address
Switch8	210.98.169.69
Switch9	210.98.169.101

Configuration of Routers

Routers were set up using the CLI interface.



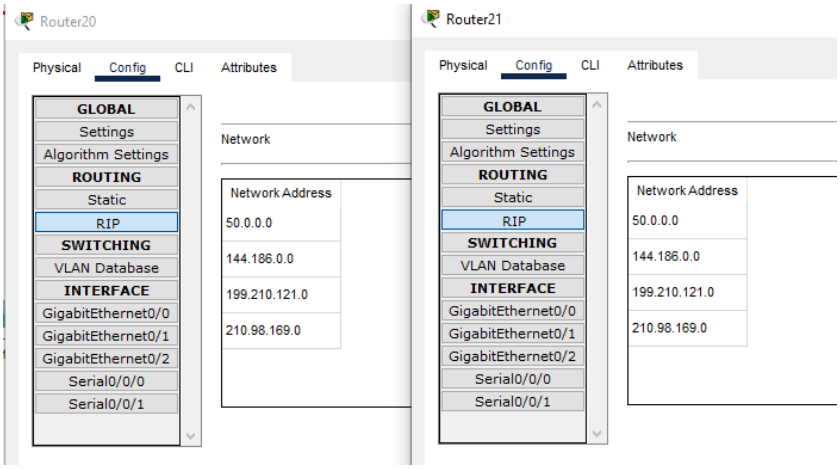


The other routers were set up similarly.

Company X

Name	Serial IP	Subnet	Network IP
Router20	199.210.121.161	255.255.255.252	199.210.121.0
Router21	199.210.121.162	255.255.255.252	199.210.121.0

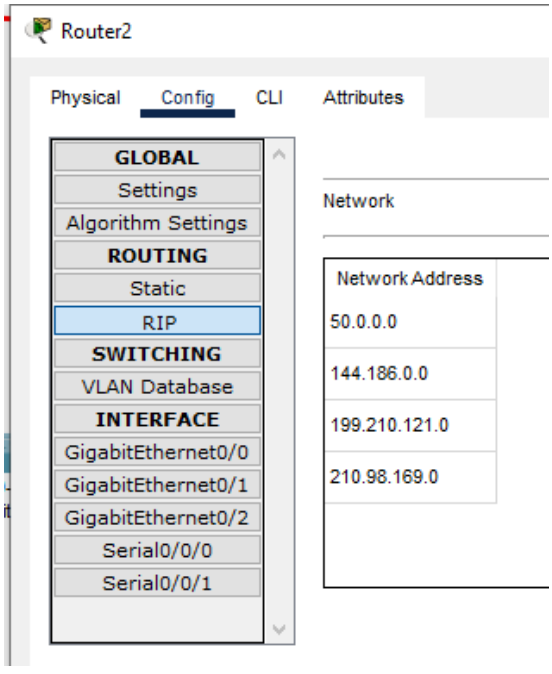
RIP of Company X



Company Y

Name	Serial IP	Subnet	Network IP
Router2	199.210.121.165	255.255.255.252	199.210.121.0

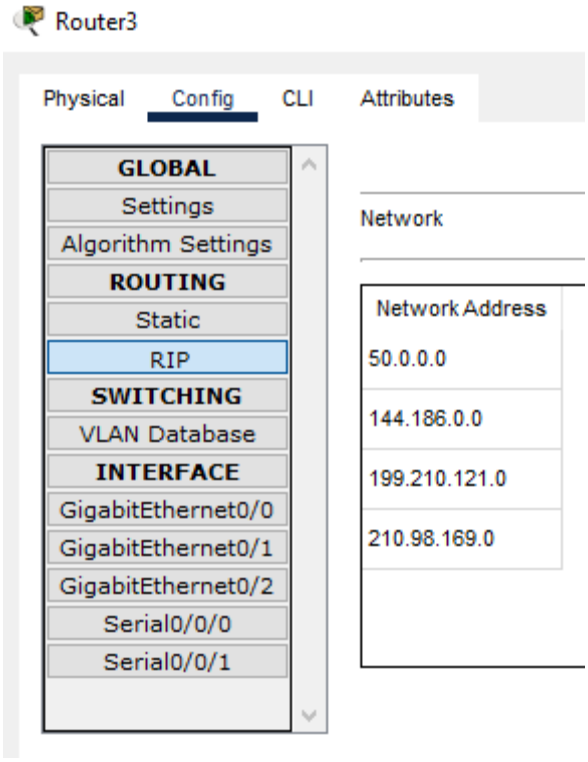
RIP of Company Y



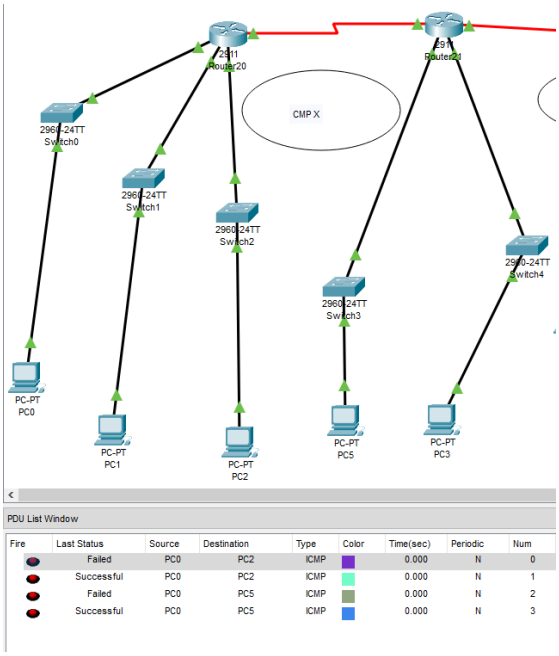
Company Z

Name	Seriel IP	Subnet	Network IP
Router20	199.210.121.161	255.255.255.252	199.210.121.0
Router21	199.210.121.162	255.255.255.252	199.210.121.0

RIP of Company Z

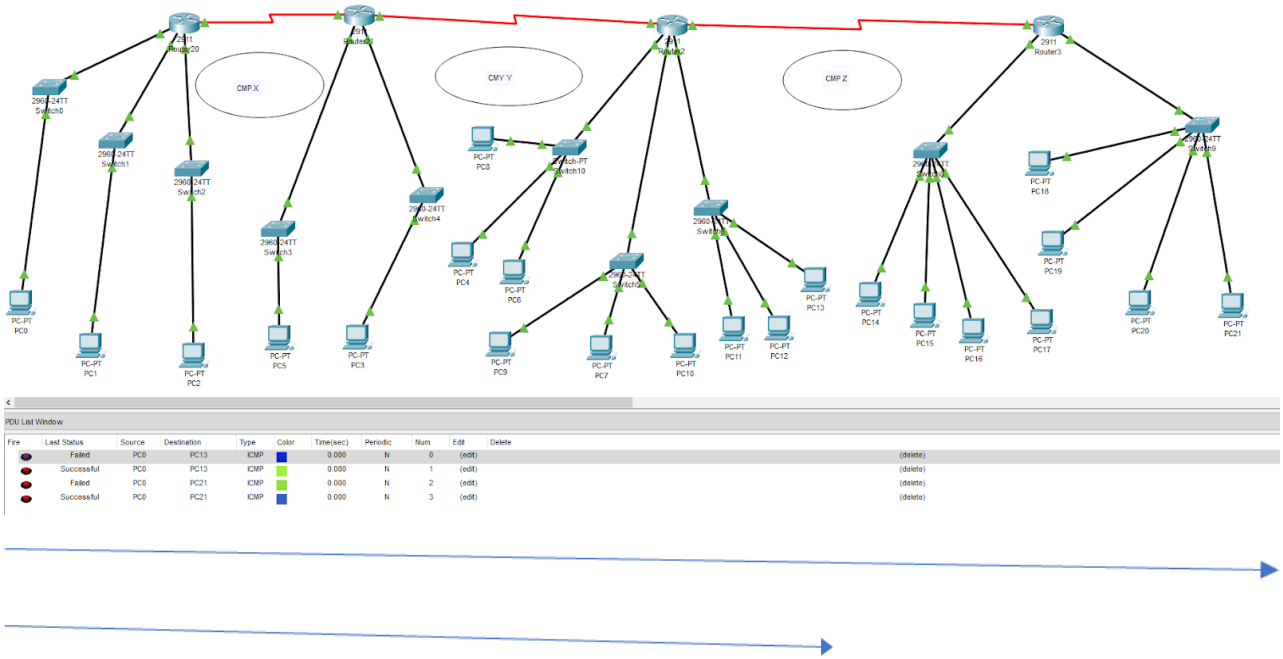


Ping Results



The first message was unsuccessful because the PC0 had not discovered the others within its network. It was successful afterwards.

The third message failed again because the broadcast IP had not gone beyond the network onto the second router. It worked on the second attempt.



Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num
	Failed	PC0	PC13	ICMP		0.000	N	0
	Successful	PC0	PC13	ICMP		0.000	N	1
	Failed	PC0	PC21	ICMP		0.000	N	2
	Successful	PC0	PC21	ICMP		0.000	N	3

Ping between companies was successful as well.

Conclusion

This project has proven that a standard network system can be designed with less cost. Although we have used the minimalist of devices we were able to connect 3 LAN's and made communication between them possible. We overcame the obstacle to assigning IP addresses to newly added networks within a LAN by assigning a unique IP to all the PC's and gateways. We also depicted the working of RIP version 2 protocol. At the end, our aim was achieved by designing a network that ticked all the conditions and requirements.