

Aled Edgell Network Portfolio

by Aled Edgell

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Network Portfolio

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*Figures are appropriately
named and easily identified.*

Part 1

1.Introduction

In the first part of the portfolio research was carried out into the basic information needed to setup and test basic network systems, the research carried out was into the basic layers of communications that each device uses to move information from one point in the network to another this can either be a local network or a bigger system such as the online network systems.

Once the research require was carried out 3 networks were created to allow testing of the first three routing methods for a local network to better understand there functions and how they are set up, each with their own requirements. Once this was done each was tested to ensure they are working correctly this was done using the software ping function which is used to test communication between devices. The networks set up were done so using the basic layout created in the design to make fault finding easier. The final task of the first part was to evaluate the systems created and recommendations for future development.

Reasonable introduction.

2. Research

The OSI (open systems interconnection) is used as the standard to the order in which devices are connected. This determined the communication levels required for information to pass through to pass on information. The data sent through a network can either move up or down a layer a single one a time or move across the level to communicate with other devices however it cannot jump through levels, starting from the layer 1 layers are Physical, Data link, Network, Transport, Session, Presentation and Application. While there are 7 layers it is fairly common in local networks to only use 4 of these layers.

Encapsulation is used in networking software system to make sure the individual devices are responsible for maintaining their own individual status and state. This ensures that other devices on the network do not need to monitor each other device this would create a lot more data for the system to work through which will inevitably slow it down and cause additional issues such as glitches and bugs it also opens up the systems status and inner workings to outside devices which could cause additional problems in the device if set up incorrectly as another device could overwrite its values. This will normally be done by the person who built the system when programming it.

Broadcasting is the method used to transfer information between devices, this can either be done in a big network using switches to communicate with many devices using methods such as Ethernet, or much simpler system by using a point to point connection to transfer the information between 2 devices. This can also be done on line, this is similar to how webpages function when loaded on PCs. "A Broadcast means that the network delivers one copy of a packet to each destination." (Firewall.CX viewed – 28th December 2018).

Port numbers work in collaboration with the networking protocols to allow easier transmission between network devices. Where the IP address is used to identify the device in the network and the connection of the device it is linked to the port number will allow access to a specific application in that device. For example a browser on a PC is required to access online information and a port is used to communicate between the software (browser) and the network.

There should be more sources researched here and images should have been used to support

3.Design requirements

Before creating the networks a design was created for the way the IP system will be assigned to each of the devices. This was done to make creating the networks easier and to assist in fault finding as the addresses to each of the devices followed the premade set of IP addresses which can be seen in the table below.

Network	Network A	Network B	Network C
Ser port 2.0	10.10.10.1	10.10.10.2	N/A
Ser port 3.0	N/A	11.11.11.1	11.11.11.2
Gateway	192.168.1.0	150.168.1.0	100.168.1.0
PC address start	192.168.1.12	150.168.1.12	100.168.1.12
Subnet	255.255.255.0	255.255.255.0	255.255.255.0

The values above were chosen to keep things simple and minimizing the wastage while adhering to the standards required, this also allows for expansion of devices if necessary. The devices used in the packet tracer software were the default ones provided this is because they came preloaded with the network cards for the device, different ones could have been used however they would require the cards to be added on afterwards.

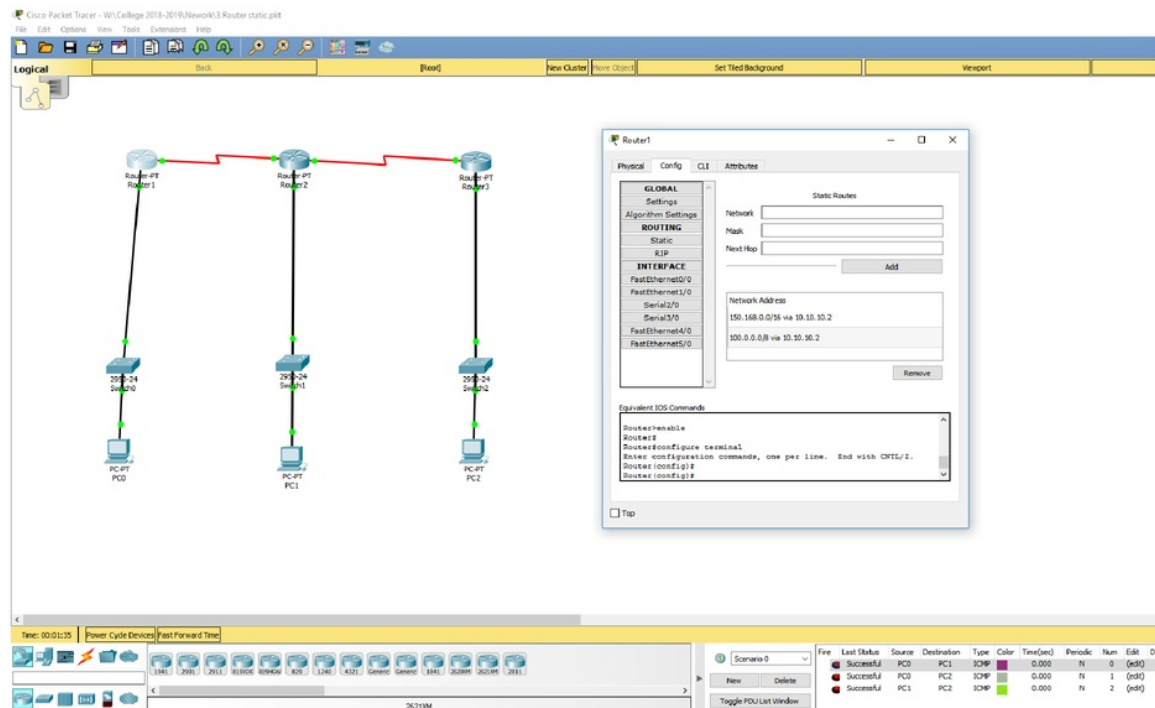
Using these values the 3 networks were created which can be seen below. These networks were the Static routing RIP routing and DHCP routing, these were created using the same setup with 2 WANS and 3 LANS for testing purposes.

The ip addressing scheme is correct. The three classes are used in the LANs and the WAN serial is your choice.

4.Implementation

The first network that was created was one consisting of 3 LAN (Local Area Network) networks connected by WAN (Wide Area Network) networks. Below is the result of the network being set up using static routing which can be seen in the figures below (Figure 1, Figure 2 and Figure 3) the values for the static table can be seen in the router tables.

Figure 1: Static router 1 IP setup.



Good
diagram
with tests
proving
good.

Figure 2: Static router 2 IP setup.

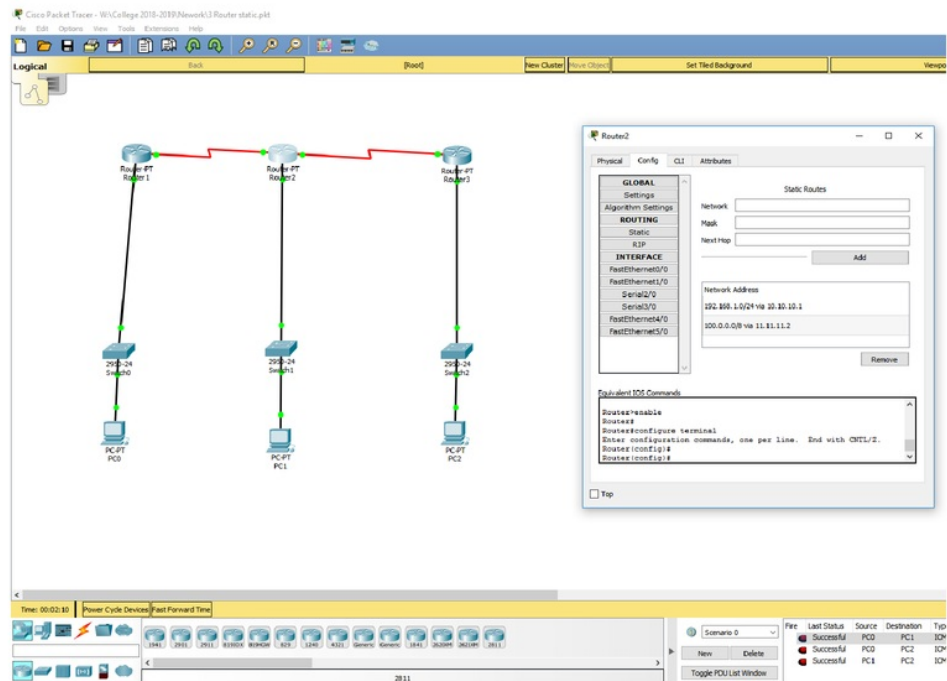
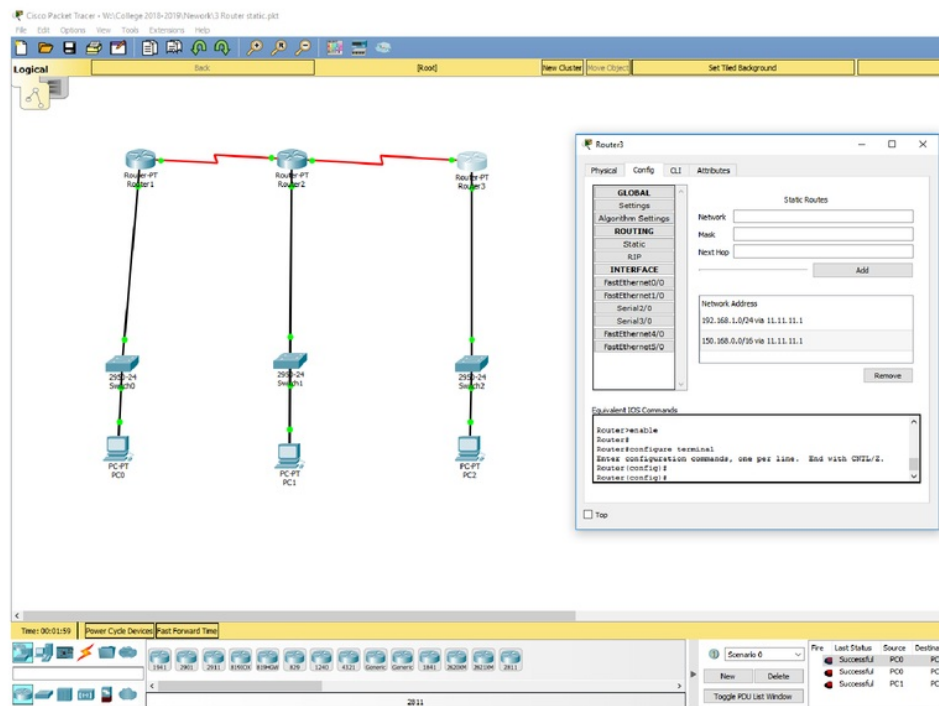


Figure 3: Static router 3 IP setup.



As can be seen from the testing table at the bottom right from pinging the system from 1 PC to another the system is functioning as expected. Once the network was finished being tested in the static routes the system was converted to a RIP addressing system, for this additional PC's were added to each LAN network adding to the IP layout created in the design period (Figure 4, Figure 5, Figure 6).

Figure 4: Router 1 RIP table setup.

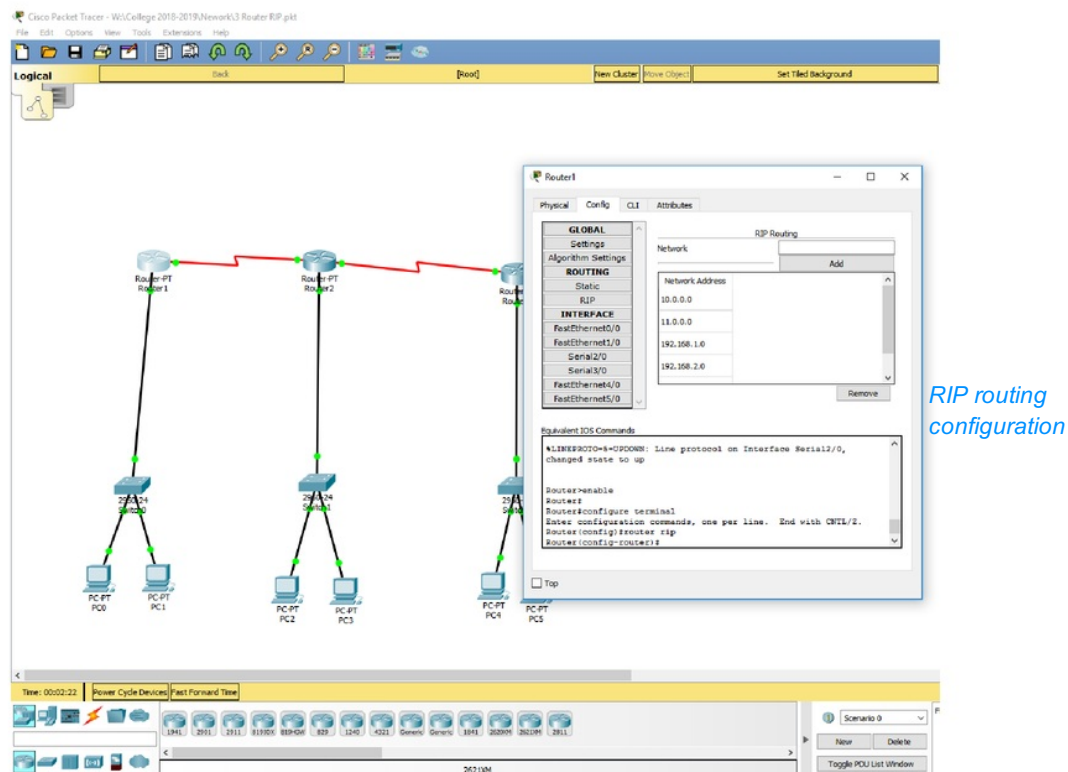


Figure 5: Router 2 RIP table setup.

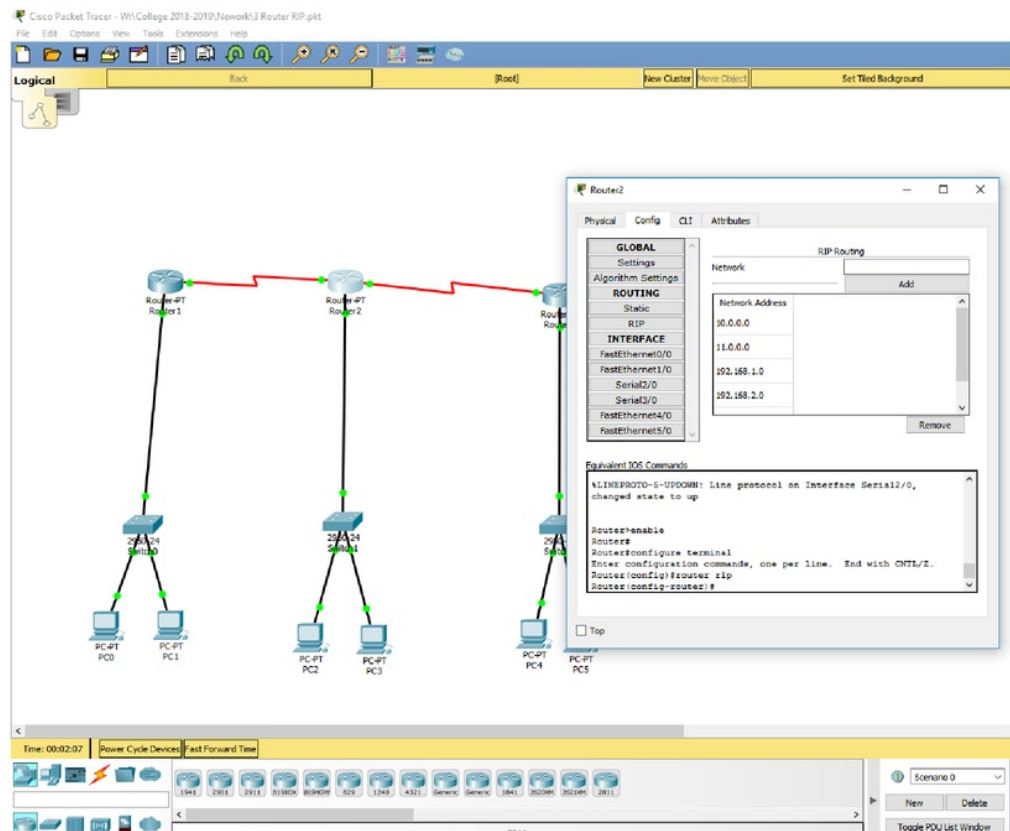
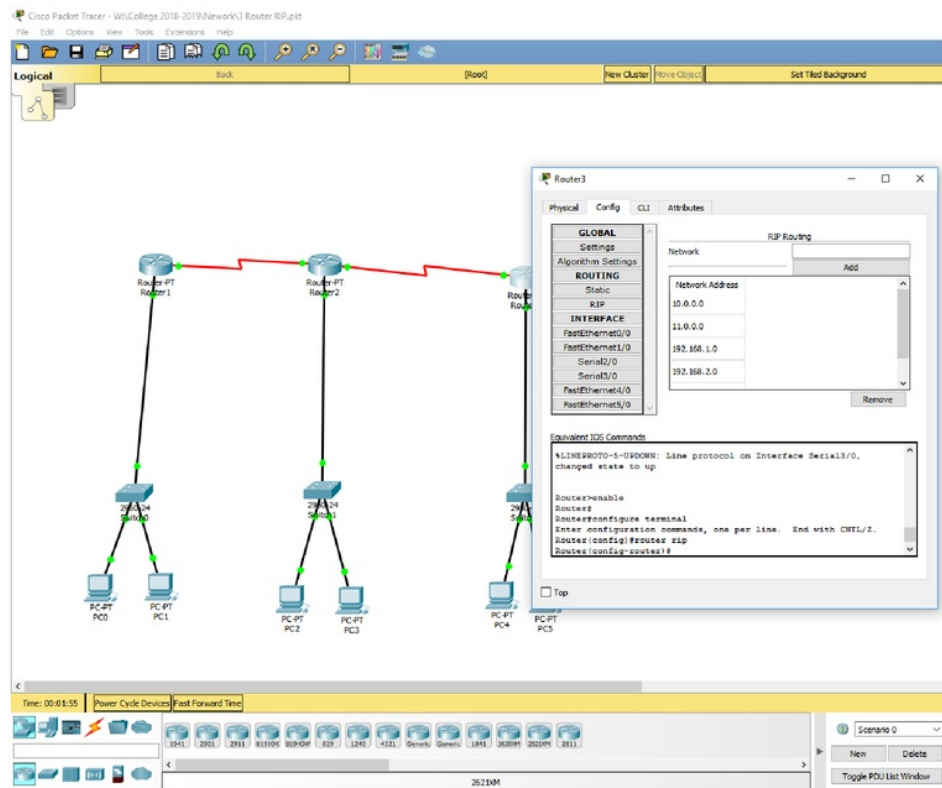


Figure 6: Router 3 RIP table setup.



RIP routing is configured on all routers.

No tests are carried out for RIP routing.

As can be seen from the testing table at the bottom right from pinging the system from 1 PC to another the system is functioning as expected. The final network that was created using this system was a DHCP network (Dynamic Host Configuration Protocol) this allows the system to assign the IP addresses to the devices itself automatically updating when new devices are added. For this the same RIP table was used and the PCs were set to DHCP allowing automatic IP allocation, however Router 1 had to have the script in place to allow for this to take place this can be seen below (Figure 7 and Figure 8)

Router1

PhysicalConfigCLIAttributes

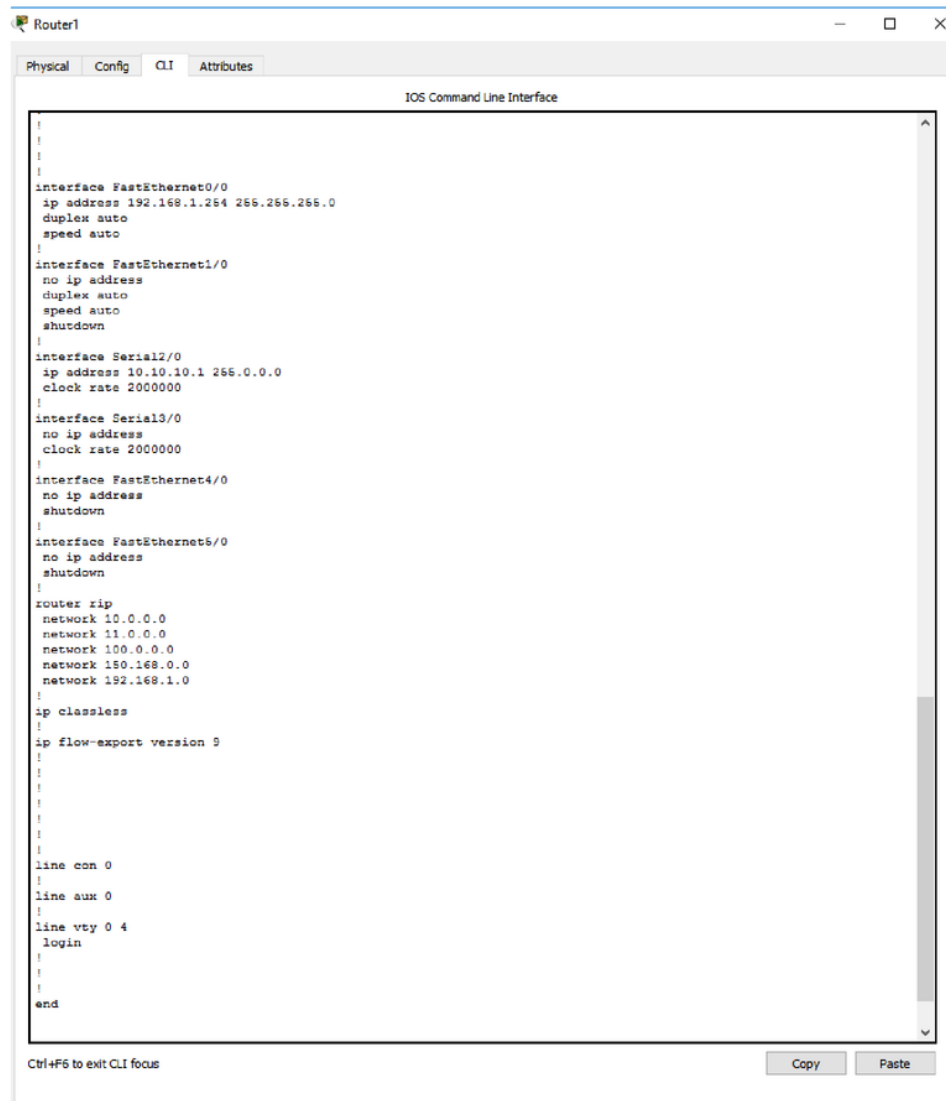
IOS Command Line Interface

```
Router#  
Router#configure terminal  
Enter configuration commands, one per line. End with CNTL/Z.  
Router(config)#router rip  
Router(config-router)#exit  
Router(config)#exit  
Router#  
%SYS-5-CONFIG_I: Configured from console by console  
  
Router#show running-config  
Building configuration...  
  
Current configuration : 1362 bytes  
!  
version 12.2  
no service timestamps log datetime msec  
no service timestamps debug datetime msec  
no service password-encryption  
!  
hostname Router  
!  
!  
!  
ip dhcp excluded-address 192.168.1.1 192.168.1.10  
ip dhcp excluded-address 150.168.0.1 192.168.0.10  
ip dhcp excluded-address 100.0.0.1 100.0.0.10  
ip dhcp excluded-address 150.168.0.1 150.168.0.10  
!  
ip dhcp pool net1  
network 192.168.1.0 255.255.255.0  
default-router 192.168.1.254  
dns-server 192.168.1.254  
ip dhcp pool net2  
network 150.168.0.0 255.255.0.0  
default-router 150.168.1.254  
dns-server 150.168.1.254  
ip dhcp pool net3  
network 100.0.0.0 255.0.0.0  
default-router 100.168.1.254  
dns-server 100.168.1.254  
!  
!  
!  
ip cef  
no ipv6 cef  
!  
!  
!  
!  
!  
!  
!  
!  
!  
!
```

Ctrl+F6 to exit CLI focusCopyPaste

13

Figure 8: Router 1 command table continued.



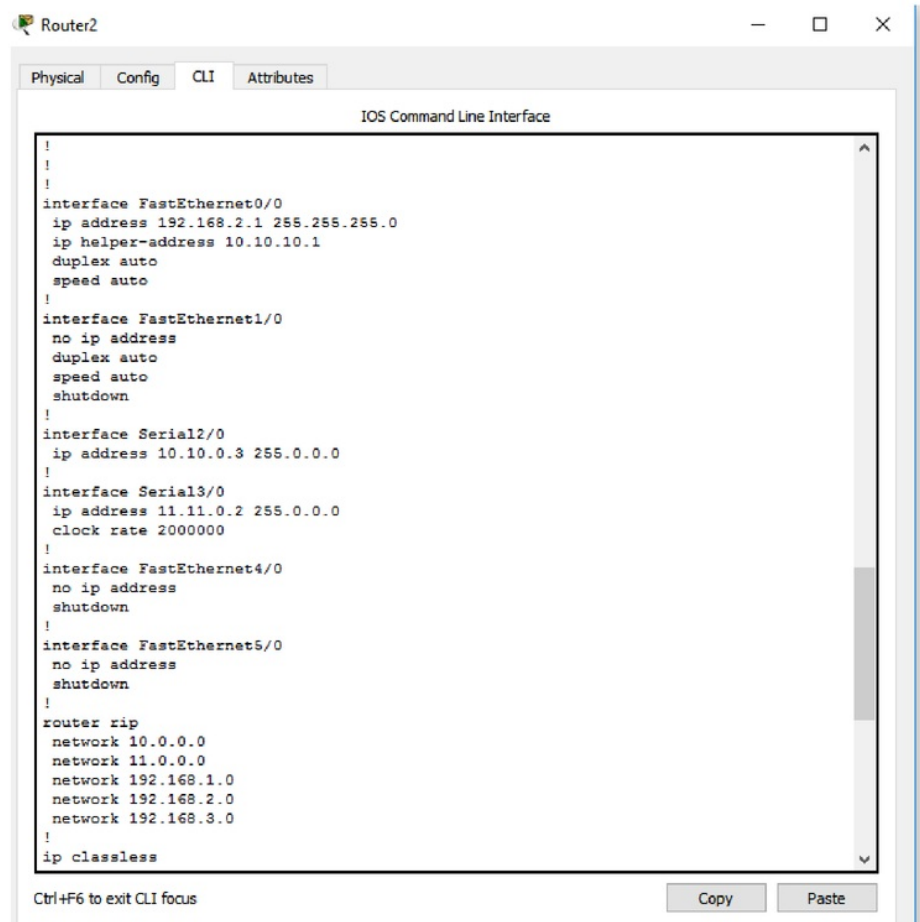
The screenshot shows a window titled "Router1" with tabs for "Physical", "Config", "CLI", and "Attributes". The "CLI" tab is active, displaying the "IOS Command Line Interface". The configuration text is as follows:

```
!
!
!
interface FastEthernet0/0
ip address 192.168.1.254 255.255.255.0
duplex auto
speed auto
!
interface FastEthernet1/0
no ip address
duplex auto
speed auto
shutdown
!
interface Serial2/0
ip address 10.10.10.1 255.0.0.0
clock rate 2000000
!
interface Serial3/0
no ip address
clock rate 2000000
!
interface FastEthernet4/0
no ip address
shutdown
!
interface FastEthernet6/0
no ip address
shutdown
!
router rip
network 10.0.0.0
network 11.0.0.0
network 100.0.0.0
network 150.168.0.0
network 192.168.1.0
!
ip classless
!
ip flow-export version 9
!
!
!
!
!
!
line con 0
!
line aux 0
!
line vty 0 4
login
!
!
end
```

At the bottom of the window, there is a status bar that says "Ctrl+F6 to exit CLI focus" and two buttons labeled "Copy" and "Paste".

However router 2 and router 3 must be assigned as the helper addresses and the IP exclusions must also be added. This is done so that the PCs aren't assigned random values by the routers and that it follows the layout created earlier. Below is the command for router 2 (Figure 9)

Figure 9: Router 2 command table.



The screenshot shows a window titled "Router2" with tabs for Physical, Config, CLI, and Attributes. The CLI tab is active, displaying the "IOS Command Line Interface" with the following configuration:

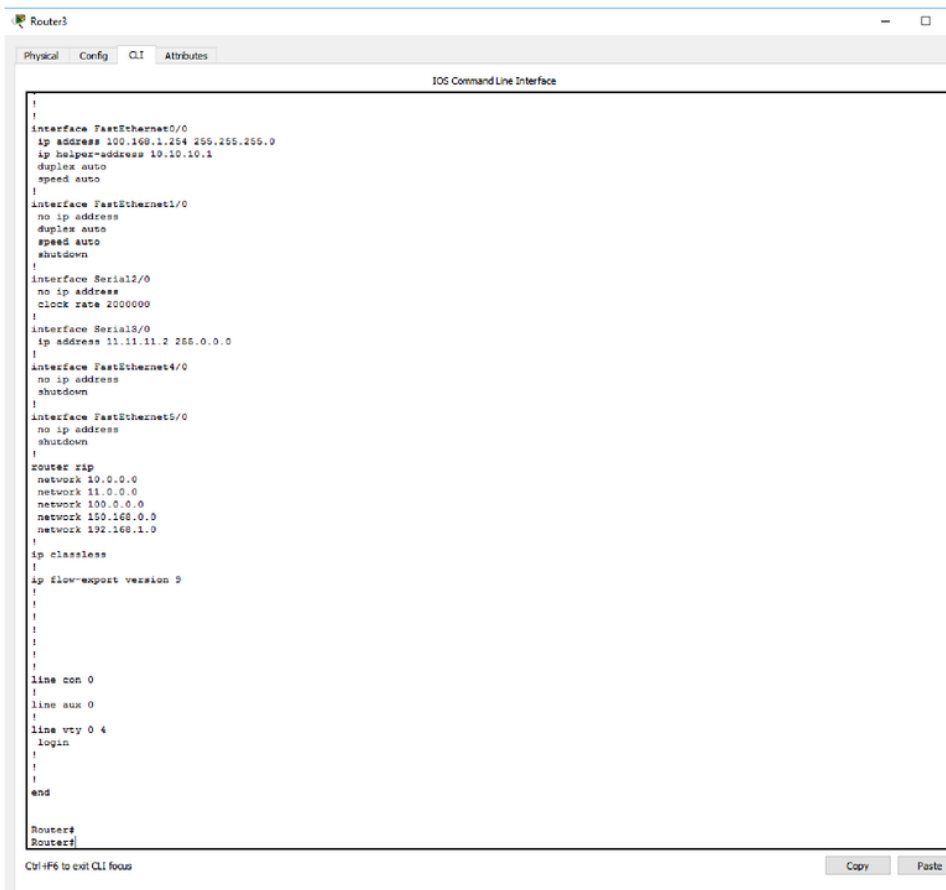
```
!
!
!
interface FastEthernet0/0
ip address 192.168.2.1 255.255.255.0
ip helper-address 10.10.10.1
duplex auto
speed auto
!
interface FastEthernet1/0
no ip address
duplex auto
speed auto
shutdown
!
interface Serial2/0
ip address 10.10.0.3 255.0.0.0
!
interface Serial3/0
ip address 11.11.0.2 255.0.0.0
clock rate 2000000
!
interface FastEthernet4/0
no ip address
shutdown
!
interface FastEthernet5/0
no ip address
shutdown
!
router rip
network 10.0.0.0
network 11.0.0.0
network 192.168.1.0
network 192.168.2.0
network 192.168.3.0
!
ip classless
```

Below the CLI window, there is a status bar with "Ctrl+F6 to exit CLI focus" and buttons for "Copy" and "Paste".

helper addresses are configured

And finally the same thing was done to router 3 which can be seen below (Figure 10).

Figure 10: Router 3 command table.



```
Router3
Physical Config CLI Attributes
IOS Command Line Interface
!
interface FastEthernet0/0
ip address 100.168.1.254 255.255.255.0
ip helper-address 10.10.10.1
duplex auto
speed auto
!
interface FastEthernet1/0
no ip address
duplex auto
speed auto
shutdown
!
interface Serial12/0
no ip address
clock rate 2000000
!
interface Serial13/0
ip address 11.11.11.2 255.0.0.0
!
interface FastEthernet4/0
no ip address
shutdown
!
interface FastEthernet5/0
no ip address
shutdown
!
router rip
network 10.0.0.0
network 11.0.0.0
network 100.0.0.0
network 150.168.0.0
network 192.168.1.0
!
ip classless
!
ip flow-export version 9
!
!
!
!
!
!
line con 0
!
line aux 0
!
line vty 0 4
login
!
!
end

Router#
Router#
```

Helper address is configured.

Once the PCs were switched to DHCP they were automatically assigned their IP address from the pool which was written in router 1 and starting from when the exclusions ended, this can be seen in the PC below (Figure 11).

Figure 11: PC IP table.

The screenshot shows the 'PC0' configuration window with tabs for Physical, Config, Desktop, Programming, and Attributes. The 'Config' tab is active, showing 'IP Configuration' and 'IPv6 Configuration' sections.

IP Configuration:

- ☒ DHCP (selected), ☐ Static
- IP Address: 192.168.1.12
- Subnet Mask: 255.255.255.0
- Default Gateway: 192.168.1.254
- DNS Server: 192.168.1.254

IPv6 Configuration:

- ☐ DHCP, ☐ Auto Config, ☒ Static
- IPv6 Address: [empty field] / [empty field]
- Link Local Address: FE80::2D0:FFFF:FE10:E007
- IPv6 Gateway: [empty field]
- IPv6 DNS Server: [empty field]

At the bottom left, there is a 'Top' button.

DHCP is tested but devices on the other routers need to be tested also to make sure the addresses are set dynamically.

Once again this system was tested by pinging the network from various point to ensure it was working correctly, the results of this test can be seen below. (Figure 12). The tesing showed that the system functioned as expected.

Figure 12: DHCP network test results.

	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC2	PC3	ICMP		0.000	N	0	(edit)	(delete)
	Successful	PC0	PC1	ICMP		0.000	N	1	(edit)	(delete)
	Successful	PC3	PC2	ICMP		0.000	N	2	(edit)	(delete)
	Successful	PC1	PC0	ICMP		0.000	N	3	(edit)	(delete)
	Successful	PC0	Router1	ICMP		0.000	N	4	(edit)	(delete)

This test shows the comms between all devices.

5. Conclusions and Recommendations

The Networks created to test each routing method functioned as predicted. However, some issues were found when pinging the systems during testing, this however turned out to be a glitch in the simulation software where there was a delay from assigning the IP addresses and before the system created the links. This resulted in the system showing the results of pinging the devices as a failure while later on showing them a success. During testing it was found that each method of routing addresses had its specific advantages however it was not clear from this test which of the three was the best.

Recommendation for more accurate testing would be to try and use less of the generic devices given by the software to allow testing of other devices with different cards. This will allow the differences of each one to be shown to see the advantages and disadvantages of each in a network and how they might need to be set up differently.

*Reasonable
conclusion.*

6.Evaluation

After carrying out the test and evaluating the results it can be seen the 3 different network routing methods each worked as intended, the DHCP network being the most difficult to setup as each router needed to be setup individually, while this system will work easily if left unaltered or if an additional PC or other device is added, if an additional router is added the helper address and pools will need to be changed and must be created in a way to not affect the exclusion list as adding a system that overlaps this will result in a system failure.

While it could not be concluded from the results carried out at this time which of the three methods was the best, based on the additional setup required to setup the DHCP system compared to STATIC and the RIP it can be said that the DHCP is only better when used in more complicated systems..

*Good
evaluati
on of
the
system.*

Part 2

7.Introduction

In the second part of the portfolio a 3-router network will be created using the class C addressing scheme the first instance will be done using a CIDR/28 scheme for the whole network. Once the network has been setup and is working correctly, the network will be adjusted to improve it by implementing 2 separate networks CIDR/30 for the 3 routers and CIDR/27 for the PCs on the individual routers. The systems that will be configured will be individually tested by pinging the devices from 1 PC to another on a different network.

8.System configuration requirements

To setup the systems the IP addresses for each of the routers and the PCs must be worked out the IP address that will be used for the base of the devices will be 192.168.10.xxx . The first one that will be worked out is the CIDR/28 using the subnet mask 255.255.255.240.

CIDR/28:

Egypt:

Subnet mask	1	1	1	1	0	0	0	0	255.255.255.240
	0	0	0	0	0	0	0	0	Not used
Network address 16	0	0	0	1	0	0	0	1	Lowest Host address 17
Network address 16	0	0	0	1	0	0	1	0	Next Host address 18
Default gateway	0	0	0	1	1	1	1	0	Fastethernet port 0/0 address 30
Broadcast address	0	0	0	1	1	1	1	1	Broadcast 31

Rome:

Subnet mask	1	1	1	1	0	0	0	0	255.255.255.240
	0	0	0	0	0	0	0	0	Not used
Network address 32	0	0	1	0	0	0	0	1	Lowest Host address 33
Network address 32	0	0	1	0	0	0	1	0	Next Host address 34
Default gateway	0	0	1	0	1	1	1	0	Fastethernet port 0/0 address 46
Broadcast address	0	0	1	0	1	1	1	1	Broadcast 47

London:

Subnet mask	1	1	1	1	0	0	0	0	255.255.255.240
	0	0	0	0	0	0	0	0	Not used
Network address 48	0	0	1	1	0	0	0	1	Lowest Host address 49
Network address 48	0	0	1	1	0	0	1	0	Next Host address 50
Default gateway	0	0	1	1	1	1	1	0	Fastethernet port 0/0 address 62
Broadcast address	0	0	1	1	1	1	1	1	Broadcast 63

Egypt → Rome:

Egypt router	0	1	0	0	1	1	0	1	Fastethernet 0/1 address 77
Rome router	0	1	0	0	1	1	1	0	Fastethernet 0/0 address 78

Rome → London:

Rome router	0	1	0	1	1	1	0	1	Fastethernet 0/1 address 93
London router	0	1	0	1	1	1	1	0	Fastethernet 0/0 address 94

CIDR/28
addressing
scheme is
correct and all
networks have

London → Egypt:

London router	0	1	1	0	1	1	0	1	Fastethernet 0/1 address 109
Egypt router	0	1	1	0	1	1	1	0	Fastethernet 0/0 address 110

been assigned
ip subnet
addresses.

The next set of IP address that were worked out were for the CIDR/27 network setup and the CIDR/30 network.

CIDR/27:

VLSM 27 and 30 is the same as
CIDR so the terms here are
correct.

Egypt:

Subnet mask	1	1	1	0	0	0	0	0	255.255.255.224
	0	0	0	0	0	0	0	0	Not used
Network address 32	0	0	1	0	0	0	0	1	Lowest Host address 33
Network address 32	0	0	1	0	0	0	1	0	Next Host address 34
Default gateway	0	0	1	1	1	1	1	0	Fastethernet port 0/0 address 62
Broadcast address	0	0	1	1	1	1	1	1	Broadcast 63

Rome:

Subnet mask	1	1	1	0	0	0	0	0	255.255.255.224
	0	0	0	0	0	0	0	0	Not used
Network address 64	0	1	0	0	0	0	0	1	Lowest Host address 65
Network address 64	0	1	0	0	0	0	1	0	Next Host address 66
Default gateway	0	1	0	1	1	1	1	0	Fastethernet port 0/0 address 94
Broadcast address	0	1	0	1	1	1	1	1	Broadcast 95

London:

Subnet mask	1	1	1	0	0	0	0	0	255.255.255.224
	0	0	0	0	0	0	0	0	Not used
Network address 96	0	1	1	0	0	0	0	1	Lowest Host address 97
Network address 96	0	1	1	0	0	0	1	0	Next Host address 98
Default gateway	0	1	1	1	1	1	1	0	Fastethernet port 0/0 address 126
Broadcast address	0	1	1	1	1	1	1	1	Broadcast 127

CIDR/30:

Egypt:

Subnet mask	1	1	1	0	0	0	0	0	255.255.255.252
	0	0	0	0	0	0	0	0	Not used
Network address 4	0	0	0	0	0	1	0	1	Lowest Host address 5
Network address 4	0	0	0	0	0	1	1	0	Next Host address 6
Broadcast address	0	0	0	0	0	1	1	1	Broadcast 7

Rome:

Subnet mask	1	1	1	0	0	0	0	0	255.255.255.252
	0	0	0	0	0	0	0	0	Not used
Network address 8	0	0	0	0	1	0	0	1	Lowest Host address 9
Network address 8	0	0	0	0	1	0	1	0	Next Host address 10
Broadcast address	0	0	0	0	1	1	0	0	Broadcast 11

London:

Subnet mask	1	1	1	0	0	0	0	0	255.255.255.252
	0	0	0	0	0	0	0	0	Not used
Network address 12	0	0	0	0	1	1	0	1	Lowest Host address 13
Network address 12	0	0	0	0	1	1	1	0	Next Host address 14
Broadcast address	0	0	0	0	1	1	1	1	Broadcast 15

ACL:

VLSM is assigned and ready for implementation.

PCA1

Gate address	192.168.10.62
IP address	192.168.10.33
Subnet mask	255.255.255.224

PCA2

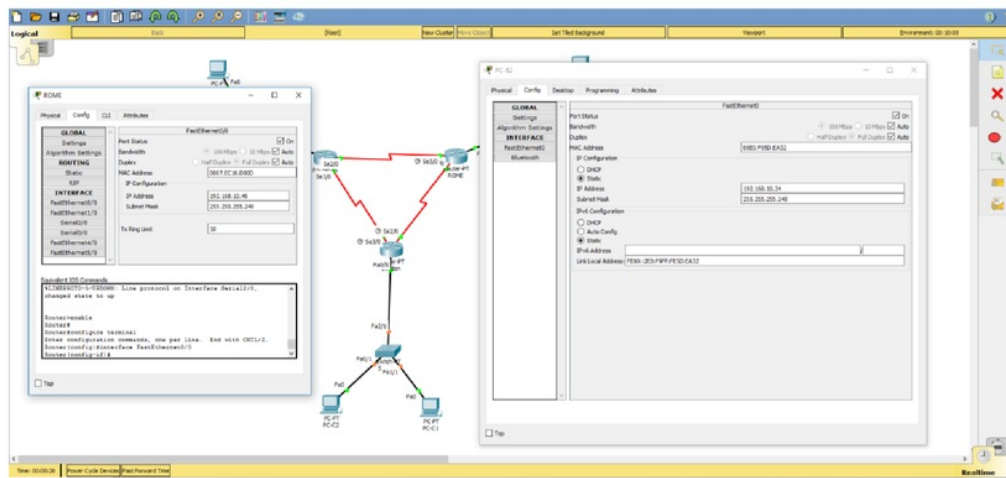
Gate address	192.168.10.63
IP address	192.168.11.34
Subnet mask	255.255.255.224

9.Implementation

CIDR/28:

The IP address from the table above were added to the devices for the CIDR/28 network which can see below. (Figure 13)

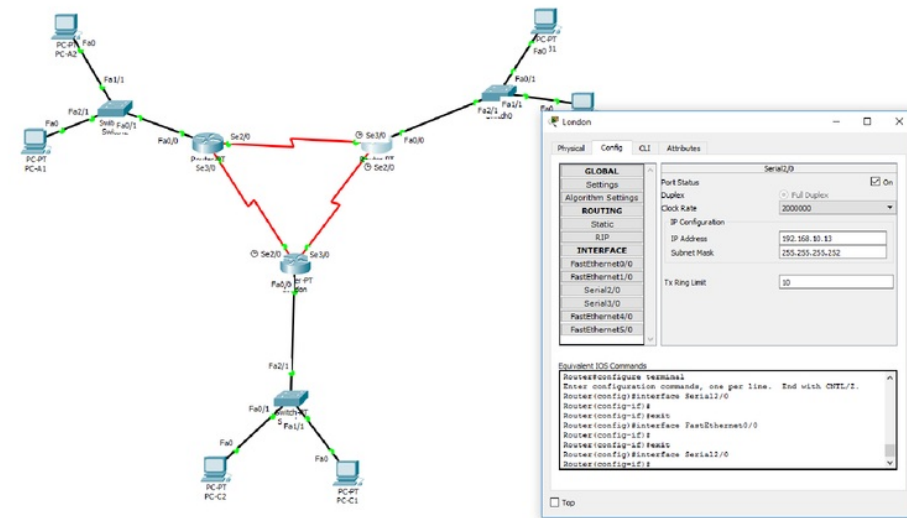
Figure 13: Setting up the CIDR/28 network.



CIDR/27 and CIDR/30:

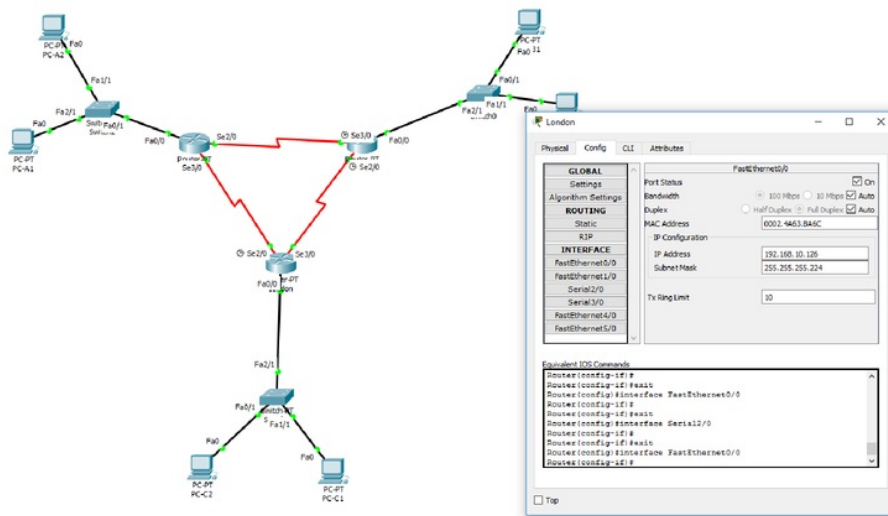
Once the first network was completed they were separated into 2 separate networks to create the new network, the first one to be implemented was the CIDR/30 network for the 3 routers. (Figure 14)

Figure 14: CIDR/30 network.



Once the first network was setup the CIDR/27 network for the PCs was setup. (Figure 15)

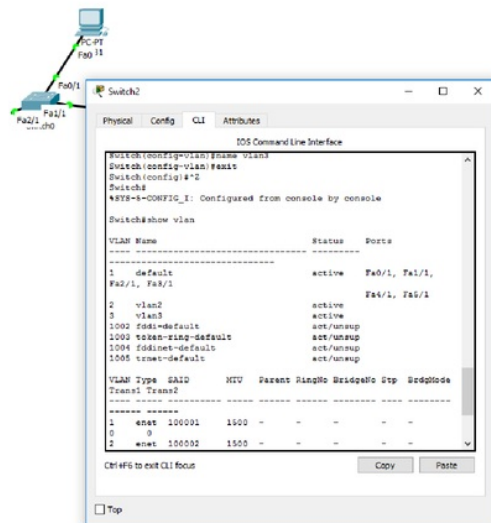
Figure 15: CIDR/27 network.



Vlan:

The next part of the network was to adjust it so that two PCs with different IP addresses can still talk to other networks by using a vlan setup. (Figure 16,17,18,19 and 20). During the setup the command dot1q was needed to setup the router which is used to allow the encapsulation of the information being sent on a specified sub interface determined by the fastethernet port used in its designation and allows a range configuration to be setup.

Figure 16: Adding the vlans.



Tests
showing
VLSM
CIDR
routing
the
image
s are
very
small
to see
any
detail.

Figure 17: Addressing the ports to the vlans.

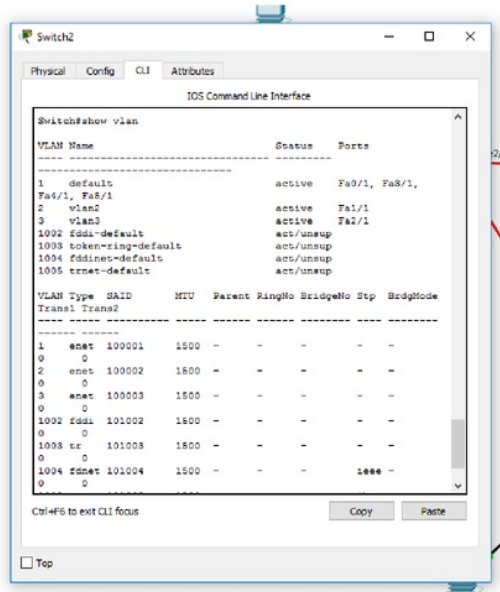
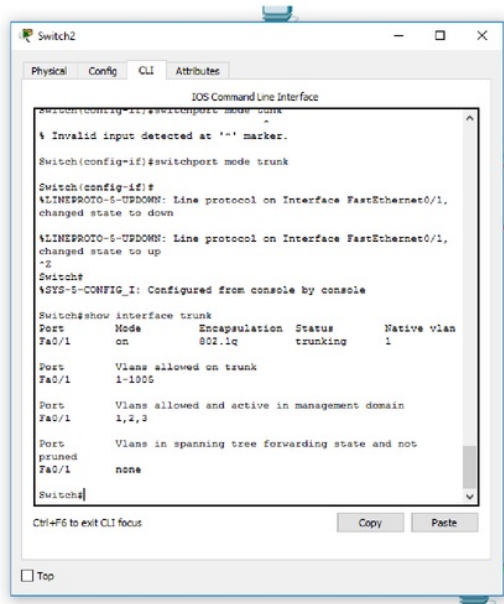


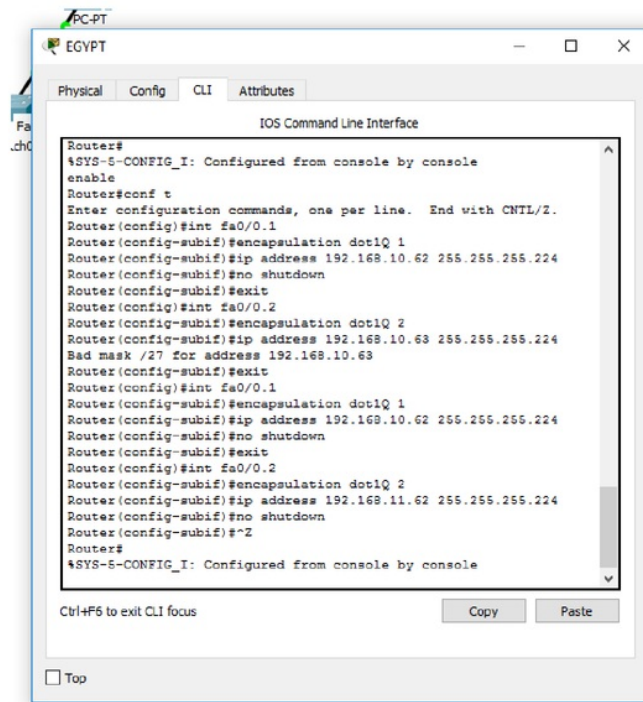
Image showing VLANs configured.

Figure 18: Setting up the trunk interface.



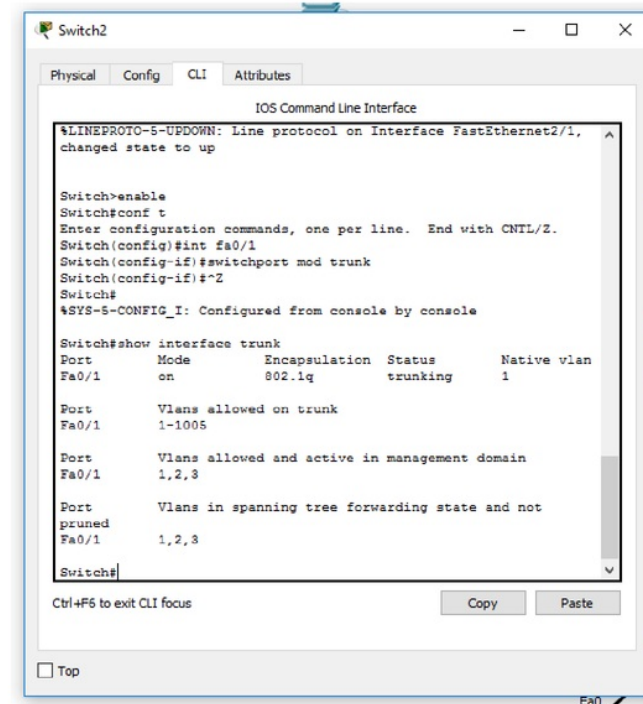
Trunk interface configured for inter VLAN routing.

Figure 19: Setting up the ports on the router.



Configuration of ports for sub interfaces are shown here.

Figure 20: Checking the trunk on the switch.



Trunk is confirmed by the switch report.

ACL:

The final alteration of the network is to configure an ACL router which will allow communication to one of the PCs and not the other on the same network. The first part that was carried out was to setup the router. (Figure 21 and Figure 22).

Figure 21: Setting up the router.



```
EGYPT
Physical Config CLI Attributes
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname Router
!
!
!
!
!
!
!
ip cef
no ipv6 cef
!
!

Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int fa0/0
Router(config-if)#ip access-group
% Incomplete command.
Router(config-if)#ip access-group?
access-group
Router(config-if)#ip access-group 1 out
Router(config-if)#^Z
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#access-list 1?
<1-99>
Router(config)#access-list 1 deny 192.168.11.63 0.0.0.0
Router(config)#access-list 1 permit any
Router(config)#^Z
Router#
%SYS-5-CONFIG_I: Configured from console by console

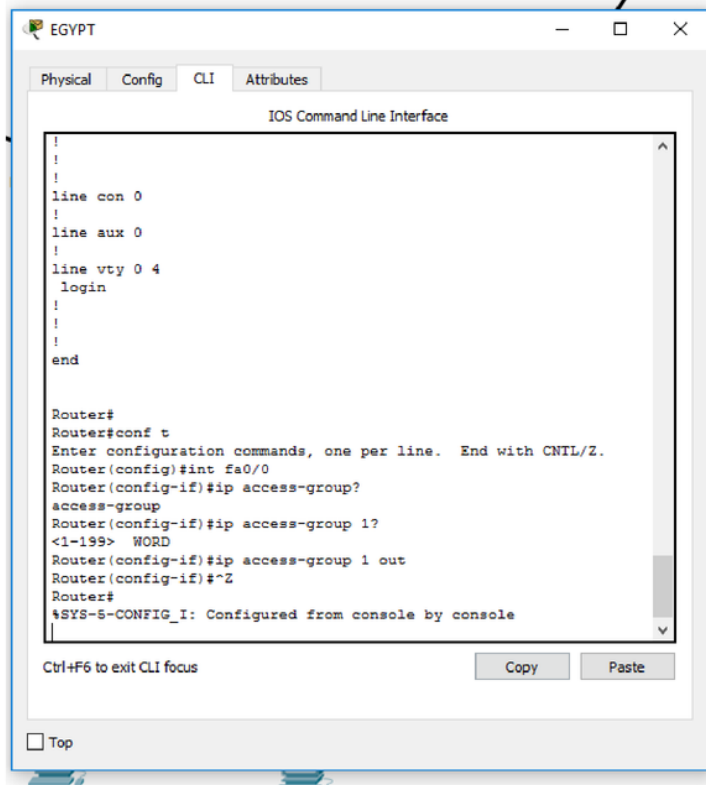
Router#show run
Building configuration...

Current configuration : 1119 bytes
!
version 12.2
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname Router
!
!
!
!
!
!
!
!
ip cef
no ipv6 cef
```

Ctrl+F6 to exit CLI focus

ACL is
set up
for
denial
of
service
for the
ip
addres
s
shown.

Figure 22: Access group.



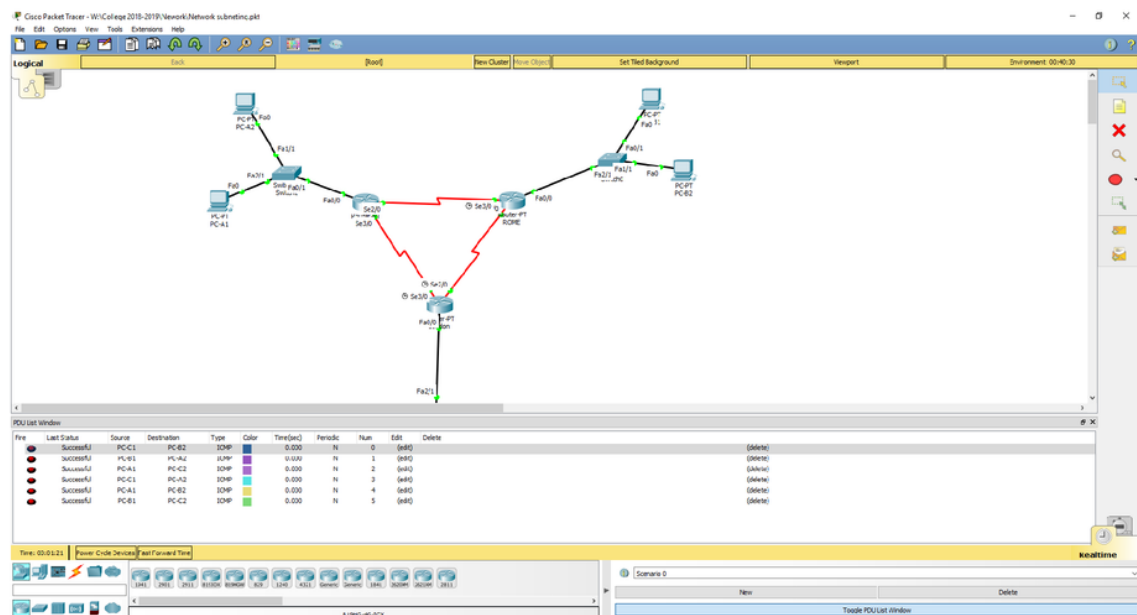
10. Testing and analysis

Once the networks were setup they were then tested by pinging from one device to another to test the functionality of the system.

CIDR/28:

The testing for the network was carried out by pinging from one device to another on a different router, this was done both sending and receiving through each router as shown below (Figure 23)

Figure 23: Testing the CIDR/28 network.

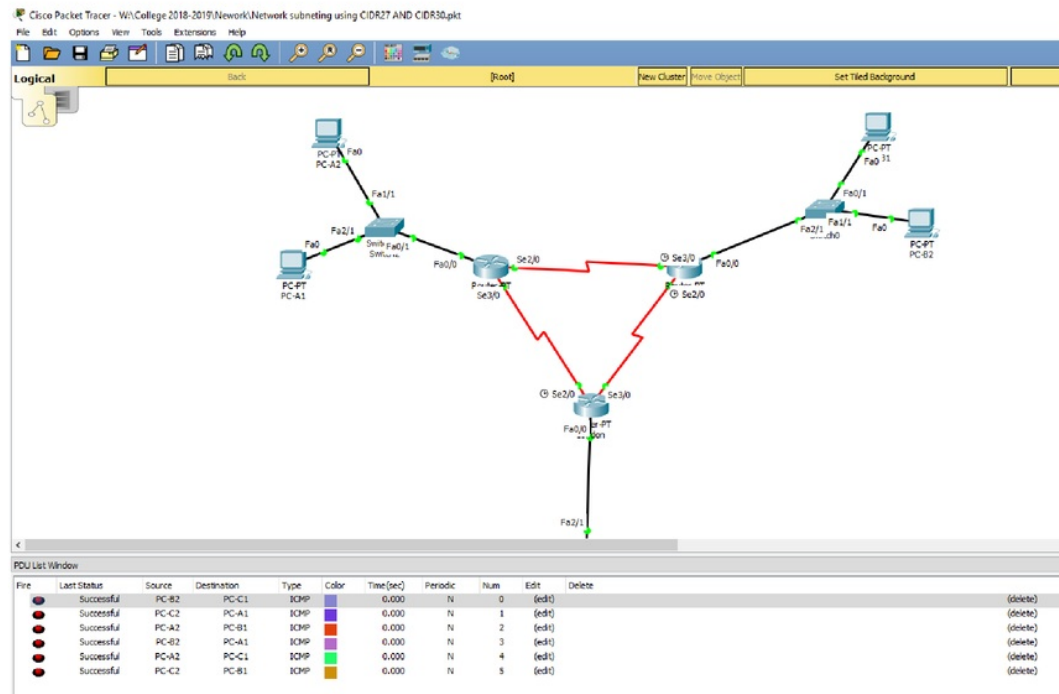


Tests are good
for CIDR/28.

CIDR/27 and CIDR/30:

This network was tested by pinging from device to device on each of the networks (Figure 24).

Figure 24: Testing the CIDR/27 and CIDR/30 networks.

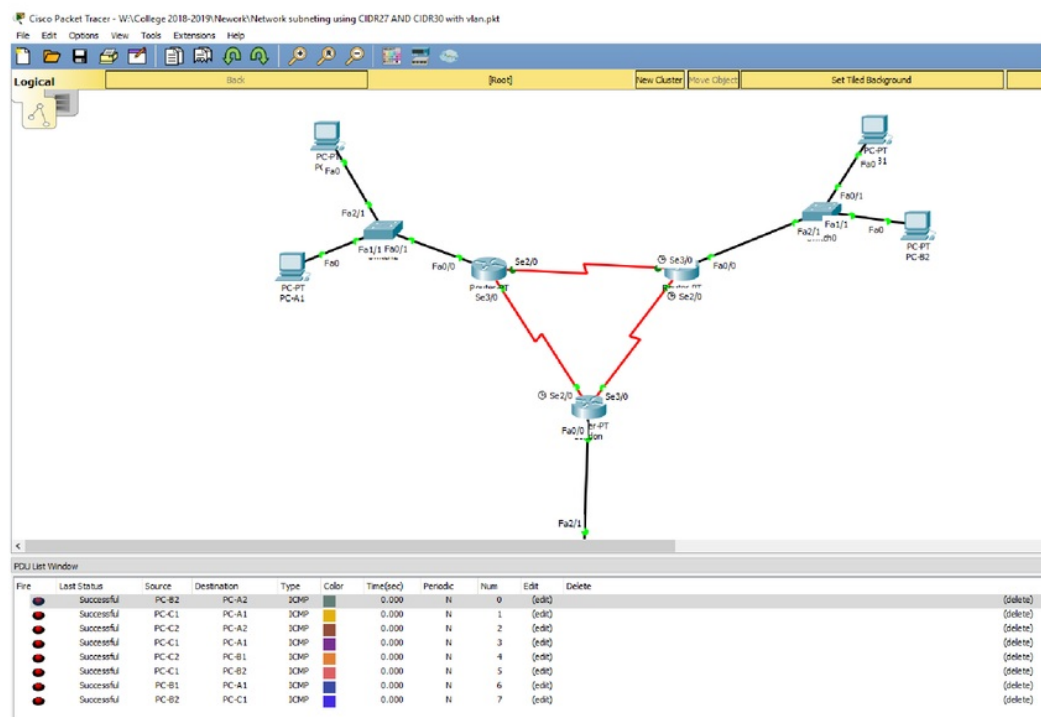


VLSM
tests are
good.

Vlan:

The same test was carried out on the Vlan network as the devices were pinged from 1 device to the other. (Figure 25).

Figure 25: Testing the Vlan network.

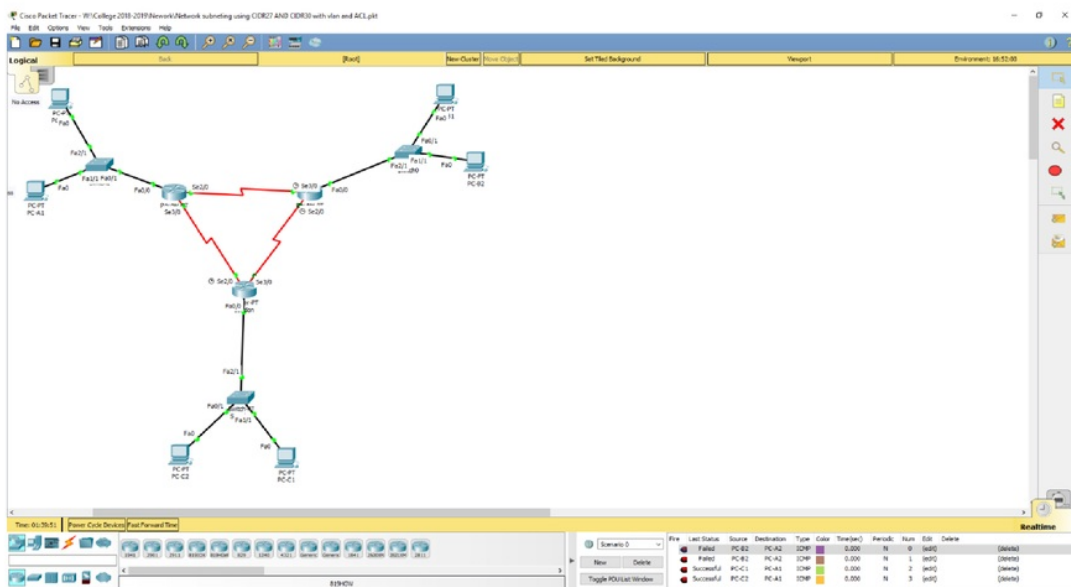


*Vlan test
shows inter
Vlan routing is
correct.*

ACL:

The final network to be tested was the ACL network where one of the devices on the Egypt network would be able to access the other devices while the other one will not be able to. (figure 26).

Figure 26: Testing the ACL network.



ACL test showing denial of service for the given ip address.

11.Evaluation

During testing the CIDR/28 functioned the first time around with no issues found the test was carried out however the first set of results showed failure to communicate this became apparent that the fault was due to the PCs and routers processing the information as after a while it worked with no issues. Bearing in mind the previous faults the testing of the CIDR/27 and CIDR/30 network was easier however it still had an issue this was due to the subnet mask mistakenly not being changed on one of the router fast Ethernet ports connecting to the switch, once rectified the system worked correctly.

The easiest network to setup was by far the CIDR/28 as there was only 1 subnet mask required to be used throughout however it was quite an inefficient choice as there were addresses that were left spare taking up space that could be used in other network systems, however it does leave room for expansion on the system. Whereas the CIDR/27 and CIDR/30 were more efficient in their allocation of the IP addresses and since the 2 networks were separated by the different subnet masks it will add an extra layer of security as if the network used for the PC's was damaged or crashed it would leave the network joining the routers left intact, the drawback of this method is that there is little room for expansion.

By comparison to the CIDR networks which were easy to setup however limited in their use the Vlan and ACL allowed fine tuning of the system using the command interface on the switches and the routers, however due to this there was a larger possibility for errors to be made by excluding the wrong IP addresses in the command or by overwriting the information already in place. However, if setup correctly accessing certain devices becomes easier to setup and the utility of the devices is also improved.

The evaluation shows there are worthwhile procedures to go through to learn about the system before tackling a more difficult task this is a prototype method which works well with this type of system.

Part 3

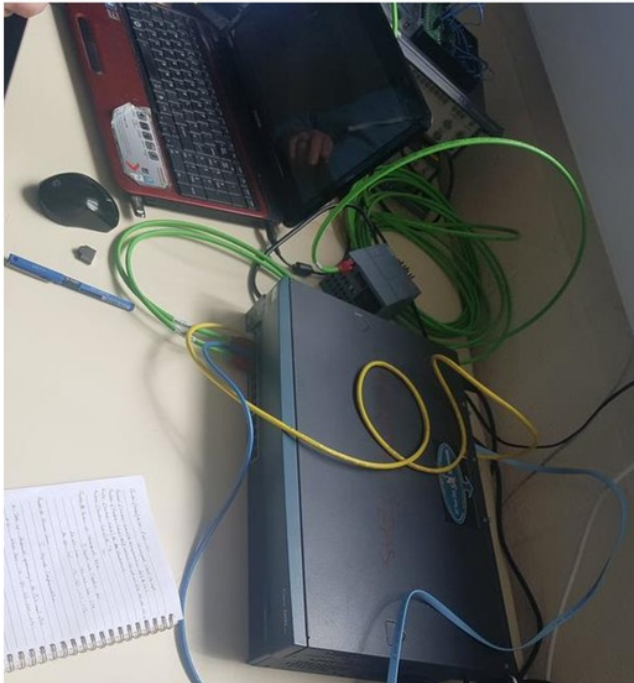
12.Introduction

In the final part of the portfolio a PLC was connected to an online web browser to read the inputs that have been set or force outputs using the online webpage. To do this a vlan was created to allow communication between the PLC and the 2 laptops that will be connected to the network.

13. Creating the Vlan network

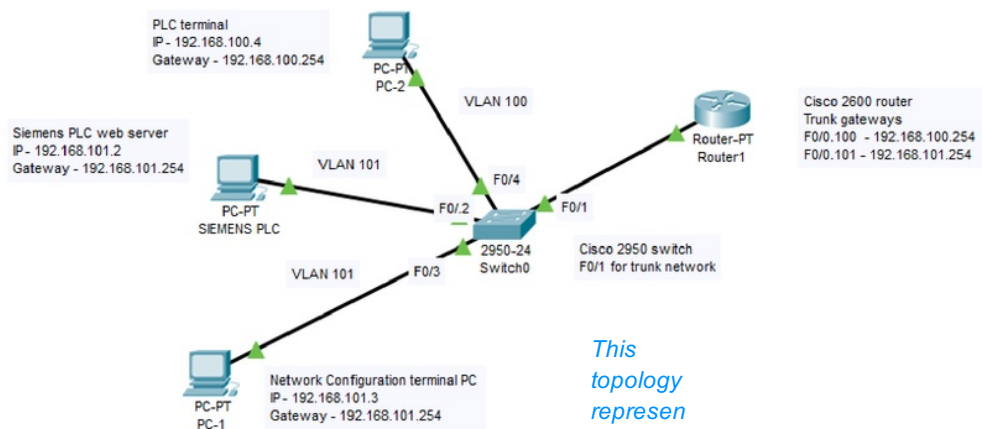
To allow communication between the PLC and the 2 laptops that will be used a Vlan network will be setup (Figure 28) using 1 router and a switch which can be seen below (Figure 27).

Figure 27: Practical setup.



Good image showing the hardware setup.

Figure 28: Vlan Network Topology.

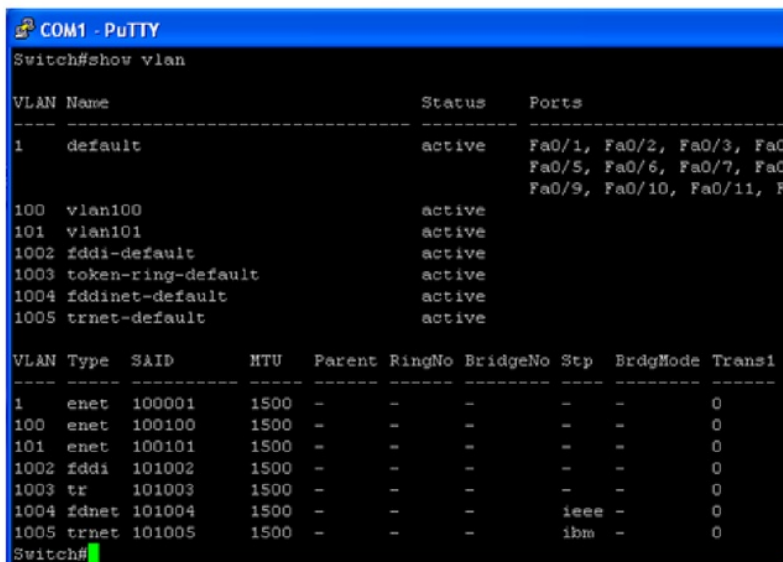


This topology represents the practical setup.

The first step to complete the network was to set the Vlans. Below is a screenshot of the results when requesting the Vlans through the switch (figure 29).

```
Switch>enable
Switch#conf t
Switch(config)#vlan 100
Switch(config-vlan)#name vlan100
Switch(config-vlan)#exit
Switch(config)#vlan 101
Switch(config-vlan)#name vlan101
Switch(config-vlan)#exit
Switch(config)#^Z
Switch#show vlan
```

Figure 29: Vlan list on the switch.



VLAN	Name	Status	Ports
1	default	active	Fa0/1, Fa0/2, Fa0/3, Fa0/4, Fa0/5, Fa0/6, Fa0/7, Fa0/8, Fa0/9, Fa0/10, Fa0/11, Fa0/12
100	vlan100	active	
101	vlan101	active	
1002	fddi-default	active	
1003	token-ring-default	active	
1004	fddinet-default	active	
1005	trnet-default	active	

VLAN	Type	SAID	MTU	Parent	RingNo	BridgeNo	Stp	BrdgMode	Transl
1	enet	100001	1500	-	-	-	-	-	0
100	enet	100100	1500	-	-	-	-	-	0
101	enet	100101	1500	-	-	-	-	-	0
1002	fddi	101002	1500	-	-	-	-	-	0
1003	tr	101003	1500	-	-	-	-	-	0
1004	fdnet	101004	1500	-	-	-	ieee	-	0
1005	trnet	101005	1500	-	-	-	ibm	-	0

Vlans are set but no interfaces are configured.

Once the Vlans were setup they needed ports to be allocated to them (Figure 30).

```
Switch#conf t
Switch(config)#int f0/2
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 101
Switch(config-if)#exit
```

```
Switch(config)#int f0/3
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 101
Switch(config-if)#exit
```

```
Switch(config)#int f0/4
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 100
Switch(config-if)#exit
Switch(config)#^Z
Switch#
Switch#show vlan
```

The code here is exactly the same as the CAD system code

Figure 30: Allocating ports to the Vlans.

VLAN	Name	Status	Ports
1	default	active	Fa0/1, Fa0/5, Fa0/6, Fa0/7, Fa0/8, Fa0/9, Fa0/10, Fa0/11, Fa0/12
100	vlan100	active	Fa0/4
101	vlan101	active	Fa0/2, Fa0/3
1002	fddi-default	active	
1003	token-ring-default	active	
1004	fddinet-default	active	
1005	trnet-default	active	

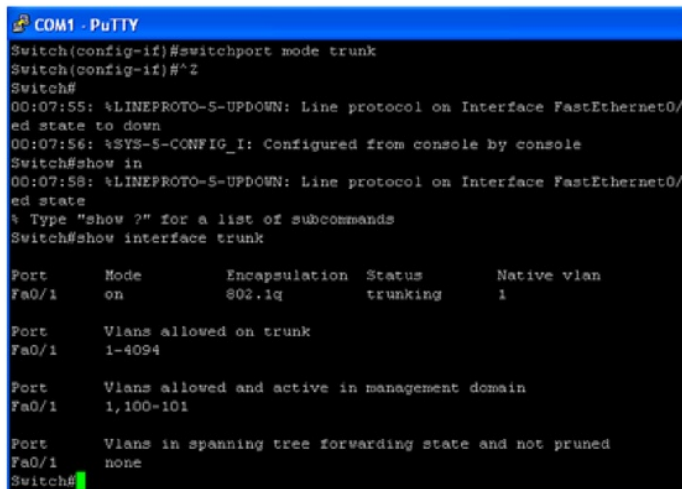
VLAN	Type	SAID	MTU	Parent	RingNo	BridgeNo	Stp	BrdgMode	Trans1	Trans2
1	enet	100001	1500	-	-	-	-	-	0	0
100	enet	100100	1500	-	-	-	-	-	0	0
101	enet	100101	1500	-	-	-	-	-	0	0
1002	fddi	101002	1500	-	-	-	-	-	0	0
1003	tr	101003	1500	-	-	-	-	-	0	0
1004	fdnet	101004	1500	-	-	-	ieee	-	0	0
1005	trnet	101005	1500	-	-	-	ibm	-	0	0

Vlans active with interface configuration.

The final part that is needed to setup the switch is to add the trunking to allow the 2 subnets to talk across the same router port (figure 31).

```
Switch#conf t
Switch(config)#int f0/1
Switch(config-if)#switchport mode trunk
Switch(config-if)#^Z
Switch#
Switch#show interface trunk
```

Figure 31: Setting the switch trunking port.



```
COM1 - PuTTY
Switch(config-if)#switchport mode trunk
Switch(config-if)#^Z
Switch#
00:07:55: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/
ed state to down
00:07:56: %SYS-5-CONFIG_I: Configured from console by console
Switch#show in
00:07:58: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/
ed state
% Type "show ?" for a list of subcommands
Switch#show interface trunk

Port      Mode      Encapsulation  Status        Native vlan
Fa0/1     on        802.1q         trunking      1

Port      Vlans allowed on trunk
Fa0/1     1-4094

Port      Vlans allowed and active in management domain
Fa0/1     1,100-101

Port      Vlans in spanning tree forwarding state and not pruned
Fa0/1     none
Switch#
```

Trunking is configured for inter Vlan routing.

For setting up the router the 2 subnet masks are added to the port connecting the router to the switch so the router can identify the 2 different gateway addresses. (Figure 32)

```
Router>enable
Router#conf t
Router(config)#int f0/0
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#int f0/0
Router(config-if)#no ip address
Router(config-if)#exit
```

```

Router(config)#int f0/0.100
Router(config-subif)#encapsulation dot1Q 100
Router(config-subif)#ip address 192.168.100.254 255.255.255.0
Router(config-subif)#no shutdown
Router(config-subif)#exit

```

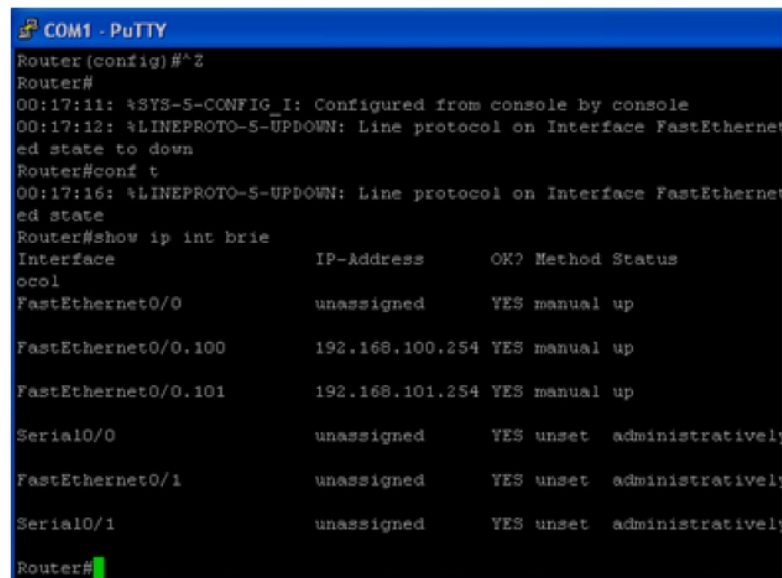
```

Router(config)#int f0/0.101
Router(config-subif)#encapsulation dot1Q 101
Router(config-subif)#ip address 192.168.101.254 255.255.255.0
Router(config-subif)#no shutdown
Router(config-subif)#exit
Router(config)#^Z

```

```
Router#show ip interfaces brie
```

Figure 32: Showing sub interfacing and gateways assigned.



The screenshot shows a PuTTY terminal window titled 'COM1 - PuTTY'. The user has entered the command 'Router#show ip int brie'. The output displays a table of interfaces and their configurations. The first two sub-interfaces, FastEthernet0/0.100 and FastEthernet0/0.101, are configured with IP addresses 192.168.100.254 and 192.168.101.254 respectively, both with 'manual' status and 'up' state. The other interfaces (FastEthernet0/0, Serial0/0, FastEthernet0/1, Serial0/1) are 'administratively down'.

Interface	IP-Address	OK?	Method	Status
FastEthernet0/0	unassigned	YES	manual	up
FastEthernet0/0.100	192.168.100.254	YES	manual	up
FastEthernet0/0.101	192.168.101.254	YES	manual	up
Serial0/0	unassigned	YES	unset	administratively down
FastEthernet0/1	unassigned	YES	unset	administratively down
Serial0/1	unassigned	YES	unset	administratively down

All systems are up.

The final stage of the setup for the router is to run it to make sure there are no issues with the subnets or the gateway addresses with regards to the encapsulation otherwise the network wont work correctly. (Figure 33)

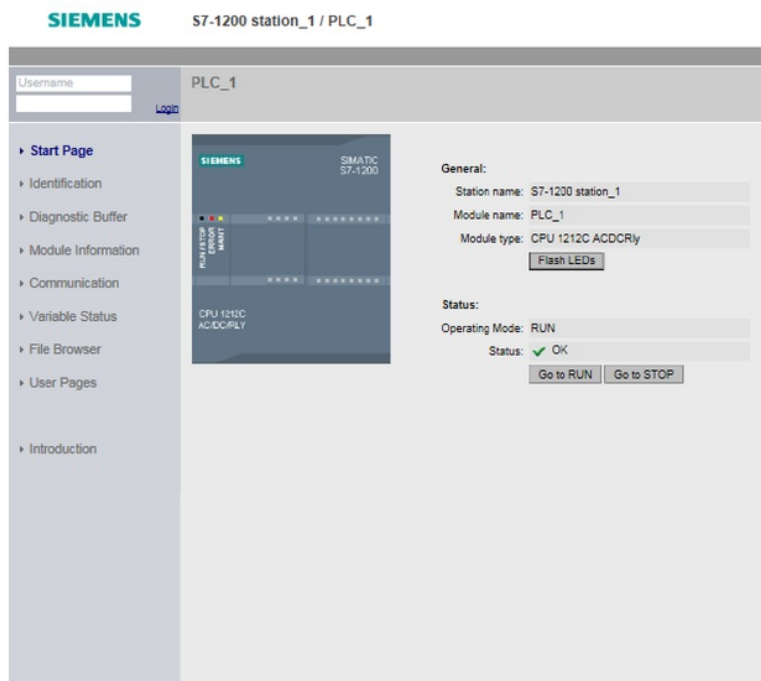
Figure 33: Router showing both encapsulations are set up correctly.

```
COM1 - PuTTY
!
!
interface FastEthernet0/0
no ip address
no ip directed-broadcast
duplex auto
speed auto
!
interface FastEthernet0/0.100
encapsulation dot1Q 100
ip address 192.168.100.254 255.255.255.0
no ip directed-broadcast
!
interface FastEthernet0/0.101
encapsulation dot1Q 101
ip address 192.168.101.254 255.255.255.0
no ip directed-broadcast
!
interface Serial0/0
no ip address
no ip directed-broadcast
no ip route-cache
shutdown
--More--
```

Ping tests show the inter Vlan routing working. The comms is working across the vlans.

Once the switch and the routers had been setup the S7-1200 PLCs web server had to be created (Figure 34) Which also shows the PLC has connected successfully to the network.

Figure 34: Image of the Siemens web server page.



PLC server is set up for the gateway address and the .htm program has been downloaded.

14. Testing the Vlan

During the testing we checked if the devices could communicate together and that the webpage could be read the information from the PLC and the PLC could receive commands from the webpage. The first test was pinging the 2 Vlan to make sure there were communications across the 2 (Figure 35).

Figure 35: Ping testing the vlan 100 and vlan 101.

```
C:\Users\Leils>ping 192.168.101.3

Pinging 192.168.101.3 with 32 bytes of data:
Reply from 192.168.101.3: bytes=32 time<1ms TTL=127
Reply from 192.168.101.3: bytes=32 time<1ms TTL=127
Reply from 192.168.101.3: bytes=32 time<1ms TTL=127
Reply from 192.168.101.3: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.101.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\Users\Leils>ping 192.168.101.2

Pinging 192.168.101.2 with 32 bytes of data:
Request timed out.
Reply from 192.168.101.2: bytes=32 time=1ms TTL=29
Reply from 192.168.101.2: bytes=32 time=1ms TTL=29
Reply from 192.168.101.2: bytes=32 time=1ms TTL=29

Ping statistics for 192.168.101.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 1ms, Average = 1ms
```

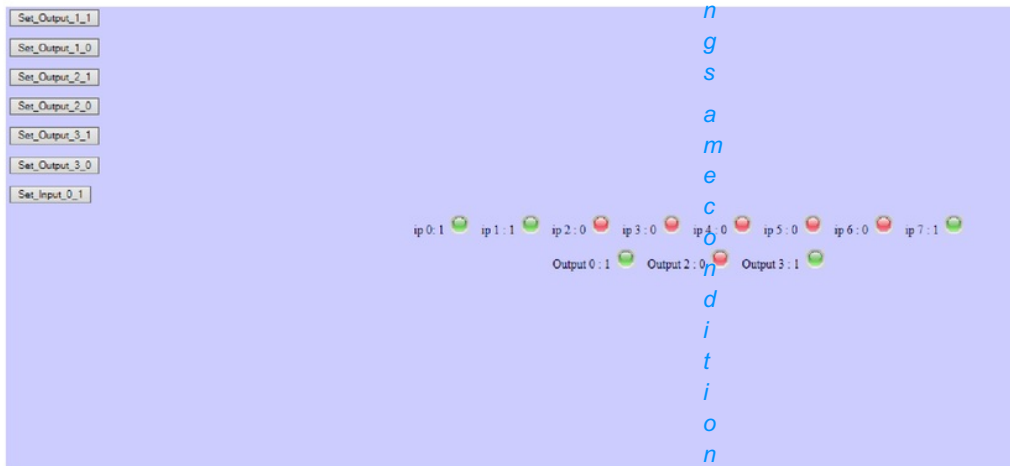
To test the reading and writing function of the webpage and the PLC values where set on both and compared to make sure they were working correctly. The first test can be seen below. (Figure 36 and 37).

*Vlan test to
the PLC.*

Figure 36: The outputs set on the PLC and the inputs being received from the webpage.



Figure 37: The webpage reading the outputs from the PLC and setting the Inputs.



This test was repeated to ensure the values changed correctly and that they were not showing incorrectly when changed, the results are shown below (Figure 38 and 39).

Figure 38: Image of the PLC for the second test.



web page control allows monitoring of inputs and setting of outputs on the PLC.

Figure 39: Image of the web browser for the second test.



15.Conclusion

After running test on both the Vlans, PLC and web browser control page the Vlan network used to control all the device has shown that it is working correctly with no issues that were found during the testing phase of the project and both the PLC and the web browser were able to read and write the information that was being set both ways with no discrepancies between the 2. If required the web page can have more pages added to it similar to a HMI screen however the web page can be accessed from multiple devices as long as they can access the network. Where the current setup requires a hard connection to be in place to allow this an improvement to the network would be to add a wireless adaptor to allow communication to other devices without the need to have a coms cable being run to it.

*Conclusion is
reasonable and the
wireless option is a
good
recommendation.
The advantages of
web pages have
been identified.*

16.Citation List

SearchNetworking. *OSI model (Open Systems Interconnection)*. Available: <https://searchnetworking.techtarget.com/definition/OSI>. Last accessed 28th December 2018.

DEVIQ. *Encapsulation*. Available: <https://deviq.com/encapsulation/>. Last accessed 28th December 2018.

Firewall.CX. *Network Broadcasting*. Available: <http://www.firewall.cx/networking-topics/general-networking/109-network-broadcast.html>. Last accessed 28th December 2018.

Techopedia. *Port Number*. Available: <https://www.techopedia.com/definition/15702/port-number>. Last accessed 28th December 2018.

Aled Edgell Network Portfolio

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

Instructor

59/100

PAGE 1

PAGE 2

Text Comment. Good list of contents

PAGE 3

PAGE 4

Text Comment. Figures are appropriately named and easily identified.

PAGE 5

Text Comment. Reasonable introduction.

PAGE 6

Text Comment. There should be more sources researched here and images should have been used to support the explanation. Some of the research has good points but without diagrams it is not clear.

PAGE 7

Text Comment. The ip addressing scheme is correct. The three classes are used in the LANs and the WAN serial is your choice.

PAGE 8

Text Comment. Good diagram with tests proving good.

PAGE 9

Text Comment. Tests good using static routing.

PAGE 10

Text Comment. RIP routing configuration

PAGE 11

PAGE 12

Text Comment. RIP routing is configured on all routers.

Text Comment. No tests are carried out for RIP routing.

PAGE 13

Text Comment. DHCP configuration showing excluded address range.

PAGE 14

PAGE 15

Text Comment. helper addresses are configured

PAGE 16

Text Comment. Helper address is configured.

PAGE 17

Text Comment. DHCP is tested but devices on the other routers need to be tested also to make sure the addresses are set dynamically.

Text Comment. This test shows the comms between all devices.

PAGE 18

Text Comment. Reasonable conclusion.

PAGE 19

Text Comment. Good evaluation of the system.

PAGE 20

Text Comment. CIDR/28 addressing scheme is correct and all networks have been assigned ip subnet addresses.

Text Comment. VLSM 27 and 30 is the same as CIDR so the terms here are correct.

Text Comment. VLSM is assigned and ready for implementation.

Text Comment. Tests showing VLSM (CIDR) running. the images are very small to see any detail.

Text Comment. Image showing Vlans configured.

Text Comment. Trunk interface configured for inter Vlan routing.

Text Comment. Configuration of ports for sub interfaces are shown here.

Text Comment. Trunk is confirmed by the switch report.

Text Comment. ACL is set up for denial of service for the ip address shown.

Text Comment. Tests are good for CIDR/28.

Text Comment. VLSM tests are good.

Text Comment. Vlan test shows inter Vlan routing is correct.

Text Comment. ACL test showing denial of service for the given ip address.

Text Comment. The evaluation shows there are worthwhile procedures to go through to learn about the system before tackling a more difficult task this is a prototype method which works well with this type of system.

Text Comment. Good image showing the hardware setup.

Text Comment. This topology represents the practical setup.

Text Comment. Vlans are set but no interfaces are configured.

Text Comment. The code here is exactly the same as the CAD system code which was implemented earlier.

Text Comment. Vlans active with interface configuration.

Text Comment. Trunking is configured for inter Vlan routing.

Text Comment. All systems are up.

Text Comment. Ping tests show the inter Vlan routing working. The comms is working across the vlans.

Text Comment. PLC server is set up for the gateway address and the .htm program has been downloaded.

Text Comment. Vlan test to the PLC.

Text Comment. PLC showing same conditions set by web page functions.

Text Comment. web page control allows monitoring of inputs and setting of outputs on the PLC.

Text Comment. Conclusion is reasonable and the wireless option is a good recommendation. The advantages of web pages have been identified.

GRADING FORM: CSG-RUBIC

ALED EDGELL

59

RESEARCH-INFORMED LITERATURE



Research has been carried out but more sources

are required and there are no images / diagrams to support your explanations. 4/10

4/10

KNOWLEDGE AND UNDERSTANDING



Element1. The simpler network system has been designed and implemented by defining the requirements from the larger system. Some of the images that are needed to support your explanations are too small to see any detail. 6/10
Element2. The network parameters were configured for the larger main network which included CIDR28, VLSM 27 and 30 implementation. This was done and tested. The six networks were all configured correctly with good understanding shown. 7/10
Element3. Practical configuration was completed and tested. Vlans all tested good and the PLC was programmed from across the Vlan using TIA software on a laptop PC. The web server was accessed using the ip address set on the PLC. Images were taken to prove the tests. There was no explanation of the HTML program in this element. 6/10

19/30

ANALYSIS



Element1. The test results showed the network operating as expected with no faults. The operation of the network was explained well and the images support the test results. There were tests results missing here. 2.5/5
Element2. The test results of the network configuration were successful and explained reasonably well. Each part of the

15/25

configuration was tested and explained where needed. The images were good and supported your explanations 7/10 Element3. The results from the practical network showed that the Vlans and inter Vlan routing was configured. This was confirmed by the programming and control of the PLC across Vlans. Images support the test results with this test. However there is no listing or explanation of the HTML program that was downloaded to the server or the web server configuration. 5.5/10

PRACTICAL APPLICATION AND DEP.



Element1. Design and implementation was achieved using good methods by which the address scheme of the three classes of ip address was designed first and then applied to the network for testing. Each LAN was tested individually before the WAN ports were configured. 3/5 Element2. Each section of this element was done separately. The CIDR/28 was implemented firstly and then the VLSM which is a form of CIDR was implemented and tested. The Vlans were implemented and tested. Tests proved positive. The ACL configuration provided the security which was implemented successfully. This was proved with testing by sending and receiving data packets. 3/5 Element3. Vlans were configured on the Cisco router and switch. The PLC program was done using a laptop on a separate Vlan. The PLC server was downloaded with a htm file and using the ip address of the PLC this was tested. There is no explanation of the HTML program that was downloaded to the PLC. 6/10

12/20



Element1. The quality of this element is very good and covers most of the requirements but there are parts missing and the diagrams are far too small.

3/5 Element2. This element covered all that was required. There are some spelling errors in the report. 3.5/5 Element3. This element covered most of the tasks in good detail but did not cover the HTML program. 2.5/5

9/15