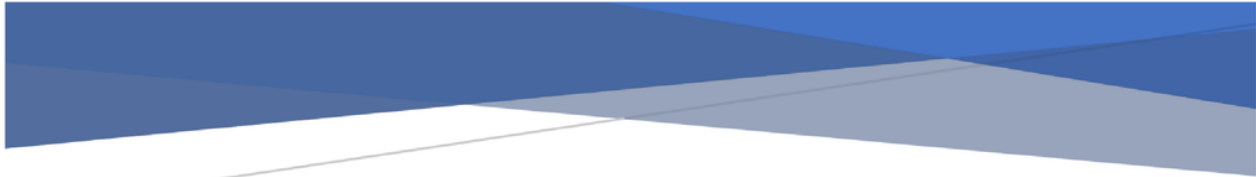


Networking Portfolio Dan Ince

by Daniel Ince

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HND ELECTRICAL & ELECTRONIC ENGINEERING

Networking Systems for Engineers

Portfolio (Elements 1, 2 & 3)

PSDE5034

Daniel Ince

21/05/19

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*Figures are named
appropriately and can be
identified.*

Element 1

This assignment involves research into network topology and design. The first part of the assignment involves setting up three LAN networks, all conjoined by WAN networks, these networks will be of different classes. Different routing methods will be used to establish communication between this networks, including static, RIP (Routing Information Protocol) and Dynamic.

*Informative introduction into the
tasks for element 1*

Research

OSI 7-layer model

OSI stands for Open Systems Interconnection and is used as a model for communication between networking systems. The first of these models is divided into 7 layers that assist each other in the networking process.

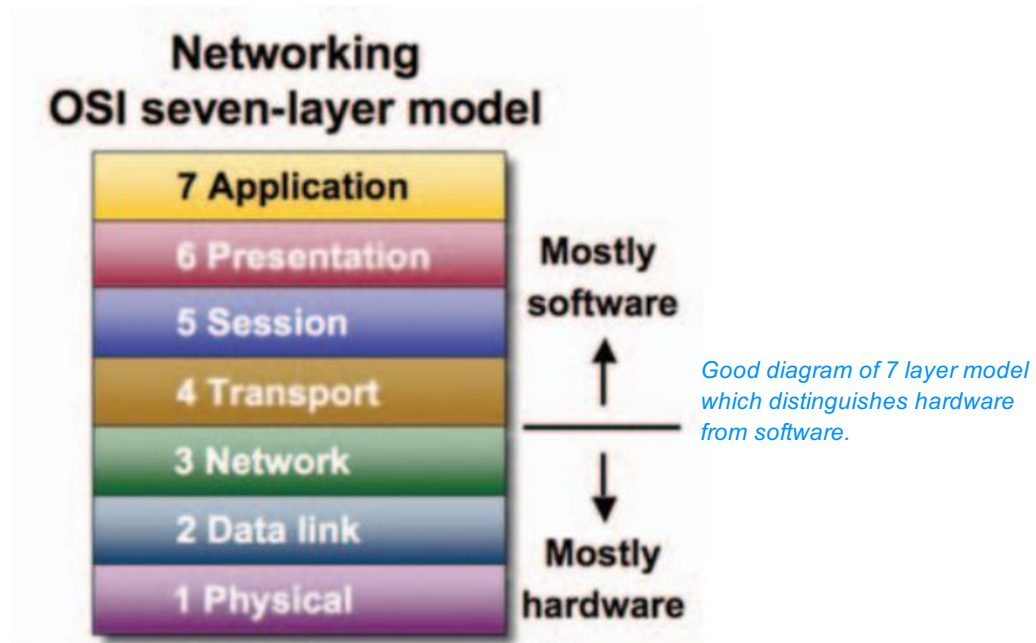


Figure 1: 7-layer model
http://ru6.cti.gr/bouras-old/WP_Simoneau_OSIModel.pdf

Figure 1 shows the hierarchy of the OSI 7-layer model, each tier organises the separate layers and allows for a system of communication which prevents chaos. Without this model, all the information would congeal into one layer and be impossible to understand.

This model incorporates protocols and rule to the system to set the standard and allow different computer systems to be interconnected through being standardized to ISO 7498-1.

An explanation for the 7-layer model is contained within the document *The OSI Model: Understanding the Seven Layers of Computer Networks*.

1. **Physical** – This defines the hardware and interface connections, such as the standard for plugs and sockets. It incorporates all the physical components required for the computer itself to communicate across the network.
2. **Data Link** – This layer is responsible for the device accessing the network and such determines network interface cards, ethernet switches and other network components. For example, the MAC address is used by an ethernet switch at layer 2. This layer affects both hardware such as switches, and software such as switches, that are responsible for directing network traffic.

3. **The Network** – Allows end to end addressing to allow information to pass several layer 2 networks. Internet Protocol (IP) addresses are layer 3 addresses that is responsible for allowing the connection to the internet from many devices around the world. Forms of routing, such as Routing Information Protocol (RIP) allow routers to communicate with each other by determining the shortest possible path between the two ends. Security can also be achieved at layer 3 as traffic can be filtered out if needed.
4. **Transport** – Responsible for the end to end communication, including functions such as message delivery confirmation, application identity, error detection, control of data transmission and data segmentation. Transmission Control Protocol (TCP) is working at layer 4 and deals with all the above functions and more.
5. **Session** – Tracks the amount of information exchanged within a certain session and manages the flow of data, including starting and stopping dialog.
6. **Presentation** – Formats the data ready for transmission across the network, allowing applications to understand the data. Extra security can be implemented at this level, such as encryption and decryption. Efficiency can also improve by compressing messages and formatting for graphics.
7. **Application** – This layer allows the end user to understand or access the data through the device which is connected to the network. It is responsible for access to the world wide web and emails. (Simoneau, 2006)

Explanation is very good and discusses the importance of standardisation.

TCP/IP 4-layer model

The TCP/IP 4-layer model performs the same functions as the OSI 7-layer model, however achieves it across 4 layers. Figure 2 shows the relationship between the 7-layer and 4-layer models.

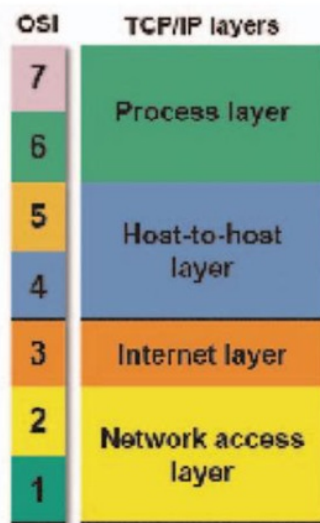


Figure 2: 4-layer model
http://ru6.cti.gr/bouras-old/WP_Simoneau_OSIModel.pdf

The TCP/IP model can achieve this because many of the OSI layers are equivalent to one layer in the 4-layer model. For example, the Network Access layer is equivalent as it performs the same function of the regulation of software and hardware accessing the network that the Data Link and Physical

layers do. This is largely the same with the other layers, however it depends on which protocol is being used, such as TCP or UDP. This changes the exchangeability of the layers between the two models, as they are not necessarily equivalent.

Good explanation of the 4 layer model and where it differs from the 7 layer model.

Encapsulation

The process of encapsulation adds extra information to a string of data, these additions are known as 'headers' and 'trailers'. Different headers/trailers are added depending on which part of the network the data is currently at and which layer of the OSI or TCP/IP model this corresponds to.

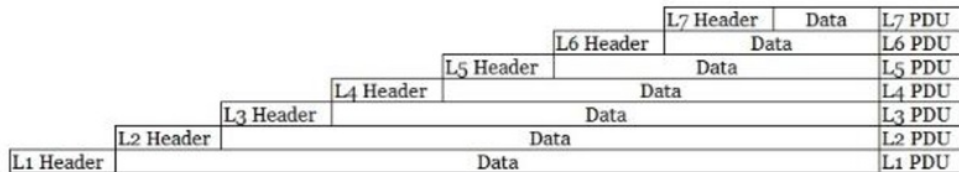


Figure 3: PDU encapsulation levels for OSI model
<https://study-ccna.com/encapsulation/>

For the OSI model, a Protocol Data Unit (PDU) is used to represent a string of data (encapsulated) with headers and trailers at each end. With the 7-layer model, there are 7 different headers and sometimes trailers which are incorporated.



Figure 4: TCP/IP encapsulation
<https://study-ccna.com/encapsulation/>

Figure 4 shows how the headers are added for the TCP/IP 4-layer model. The 'Frame' is provided by the Network Access layer and can add a header and a trailer if needed. 'Packet' is the data with a header that contains a source and the data destination IP address. The *Encapsulation* webpage on the CCNA website states, "Segment – encapsulated data as defined by the Transport layer. Information such as the source and destination ports or sequence and acknowledgment numbers are included in the header." (CCNA, n.d.)

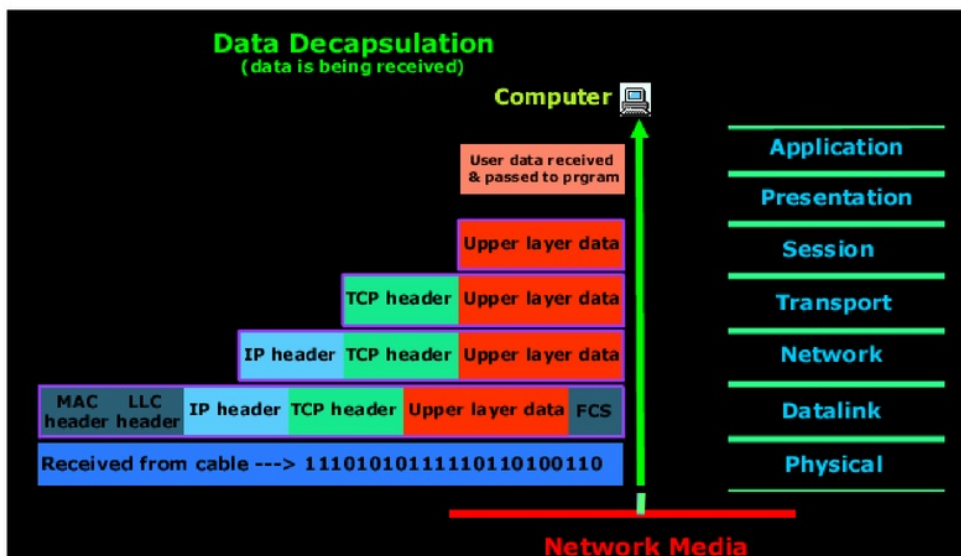


Figure 5: Decapsulation of data
<http://www.firewall.cx/networking-topics/the-osi-model/179-osi-data-encapsulation.html>

Decapsulation of the data is shown in figure 5, here the seven layers of the OSI model can be seen next to the encapsulated data. When received at the physical layer, the data is at its maximum

encapsulation and needs to be decapsulated. The first layer to decapsulate is the Datalink layer, this will remove its constituent headers and pass the remaining information known as a 'packet' to the next layer. It does this through first performing a cyclic redundancy check, to check if the return value is the same as the field, it will then assume that the frame section is errorless and remove the remove the heard and extra information. This process is repeated as the information progresses up the layers until it is finally passed on to the application for the end user to access.

*Encapsulation is explained
very well and identifying
how the headers are
attached and removed.*

Broadcasting

Broadcasting is used to send information to a large number of devices over the same network or across multiple networks depending on the type of broadcast. A broadcast can be performed over a Local Area Network, to all devices connected through using the Address Resolution Protocol (ARP) to communicate an address resolution query to all LAN devices. If there is only one sender and receiver, this is known as a unicast and is the typical format of data transmission using the TCP protocol.

Another form of network transmission is known as Multicasting, this is designed to send data to multiple devices across networks simultaneously. The packet for the multicast is like that of a unicast packet, however instead also includes a specific destination multicast group address.

The *University of Aberdeen Broadcast course* webpage states, “The majority of installed LANs (e.g. Ethernet) are able to support the multicast transmission mode. Shared LANs (using hubs/repeaters) inherently support multicast, since all packets reach all network interface cards connected to the LAN.” (Fairhurst, 2009)

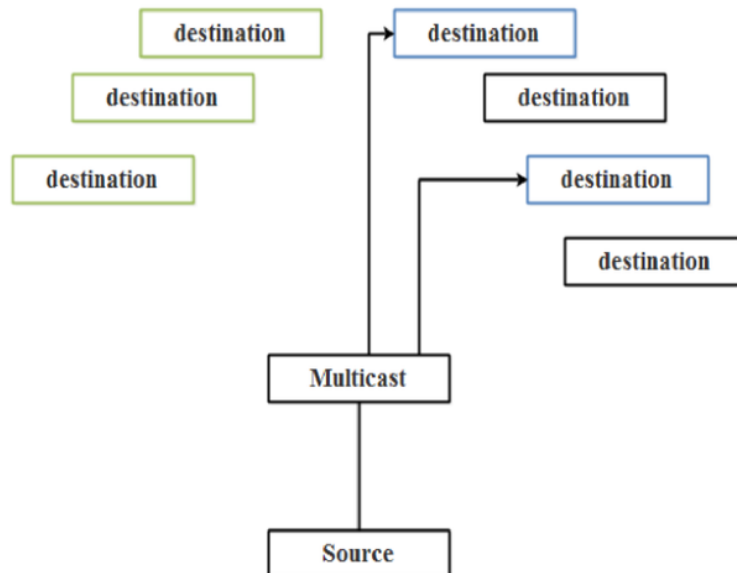


Figure 6: Multicast
<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.736.1118&rep=rep1&type=pdf>

Figure 6 shows how a multicast targets only the specific devices that have the multicast group address, rather than broadcasting to all devices on the network regardless if they want to receive the information or not, such as shown in figure 7. (Shivraj Kaur, 2016)

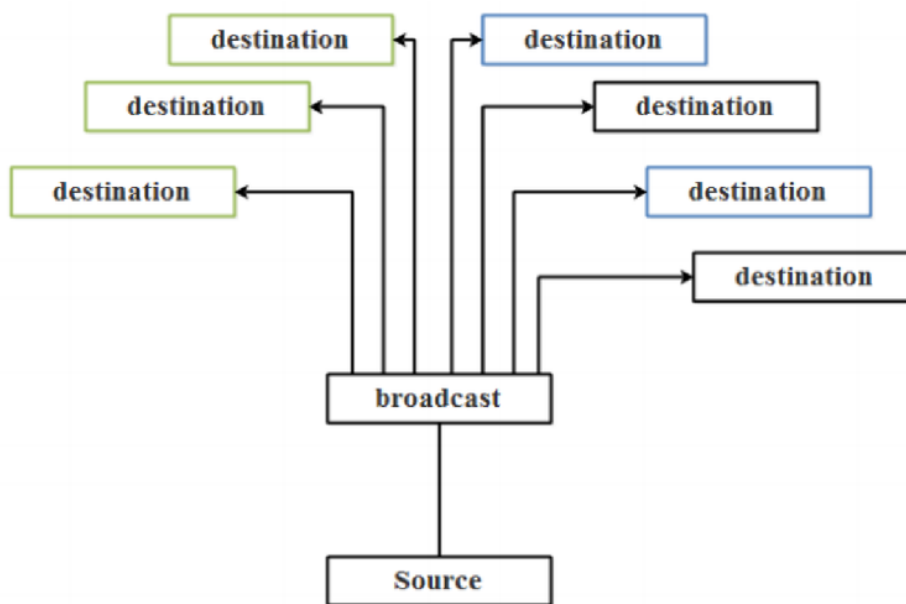


Figure 7: Broadcast

<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.736.1118&rep=rep1&type=pdf#>

*Broadcasting is explained
and the images support your
explanation. Good to illustrate
that there are other types of
broadcasts.*

Port allocation

Ports are software access points found on routers and ethernet switches across networks, they can be allocated to different protocols. An example on an ethernet switch is that the ports can be organised into groups such as LAN and WAN. As stated on *Understanding Ethernet Switches and Routers*, “When a transmission is received on a particular switch port, the source of the MAC address of the sender is stored in the database of the switch.” (Contemporary Control Systems Inc, 2011, p. 2) This explains how router-switches can prevent unnecessary data from flooding all ports by sending it directly to the previous sender.

Port allocation is explained but you should also have stated that the ports are not static and the number of ports available to assign (49152-65535).

Routing

Network address configuration

A network was set up, with three routers connected using serial links, each with a switch and PC on the LAN, this is shown in figure 8.

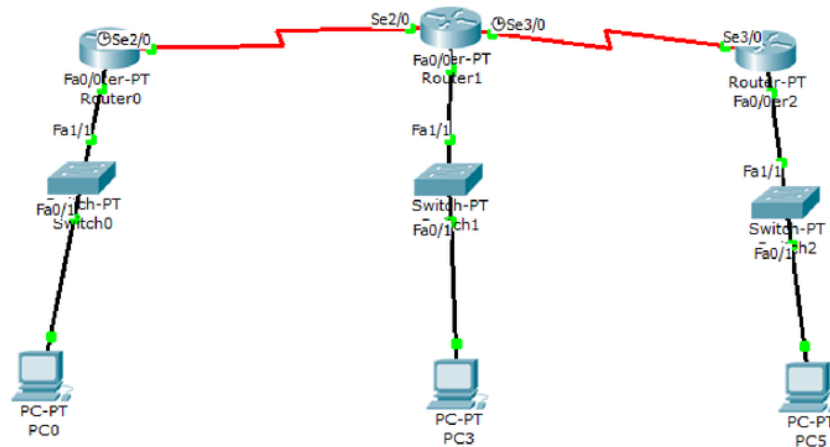


Figure 8: Network setup

This network was configured using IP addresses from three classes A, B and C, the table below shows the address configuration.

	Router 0	Serial2	Router 1	Serial3	Router 2
Network	192.168.10.0	20.20.20.0	100.100.100.0	30.30.30.0	170.10.0.0
Router IP	192.168.10.50	20.20.20.1 and 20.20.20.2	100.100.100.50	30.30.30.1 and 30.30.30.2	170.10.0.50
Device IP	192.168.10.10		100.100.100.10		170.10.0.10
Subnet Mask	255.255.255.0	255.0.0.0	255.0.0.0	255.0.0.0	255.255.0.0
Gateway	192.168.10.50		100.100.100.50		170.10.0.50

Router 0 is a class C. Router 1 is a class A. Router 2 is class B.

Very good address class allocation for the LAN's. The serial ports are set with any class of your choice. The gateways are set for each router and all looks good.

Static routing

The static routing was set up as follows, starting with Router0 in figure 9.

The screenshot shows the 'Router0' configuration window with the 'CLI' tab selected. On the left, a sidebar menu has 'ROUTING' expanded, showing 'Static' as the active option. The main area is titled 'Static Routes' and contains a form with three input fields: 'Network', 'Mask', and 'Next Hop'. Below these fields is an 'Add' button. A large text box below the 'Add' button displays the current static routes: '100.0.0.0/8 via 20.20.20.2' and '170.10.0.0/16 via 20.20.20.2'. A 'Remove' button is located at the bottom right of this text box.

Figure 9: Router0 static table

The screenshot shows the 'Router1' configuration window with the 'CLI' tab selected. The sidebar menu on the left is identical to Figure 9, with 'ROUTING' expanded and 'Static' selected. The 'Static Routes' section in the main area has the same 'Add' button. The 'Network Address' text box displays two routes: '192.168.10.0/24 via 20.20.20.1' and '170.10.0.0/16 via 30.30.30.2'. A 'Remove' button is at the bottom right.

Figure 10: Router1 static table

Figure 10 shows the static table for Router1, here the 'via' option contains both serials for allowing passage to the networks either side and through these connections.

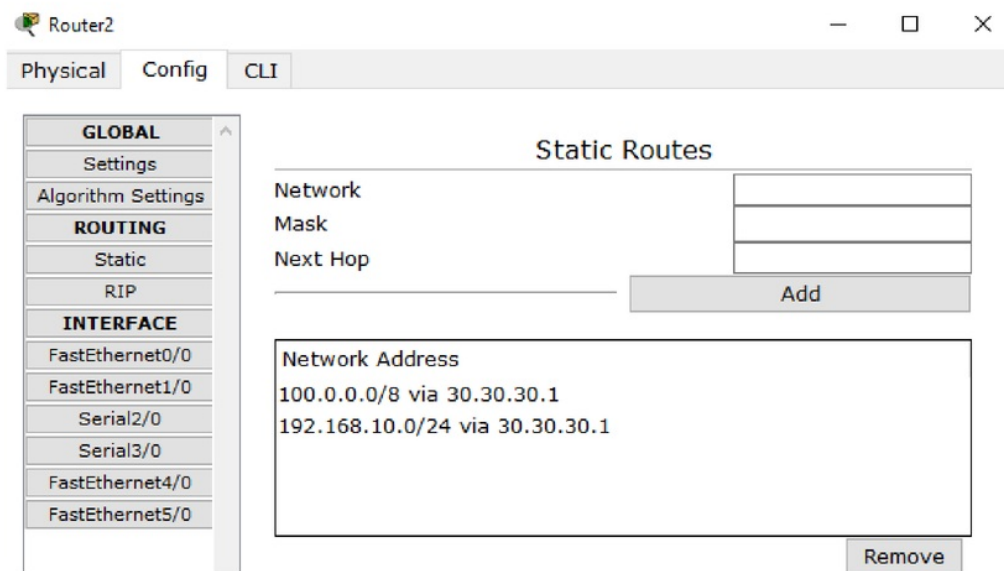


Figure 11: Router2 static table

Figure 11 shows the static config for Router 2, a summary of all static configuration, including the mask can be seen in the table below.

Router0 static	Router0 static masks	Router1 static	Router1 static masks	Router2 static	Router2 static masks
100.0.0.0 via 20.20.20.2	255.0.0.0	192.168.10.0 via 20.20.20.1	255.255.255.0	100.0.0.0 via 30.30.30.1	255.0.0.0
170.10.0.0 via 20.20.20.2	255.255.0.0	170.10.0.0 via 30.30.30.2	255.255.0.0	192.168.10.0 via 30.30.30.1	255.255.255.0

A series of packet sending tests was performed to this network to check the integrity of the static routing system. Tests were performed both ways to all devices and all were successful, seen in figure 12.

Fire	Last Status	Source	Destination	Type	Color	Time (sec)	Periodic	Num	Edit	Delete
	Successful	PC0	PC5	ICMP		0.000	N	0	(edit)	(delete)
	Successful	PC0	PC3	ICMP		0.000	N	1	(edit)	(delete)
	Successful	PC5	PC0	ICMP		0.000	N	2	(edit)	(delete)
	Successful	PC5	PC3	ICMP		0.000	N	3	(edit)	(delete)
	Successful	PC3	PC0	ICMP		0.000	N	4	(edit)	(delete)
	Successful	PC3	PC5	ICMP		0.000	N	5	(edit)	(delete)

Figure 12: Static routing tests

Static routing has been configured and tested showing comms between all devices on all networks.

RIP Routing

Figure 13 shows the RIP routing tables created for each router.

Routing Table for Router1					
Type	Network	Port	Next Hop IP	Metric	
C	20.0.0.0/8	Serial2/0	---	0/0	
R	30.0.0.0/8	Serial2/0	20.20.20.2	120/1	
R	100.0.0.0/8	Serial2/0	20.20.20.2	120/1	
R	170.10.0.0/16	Serial2/0	20.20.20.2	120/2	
C	192.168.10.0/24	FastEthernet0/0	---	0/0	

Routing Table for Router2					
Type	Network	Port	Next Hop IP	Metric	
C	20.0.0.0/8	Serial2/0	---	0/0	
C	30.0.0.0/8	Serial3/0	---	0/0	
C	100.0.0.0/8	FastEthernet0/0	---	0/0	
R	170.10.0.0/16	Serial3/0	30.30.30.2	120/1	
R	192.168.10.0/24	Serial2/0	20.20.20.1	120/1	

Routing Table for Router3					
Type	Network	Port	Next Hop IP	Metric	
R	20.0.0.0/8	Serial2/0	30.30.30.1	120/1	
C	30.0.0.0/8	Serial2/0	---	0/0	
R	100.0.0.0/8	Serial2/0	30.30.30.1	120/1	
C	170.10.0.0/16	FastEthernet0/0	---	0/0	
R	192.168.10.0/24	Serial2/0	30.30.30.1	120/2	

Good images to support RIP routing configuration.

Figure 13: RIP tables

```
Router1
Physical Config CLI Attributes
IOS Command Line Interface

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0,
changed state to up

Router>en
Router#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile,
B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter
area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external
type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E -
EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia -
IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

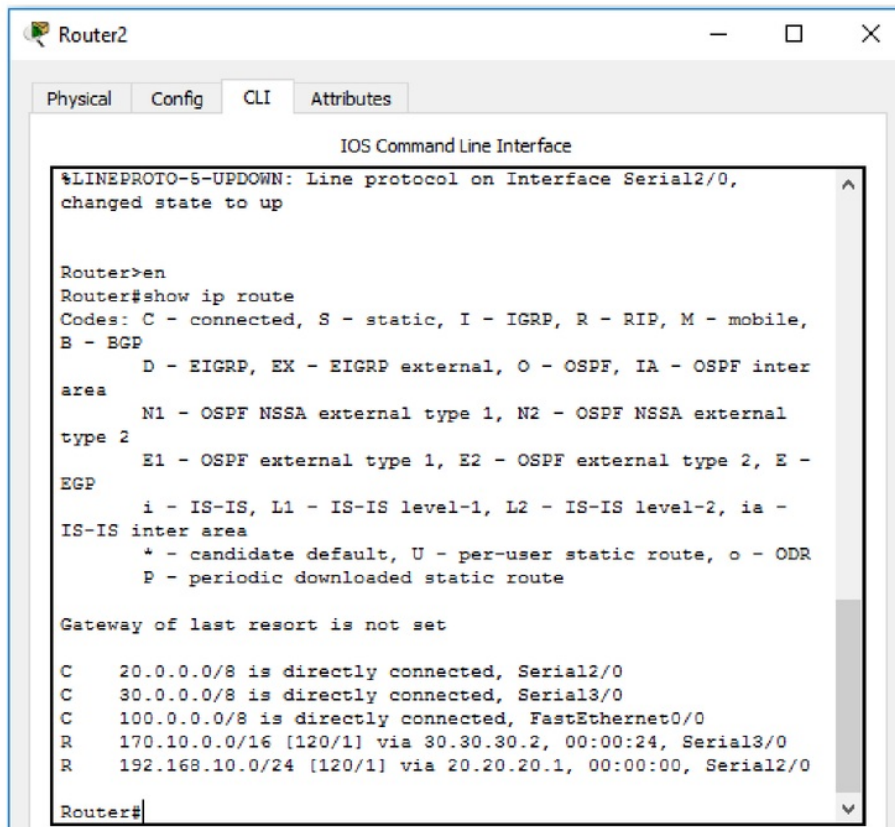
C    20.0.0.0/8 is directly connected, Serial2/0
R    30.0.0.0/8 [120/1] via 20.20.20.2, 00:00:20, Serial2/0
R    100.0.0.0/8 [120/1] via 20.20.20.2, 00:00:20, Serial2/0
R    170.10.0.0/16 [120/2] via 20.20.20.2, 00:00:20, Serial2/0
C    192.168.10.0/24 is directly connected, FastEthernet0/0

Router#
```

Good router report for the routing configuration.

Figure 14: Router 1 config for RIP

This proves that the router is setup for RIP routing.



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". The output of the "show ip route" command is shown, including a message about the line protocol on Serial2/0, a legend for route codes, and a list of routes.

```
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0,
changed state to up

Router>en
Router#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile,
B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter
area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external
type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E -
EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia -
IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

C    20.0.0.0/8 is directly connected, Serial2/0
C    30.0.0.0/8 is directly connected, Serial3/0
C    100.0.0.0/8 is directly connected, FastEthernet0/0
R    170.10.0.0/16 [120/1] via 30.30.30.2, 00:00:24, Serial3/0
R    192.168.10.0/24 [120/1] via 20.20.20.1, 00:00:00, Serial2/0
Router#
```

Figure 15: Router 2 config for RIP

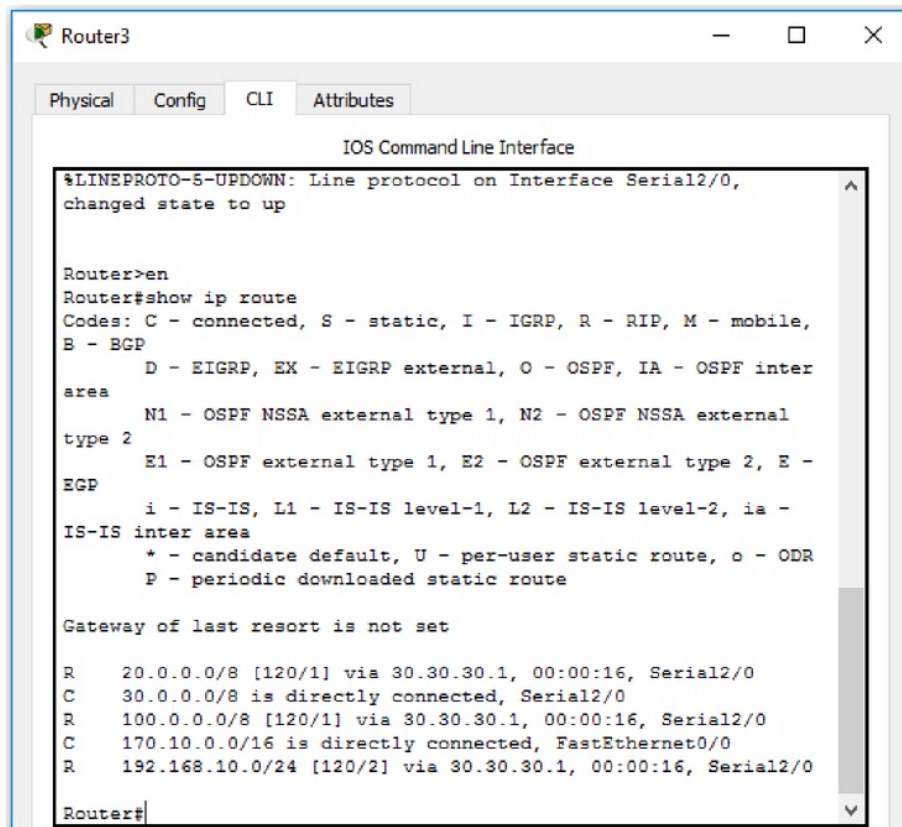


Figure 16: Router 3 config for RIP

All 3 routers
are setup.
The images
show the

routed paths
and directly
connected

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit
	Successful	PC0	PC2	ICMP		0.000	N	0	(edit)
	Successful	PC0	PC1	ICMP		0.000	N	1	(edit)
	Successful	PC1	PC2	ICMP		0.000	N	2	(edit)
	Successful	PC2	PC0	ICMP		0.000	N	3	(edit)
	Successful	PC1	PC0	ICMP		0.000	N	4	(edit)
	Successful	PC2	PC1	ICMP		0.000	N	5	(edit)

Figure 17: RIP testing

Above shows the successful testing between the PCs following the set-up of the RIP routing.

Test are good between all
devices on all networks.
The comms should be as
good as the static routing.

DHCP

Dynamic addressing was then established through configuring the routers to assign the correct addresses. The proof of successful DHCP addressing is shown in figure 18.

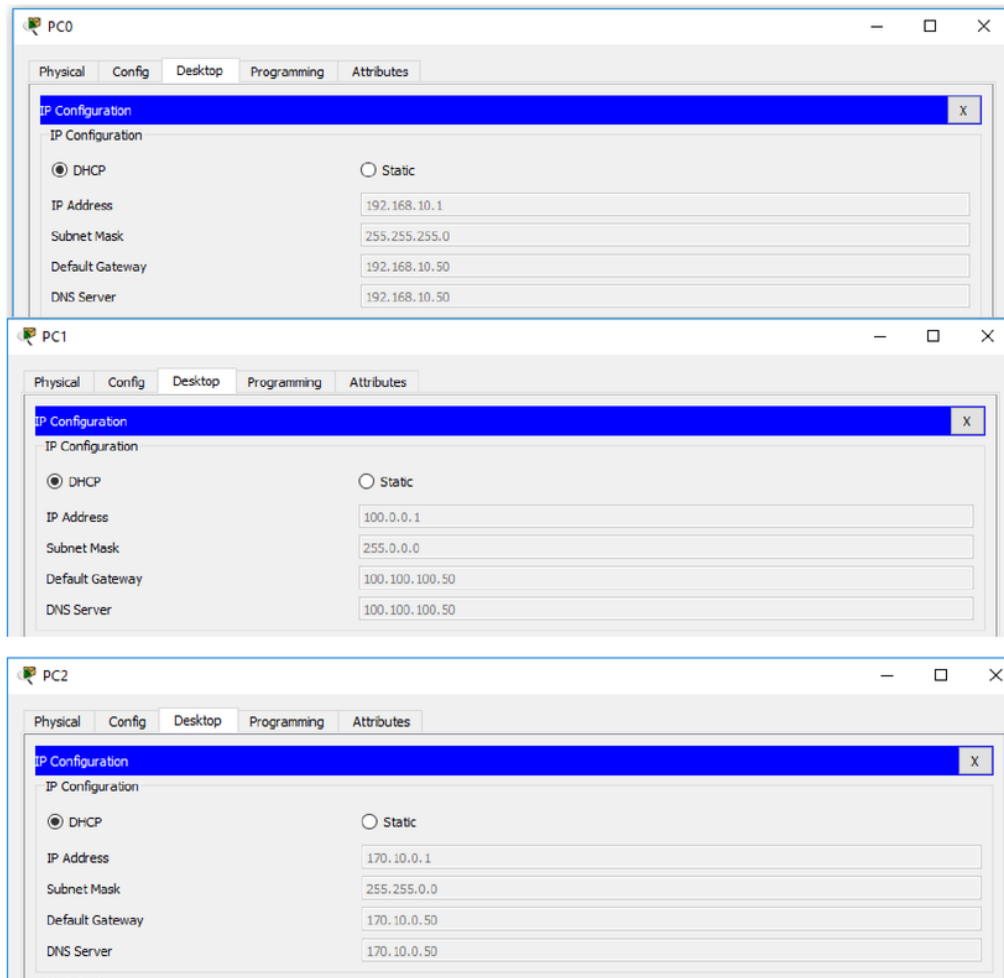


Figure 18: DHCP addressing for all three routers

The DHCP is configured and is tested as the images show. The addresses and gateways are set automatically by the control router.

The assigned DHCP addresses were confirmed again but this time they were assigned with excluded addresses 1 to 10, as shown in the following tests shown in figure 19.

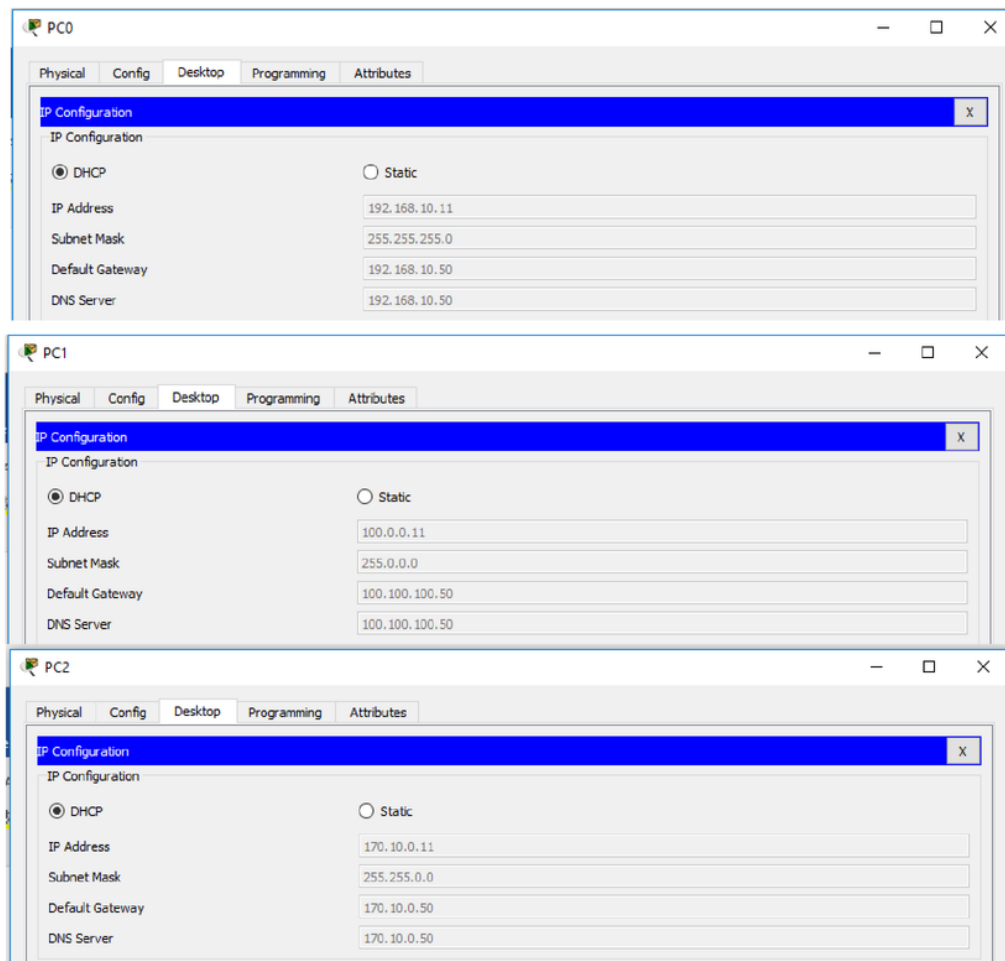


Figure 19: Addressing with excluded and helper

The running configuration of the routers will now be shown, including the control device and helper address (20.20.20.1) information.

test
es
for
exc
lusi
on
add
res
ses
are

ROUTER 1

```
hostname Router
!
!
!
!
ip dhcp excluded-address 192.168.10.1 192.168.10.10
ip dhcp excluded-address 100.100.100.1 100.100.100.10
ip dhcp excluded-address 170.20.0.1 170.20.0.10
ip dhcp excluded-address 170.10.0.1 170.10.0.10
ip dhcp excluded-address 100.0.0.1 100.0.0.10
!
ip dhcp pool net1
 network 192.168.10.0 255.255.255.0
 default-router 192.168.10.50
 dns-server 192.168.10.50
ip dhcp pool net2
 network 100.0.0.0 255.0.0.0
 default-router 100.100.100.50
 dns-server 100.100.100.50
ip dhcp pool net3
 network 170.10.0.0 255.255.0.0
 default-router 170.10.0.50
 dns-server 170.10.0.50
!
!
!
ip cef
no ip vrf conf
```

```
!
interface FastEthernet0/0
 ip address 192.168.10.50 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial2/0
 ip address 20.20.20.1 255.0.0.0
 clock rate 64000
!
interface Serial3/0
 no ip address
 clock rate 64000
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
!
router rip
 version 2
 network 20.0.0.0
 network 100.0.0.0
 network 192.168.10.0
!
ip classless
!
ip flow-export version 9
```

Figure 20: Router 1 config

This is the setup for the control router. This shows the configuration for DHCP pools and excluded address ranges.

ROUTER 2

```
interface FastEthernet0/0
 ip address 100.100.100.50 255.0.0.0
 ip helper-address 20.20.20.1
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial12/0
 ip address 20.20.20.2 255.0.0.0
!
interface Serial13/0
 ip address 30.30.30.1 255.0.0.0
 clock rate 64000
!
```

```
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
!
router rip
 version 2
 network 20.0.0.0
 network 30.0.0.0
 network 100.0.0.0
 network 170.10.0.0
 network 192.168.10.0
!
ip classless
!
ip flow-export version 9
```

Figure 21: Router 2 config

Image shows router configuration for ports but not for DHCP. This is only configured in the control router.

```

interface FastEthernet0/0
ip address 170.10.0.50 255.255.0.0
ip helper-address 20.20.20.1
duplex auto
speed auto
!
interface FastEthernet1/0
no ip address
duplex auto
speed auto
shutdown
!
interface Serial2/0
ip address 30.30.30.2 255.0.0.0
!
interface Serial3/0
no ip address
clock rate 64000
!
interface FastEthernet4/0
no ip address
shutdown
!
interface FastEthernet5/0
no ip address
shutdown
!
!
router rip
version 2
network 30.0.0.0
network 100.0.0.0
network 170.10.0.0
!

```

Figure 22: Router 3 config

ROUTER 3

The other routers need the helper address as shown in the image. This proves the router is setup correctly.

All routers are configured correctly. The tests would

show a fail if there was a config error. The tests here are all good.

Element 1 Evaluation

Through conducting research into the layout of these models, the tasks could be completed with different routing methods being established across the LAN and WAN communication.

Static and dynamic addressing performed in these tasks allows the networks to be controlled remotely. With the layer 3 OSI model, Dynamic RIP routing allows shorter paths to be used to establish WAN and LAN communication, including setting up each router remotely, so long as the address is known.

DHCP (Dynamic Host Communication Protocol) can use a helper address to assist with communication and auto assigning addresses from the control device. Certain addresses or address ranges can be excluded with DHCP, this was explored in the assignment and tested to prove the assigned dynamic values were outside of the exclusion range.

The OSI model is to be referenced with each operation occurring at a specific level. For networks, the routing is performed at layer 3 and the switching at layer 2.

Overall the results and router configuration reflect each routing method successfully and tie in with the research performed.

*Good
evaluation of
element 1.*

Element 2

CIDR 28 Network with Subnetting

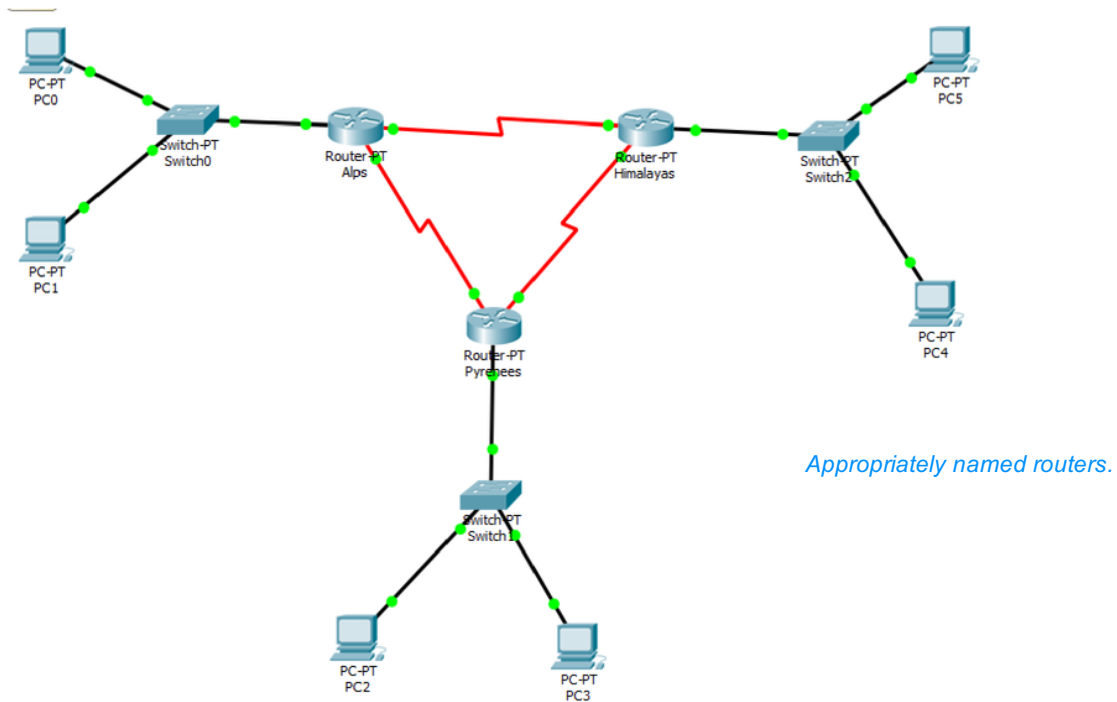


Figure 23: Three Router Network

Figure 23 shows the network for Packet Tracer created using CIRD/28 to subnet, this consists of three routers, each with a switch connected and two PC end hosts from each switch. The following tables show how the IP addresses for the routers and hosts are determined.

CIDR/28	Subnet Mask	1	1	1	1	0	0	0	0	255.255.255.240
Increment=16		0	0	0	0	0	0	0	0	Not used
	Net address 16	0	0	0	1	0	0	0	1	lowest host add 17
	Net address 16	0	0	0	1	0	0	1	0	Next host add 18
	Default Gateway	0	0	0	1	1	0	0	1	My add 25
Alps		0	0	0	1	1	1	1	1	Broadcast 31
192.168.144.16		128	64	32	16	8	4	2	1	
CIDR/28	Subnet Mask	1	1	1	1	0	0	0	0	255.255.255.240
Increment=16		0	0	0	0	0	0	0	0	Not used
	Net address 32	0	0	1	0	0	0	0	1	lowest host add 33
	Net address 32	0	0	1	0	0	0	1	0	Next host add 34
	Default Gateway	0	0	1	0	1	0	0	1	My add 41
Pyrenees		0	0	1	0	1	1	1	1	Broadcast 47
192.168.144.32		128	64	32	16	8	4	2	1	
CIDR/28	Subnet Mask	1	1	1	1	0	0	0	0	255.255.255.240
Increment=16		0	0	0	0	0	0	0	0	Not used
	Net address 48	0	0	1	1	0	0	0	1	lowest host add 49
	Net address 48	0	0	1	1	0	0	1	0	Next host add 50
	Default Gateway	0	0	1	1	1	0	0	1	My add 57
Himalayas		0	0	1	1	1	1	1	1	Broadcast 63
192.168.144.48		128	64	32	16	8	4	2	1	
72	pyrenees									ser 3/0
73	Pyrenees									ser 2/0
88	Pyrenees									ser 3/0
89	Himalayas									ser 3/0
104	Himalayas									ser 2/0
105	Alps									ser 2/0

Figure 24: Router addressing table

Addresses were determined through the addressing hierarchy to find unallocated IP address for each particular CIDR28 subnet as shown in figure 24. The bit configuration for each address is shown along with the increment between networks being 16. The serial connections can also be seen for each set. For this set up, even more bits are taken up for the network, leaving less room for hosts, therefore the increment is 16.

Good
addressin
g scheme
using
CIDR/28.

CIDR27 and 30

Classless Inter-Domain Routing testing was performed between the PCs on different subnets for CIDR 27 and 30 as shown below in figure 25.

Improving the network by using VLSM addressing method is shown and tested.

Fire	Last Status	Source	Destination	Type	Color	Test Size	Periodic	Num	Edit	Delete
	Successful	PC4	PC5	ICMP		0.000	N	0	(edit)	(delete)
	Successful	PC5	PC4	ICMP		0.000	N	1	(edit)	(delete)
	Successful	PC0	PC1	ICMP		0.000	N	2	(edit)	(delete)
	Successful	PC1	PC0	ICMP		0.000	N	3	(edit)	(delete)
	Successful	PC2	PC0	ICMP		0.000	N	4	(edit)	(delete)
	Successful	PC1	PC3	ICMP		0.000	N	5	(edit)	(delete)
	Successful	PC2	PC5	ICMP		0.000	N	6	(edit)	(delete)
	Successful	PC4	PC3	ICMP		0.000	N	7	(edit)	(delete)
	Successful	PC5	PC0	ICMP		0.000	N	8	(edit)	(delete)
	Successful	PC1	PC4	ICMP		0.000	N	9	(edit)	(delete)

Figure 25: Successful testing using the Ping command

Routing Table for Alps

Type	Network	Port	Next Hop IP	Metric
C	192.168.32.4/30	Serial3/0	---	0/0
R	192.168.32.8/30	Serial3/0	192.168.32.6	120/1
R	192.168.32.8/30	Serial2/0	192.168.32.13	120/1
C	192.168.32.12/30	Serial2/0	---	0/0
C	192.168.32.32/27	FastEthernet0/0	---	0/0
R	192.168.32.64/27	Serial3/0	192.168.32.6	120/1

Figure 27: Alps routing table

Routing Table for Pyrenees

Type	Network	Port	Next Hop IP	Metric
C	192.168.32.4/30	Serial2/0	---	0/0
C	192.168.32.8/30	Serial3/0	---	0/0
R	192.168.32.12/30	Serial3/0	192.168.32.10	120/1
R	192.168.32.12/30	Serial2/0	192.168.32.5	120/1
R	192.168.32.32/27	Serial2/0	192.168.32.5	120/1
C	192.168.32.64/27	FastEthernet0/0	---	0/0

Figure 26: Pyrenees routing table

Comms to all devices on all networks areas are good.

Routing tables show the RIP routing for the VLSM address configuration.

Routing Table for Himalayas

Type	Network	Port	Next Hop IP	Metric
R	192.168.32.4/30	Serial3/0	192.168.32.9	120/1
R	192.168.32.4/30	Serial2/0	192.168.32.14	120/1
C	192.168.32.8/30	Serial3/0	---	0/0
C	192.168.32.12/30	Serial2/0	---	0/0
R	192.168.32.32/27	Serial2/0	192.168.32.14	120/1
R	192.168.32.64/27	Serial3/0	192.168.32.9	120/1

Figure 28: Himalayas routing table

The routing table can be seen in figures 26, 27 and 28 for each routers. The /27 and /30 at the end of the IP represents.

Figure 3 shows the use of the ping command to test between the CIDR 27 and 30 networks. All tests between PCs across networks were successful proving the system was set up correctly.

*Routers are all
configured
correctly.*

VLSM

VLSM27	Subnet Mask	1	1	1	0	0	0	0	0	255.255.255.224
Increment=32		0	0	1	0	0	0	0	0	Net: 192.168.32.0
	Net address	0	0	1	0	0	0	0	1	lowest host add 33
	Net address	0	0	1	0	0	0	1	0	Next host add 34
	Default Gateway	0	0	1	0	0	0	1	1	My add 35
Alps		0	0	1	1	1	1	1	1	Broadcast 63
192.168.32.32		128	64	32	16	8	4	2	1	
VLSM27	Subnet Mask	1	1	1	0	0	0	0	0	255.255.255.224
Increment=32		0	1	0	0	0	0	0	0	Net: 192.168.64.0
	Net address	0	1	0	0	0	0	0	1	lowest host add 65
	Net address	0	1	0	0	0	0	1	0	Next host add 66
	Default Gateway	0	1	0	0	0	0	1	1	My add 67
Pyrenees		0	1	0	1	1	1	1	1	Broadcast 95
192.168.32.64		128	64	32	16	8	4	2	1	
VLSM27	Subnet Mask	1	1	1	0	0	0	0	0	255.255.255.224
Increment=32		0	1	1	0	0	0	0	0	Net: 192.168.96.0
	Net address	0	1	1	0	0	0	0	1	lowest host add 97
	Net address	0	1	1	0	0	0	1	0	Next host add 98
	Default Gateway	0	1	1	0	0	0	1	1	My add 99
Himalayas		0	1	1	1	1	1	1	1	Broadcast 127
192.168.32.96		128	64	32	16	8	4	2	1	
192.168.32.4/30	Alps									[5] ser 3/0
255.255.255.252	Pyrenees									[6] ser 2/0
192.168.32.8/30	Pyrenees									[9] ser 3/0
	Himalayas									[10] ser 3/0
	Himalayas									[13] ser 2/0
	Alps									[14] ser 2/0

Figure 29: VLSM 27 and 30

The Himalayas and Alps network should be subnet 192.168.32.12/30.

Serial port addresses are correct at .13 and .14

Variable Length Subnet Mask was carried as there is a mix of CIDR 27 and 30 within these. The address bit is set by the subnet mask, as the increment is 32 between networks. The table shows this, how the 32 value bit is taken up, leaving the bits below for hosts. The more bits that are used for the network, the fewer host addresses that can be assigned.

Table shows how the VLSM addressing scheme is configured. All subnets are correct. You missed the subnet address identifier on the last part of the table.

VLAN Testing

Testing network with VLANs enabled is shown in the following figures, 8 and 9.

Simulation Panel					
Event List					
Vis.	Time(sec)	Last Device	At Device	Type	Info
	0.000	--	PC0	ICMP	
	0.001	PC0	Switch0	ICMP	
	0.002	Switch0	PC1	ICMP	
	0.003	PC1	Switch0	ICMP	
	0.004	Switch0	PC0	ICMP	

Good test to show when VLAN is configured.

Figure 30: Test with VLAN

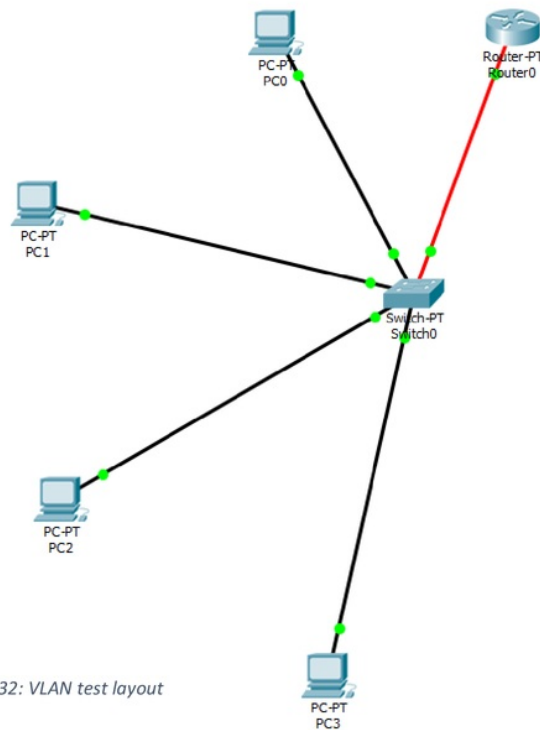
Figure 30 shows the test when the VLAN was enabled. This allowed the ping test to only reach PC0 and PC1 that are set up on the same VLAN.

Simulation Panel					
Event List					
Vis.	Time(sec)	Last Device	At Device	Type	Info
	0.001	PC0	Switch0	ICMP	
	0.002	Switch0	PC3	ICMP	
	0.002	Switch0	PC2	ICMP	
	0.002	Switch0	PC1	ICMP	
	0.003	PC1	Switch0	ICMP	
	0.004	Switch0	PC0	ICMP	

Good test for broadcast when VLAN is not configured.

Figure 31: Test with VLAN disabled

Figure 31 displays the test showing the passage of the ping test to all available hosts. This is because the VLAN was disabled to check functionality. The testing layout can be seen in figure 32.



Explanation here is correct.

This image is supposed to show the packets going to all devices. This is what happens when VLAN is not configured.

Figure 32: VLAN test layout

Inter VLAN Routing

This form of routing was set up to allow the VLANs to communicate to each other while remaining on separate VLAN networks.

The router was configured to allow inter-VLAN routing by encapsulating the router to the dot 1Q protocol. This assigns the system the virtual protocol for the virtual sub interface (in this case this is f 4/0.10)

Good explanation with the configuration setup.

The following text shows the configuration of the network to allow inter-VLAN routing.

```
Router>en
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int f 4/0
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet4/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet4/0, changed state to up

Router(config-if)#exit
Router(config)#int f 4/0
Router(config-if)#no ip address
Router(config-if)#exit
Router(config)#int f 4/0.10
Router(config-subif)#
%LINK-5-CHANGED: Interface FastEthernet4/0.10, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet4/0.10, changed state to up

Router(config-subif)#encapsulation dot1Q 10
Router(config-subif)#ip address 192.168.10.254 255.255.255.0
Router(config-subif)#no shutdown
Router(config-subif)#exit
Router(config)#int f 4/0.11
Router(config-subif)#
%LINK-5-CHANGED: Interface FastEthernet4/0.11, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet4/0.11, changed state to up

Router(config-subif)#encapsulation dot1Q 11
Router(config-subif)#ip address 192.168.11.254 255.255.255.0
Router(config-subif)#no shutdown
Router(config-subif)#^Z
Router#
%SYS-5-CONFIG_I: Configured from console by console
en
Router#show ip int brief
Interface IP-Address OK? Method Status Protocol
FastEthernet0/0 unassigned YES unset administratively down down
FastEthernet1/0 unassigned YES unset administratively down down
Serial2/0 unassigned YES unset administratively down down
Serial3/0 unassigned YES unset administratively down down
FastEthernet4/0 unassigned YES unset up up
FastEthernet4/0.10 192.168.10.254 YES manual up up
FastEthernet4/0.11 192.168.11.254 YES manual up up
```

Configuration is correct and shows clearly the sub interface for the two separate gateways i.e. separate


```

interface FastEthernet4/0
no ip address
!
interface FastEthernet4/0.10
encapsulation dot1Q 10
ip address 192.168.10.254 255.255.255.0
!
interface FastEthernet4/0.11           These are the two VLAN
encapsulation dot1Q 11                 gateways on the sub interfaces
ip address 192.168.11.254 255.255.255.0 with encapsulation protocols
!                                       set.
interface FastEthernet5/0
no ip address
shutdown
!
ip classless
!
ip flow-export version 9
!
!
!
!
!
!
line con 0
!
line aux 0
!
line vty 0 4
login
!
!
!
end

```

The following text is the running config from setting up and configuring the VLANs on the switches.

```
Switch>enable
Switch#
Switch#vlan database
% Warning: It is recommended to configure VLAN from config mode,
as VLAN database mode is being deprecated. Please consult user
documentation for configuring VTP/VLAN in config mode.

Switch(vlan)#en
^
% Invalid input detected at '^' marker.
Switch(vlan)#exit
APPLY completed.
Exiting....
Switch#en
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 10
Switch(config-vlan)#name vlan10
Switch(config-vlan)#exit
Switch(config)#vlan 11
Switch(config-vlan)#name vlan11
Switch(config-vlan)#exit
```

Vlan configuration is correct and vlan 10 and vlan 11 are clearly identified.

Switch#show vlan

VLAN Name Status Ports

```
-----
1 default active Fa0/1, Fa1/1, Fa2/1, Fa3/1
Fa4/1, Fa5/1
2 VLANnister active
10 vlan10 active
11 vlan11 active
1002 fddi-default act/unsup
1003 token-ring-default act/unsup
1004 fddinet-default act/unsup
1005 tmet-default act/unsup
```

This is the config report from the switch

VLAN Type SAID MTU Parent RingNo BridgeNo Stp BrdgMode Trans1 Trans2

```
-----
1 enet 100001 1500 - - - - 0 0
2 enet 100002 1500 - - - - 0 0
10 enet 100010 1500 - - - - 0 0
11 enet 100011 1500 - - - - 0 0
1002 fddi 101002 1500 - - - - 0 0
1003 tr 101003 1500 - - - - 0 0
1004 fdnet 101004 1500 - - - ieee - 0 0
1005 tmet 101005 1500 - - - ibm - 0 0
```

and show all the configurations.

VLAN Type SAID MTU Parent RingNo BridgeNo Stp BrdgMode Trans1 Trans2

Remote SPAN VLANs

Primary Secondary Type Ports

The switch is then set to switchport mode access to command the port to access the VLANs as this is not going to be used for trunking.

```
Switch#
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#int f 3/1
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 10
Switch(config-if)#exit
Switch(config)#int f 2/1
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 11
Switch(config-if)#exit
Switch(config)#int f 1/1
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 10
Switch(config-if)#exit
Switch(config)#int f 0/1
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 11
Switch(config-if)#exit
Switch(config)#^Z
Switch#
%SYS-5-CONFIG_I: Configured from console by console
show vlan
```

VLAN Name Status Ports

```
-----
1 default active Fa4/1, Fa5/1
2 VLANnister active
10 vlan10 active Fa1/1, Fa3/1
11 vlan11 active Fa0/1, Fa2/1
1002 fddi-default act/unsup
1003 token-ring-default act/unsup
1004 fddinet-default act/unsup
1005 trnet-default act/unsup
```

VLAN Type SAID MTU Parent RingNo BridgeNo Stp BrdgMode Trans1 Trans2

```
-----
1 enet 100001 1500 - - - - 0 0
2 enet 100002 1500 - - - - 0 0
10 enet 100010 1500 - - - - 0 0
11 enet 100011 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
```

VLAN Type SAID MTU Parent RingNo BridgeNo Stp BrdgMode Trans1 Trans2

Remote SPAN VLANs

Primary Secondary Type Ports

```
-----
Switch#
Switch#
Switch#
```

```

Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#int f 4/1
Switch(config-if)#switchport mode trunk
Switch(config-if)#
Switch(config-if)#^Z
Switch#
%SYS-5-CONFIG_I: Configured from console by console
en
Switch#show interface trunk

Switch#show interfaces trunk

Switch#
Switch#^Z
Switch#
%LINK-5-CHANGED: Interface FastEthernet4/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet4/1, changed state to up
show interfaces trunk
Port Mode Encapsulation Status Native vlan
Fa4/1 on 802.1q trunking 1

Port Vlans allowed on trunk
Fa4/1 1-1005

Port Vlans allowed and active in management domain
Fa4/1 1,2,10,11

Port Vlans in spanning tree forwarding state and not pruned
Fa4/1 1,2,10,11

Switch#
Switch>
Switch>en
Switch#show vlan

```

The switch configuration report is correct.

The images on the next page show testing of the VLANs on the test network, now they have been set up. The text above shows the configuration process of configuring the switch to act as a trunk on interface f4/1.

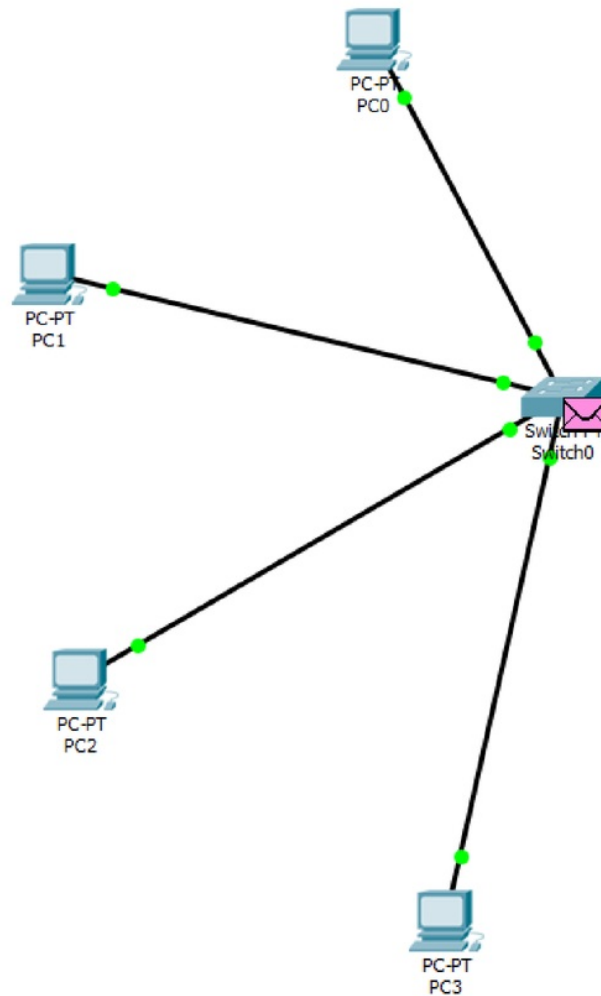


Figure 33: VLAN test network and results

PDU List Window

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	Router0	PC3	ICMP		0.000	N	0	(edit)	(delete)
	Successful	Router0	PC2	ICMP		0.000	N	1	(edit)	(delete)
	Successful	Router0	PC1	ICMP		0.000	N	2	(edit)	(delete)
	Successful	Router0	PC0	ICMP		0.000	N	3	(edit)	(delete)
	Successful	PC0	PC3	ICMP		0.000	N	4	(edit)	(delete)
	Successful	PC0	PC2	ICMP		0.000	N	5	(edit)	(delete)
	Successful	PC0	PC1	ICMP		0.000	N	6	(edit)	(delete)

VLAN Name Status Ports

```

1 default active Fa5/1
10 vlan10 active Fa1/1, Fa3/1
11 vlan11 active Fa0/1, Fa2/1
1002 fddi-default act/unsup
1003 token-ring-default act/unsup
1004 fddinet-default act/unsup

```

*Test are all good and show
comms to all devices on all
Vlan's*

1005 tmet-default act/unsup

VLAN Type SAID MTU Parent RingNo BridgeNo Stp BrdgMode Trans1 Trans2

1 enet 100001 1500 ----- 0 0
10 enet 100010 1500 ----- 0 0
11 enet 100011 1500 ----- 0 0
1002 fddi 101002 1500 ----- 0 0
1003 tr 101003 1500 ----- 0 0
1004 fdnet 101004 1500 --- ieee - 0 0
1005 tmet 101005 1500 --- ibm - 0 0

VLAN Type SAID MTU Parent RingNo BridgeNo Stp BrdgMode Trans1 Trans2

Remote SPAN VLANs

Primary Secondary Type Ports

Switch#

Router#show ip int brie

Interface IP-Address OK? Method Status Protocol

FastEthernet0/0 unassigned YES manual up up

FastEthernet0/0.1 192.168.32.100 YES manual up up

FastEthernet0/0.2 192.168.32.130 YES manual up up

FastEthernet1/0 unassigned YES unset up down

Serial2/0 192.168.32.13 YES manual up up

Serial3/0 192.168.32.10 YES manual up up

FastEthernet4/0 unassigned YES unset administratively down down

FastEthernet5/0 unassigned YES unset administratively down down

Switch1#show vlan

```
*LINK-5-CHANGED: Interface FastEthernet0/10, changed state to up
*LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/10, changed state to up

Switch>en
Switch#show vlan
```

VLAN	Name	Status	Ports
1	default	active	Fa0/3, Fa0/4, Fa0/5, Fa0/6 Fa0/7, Fa0/8, Fa0/9, Fa0/11 Fa0/12, Fa0/13, Fa0/14, Fa0/15 Fa0/16, Fa0/17, Fa0/18, Fa0/19 Fa0/20, Fa0/21, Fa0/22, Fa0/23 Fa0/24
100	vlan100	active	Fa0/1
101	vlan101	active	Fa0/2
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

--More--

This is the Vlan set up on the main network Switch 1. This time the Vlans are 100 and 101

Figure 34: Switch 1 VLAN config

This figure 34 shows the current VLANs active, [VLAN100 and VLAN101] that have been added into this system on switch 1.

These are on the main network and configured on the switch.

```
Switch#show interface trunk
Port Mode Encapsulation Status Native vlan
Fa0/10 on 802.1q trunking 1
```

```
Port Vlans allowed on trunk
Fa0/10 1-1005
```

```
Port Vlans allowed and active in management domain
Fa0/10 1,100,101
```

```
Port Vlans in spanning tree forwarding state and not pruned
Fa0/10 1,100,101
```

Trunking is enabled for the two Vlans

```
R2#show ip int brief
Interface IP-Address OK? Method Status Protocol
FastEthernet0/0 unassigned YES unset up up
FastEthernet0/0.100 192.168.32.94 YES manual up up
FastEthernet0/0.101 192.168.32.130 YES manual up up
FastEthernet0/1 unassigned YES unset administratively down down
Serial0/0 192.168.32.6 YES manual up up
Serial0/1 192.168.32.9 YES manual up up
```

This shows the correct configuration for the sub interfaces 0.100 and 0.101

Setting up Inter-VLAN on Main Network

Inter-VLAN routing and an ACL were set up on the main network, this allowed cross communications across VLANs while blocking certain hosts. The show run for router 0 is provided below, where the ACL is added in.

```
R0#show run
Building configuration...
```

Current configuration : 799 bytes

```
version 12.2
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
```

```
hostname R0
```

```
no ip cef
no ipv6 cef
```

```
interface FastEthernet0/0
ip address 192.168.32.35 255.255.255.224
ip access-group 1 out
duplex auto
speed auto
```

```
interface FastEthernet0/1
no ip address
duplex auto
speed auto
shutdown
```

```

:
interface Serial0/0

```

```

ip address 192.168.32.14 255.255.255.252
clock rate 64000
!
interface Serial0/1
ip address 192.168.32.5 255.255.255.252
clock rate 2000000
!
router rip
version 2
network 192.168.32.0
!
ip classless
!
ip flow-export version 9
!
!
access-list 1 deny host 192.168.32.65
access-list 1 permit any
!
!
!
!
!
!
line con 0
!
line aux 0
!
line vty 0 4
login
!
!
!
end

```

*ACL config is here and has
set to deny the host address
shown and permit all others
on router R0.*

ACL Testing

Access Control List was enabled to prevent certain hosts from accessing data. This was enabled earlier to block access to PC2 (IP 192.168.32.65)

PDU List Window

Fire	Last Status	Source	Destination	Type	Color
	Successful	PC3	PC7	ICMP	Grey
	Successful	PC3	PC6	ICMP	Light Green
	Failed	PC2	PC7	ICMP	Red
	Failed	PC2	PC6	ICMP	Dark Green
	Successful	PC3	PC10	ICMP	Purple
	Successful	PC2	PC11	ICMP	Dark Purple
	Successful	PC3	PC11	ICMP	Dark Blue
	Successful	PC2	PC10	ICMP	Blue
	Successful	PC11	PC6	ICMP	Dark Blue
	Successful	PC11	PC7	ICMP	Brown
	Successful	PC10	PC6	ICMP	Green
	Successful	PC10	PC7	ICMP	Pink

The test shows the ACL test denying the host PC2 and allowing all others.

Figure 35: ACL Test results and PC2 settings

PC2

Physical Config **Desktop** Programming Attributes

☐ DHCP ☒ Static

IP Address: 192.168.32.65

Subnet Mask: 255.255.255.224

Default Gateway: 192.168.32.94

All ping commands pass onto all hosts apart from the denied PC2 during the test, proving the functionality of the ACL and inter-VLAN routing.


```
ip address 192.168.32.10 255.255.255.252
!  
router rip  
version 2  
network 192.168.32.0  
!  
ip classless  
!  
ip flow-export version 9  
!  
!  
!  
!  
!  
!  
!  
line con 0  
!  
line aux 0  
!  
line vty 0 4  
login  
!  
!  
!  
end
```

Himalayas show run, no ACL.

```
R2#show run
Building configuration...
```

Current configuration : 864 bytes

```
version 12.2
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
```

```
hostname R2
```

!

```
no ip cef
no ipv6 cef
```

! ! ! ! ! ! ! ! ! ! ! ! ! ! ! !

```
interface FastEthernet0/0
no ip address
duplex auto
speed auto
```

```
interface FastEthernet0/0.100
encapsulation dot1Q 100
ip address 192.168.32.94 255.255.255.224
```

```
interface FastEthernet0/0.101
 encapsulation dot1Q 101
 ip address 192.168.32.130 255.255.255.224
```

```
interface FastEthernet0/1
no ip address
duplex auto
speed auto
shutdown
!
```

This is the router that has the VLAN's configured.

```
interface Serial0/0
ip address 192.168.32.6 255.255.255.252
!
interface Serial0/1
ip address 192.168.32.9 255.255.255.252
clock rate 64000
!
router rip
version 2
network 192.168.32.0
!
ip classless
!
ip flow-export version 9
!
!
!
!
!
!
!
!
line con 0
!
line aux 0
!
line vty 0 4
login
!
!
!
end
```

Final Tests

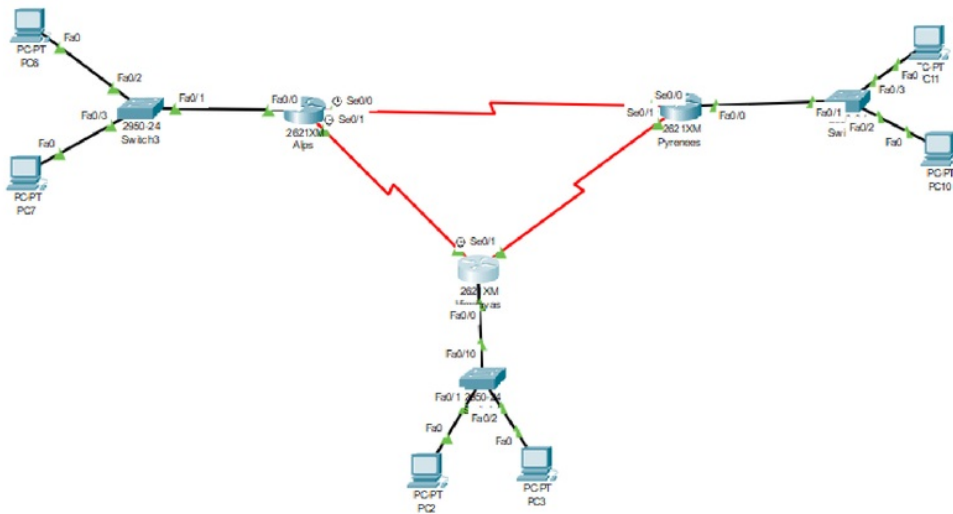


Figure 36: Final build with VLANs

Above in figure 36 the final inter-VLAN network set up is shown. The details for the encapsulation and trunking can be seen in the previous router show run command texts.

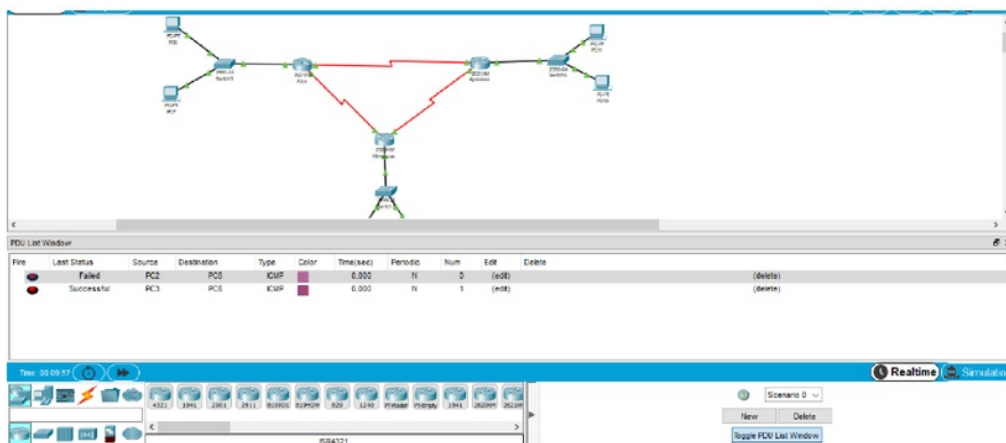


Figure 37: ACL testing

Figure 37 shows the inter-VLAN testing with ACL enabled, as seen the ping command from PC2 has been blocked whereas it allowed the message from PC3.

Good test to prove the ACL config.

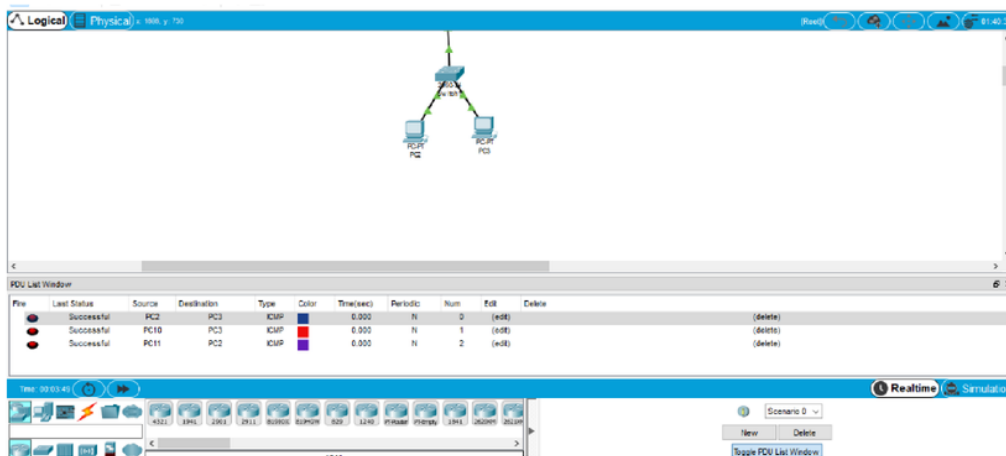


Figure 38: Inter VLAN routing testing with no ACL

Figure 38 shows the testing across the separate VLANs with no ACL enabled. In this test, all hosts are allowed, and the ping command passes across VLANs, as per the text in the router show run config.

Overall, the system has been designed and tested for use of the inter-VLAN and ACL, and has worked successfully.

Tests are good and show the comms across Vlan's with no ACL.

Element 2 Evaluation

Throughout Element 2, a simple network model has been built on and developed using a range of techniques such as CIDR and VLSM. This helped determine the number of networks and hosts that can be assigned based on the subnet mask and IP address, proving its use for different applications.

Enabling a VLAN allows isolated links between hosts for increased security and faster communication. Having an Access Control List set up prevents unwanted hosts from receiving data, while trunking and encapsulation allows inter-VLAN communication.

Overall these techniques are particularly useful to industry with larger networks and hosts, while also allowing faster and secure data exchange on smaller networks.

A fair point made here and sums up the element.

Element 3

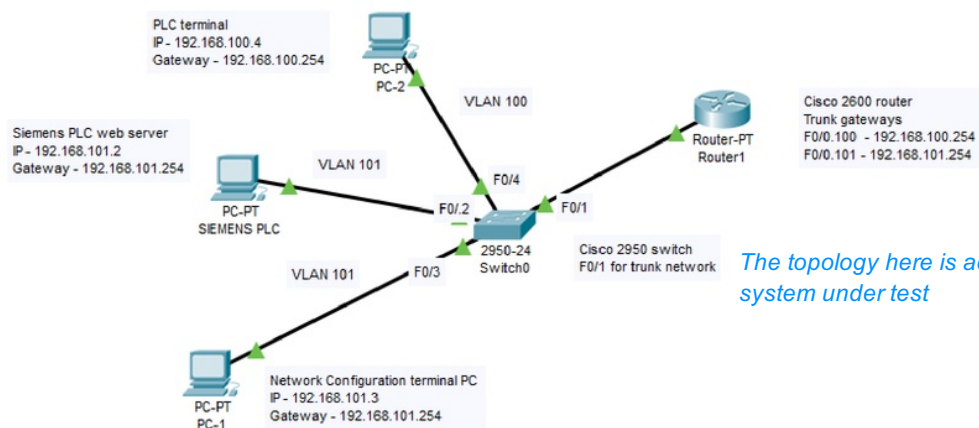
The practical setup for this element involved using a Cisco 2600 router and switch to allow communication between a Siemens PLC and two PC hosts. Figure 39 displays the equipment set up.



Good image of test setup.

Figure 39: Practical Setup

The PLC is connected to the network to allow it to access data on a webpage and read/write inputs and outputs based on the information. To enable communication, a VLAN was set up between the hosts and the PLC. Figure 40 displays the topology for the VLANs.



The topology here is accurate of the system under test

Figure 40: Network topology using VLAN

With the system hardware connected as per figure 40, each system needed to be configured and VLANs set up.

The first configuration was carried out on the switch, setting up VLAN 100 and 101.

```
Switch#show vlan
```

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	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

```
Switch#
```

Figure 41: VLANs enabled

At this point, no ports have been assigned to the VLAN, as can be seen in figure 41. These were then assigned to give Fa0/4 to VLAN100 and Fa0/2 and Fa0/3 to VLAN101, tying in with the hardwired connections to the first PC, PLC and second PC. This is shown in figure 42.

```
Switch#show vlan
```

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	

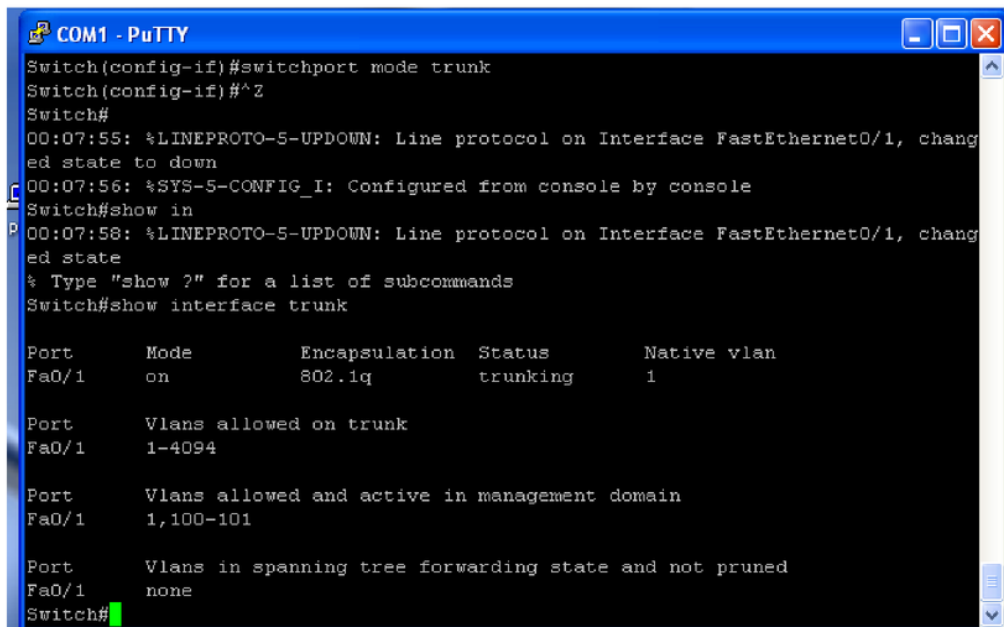
VLAN	Type	SAID	MTU	Parent	RingNo	BridgeNo	Stp	BrdgMode	Trans1	Trans2
1	enet	100001	1500	-	-	-	-	-	0	0
100	enet	100100	1500	-	-	-	-	-	0	0
101	enet	100101	1500	-	-	-	-	-	0	0
1002	fddi	101002	1500	-	-	-	-	-	0	0
1003	tr	101003	1500	-	-	-	-	-	0	0
1004	fdnet	101004	1500	-	-	-	ieee	-	0	0
1005	trnet	101005	1500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

```
Switch#conf t
```

Figure 42: Ports assigned to VLANs

This was carried out with the switchport mode access command.

Now the inter-VLAN routing needed to be set up by first creating a trunking on the switch for port f0/1. The router was also configured for encapsulation for int f0/0.100 with an IP address of 192.168.100.254 and int f0/0.101 with an IP address of 192.168.101.254.



```
COM1 - PuTTY
Switch(config-if)#switchport mode trunk
Switch(config-if)#^Z
Switch#
00:07:55: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed 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 FastEthernet0/1, changed state
% Type "show ?" for a list of subcommands
Switch#show interface trunk

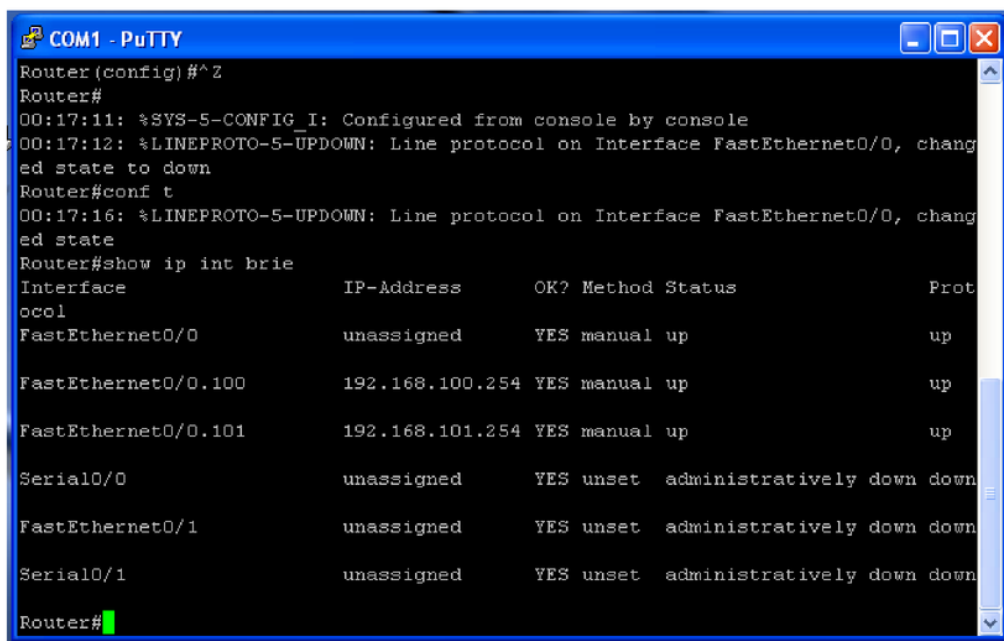
Port      Mode      Encapsulation  Status      Native vlan
Fa0/1     on        802.1q         trunking    1

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#
```

Figure 43: Trunking setup on switch



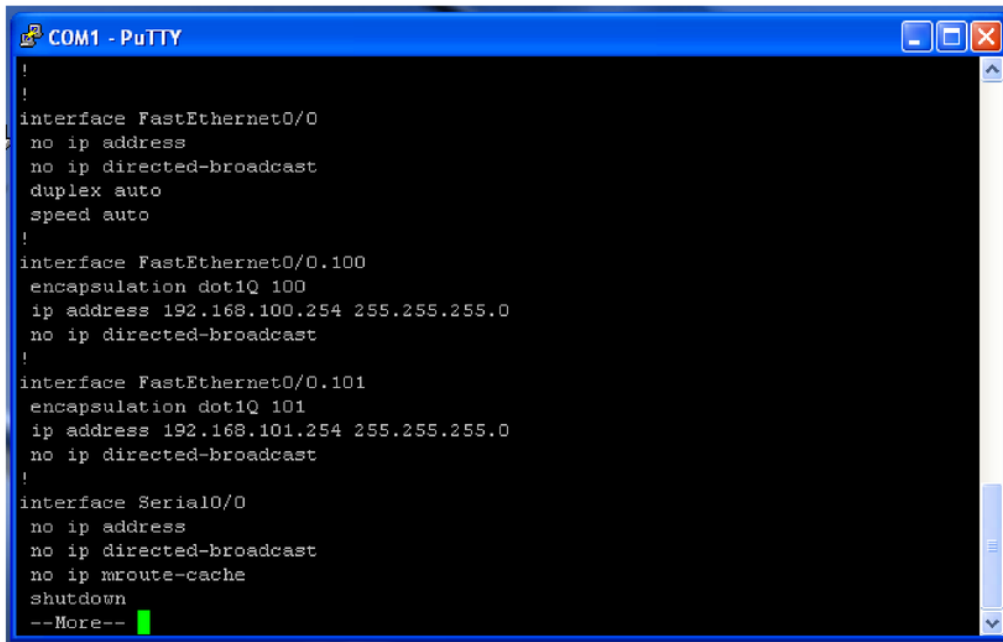
```
COM1 - PuTTY
Router(config)#^Z
Router#
00:17:11: %SYS-5-CONFIG_I: Configured from console by console
00:17:12: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to down
Router#conf t
00:17:16: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state
Router#show ip int brief

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

Figure 44: Encapsulation config

Figures 43 and 44 display the trunking and encapsulation on the switch and router respectively. Each IP address has been interfaced correctly and is status up. The trunking was set up to allow both channels to be present on the gateway and ethernet cable.

The router was configured with the following settings, shown in figure 45.



```
!
!
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 mroute-cache
  shutdown
--More--
```

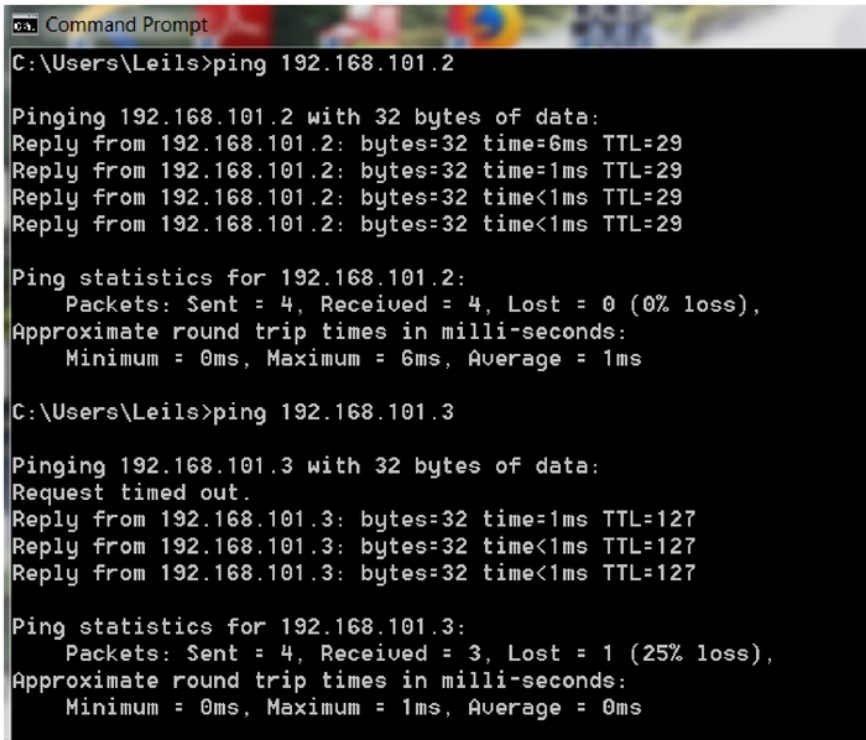
Figure 45: Router configuration

The configuration shown in figure 45 displays the protocol used along with the IP address and subnet mask on each interface.

*Image
supports the
explanation
which is
correct.*

Network Test

Now with the VLAN, sub-interfacing, gateways, trunking and encapsulation configured for the network, a ping test could be performed.



```
Command Prompt
C:\Users\Leils>ping 192.168.101.2

Pinging 192.168.101.2 with 32 bytes of data:
Reply from 192.168.101.2: bytes=32 time=6ms 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
Reply from 192.168.101.2: bytes=32 time<1ms TTL=29

Ping statistics for 192.168.101.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 6ms, Average = 1ms

C:\Users\Leils>ping 192.168.101.3

Pinging 192.168.101.3 with 32 bytes of data:
Request timed out.
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 = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Ping test show the integrity of the comms link between Vlans.

Figure 46: Ping test

The ping test was performed from the configuration PC to ensure that the network functioned sufficiently. The ping can be seen successful across VLANs to addresses 192.168.101.2 and 192.168.101.3 in figure 46. Another test was performed through VLAN101 and was found successful, this can be seen in figure 47.

```
C:\WINDOWS\system32\cmd.exe

Pinging 192.168.101.2 with 32 bytes of data:
Reply from 192.168.101.2: bytes=32 time=2ms TTL=30
Reply from 192.168.101.2: bytes=32 time<1ms TTL=30
Reply from 192.168.101.2: bytes=32 time<1ms TTL=30
Reply from 192.168.101.2: bytes=32 time<1ms TTL=30

Ping statistics for 192.168.101.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 2ms, Average = 0ms

C:\Documents and Settings\Administrator>ipconfig

Windows IP Configuration

Ethernet adapter Local Area Connection:

    Connection-specific DNS Suffix  . : 
    IP Address. . . . . : 192.168.101.3
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.101.254

C:\Documents and Settings\Administrator>
C:\Documents and Settings\Administrator>ping 192.168.101.2

Pinging 192.168.101.2 with 32 bytes of data:
Reply from 192.168.101.2: bytes=32 time=2ms TTL=30
Reply from 192.168.101.2: bytes=32 time<1ms TTL=30
Reply from 192.168.101.2: bytes=32 time<1ms TTL=30
Reply from 192.168.101.2: bytes=32 time<1ms TTL=30

Ping statistics for 192.168.101.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 2ms, Average = 0ms

C:\Documents and Settings\Administrator>_
```

Figure 47: Through VLAN101

*Test have
shown the*

*comms link
across the
Vlans.*

Webpage Setup

For this system to work, a web page has to be set up so I/O can be read and written between the hosts and Siemens S7-1200 PLC.

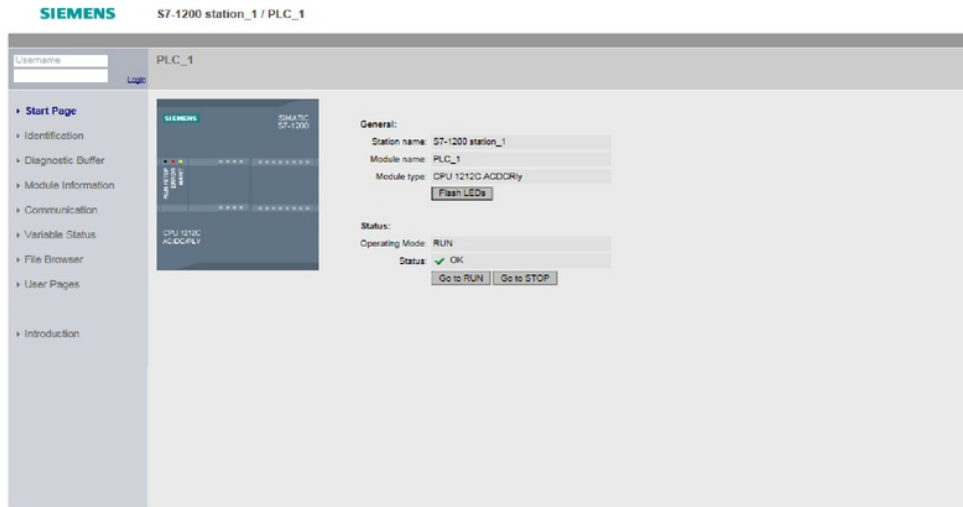


Figure 48: Web server home

On the PLC itself, a web server function block was added and configured to allow the correct inputs and outputs for the test. The router IP address and subnet mask was set before the PLC tags being declared.

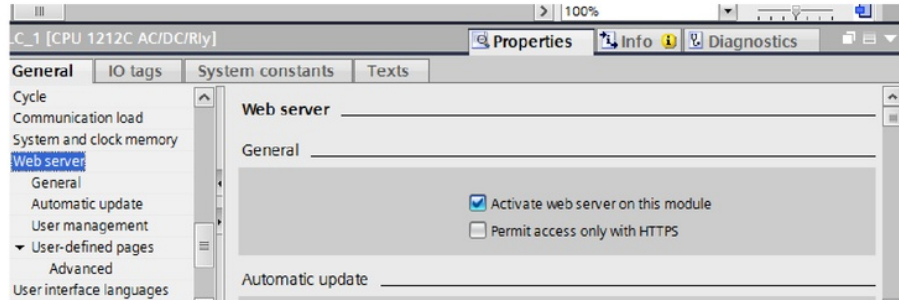


Figure 49: Webserver option

To set up the webserver, TIA portal software is used to activate the webserver option on the PLC, shown in figure 49. File extensions for the web program are also configured into the advanced settings to define the used files for the user webpage. Shown in figure 50.

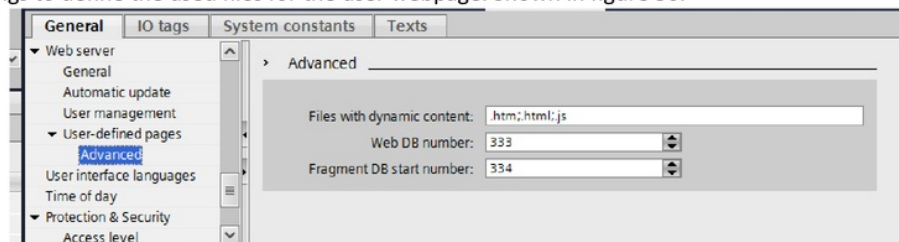


Figure 50: File extensions enabled

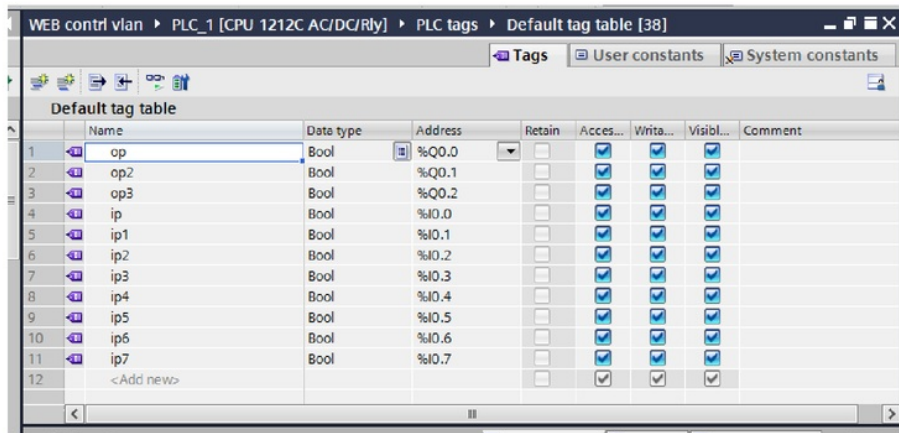


Figure 51: Tag configuration

The tags are configured as BOOLEAN data types with the inputs I0.0 to I0.7 and outputs Q0.0 to Q0.2, as seen in figure 51.

The final configuration for the webserver is to have the WWW block dropped into the main program logic on a single rung, shown in figure 52.

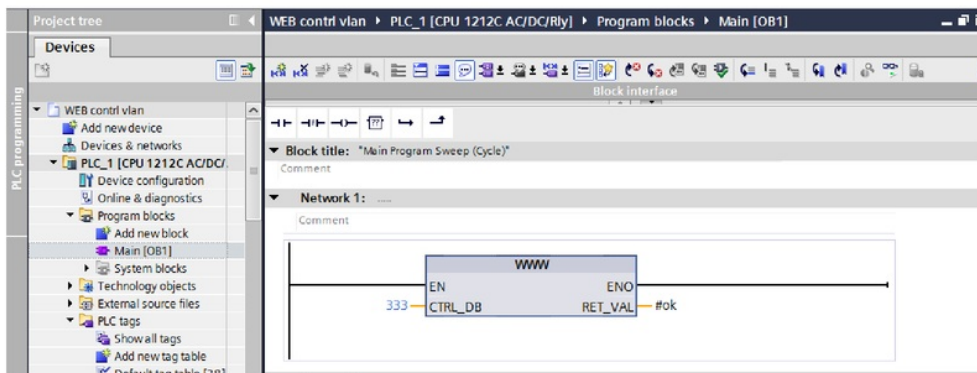


Figure 52: Main program block

Figure 53 shows the settings for downloading the html page, this will use the http protocol for the index. The option generate blocks is selected to allow the webpage to be downloaded onto the PLC server.

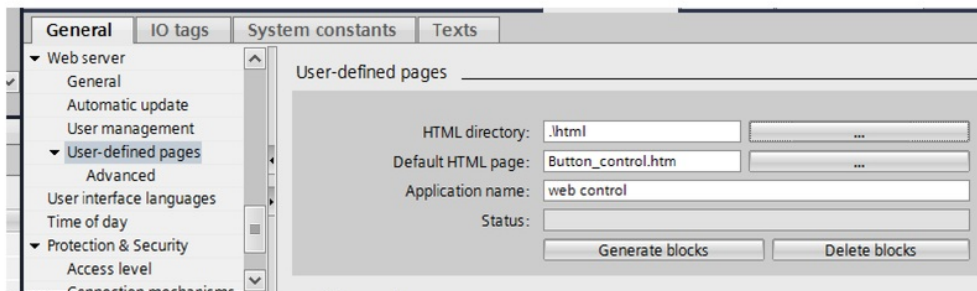


Figure 53: Downloading to the server

The .htm file here is the html program downloaded to the PLC web server.

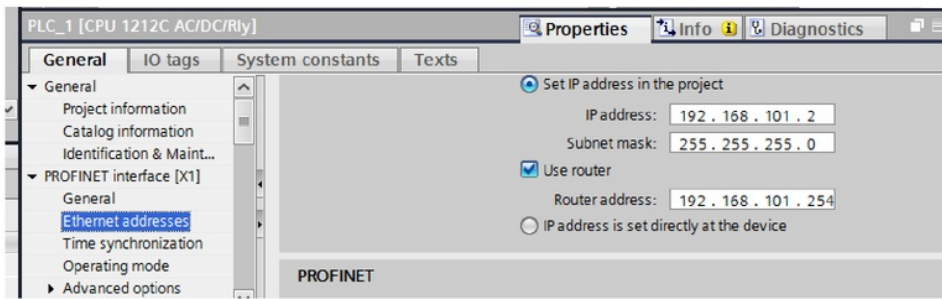


Figure 54: Setting VLAN gateway

The IP address for the router is set in the PLC in figure 54 to allow communication to the correct VLAN.

The HTML page was built to the desired specification, figure 55 shows the beginning of the program where the refresh rate is defined, along with aesthetics such as colour and titles.

```

1 <html>
2
3 <head>
4   <meta http-equiv="refresh" content="0.2">
5
6   <title>Web_control</title>
7   <meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1"><style type="text/css">
8   <!--
9     body,td,th {
10       color: #000033;
11     }
12     body {
13       background-color: #CCCCCC;
14     }
15   -->
16 </style></head>

```

Figure 55: Top of program

The main body of the program contains the information regarding the changing values for the tag variables. Shown in figure 56.

```

16 </style></head>
17
18 <body>
19
20 <!-- AWP_In_Variable Name="op" -->
21 <!-- AWP_In_Variable Name="op2" -->
22 <!-- AWP_In_Variable Name="op3" -->
23 <!-- AWP_In_Variable Name="ip" -->
24 <!-- AWP_In_Variable Name="ip1" -->
25 <!-- AWP_In_Variable Name="ip2" -->
26 <!-- AWP_In_Variable Name="ip3" -->
27 <!-- AWP_In_Variable Name="ip4" -->
28 <!-- AWP_In_Variable Name="ip5" -->
29 <!-- AWP_In_Variable Name="ip6" -->
30 <!-- AWP_In_Variable Name="ip7" -->
31
32 <form>
33   <input type="submit" value="Set_Output_1_1">
34   <input type="hidden" name="op" value="1">
35 </form>
36
37 <form>
38   <input type="submit" value="Set_Output_1_0">
39   <input type="hidden" name="op" value="0">
40 </form>
41
42
43
44 <p>
45 <form>
46   <input type="submit" value="Set_Output_2_1">
47   <input type="hidden" name="op2" value="1">
48 </form>
49 <form>
50   <input type="submit" value="Set_Output_2_0">
51   <input type="hidden" name="op2" value="0">
52 </form>
53 </p>
54 <form>
55   <input type="submit" value="Set_Output_3_1">
56   <input type="hidden" name="op3" value="1">
57 </form>
58 <form>
59   <input type="submit" value="Set_Output_3_0">
60   <input type="hidden" name="op3" value="0">
61 </form>
62 </form>

```

Figure 56: Tag configuration and PLC output write

This figure also shows the section of the program responsible for altering the outputs of the PLC based on which button is selected, this was done for the three outputs.

The AWP commands are necessary to link to the PLC tags.

Figure 57: Program input read logic

Program
explanation and
functions are
good

Testing

An operator testing screen was used with these tags to allow forcing of the PLC outputs, shown in figure 11.

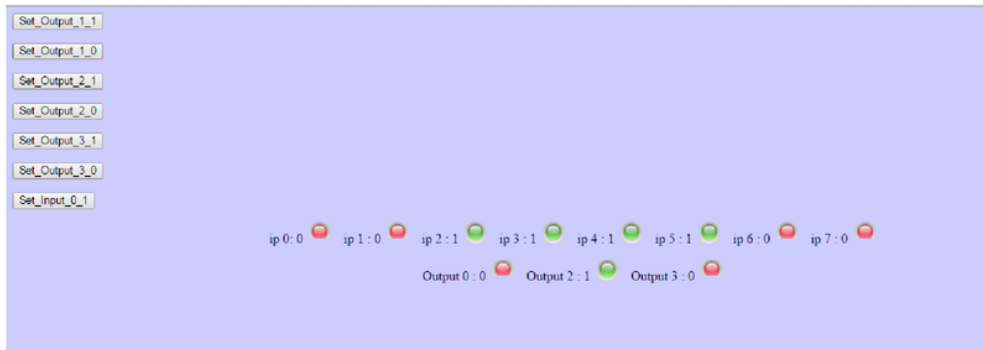


Figure 58: Testing screen

The outputs are to be forced by accessing the PLC webserver and clicking the Set_Output tags on the top left of the window. The inputs to the PLC are to be forced manually using switches connected directly to the input terminals.

The first test was performed with inputs 2:1, 3:1, 4:1 and 5:1 switched on and output 2:1 forced on. Figure 58 shows the view from the webserver, whereas figure 59 shows the correct PLC lights illuminated.



Figure 59: Test 1

After comparing both the PLC and webserver it can be seen that this is a successful test. The next test had inputs 0:1, 3:1, 4:1, 6:1 and 7:1 enabled, and outputs 0:1 and 3:1 forced.

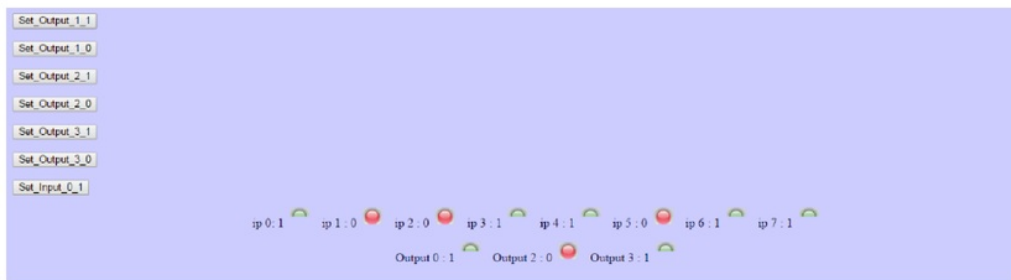


Figure 60: Test 2 webserver

The results of this test are seen in figure 60 and 61, matching up successfully.



Figure 61: Test 2 PLC

The final test shows inputs 0:1 and 3:1 switched on and output 0:1 forced.

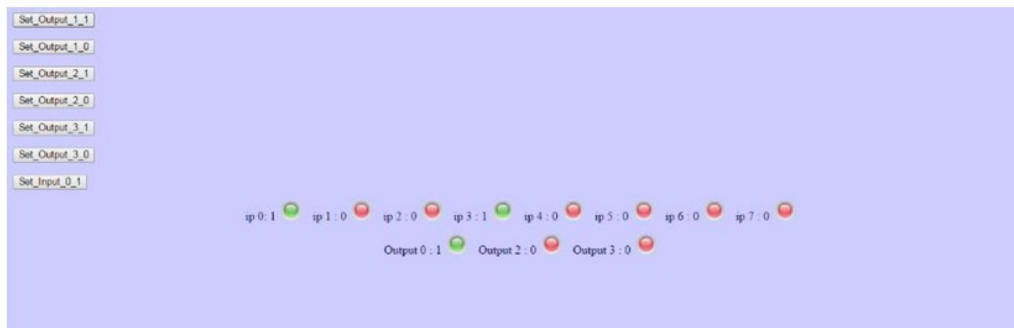


Figure 62: Test 3 webserver

Figures 62 and 63 show the successful results of the final test.



Figure 63: Test 3 PLC

Tests carried out are good and show the link between the PLC io and the web page functions.

Element 3 Evaluation

The results of the test confirmed that the communication between the PLC across VLANs to the hosts was successful. The variation in input and output settings in the test allowed it to be seen how the network responded to changes. The ping tests from both directions confirmed interVLAN network integrity and were completed to ensure the network itself was established before writing I/O across devices.

The tests proved the network functionality, as the PC accessing the web server to change I/O was on a separate VLAN to that of the PLC, accessing the webpage on the Google Chrome browser using the HTTP protocol.

An improvement to this system would be to upgrade the router to use a wireless protocol for accessing the online webpage. This would mean that excessive hardwiring would not be needed and will allow wireless devices to communicate with the PLC.

A more thorough test could be to increase the number of hosts available to access the webpage at once and observe how the network deals with the increased traffic. However, overall the tests performed were sufficient in establishing the network with the current application.

*Good
evaluation of
the element.*

Overall Conclusion

This portfolio has involved carrying out research into different areas of networking, and then applying them in a simulation and practical aspect. Throughout this module there has been a steady progression into more advanced networking techniques. The first element built up the background knowledge and basic application of routing. The second element explored more advanced routing techniques and the setting up of encapsulation and VLAN. Finally, all this was put into a practical scenario by establishing communication between hosts and a PLC.

Networking is a very effective way of transferring information between devices, a correct plan and network design will ensure this system is efficient as possible. The skills learnt during this module will aid in developing a well thought out network suitable for the application and will also help with working on larger industrial scale systems. Setting up a webserver is also an excellent way of communicating with a PLC from a distant location.

Overall, developing the simulation networks aided the practical application and allowed larger systems to be available. Thorough tests were performed to both simulation and practical experiments to prove functionality with recorded test evidence.

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Appendix

Program printout for PLC webserver

```
<html>

<head>

<meta http-equiv="refresh" content="0.2">

<title>Web_control</title>

<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1"><style type="text/css">

<!--
body,td,th {
    color: #000033;
}
body {
    background-color: #CCCCCC;
}
-->
</style></head>

<body>

<!-- AWP_In_Variable Name=""op"" -->
<!-- AWP_In_Variable Name=""op2"" -->
<!-- AWP_In_Variable Name=""op3"" -->
<!-- AWP_In_Variable Name=""ip"" -->
<!-- AWP_In_Variable Name=""ip1"" -->
<!-- AWP_In_Variable Name=""ip2"" -->
<!-- AWP_In_Variable Name=""ip3"" -->
<!-- AWP_In_Variable Name=""ip4"" -->
<!-- AWP_In_Variable Name=""ip5"" -->
<!-- AWP_In_Variable Name=""ip6"" -->
<!-- AWP_In_Variable Name=""ip7"" -->

<form>
```

```
<input type="submit" value="Set_Output_1_1">
<input type="hidden" name=""op"" value="1">
</form>
```

```
<form>
  <input type="submit" value="Set_Output_1_0">
  <input type="hidden" name=""op"" value="0">
</form>
```

```
<p>
<form>
  <input type="submit" value="Set_Output_2_1">
  <input type="hidden" name=""op2"" value="1">
</form>
```

```
<form>
  <input type="submit" value="Set_Output_2_0">
  <input type="hidden" name=""op2"" value="0">
</form>
```

```
<p>
<form>
  <input type="submit" value="Set_Output_3_1">
  <input type="hidden" name=""op3"" value="1">
</form>
```

```
<form>
  <input type="submit" value="Set_Output_3_0">
  <input type="hidden" name=""op3"" value="0">
</form>
```

```
<form>
  <input type="submit" value="Set_Input_0_1">
  <input type="hidden" name=""ip"" value="1">
</form>
```

69

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Networking Portfolio Dan Ince

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

72/100

Instructor

PAGE 1

PAGE 2

Text Comment. List of contents is good.

PAGE 3

PAGE 4

Text Comment. Figures are named appropriately and can be identified.

PAGE 5

Text Comment. Informative introduction into the tasks for element 1

PAGE 6

Text Comment. Good diagram of 7 layer model which distinguishes hardware from software.

PAGE 7

Text Comment. Explanation is very good and discusses the importance of standardisation.

PAGE 8

Text Comment. Good explanation of the 4 layer model and where it differs from the 7 layer model.

PAGE 9

Text Comment. Encapsulation is explained very well and identifying how the headers are attached and removed.

Text Comment. Broadcasting is explained and the images support your explanation. Good to illustrate that there are other types of broadcasts.

Text Comment. Port allocation is explained but you should also have stated that the ports are not static and the number of ports available to assign (49152-65535).

Text Comment. Very good address class allocation for the LAN's. The serial ports are set with any class of your choice. The gateways are set for each router and all looks good.

Text Comment. Static routing has been configured and tested showing comms between all devices on all networks.

Text Comment. Good images to support RIP routing configuration.

Text Comment. Good router report for the routing configuration.

Text Comment. This proves that the router is setup for RIP routing.

Text Comment. All 3 routers are setup. The images show the routed paths and directly connected.

Text Comment. Test are good between all devices on all networks. The comms should be as good as the static routing.

PAGE 21

Text Comment. The DHCP is configured and is tested as the images show. The addresses and gateways are set automatically by the control router.

PAGE 22

Text Comment. testes for exclusion addresses are good and show addresses start at .11 on all networks.

PAGE 23

Text Comment. This is the setup for the control router. This shows the configuration for DHCP pools and excluded address ranges.

PAGE 24

Text Comment. Image shows router configuration for ports but not for DHCP. This is only configured in the control router.

PAGE 25

Text Comment. The other routers need the helper address as shown in the image. This proves the router is setup correctly.

Text Comment. All routers are configured correctly. The tests would show a fail if there was a config error. The tests here are all good.

PAGE 26

Text Comment. Good evaluation of element 1.

PAGE 27

Text Comment. Appropriately named routers.

PAGE 28

Text Comment. Good addressing scheme using CIDR/28.

PAGE 29

Text Comment. Improving the network by using VLSM addressing method is shown and tested .

Text Comment. Comms to all devices on all networks areas are good.

Text Comment. Routing tables show the RIP routing for the VLSM address configuration.

PAGE 30

Text Comment. Routers are all configured correctly.

PAGE 31

Text Comment. The Himalayas and Alps network should be subnet 192.168.32.12/30. Serial port addresses are correct at .13 and .14

Text Comment. Table shows how the VLSM addressing scheme is configured. All subnets are correct. You missed the subnet address identifier on the last part of the table.

PAGE 32

Text Comment. Good test to show when VLAN is configured.

Text Comment. Good test for broadcast when VLAN is not configured.

Text Comment. Explanation here is correct.

Text Comment. This image is supposed to show the packets going to all devices. This is what happens when VLAN is not configured.

PAGE 33

Text Comment. Good explanation with the configuration setup.

Text Comment. Configuration is correct and shows clearly the sub interface for the two separate gateways i.e. separate networks.

PAGE 34

PAGE 35

Text Comment. These are the two VLAN gateways on the sub interfaces with encapsulation protocols set.

Text Comment. Vlan configuration is correct and vlan 10 and vlan 11 are clearly identified.

Text Comment. This is the config report from the switch and shows all the configurations.

Text Comment. The trunk is configured correctly.

Text Comment. The switch configuration report is correct.

Text Comment. Test are all good and show comms to all devices on all Vlan's

Text Comment. This is the Vlan set up on the main network switch 1. This time the Vlan's are 100 and 101

Text Comment. These are on the main network and configured on the switch.

Text Comment. Trunking is enabled for the two Vlan's

Text Comment. This shows the correct configuration for the sub interfaces 0.100 and 0.101

Text Comment. ACL config is here and has set to deny the host address shown and permit all others on router R0.

Text Comment. The test shows the ACL test denying the host PC2 and allowing all others.

Text Comment. This is the router that has the VLAN's configured.

Text Comment. Good test to prove the ACL config.

Text Comment. Tests are good and show the comms across Vlans with no ACL.

Text Comment. A fair point made here and sums up the element.

Text Comment. Good image of test setup.

Text Comment. The topology here is accurate of the system under test

Text Comment. Vlans are have been configured and image support this.

Text Comment. Inter Vlan routng is configured with gateways and images show the configuration.

Text Comment. Image supports the explanation which is correct.

Text Comment. Ping test show the integrity of the comms link between Vlans.

Text Comment. Test have shown the comms link across the Vlans.

Text Comment. The .htm file here is the html program downloaded to the PLC web server.

Text Comment. The PLC is configured correctly.

Text Comment. Note: the gateway address needs to be set.

Text Comment. The AWP commands are necessary to link to the PLC tags.

Text Comment. Program explanation and functions are good

Text Comment. Tests carried out are good and show the link between the PLC io and the web page functions.

Text Comment. Good evaluation of the element.

Text Comment. Good conclusion and a good recommendation to improve the system with wireless control.

GRADING FORM: CSG-RUBIC

DANIEL INCE**72****RESEARCH-INFORMED LITERATURE**

Research has been carried out effectively and identified key area for this portfolio. 8/10

8/10**KNOWLEDGE AND UNDERSTANDING**

Element1. The simpler network system has been designed and implemented by defining the requirements form the larger system. This was done effectively using three classes of addressing for the Lans. 8/10 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.

22/30

Images were taken to prove the tests. 7/10

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. 3.5/5 Element2. The test results of the network configuration were good and explained reasonably well. Each part of the configuration was tested and explained where needed. 6.5/10 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. 8/10

18/25

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 setting up the serial WAN networks. the prototyping method was used. 3.5/5 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 an add on for this element just to test a simulation before element 3 practical. Tests proved successful. The ACL configuration provided the

14/20

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. 7.5/10

SKILLS FOR PROFESSIONAL PRAC.



Element1. The quality of this element is very good and covers all that was asked and more. 4/5

Element2. This element covered all that was required but had some tasks in the wrong order. 3/5

Element3. This element covered all areas and the tasks followed the correct pattern. 3/5

10/15