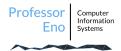


Objectives

- Students need to demonstrate their deep understanding of LAN/WAN protocols designing and enterprise level network
- Configure eight (8) IPv4 networks with subnets, three (3) IPv6 networks using over 90 intermediary and end devices
- Enterprise network based on Cisco Hierarchical Model
- Students will use the ISO OSI Reference Model to help them troubleshoot network issues during their design phase
- Students will use Cisco IOS commands to configure, troubleshoot and verify proper connectivity
- Configure and connect personal computers, laptops and mobile devices with switches and routers
- Configure a wired and wireless network with PC's, laptops and mobile devices
- Configure multiple VLANs, and switches will be configured with SVI and be able to be managed remotely
- Configure hostnames, ports and secure all intermediate devices
- Configure Telnet and SSH
- Connect multiple LAN segments using either static routes or dynamic routes
- Use proper transmission mediums for wired (copper and fiber) and wireless devices (air)
- Configure the layer 2 WAN protocol Frame-relay
- Design an IPv4 network and subnetworks (using FLSM and VLSM)
- Develop IPv6 / IPv4 Dual Stack network using RIPv2 and RIPng
- Develop and deploy DNS, DHCP and Web servers
- Configure and implement Access Point
- Configure email server and email clients
- Configure IP phones using Voice over Internet Protocol (VoIP)
- FTP and TFTP Server

Cisco Hierarchical Model	IPv6 Local and Global	Static Routes	Frame Relay	IOS Modes
OSI Model	Switches	Route of last resort	DHCP	IOS Commands
TCP/IP Model	Layer 3 Switches	Dynamic Routing (RIPv2 and RIPng)	HTTP	Show
LAN Technology	Routers	Vector-Distance	TFTP	Ping
WAN Technology	Integrated Service Routers	Link-State	FTP	Tracert
Classful Addressing	Access Points	Administrative Cost	DNS	Netstat
Classless Addressing	End Devices	Route Summarization	SSH	Nmap
CIDR	Collision Domain	Subnetting & Supernetting	Telnet	SVI
IPv4 Addressing	Broadcast Domain	IPv4 FLSM and IPv4 VLSM	Security	VTP
Netmask	RoaS	Telco (copper, glass & air)	VLAN	DTP
Cisco Hierarchical Model	IPv6 Local and Global	Static Routes	Frame Relay	IOS Modes
OSI Model	Switches	Route of last resort	DHCP	IOS Commands



Network Equipment

Routers (11) 10 1941 or 4321 router

1 2811 (CME) router

Wireless (4)

2 WRT300N

2 Access Points

Switches (12)

11 2960 switch 1 Cloud-PT Servers (9)

2 DHCP servers 1 Email servers

1 FTP

2 TFTP

1 NTP

2 HTTP

End Devices (61)

28 PC

3 Laptop

8 Wireless Laptops

7 VoIP Phone

2 VoIP Device

2 Analog Phones

1 Smartphone

1 Printer

Cables (77 cables)

12 copper cross-over cables

48 copper straight-through cables

12 serial DTE cables

3 console cables

2 phone cable

IP Information

Eight (8) Primary IPv4 Networks Several FLSM subnets

Twelve (12) Inter-linked routers

VLSM

Route Summarization

RIPv2 and Static Routes

Four (4) IPv6 Networks

Dual Stack

Subnetted

RIPng and Static Routes



IP Scheme

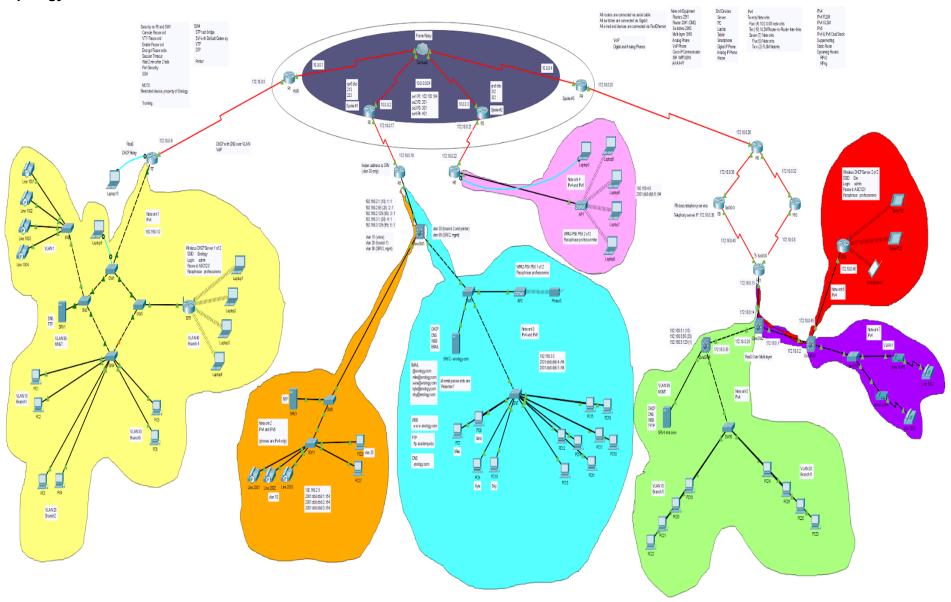
Student	Network Range (use FLSM as needed)	Interlink (use VLSM)	Frame Relay
Chris Phillips	192.168.0.0- 192.168.9.0 /24	172.18.0.0/24	10.0.0.0
Millie Choy	192.168.10.0- 192.168.19.0 /24	172.18.1.0/24	11.0.0.0
Mike Grosman	192.168.20.0- 192.168.29.0 /24	172.18.2.0/24	12.0.0.0
Alex Patalano	192.168.30.0- 192.168.39.0 /24	172.18.3.0/24	13.0.0.0
Ryan Sheidow	192.168.40.0- 192.168.49.0 /24	172.18.4.0/24	14.0.0.0
Trevor Demers	192.168.50.0- 192.168.59.0 /24	172.18.5.0/24	15.0.0.0
lan Derego	192.168.60.0- 192.168.69.0 /24	172.18.6.0/24	16.0.0.0

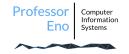
IPv6 Table

2001:db8:db8:0::/76 (NNNN.NNNN.NNNN:NNNx:xxxx:xxxx:xxxx) n = network, x = subnet ID/interface								
Network 2:		Network 3:		Network 4:				
VLAN 10	2001:db8:db8:1::/64	VLAN 30	2001:db8:db8:4::/64	VLAN 1	2001:db8:db8:6::/64			
VLAN 20	2001:db8:db8:2::/64	VLAN 99	2001:db8:db8:5::/64					
VLAN 98	2001:db8:db8:3::/64							
R5-R2:		Frame Relay:		R3-R6:				
2001:db8:db8:7::/64		2001:db8:db8:8::/64		2001:db8:db8:9::/64				



Topology Overview





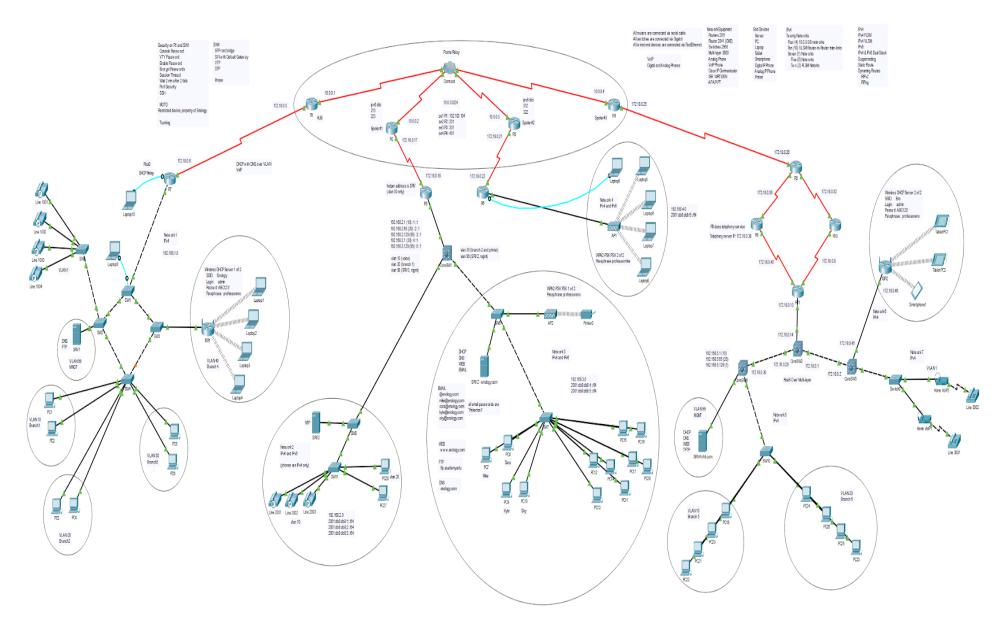
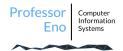
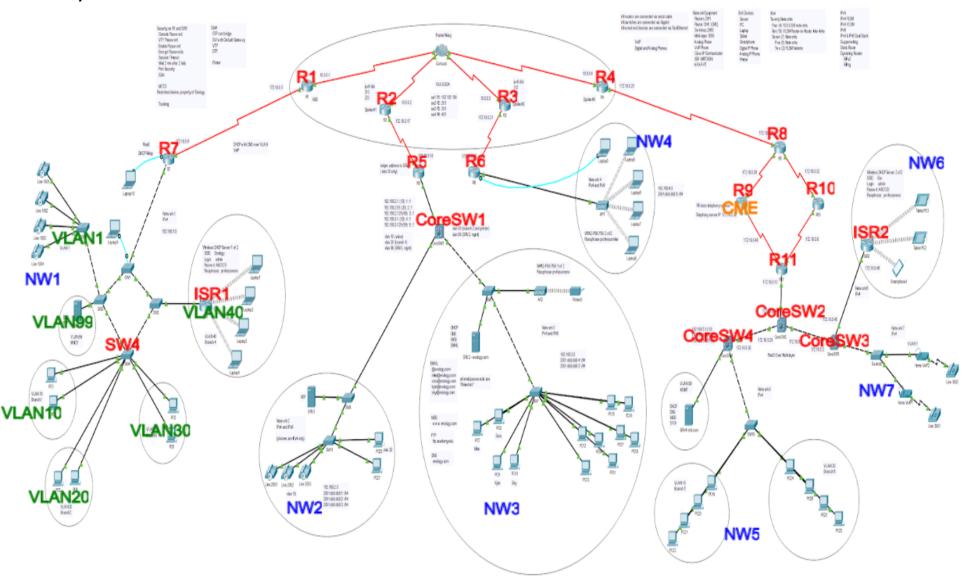


Figure 1

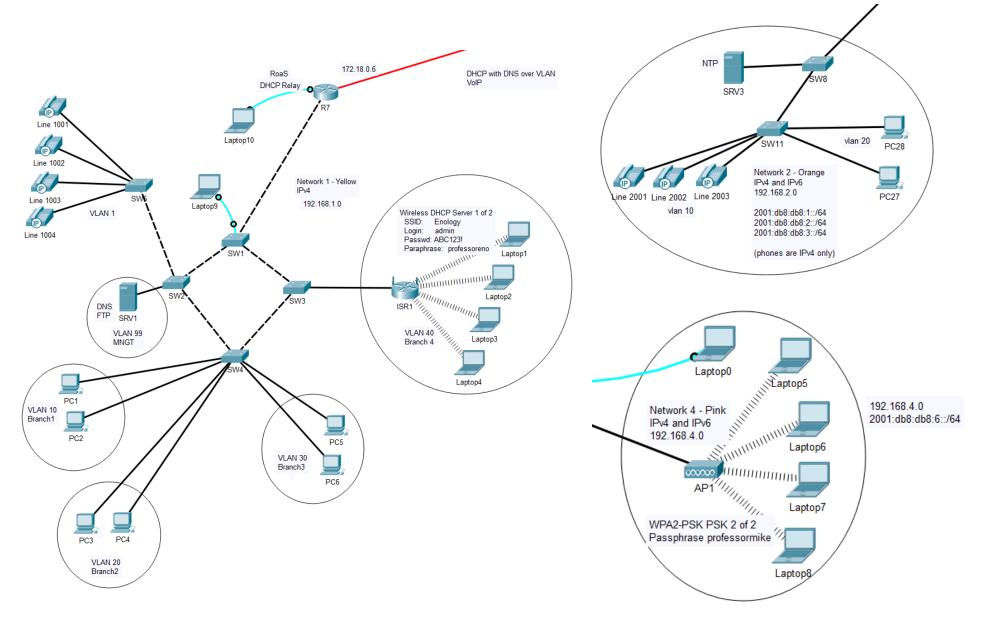


Intermediary Device Clarification



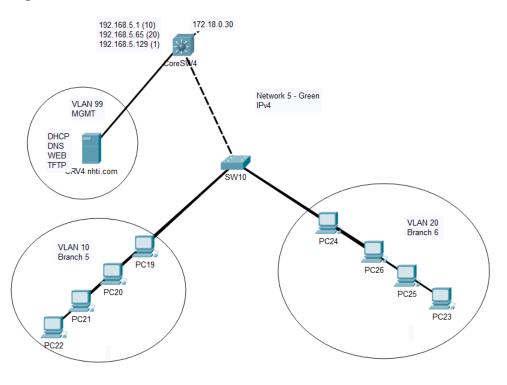


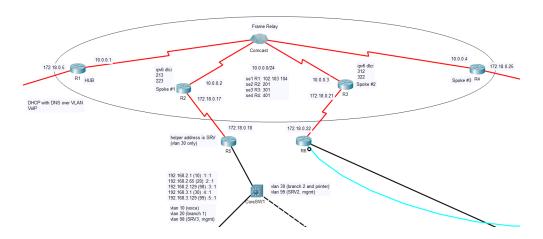
Segments

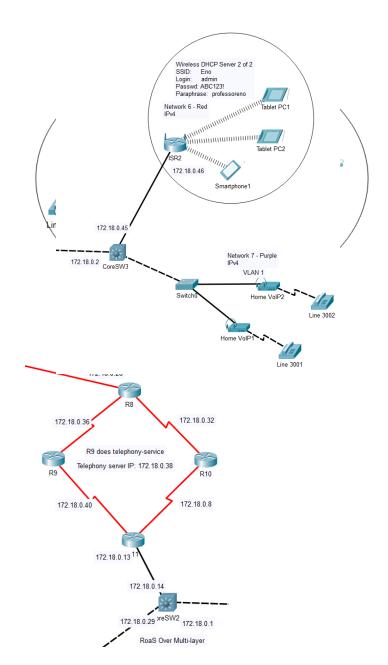


Professor Computer Information Systems

Segments continued









Directions for Figure 1

Network 1 - IPv4 only (Yellow)

Six (6) VLANs:

VLAN 1 (phones)

VLAN 10 (branch 1)

VLAN 20 (branch 2)

VLAN 30 (branch 3)

VLAN 40 (wireless ISR)

VLAN 99 (management)

R1 is the DHCP server. DHCP traffic will be forwarded from R7 to R1.

Configure Inter-vlan (RoaS) on R7

SRV1 does FTP and DNS (username: admin and password: cisco) and DNS (@enology.com)

ISR info:

SSID: Enology Login: Admin Passwd: ABC123!

Paraphrase: professoreno

Note: Phones are configured on router 9 (R9) - CME model 2811

Security on R1 and SW1:

Console Password cisco

VTY password **cisco**

Enable password class

Encrypt passwords enology

Session Timeout

Wait 2 min after 2 fails

Port security (offline unused switchports)

Configure SSH

Domain: pinkertonacadmy.org

MOTD: "Restricted device, property of Enology"

SW4

STP root bridge

SVI with Default Gateway

From PC5 FTP to server and get asa842-k8.bin



Network 2 - Dual stack IPv4 and IPv6 (Orange)

3 VLANs:

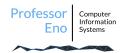
VLAN 10 (voice) VLAN 15 (data) VLAN 98 (for SRV3 mgmt)

SRV3 does NTP

Sync SW8, SW11, and CoreSW1 to the NTP server (Hint: Switch#show clock)

Update CoreSW1 to version 12.2(46)SE with TFTP from SRV3

*phones are only IPv4 configured on router 9 (R9) - CME model 2811



Network 3 - Dual stack IPv4 and IPv6 (Blue)

Static IPv6 and DHCPv6 (no eui-64) from the router

2 VLANs:

VLAN 30 (Branch 2 and printer/AP2) VLAN 99 (SRV2, mgmt)

SRV2 does DHCP, DNS (@eno.com), Web, and Email @enology.com)

The Printer is wirelessly connected to AP2

PC7 to PC18 uses SRV2 as DHCP server for **IPv4** PC7 to PC18 uses R5 as **DHCPv6** server

Access point WPA2-PSK:

Passphrase: professormike

Email: @enology.com:

username / password
mike@enology.com / 123
sara@enology.com / 123
kyle@enology.com / 123
sky@enology.com / 123



Network 4 - Dual stack IPv4 and IPv6 (Pink)

IPv6 Autoconfig EUI-64 for devices. RIPng routing process name "eno"

1 VLAN:

VLAN 1 (everything)

Access point:

Passphrase: **professormike** WPA2-PSK

Network 5 - IPv4 only (Green)

3 VLANs:

VLAN 10 (Branch 5) VLAN 20 (Branch 6) VLAN 99 (mgmt)

SRV4 does DHCP, DNS, WEB, TFTP

Put configuration files of SW10, CoreSW2, and CoreSW4 on SRV4's TFTP server



Network 6 - IPv4 only (Red)

All tablets and phones are connected to ISR2

ISR Information

SSID: **Eno** Login: **Admin** Password: **ABC123!**

Paraphrase: professoreno

Network 7 - IPv4 only (Purple)

Switch0

VLAN 1 (phones)

Home Phone Device (Analog)

IP Source Address - add gateway of the CME (R9)

Frame Relay - Spoke and Hub for or Full Mesh IPv4 (Navy Blue)

Hub R1 connects Frame relay to R7
Spoke 1 R2 connects Frame relay to R5
Spoke 2 R3 connects Frame relay to R6
Spoke 3 R4 connects Frame relay to R8

se1 R1: 102 103 104

se2 R2: 201 se3 R3: 301 se4 R4: 401



Router and Layer 3 Switch Information:



Does DHCP for all the VLANs on Network 1, including VLAN 1 for VoIP (not telephony server, R9 is the CME server) The Hub for the frame relay. Will act as the router to allow the other routers (R2, R3, R4) to communicate This device needs to be secured with passwords, encryption, and logout times

R2

Communicates with the hub R1 for Frame relay

R3

Communicates with the hub R1 for Frame relay

R4

Communicates with the hub R1 for Frame relay

R5

Acts as the router for both Network 2 and Network 3. Dual stacked for both Network 2 and Network 3.

R6

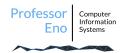
The router for Network 4, dual stacked and is connected to R3 and AP1.

R7

The router for Network 1 has multiple vlans and forwards DHCP packets to and from R1.

R8

Beginning of diamond shape. Connected directly to R4.



R9

2811 CME router that does telephony for the entire WAN. Phones should be configured without automatic phone registration. Every network should have a different first number (Network 1: 1000, Network 2: 2000 and Network 7: 3000)

R10

Connects directly to R11 and R8. acts as an optional route to Network 5, 6, 7 (the other route would be through R9 instead of R10)

R11

Acts as a router for Network 5, Network 6, and Network 7. The router should be connected to the switch through L3 (this is so that Networks 5-through-7 are not all one giant network).

CoreSW1

Connects directly to R5, Network 2, and Network 3. This device can either be configured as a L2 switch (for VLANs) or as a L3 switch using different gateways for the VLANs.

CoreSW2

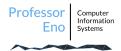
Directly connects to R11, CoreSW3, and CoreSW4. Should act as a strictly L3 switch. Routing processes (rip or static) should be used.

CoreSW3

Directly connects to CoreSW2, Network 6, and Network 7. Should route traffic for Network 6 and Network 7 through CoreSW2.

CoreSW4

Connects Network 5. Can act as both a L2 switch and a L3 switch. Connects directly to SRV4 and the rest of Network 5. SRV4 can be treated as its own network.



Answer the following essential questions (3 points each):

1. How would you troubleshoot/resolve DNS problems? 2. What command would you use to troubleshoot a DNS problem, why? 3. What command would you use to see if the gateway is up, why? 4. Your PC, DNS and your company router are functioning properly. What command would you use to troubleshoot where the breakdown in communications is, why? 5. What command would you use to verify your PC's IP Address, netmask and gateway address? 6. Name some steps and commands which you would use to troubleshoot Internet related problems: 7. How would you troubleshoot DHCP server related issues? 8. What are the commands to get a new DHCP IP address on a PC? 9. A user is unable to telnet/ssh into the router. Explain the methodology of troubleshooting: 10. What are the big differences between routers, switches and Hubs?

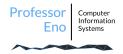


- 11. What are the two types of copper LAN cables and console cable?
- 12. What type of cable do you use to connect two switches together, why?
- 13. What type of cable do you use to connect a laptop to a router, why?
- 14. What are the differences between a crossover cable and a straight-through cable?
- 15. What does the ping command do?
- 16. What is the difference between a public and a private IP address?
- 17. Why would you need a default gateway configured on your PC?
- 18. What command on a switch would you use to display the SVI address?
- 19. What command on a switch would you use to display the trunking information?
- 20. What command on a router would you use to display the route table?
- 21. What command on a router would you use to display the IP address of each interface?



22. What utility would you use to connect to a router from a laptop? 23. What is data encapsulation? 24. Briefly describe NAT: 25. What is the major difference between RIP and RIPv2? 26. What is the importance of the OSI Physical Layer? 27. What are MAC addresses? 28. What is the difference between a default and a custom netmask? 29. Explain the difference between a Client/Server architecture and a Peer-to-Peer architecture: 30. What is the difference between CSMA/CD and CSMA/CA? Answer the following essential questions (5 points each): 31. Explain the purpose of IPv4 / IPv6 Dual Stack

32. Explain the purpose of 6to4 Tunneling



Grading

Create a complex fully hierarchical and functional network topology as illustrated in *Figure 1* in Cisco PacketTracer. Design an IP scheme and configure all the devices. Configure the hostnames as shown on the *Figure 1*. Students must configure router 6 and 7 via console connection using IOS commands. Label your project exactly as in *Figure 1* and add route tables, IP ranges, netmasks and/or CIDR notions where applicable. All end devices and intermediary devices are pingable except switches.

Routers are connected via serial connections: *1 pt* Switches are connected to the routers via GigE: *2 pts*

Laptops are connected to the routers via GigE and/or via console: 1 pt

PC are connected to switches via FastEthernet: 1 pt

Proper Labeling throughout PacketTracer (upload to Google Classroom when finished): 5 pts

Network 1 - IPv4 only (Yellow) 20 pts

Six (6) Vlans (1, 10, 20, 30, 40, and 99)

R1 is the DHCP server for network 1 and will be forwarding from R7 to R1

SRV1 does FTP (username and password) and DNS (domain name)

ISR (SSID: Enology, Username "admin" and Password "ABC123!" with the Paraphrase "professoreno")

R7 inter-vlan configured (RoaS)

Security on R1 and SW1 (console and vty passwords, encryption, session timeout, port security and ssh configured)

SW4 STP root bridge with SVI and Default Gateway

Network 1 *VoIP phone connects to other Network 1 VoIP phones

Network 1 *VoIP phone connects with network 2 VoIP phone

Network 1 *VoIP phone connects with network 7 analog phone

Network 1 end devices ping R7 and other end device on Network 1

Network 1 end devices ping across the network (2, 3, 4, 5, 6, and 7)

FLSM CHART (hand in)

Note: *Phones are configured on router 9 (R9)



Network 2 - Dual stack IPv4 and IPv6 (Orange) 10 pts

Three (3) VLANs (10, 15, (98 to SRV3 for mgmt))

SRV3 does NTP

IPv6 Static address (for all devices)

Sync SW8, SW11, and CoreSW1 to the NTP server (Hint: Switch#show clock)

Update CoreSW1 to version 12.2(46)SE with TFTP from SRV3

SRV3 has IPv4 and IPv6 (dual stack) addresses

SRV3 ping SRV1 (IPv4)

SRV3 ping SRV2 (IPv6)

FLSM CHART (hand in)

Network 3 - Dual stack IPv4 and IPv6 (Blue) 20 pts

Static IPv6 and DHCPv6 (no eui-64)

Two (2) VLANs (30 to branch 2 and printer via AP2) and 99 to SRV2 for mgmt

SRV2 does DHCP, DNS, Web, and Email

PC7 to PC18 uses SRV2 DHCP server

Access point WPA2-PSK (passphrase)

Email: @enology.com (mike@enology.com, sara@enology.com, kyle@enology.com, and sky@enology.com)

Network 4 - Dual stack IPv4 and IPv6 (Pink) 10 pts

IPv6 Autoconfig EUI-64 for all devices One (1) VLAN (VLAN 1 for everything)

Access point (passphrase) and WPA2-PSK

FLSM CHART (hand in)

^{*}phones are only IPv4 and are configured on router 9 (R9)



Network 5 - IPv4 only (Green) 10 pts

Three (3) VLANs (10, 20, (99 for mgmt)) SRV4 does DHCP, DNS, WEB, TFTP Configuration files of SW9, SW10, and CoreSW4 on SRV4's TFTP server FLSM CHART (hand in)

Network 6 - IPv4 only (Red) 10 pts

All tablets and phones are connected to ISR2 ISR (SSID, Login, Password, and Paraphrase) TabletPC1 ping SRV1

Network 7 - IPv4 only (Purple) 5 pts

Three (3) VLANs (10, 20 and (99 for mgmt) SRV4 does DHCP, DNS, WEB, TFTP Put configuration files of SW9, SW10, and CoreSW4 on SRV4's TFTP server Network 6 Analog phone (Line 3002) connects to Network 2 VoIP Phone (Line 2001) Network 6 Analog phone (Line 3001) connects to Network 1 VoIP Phone (Line 104)

Frame Relay - Spoke and Hub for IPv4 (Navy Blue) 15 pts

Hub R1 connects Frame relay to R7 Spoke 1 R2 connects Frame relay to R5 Spoke 2 R3 connects Frame relay to R6 Spoke 3 R4 connects Frame relay to R8 R7 can ping R11

VLSM CHART for router-interlinks (hand in)