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Student Reference	Number:

Module Code: CNET237SL Module Name: COMPUTER NETWORKS						
Coursework Title: Disaster Management	System					
Deadline Date:	Member of staff res	sponsible for coursewor	k:			
_ Mr.Saliya Patabandi						
Programme:			b-:			
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ebsite www.plymouth.ac.uk/studentha	ndbook.					
Group work: please list all names of al was undertaken alone or as part of a to component parts.	l participants formally a eam. Please note you r	associated with this work may be required to iden	k and state whether the work tify individual responsibility for			
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Introduction.

Our solution for "NSCS" university includes different type of technologies. For an example we use "EIGRP" as our routing protocol, which brings lots of benefits to our network solutions. As well we use VLAN technologies without using physical LANS everywhere. We use regency protocols like HSRP. Also we have used VLAN trucking protocol. Also we use VLSM for subnetting.

Table of Contents

BOM including all necessary equipment and materials to build the network	4
Topology for each internal network	. 5
WAN topology for interconnecting two marketing offices	. 5
Appropriate private IP address plan for the whole network	6
Using Cisco packet tracer or other network simulation software configure all network devices to a level of fully functional network1	
Decide routing architecture of the network and provide interface configurations of all routers in the template table given below	.2
Routing table of each router using the following template table. (Screen shots also included.)1	٤.
By using configuration commands getting the following information	.8
Routing tables output - screenshots1	.8
Describe all routing table parameters (E.g. Destination network, next hop, cost, etc.) in one routing entry in one routing table. Use an entry for a remote network	!1
Router's interface IP addresses details and status (up/down)Provide screenshots2	23
Multilayer Switch 0 load balancing (Standby and active)2	27
Multilayer Switch 1 load balancing (Standby and Active)2	28
IP protocols	29
PING command output from each router to other two routers for verifying the connectivity. Provide screenshots	31
Verify connectivity from one PC in one of the LANs to a PC in each of other LANs using PING command (screenshots)	34
Do a trace route from a one location PC to another two location's PC and get the trace route output. Provide screenshots	39
Justifying all configuration options we have chosen while comparing with possible alternatives4	
References	16

(BOM IS INCLUDED IN EXEL FILE)

BOM including all necessary equipment and materials to build the network.

(BOM is included with the EXEL file and it also displays in below tables with screen shots)

Brand / Model				Cabling	Cyberpower			el Lisco Lai		Cisco WAP371 Wireless	Cisco 2300 Series	Lisco Latalyst 3560 Seri	es	
Building/Branch	Copper ports	eystone jack per brane	double Face plate Per Bra	nch Wall MountNetwork Rack	UPS	Pate 24 port	ch Panel 48port	24 port	Switch 48 port	Acess point	Router	Multy layer switch	RJ45	Sunb
chool of computing														+
ab1	50	50	25										40	
ab2	50	50	25	21U	1KV	1	3						40	
ab3 ab4	50 50	50 50	25 25										40 40	
ь ч Ь5	50	50	25	21U	1KV	1	3	3	6				40	
b6	50	50	25	210			Ť						40	
Ь7	20	20	10	120	1KV	0	1			1	0	0	40	
Ь8	20	20	10	120	IINV	۰								30
ctures Rooms	15	15	8											30
ad of departments ro		5	3	210	1KV	0	1	0	1					20 32
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School of Business														+
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ab 2	50	50	25	210	INV	1	۷	'	۷				40	0
ecture Rooms	23	23	16							1	0	0		32
IOD rooms	7	7	4	120	1KV	1	1	1	1	' '	ŭ	Ů		28
Program admin	11	11	6											14
Dean's office	13	13	7											52
														+
School of Business														
ab1 ab2	50 50	50 50	25 25 16	210	1KV	1	2	1	2				40 40	
.ab Z .ecture Rooms	23	23	25 16										90	12
HOD rooms	7	7	4	12U	1KV	1	1		1	1	0	0	2	92 28
Program admin	11	11	6	120	INV	'	'	1	'				4	14
Dean's office	13	13	7											52
														+
Administration division														
xaminations	25	25	13					0	1					0
.ibrary	25	25	13					0	1				10	
inance	25	25	13	210	1KV	1	3	0	1	1	0	0	10	
HR .	25	25	13				-	0	1	·	·	•	10	
laintenance	25	25	13					0	1				10	
Marketing	25	25	13					0	1				10)0
Colombo	10	10	10	8U	1KV	1	0	1	0	0	1	0	4	10
(andy	10	10	10	8U	1KV	1	0	1	0	0	1	0	4	10
_		40	40	4411	451.0							_		
erver Room	10	10	10	42U	10KV	0	0	0	0	0	1	2	4	10

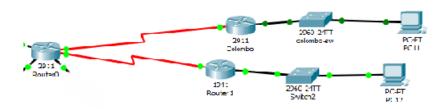
Topology for each internal network

There are few physical LAN networks and Virtual LAN networks on our solution. For each network we suggest creating the network with start topology.

- Computing lab Star Topology.
- Computing Staff network (Dean office, Program office, Lecture room, Head of Department) - Star topology.
- Business lab Star topology.
- Business Staff network (Dean office, Program office, Lecture room, Head of Department) – Star Topology.
- ♣ Administrative marketing office Star topology.
- Administrative Maintains office Star topology.
- Administrative Exam office Star topology.
- Administrative Library Star topology.
- Administrative Finance Star topology.
- Administrative HR Star topology.

WAN topology for interconnecting two marketing offices.

For connecting 2 marketing offices in Colombo and Kandy We propose a Star topology network.



Appropriate private IP address plan for the whole network

Proposed VLANs For the Network

- 1. VLAN10 computing lab
- 2. VLAN20 computer management (School of computing Staff)
- 3. VLAN30 business management (School of Business Staff)
- 4. VLAN40 business lab
- 5. VLAN50 admin-marketing
- 6. VLAN60 admin-HR
- 7. VLAN70 admin-finance
- 8. VLAN80 admin-library
- 9. VLAN90 admin-maintenance
- 10. VLAN100 admin-exam
- 11. VLAN110 WIFI
- Computing Lab(50 lab 6, 20 machine 2 labs)

\checkmark	"Subnet Mask"	255.255.254.0	

- ✓ "Network ID" 192.168.0.0
- √ "Total Usable addresses" 510
- ✓ "Addresses want"

 340
- ✓ "First IP address" 192.168.0.1
- ✓ "Last usable IP address" 192.168.1.254
- √ "Broadcast Address" 192.168.1.255

• Business (50 lab 2)

✓ "Subnet Mask" 255.255.255.128

✓ "Network ID" 192.168.2.0

√ "Total Usable addresses" 126

√ "Addresses require" 100

✓ "First usable IP address" 192.168.2.1

✓ "Last usable IP" 192.168.2.126

√ "Broadcast Address" 192.168.2.127

 Business management [staff] (Dean office, Program office, Lecture room, Head of Department)

✓ "Subnet Mask" 255.255.255.192.2/26

✓ "Network_id" 192.168.2.128

√ "Total Usable addresses" 62

✓ "Addresses require" 54

✓ "First usable" 192.168.2.129

✓ "Last usable" 192.168.2.190

√ "Broadcast address" 192.168.2.191

• Computing management [Staff] (Lecture hall, Head of Department, Program office, Dean office)

✓ "Subnet Mask" 255.255.255.192/26

✓ "Network ID" 192.168.2.192

✓ "Total Usable Addresses" 62

√ "Addresses require" 39

✓ "First usable IP" 192.168.2.193

✓ "Last usable IP" 192.168.2.254

√ "Broadcast Address" 192.168.2.255

• Administration division - Maintains

✓ "Mask" 255.255.224/27
 ✓ "Network_id" 192.168.3.0
 ✓ "First usable IP" 192.168.3.1
 ✓ "Total Usable Addresses" 30
 ✓ "Addresses require" 25
 ✓ "Last usable IP" 192.168.3.30

192.168.3.31

• Administration division – Exam

✓ "Broadcast address"

✓ "Mask" 255.255.224/27
 ✓ "Network _ID" 192.168.3.32
 ✓ "Total Usable Addresses" 30
 ✓ "Addresses require" 25
 ✓ "First usable IP" 192.168.3.33
 ✓ "Last usable IP" 192.168.3.62
 ✓ "Broadcast address" 192.168.3.63

• Administration division - Library

✓ "Mask"	255.255.255.224/27
✓ "Network_id"	192.168.3.64
✓ "Total Usable Addresses"	30
✓ "Addresses require"	25
✓ "First usable IP address"	192.168.3.65
✓ "Last usable IP address"	192.168.3.94
✓ "Broadcast address"	192.168.3.95

• Administration division – Finance

✓ "Mask" 255.255.224/27
 ✓ "Network_id" 192.168.3.96
 ✓ "Total Usable Addresses" 30
 ✓ "Addresses require" 25
 ✓ "First usable IP address" 192.168.3.97
 ✓ "Last usable IP address" 192.168.3.126
 ✓ "Broadcast address" 192.168.3.127

Administration division – HR

✓ "Mask" 255.255.224/27
 ✓ "Network _ID" 192.168.3.128
 ✓ "Total Usable Addresses" 30
 ✓ "Addresses require" 25
 ✓ "First usable IP address" 192.168.3.129
 ✓ "Last usable IP address" 192.168.3.158
 ✓ "Broadcast address" 192.168.3.159

• Administration division – Marketing

✓	"Mask"	255.255.255.224/27
✓	"Network _ID"	192.168.3.160
✓	"Total Usable Addresses"	30
✓	"Addresses require"	25
✓	"First usable IP address"	192.168.3.161
✓	"Last usable IP address"	192.168.3.190
✓	"Broadcast address"	192.168.3.191

• Colombo Marketing Office

✓	"Mask"	255.255.255.0
/	"Natural ID"	102.160.4.0./24
V	"Network_ID"	192.168.4.0 /24
✓	"Total Usable Addresses"	254
✓	"Addresses require"	10
✓	"First usable IP address"	192.168.4.1

✓ "Last usable IP address" 192.168.4.254
 ✓ "Broadcast address" 192.168.4.255

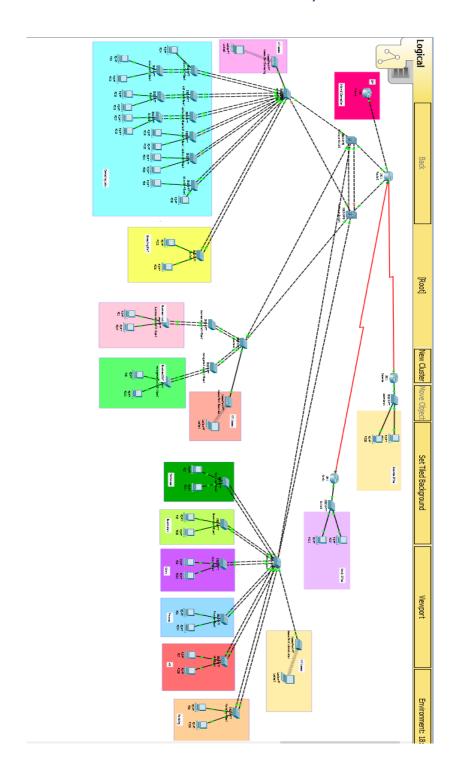
• Kandy Marketing Office

✓	"Mask"	255.255.255.0
✓	"Network_ID"	192.168.5.0 /24
✓	"Total Usable Addresses"	254
✓	"Addresses require"	10
✓	"First usable IP address"	192.168.5.1
✓	"Last usable IP address"	192.168.5.254
✓	"Broadcast address"	192.168.5.255

FOR WIFI

✓	"Mask"	255.255. 254.0
✓	"Network_ID"	192.168.6.0 /24
✓	"Total Usable Addresses"	510
✓	"First usable IP address"	192.168.6.1
✓	"Last usable IP address"	192.168.7.254
\checkmark	"Broadcast address"	192.168.7.255

Using Cisco packet tracer or other network simulation software configure all network devices to a level of fully functional network.



Decide routing architecture of the network and provide interface configurations of all routers in the template table given below.

Interface Number	Main Router IP Address	Kandy Branch Router IP Address	Colombo Branch Router IP Address	Multilayer 0	Multilayer 1	Multilayer Virtual IP (Standby IP)	Router ISP
interface GigabitEthernet0/0	10.0.0.2	-	-	-	-	-	192.168.7.252
interface GigabitEthernet0/1	20.0.0.2	192.168.5.254	192.168.4.254	10.0.0.1	20.0.0.1	-	-
interface GigabitEthernet0/2	172.168.1.2	-	-	-	-	-	-
interface Serial0/0/0	40.0.0.1	30.0.0.2	40.0.0.2	-	-	-	-
interfaceSerial0/0/1	30.0.0.1	-	-	-	-	-	-
interface Vlan10	-	-	-	192.168.1.252	192.168.1.253	192.168.1.254	-
interface Vlan20	-	-	-	192.168.2.252	192.168.2.253	192.168.2.254	-
interface Vlan30	-	-	-	192.168.2.188	192.168.2.189	192.168.2.190	-
interface Vlan40	-	-	-	192.168.2.124	192.168.2.125	192.168.2.126	-
interface Vlan50	-	-	-	192.168.3.188	192.168.3.189	192.168.3.190	-
interface Vlan60	-	-	-	192.168.3.156	192.168.3.157	192.168.3.158	-
interface Vlan70	-	-	-	192.168.3.124	192.168.3.125	192.168.3.126	-
interface Vlan80	-	-	-	192.168.3.92	192.168.3.93	192.168.3.94	-
interface Vlan90	-	-	-	192.168.3.28	192.168.3.29	192.168.3.30	-
interface Vlan100	-		-	192.168.3.60	192.168.3.61	192.168.3.62	-
interface Vlan110	-	-		192.168.7.252	192.168.7.253	192.168.7.254	-

Routing table of each router using the following template table. (Screen shots also included.)

Kandy Router

Target Network	Next Step Router	Metric	Interface
172.168.1.0	30.0.0.1	2170112	Serial0/0/0
192.168.0.0/23	30.0.0.1	27770112	Serial0/0/0
192.168.2.0/24	30.0.0.1	27770112	Serial0/0/0
192.168.3.0/24	30.0.0.1	27770112	Serial0/0/0
192.168.6.0/23	30.0.0.1	27770112	Serial0/0/0
40.0.0.0	30.0.0.1	2681856	Serial0/0/0
10.0.0.0/24	30.0.0.1	2170112	Serial0/0/0
20.0.0.0/24	30.0.0.1	2170112	Serial0/0/0
10.0.0.0/8	30.0.0.1	27770368	Serial0/0/0
20.0.0/8	30.0.0.1	27770368	Serial0/0/0

```
Router>
Router>ena
Router#show ip
Router#show ip ro
Router#show ip route ei
Router#show ip route eigrp
     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
      10.0.0.0/8 [90/27770368] via 30.0.0.1, 02:15:07, Serial0/0/0
D
       10.0.0.0/24 [90/2170112] via 30.0.0.1, 02:15:09, Serial0/0/0
    20.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
       20.0.0.0/8 [90/27770368] via 30.0.0.1, 02:15:08, Serial0/0/0
D
       20.0.0.0/24 [90/2170112] via 30.0.0.1, 02:15:09, Serial0/0/0
     40.0.0.0/24 is subnetted, 1 subnets
       40.0.0.0 [90/2681856] via 30.0.0.1, 02:15:09, Serial0/0/0
    172.168.0.0/24 is subnetted, 1 subnets
       172.168.1.0 [90/2170112] via 30.0.0.1, 02:15:09, Serial0/0/0
    192.168.0.0/23 [90/27770112] via 30.0.0.1, 02:15:08, Serial0/0/0
    192.168.2.0/24 [90/27770112] via 30.0.0.1, 02:15:08, Serial0/0/0
    192.168.3.0/24 [90/27770112] via 30.0.0.1, 02:15:08, Serial0/0/0
    192.168.4.0/24 [90/2682112] via 30.0.0.1, 02:15:08, Serial0/0/0
     192.168.5.0/24 is variably subnetted, 2 subnets, 2 masks
     192.168.6.0/23 [90/27770112] via 30.0.0.1, 02:15:08, Serial0/0/0
Router#
```

Colombo Router

Target Network	Next Step Router	Metric	Interface
10.0.0.0/8	40.0.0.1	27770368	Serial0/0/0
10.0.0.0/24	40.0.0.1	2170112	Serial0/0/0
20.0.0.0/8	40.0.0.1	27770368	Serial0/0/0
20.0.0.0/24	40.0.0.1	2170112	Serial0/0/0
30.0.0.0	40.0.0.1	2681856	Serial0/0/0
172.168.1.0	40.0.0.1	2170112	Serial0/0/0
192.168.0.0/23	40.0.0.1	27770112	Serial0/0/0
192.168.2.0/24	40.0.0.1	27770112	Serial0/0/0
192.168.3.0/24	40.0.0.1	27770112	Serial0/0/0
192.168.5.0/24	40.0.0.1	2682112	Serial0/0/0
192.168.6.0/23	40.0.0.1	27770112	Serial0/0/0

```
kouter.
Router>
Router>enab
Router#show ip
Router#show ip ro
Router#show ip route ei
Router#show ip route eigrp
    10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
        10.0.0.0/8 [90/27770368] via 40.0.0.1, 02:13:41, Serial0/0/0
D
D
        10.0.0.0/24 [90/2170112] via 40.0.0.1, 02:13:43, Serial0/0/0
    20.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
D
       20.0.0.0/8 [90/27770368] via 40.0.0.1, 02:13:41, Serial0/0/0
D
        20.0.0.0/24 [90/2170112] via 40.0.0.1, 02:13:43, Serial0/0/0
     30.0.0.0/24 is subnetted, 1 subnets
D
       30.0.0.0 [90/2681856] via 40.0.0.1, 02:13:42, Serial0/0/0
     172.168.0.0/24 is subnetted, 1 subnets
D
       172.168.1.0 [90/2170112] via 40.0.0.1, 02:13:43, Serial0/0/0
     192.168.0.0/23 [90/27770112] via 40.0.0.1, 02:13:42, Serial0/0/0
    192.168.2.0/24 [90/27770112] via 40.0.0.1, 02:13:42, Serial0/0/0
D
    192.168.3.0/24 [90/27770112] via 40.0.0.1, 02:13:41, Serial0/0/0
    192.168.4.0/24 is variably subnetted, 2 subnets, 2 masks
D
     192.168.5.0/24 [90/2682112] via 40.0.0.1, 02:13:42, Serial0/0/0
    192.168.6.0/23 [90/27770112] via 40.0.0.1, 02:13:41, Serial0/0/0
D
Router#
```

Homagama Router

Target Network	Next Step Router	Metric	Interface
10.0.0.0/8	20.0.0.1	90/25626112	GigabitEthernet 0/1
20.0.0.8	10.0.0.1	90/25626112	GigabitEthernet0/1
192.168.0.0/23	10.0.0.1	90/25625856	GigabitEthernet0/0
192.168.0.0/23	20.0.0.1	90/25625856	GigabitEthernet0/1
192.168.2.0/24	10.0.0.1	90/25625856	GigabitEthernet0/0
192.168.2.0/24	20.0.0.1	90/25625856	GigabitEthernet0/1
192.168.3.0/24	10.0.0.1	90/25625856	GigabitEthernet0/0
192.168.3.0/24	20.0.0.1	90/25625856	GigabitEthernet0/1
192.168.4.0/24	40.0.0.2	90/2170112	Serial0/0/0
192.168.5.0/24	30.0.0.2	90/2170112	Serial0/0/1

```
Router>enabel
Translating "enabel"...domain server (255.255.255.255) % Name lookup aborted
Router>en
Router>enable
Router#show ip rou
Router#show ip route ei
Router#show ip route eigrp
    10.0.0.0/8 is variably subnetted, 3 subnets, 3 masks
       10.0.0.0/8 [90/25626112] via 20.0.0.1, 02:03:35, GigabitEthernet0/1
    20.0.0.0/8 is variably subnetted, 3 subnets, 3 masks
       20.0.0.0/8 [90/25626112] via 10.0.0.1, 02:03:36, GigabitEthernet0/0
D
    172.168.0.0/16 is variably subnetted, 2 subnets, 2 masks
   192.168.0.0/23 [90/25625856] via 10.0.0.1, 02:03:36, GigabitEthernet0/0
                   [90/25625856] via 20.0.0.1, 02:03:36, GigabitEthernet0/1
D
   192.168.2.0/24 [90/25625856] via 10.0.0.1, 02:03:36, GigabitEthernet0/0
                   [90/25625856] via 20.0.0.1, 02:03:36, GigabitEthernet0/1
   192.168.3.0/24 [90/25625856] via 10.0.0.1, 02:03:36, GigabitEthernet0/0
D
                   [90/25625856] via 20.0.0.1, 02:03:36, GigabitEthernet0/1
D
   192.168.4.0/24 [90/2170112] via 40.0.0.2, 02:03:36, Serial0/0/0
D
   192.168.5.0/24 [90/2170112] via 30.0.0.2, 02:03:37, Serial0/0/1
    192.168.6.0/23 [90/25625856] via 10.0.0.1, 02:03:36, GigabitEthernet0/0
                   [90/25625856] via 20.0.0.1, 02:03:36, GigabitEthernet0/1
Router#
Router#
```

Multilayer Switch 0

Target Network	Next Step Router	Metric	Interface
20.0.0.0/8	192.168.2.189	25625856	Vlan30
20.0.0.0/8	192.168.3.125	25625856	Vlan70
20.0.0.0/8	192.168.3.189	25625856	Vlan50
20.0.0.0/8	192.168.3.93	25625856	Vlan80
20.0.0.0/8	192.168.2.125	25625856	Vlan40
20.0.0.0/8	192.168.1.253	25625856	Vlan10
20.0.0.0/8	192.168.3.29	25625856	Vlan90
20.0.0.0/8	192.168.7.253	25625856	Vlan110
20.0.0.0/8	192.168.3.61	25625856	Vlan100
20.0.0.0/8	192.168.3.157	25625856	Vlan60
20.0.0.0/8	192.168.2.253	25625856	Vlan20
20.0.0.0/24	10.0.0.2	3072	GigabitEthernet0/1
30.0.0.0	10.0.0.2	2170112	GigabitEthernet0/1
40.0.0.0	10.0.0.2	2170112	GigabitEthernet0/1
172.168.1.0	10.0.0.2	3072	GigabitEthernet0/1

```
corel#show ip route ei
corel#show ip route eigrp
     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
D
        10.0.0.0/8 is a summary, 08:12:50, Null0
     20.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
       20.0.0.0/8 [90/25625856] via 192.168.2.189, 02:37:43, Vlan30
D
                   [90/25625856] via 192.168.3.125, 02:37:43, Vlan70
                   [90/25625856] via 192.168.3.189, 02:37:43, Vlan50
                   [90/25625856] via 192.168.3.93, 02:37:40, Vlan80
                   [90/25625856] via 192.168.2.125, 02:37:40, Vlan40
                   [90/25625856] via 192.168.1.253, 02:37:40, Vlan10
                   [90/25625856] via 192.168.3.29, 02:37:40, Vlan90
                   [90/25625856] via 192.168.7.253, 02:37:39, Vlan110
                   [90/25625856] via 192.168.3.61, 02:37:39, Vlan100
                   [90/25625856] via 192.168.3.157, 02:37:39, Vlan60
                   [90/25625856] via 192.168.2.253, 02:37:39, Vlan20
D
       20.0.0.0/24 [90/3072] via 10.0.0.2, 02:37:44, GigabitEthernet0/1
     30.0.0.0/24 is subnetted, 1 subnets
D
       30.0.0.0 [90/2170112] via 10.0.0.2, 02:37:43, GigabitEthernet0/1
     40.0.0.0/24 is subnetted, 1 subnets
D
        40.0.0.0 [90/2170112] via 10.0.0.2, 02:37:44, GigabitEthernet0/1
     172.168.0.0/24 is subnetted, 1 subnets
D
       172.168.1.0 [90/3072] via 10.0.0.2, 02:37:44, GigabitEthernet0/1
     192.168.2.0/24 is variably subnetted, 4 subnets, 3 masks
```

Multilayer Switch 1

Target Network	Next Step Router	Metric	Interface
10.0.0.0/8	192.168.2.188	25625856	Vlan30
10.0.0.0/8	192.168.3.124	25625856	Vlan70
10.0.0.0/8	192.168.3.188	25625856	Vlan50
10.0.0.0/8	192.168.3.92	25625856	Vlan80
10.0.0.0/8	192.168.1.252	25625856	Vlan10
10.0.0.0/8	192.168.2.124	25625856	Vlan40
10.0.0.0/8	192.168.3.60	25625856	Vlan100
10.0.0.0/8	192.168.7.252	25625856	Vlan110
10.0.0.0/8	192.168.3.28	25625856	Vlan90
10.0.0.0/8	192.168.3.156	25625856	Vlan60
10.0.0.0/8	192.168.2.252	25625856	Vlan20
10.0.0.0/24	20.0.0.2	3072	GigabitEthernet0/1
30.0.0.0/24	20.0.0.2	2170112	GigabitEthernet0/1
172.168.0.0/24	20.0.0.2	3072	GigabitEthernet0/1
192.168.3.0/24	20.0.0.2	2170368	GigabitEthernet0/1

```
core2#show ip route ei
core2#show ip route eigrp
     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
       10.0.0.0/8 [90/25625856] via 192.168.2.188, 02:59:01, Vlan30
                   [90/25625856] via 192.168.3.124, 02:59:01, Vlan70
                   [90/25625856] via 192.168.3.188, 02:59:01, Vlan50
                   [90/25625856] via 192.168.3.92, 02:59:00, Vlan80
                   [90/25625856] via 192.168.1.252, 02:59:00, Vlan10
                   [90/25625856] via 192.168.2.124, 02:59:00, Vlan40
                   [90/25625856] via 192.168.3.60, 02:58:59, Vlan100
                   [90/25625856] via 192.168.7.252, 02:58:59, Vlan110
                   [90/25625856] via 192.168.3.28, 02:58:59, Vlan90
                   [90/25625856] via 192.168.3.156, 02:58:58, Vlan60
                   [90/25625856] via 192.168.2.252, 02:58:58, Vlan20
       10.0.0.0/24 [90/3072] via 20.0.0.2, 02:59:01, GigabitEthernet0/1
D
    20.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
D
       20.0.0.0/8 is a summary, 08:34:09, Null0
     30.0.0.0/24 is subnetted, 1 subnets
D
       30.0.0.0 [90/2170112] via 20.0.0.2, 02:59:01, GigabitEthernet0/1
     40.0.0.0/24 is subnetted, 1 subnets
       40.0.0.0 [90/2170112] via 20.0.0.2, 02:59:01, GigabitEthernet0/1
    172.168.0.0/24 is subnetted, 1 subnets
D
       172.168.1.0 [90/3072] via 20.0.0.2, 02:59:01, GigabitEthernet0/1
    192.168.2.0/24 is variably subnetted, 4 subnets, 3 masks
D
       192.168.2.0/24 is a summary, 08:34:09, Null0
    192.168.3.0/24 is variably subnetted, 7 subnets, 2 masks
D
       192.168.3.0/24 is a summary, 08:34:09, Null0
D
     192.168.4.0/24 [90/2170368] via 20.0.0.2, 02:59:01, GigabitEthernet0/1
    192.168.5.0/24 [90/2170368] via 20.0.0.2, 02:59:01, GigabitEthernet0/1
```

By using configuration commands getting the following information.

Routing tables output - screenshots

Kandy Router

```
Router>
Router>ena
Router#show ip
Router#show ip ro
Router#show ip route ei
Router#show ip route eigrp
    10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
       10.0.0.0/8 [90/27770368] via 30.0.0.1, 02:15:07, Serial0/0/0
       10.0.0.0/24 [90/2170112] via 30.0.0.1, 02:15:09, Serial0/0/0
    20.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
       20.0.0.0/8 [90/27770368] via 30.0.0.1, 02:15:08, Serial0/0/0
       20.0.0.0/24 [90/2170112] via 30.0.0.1, 02:15:09, Serial0/0/0
    40.0.0.0/24 is subnetted, 1 subnets
D
       40.0.0.0 [90/2681856] via 30.0.0.1, 02:15:09, Serial0/0/0
    172.168.0.0/24 is subnetted, 1 subnets
      172.168.1.0 [90/2170112] via 30.0.0.1, 02:15:09, Serial0/0/0
    192.168.0.0/23 [90/27770112] via 30.0.0.1, 02:15:08, Serial0/0/0
    192.168.2.0/24 [90/27770112] via 30.0.0.1, 02:15:08, Serial0/0/0
    192.168.3.0/24 [90/27770112] via 30.0.0.1, 02:15:08, Serial0/0/0
D
    192.168.4.0/24 [90/2682112] via 30.0.0.1, 02:15:08, Serial0/0/0
    192.168.5.0/24 is variably subnetted, 2 subnets, 2 masks
    192.168.6.0/23 [90/27770112] via 30.0.0.1, 02:15:08, Serial0/0/0
Router#
```

Colombo Router

```
Router>enab
Router#show ip
Router#show ip ro
Router#show ip route ei
Router#show ip route eigrp
    10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
D
        10.0.0.0/8 [90/27770368] via 40.0.0.1, 02:13:41, Serial0/0/0
D
       10.0.0.0/24 [90/2170112] via 40.0.0.1, 02:13:43, Serial0/0/0
     20.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
       20.0.0.0/8 [90/27770368] via 40.0.0.1, 02:13:41, Serial0/0/0
D
       20.0.0.0/24 [90/2170112] via 40.0.0.1, 02:13:43, Serial0/0/0
     30.0.0.0/24 is subnetted, 1 subnets
D
       30.0.0.0 [90/2681856] via 40.0.0.1, 02:13:42, Serial0/0/0
    172.168.0.0/24 is subnetted, 1 subnets
D
       172.168.1.0 [90/2170112] via 40.0.0.1, 02:13:43, Serial0/0/0
     192.168.0.0/23 [90/27770112] via 40.0.0.1, 02:13:42, Serial0/0/0
    192.168.2.0/24 [90/27770112] via 40.0.0.1, 02:13:42, Serial0/0/0
    192.168.3.0/24 [90/27770112] via 40.0.0.1, 02:13:41, Serial0/0/0
    192.168.4.0/24 is variably subnetted, 2 subnets, 2 masks
     192.168.5.0/24 [90/2682112] via 40.0.0.1, 02:13:42, Serial0/0/0
D
    192.168.6.0/23 [90/27770112] via 40.0.0.1, 02:13:41, Serial0/0/0
Router#
```

Homagama Router

```
Router>enabel
Translating "enabel"...domain server (255.255.255.255) % Name lookup aborted
Router>en
Router>enable
Router#show ip rou
Router#show ip route ei
Router#show ip route eigrp
     10.0.0.0/8 is variably subnetted, 3 subnets, 3 masks
D
       10.0.0.0/8 [90/25626112] via 20.0.0.1, 02:03:35, GigabitEthernet0/1
    20.0.0.0/8 is variably subnetted, 3 subnets, 3 masks
D
       20.0.0.0/8 [90/25626112] via 10.0.0.1, 02:03:36, GigabitEthernet0/0
    172.168.0.0/16 is variably subnetted, 2 subnets, 2 masks
D
    192.168.0.0/23 [90/25625856] via 10.0.0.1, 02:03:36, GigabitEthernet0/0
                    [90/25625856] via 20.0.0.1, 02:03:36, GigabitEthernet0/1
D
    192.168.2.0/24 [90/25625856] via 10.0.0.1, 02:03:36, GigabitEthernet0/0
                    [90/25625856] via 20.0.0.1, 02:03:36, GigabitEthernet0/1
D
    192.168.3.0/24 [90/25625856] via 10.0.0.1, 02:03:36, GigabitEthernet0/0
                    [90/25625856] via 20.0.0.1, 02:03:36, GigabitEthernet0/1
D
    192.168.4.0/24 [90/2170112] via 40.0.0.2, 02:03:36, Serial0/0/0
D
    192.168.5.0/24 [90/2170112] via 30.0.0.2, 02:03:37, Serial0/0/1
D
    192.168.6.0/23 [90/25625856] via 10.0.0.1, 02:03:36, GigabitEthernet0/0
                    [90/25625856] via 20.0.0.1, 02:03:36, GigabitEthernet0/1
Router#
Router#
```

Multilayer Switch 0

```
corel#show ip route ei
corel#show ip route eigrp
     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
D
        10.0.0.0/8 is a summary, 08:12:50, Null0
     20.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
D
       20.0.0.0/8 [90/25625856] via 192.168.2.189, 02:37:43, Vlan30
                   [90/25625856] via 192.168.3.125, 02:37:43, Vlan70
                   [90/25625856] via 192.168.3.189, 02:37:43, Vlan50
                   [90/25625856] via 192.168.3.93, 02:37:40, Vlan80
                   [90/25625856] via 192.168.2.125, 02:37:40, Vlan40
                   [90/25625856] via 192.168.1.253, 02:37:40, Vlan10
                   [90/25625856] via 192.168.3.29, 02:37:40, Vlan90
                   [90/25625856] via 192.168.7.253, 02:37:39, Vlan110
                   [90/25625856] via 192.168.3.61, 02:37:39, Vlan100
                   [90/25625856] via 192.168.3.157, 02:37:39, Vlan60
                   [90/25625856] via 192.168.2.253, 02:37:39, Vlan20
D
        20.0.0.0/24 [90/3072] via 10.0.0.2, 02:37:44, GigabitEthernet0/1
     30.0.0.0/24 is subnetted, 1 subnets
D
        30.0.0.0 [90/2170112] via 10.0.0.2, 02:37:43, GigabitEthernet0/1
     40.0.0.0/24 is subnetted, 1 subnets
D
        40.0.0.0 [90/2170112] via 10.0.0.2, 02:37:44, GigabitEthernet0/1
     172.168.0.0/24 is subnetted, 1 subnets
D
       172.168.1.0 [90/3072] via 10.0.0.2, 02:37:44, GigabitEthernet0/1
     192.168.2.0/24 is variably subnetted, 4 subnets, 3 masks
```

Multilayer Switch 1

```
core2#show ip route ei
core2#show ip route eigrp
     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
       10.0.0.0/8 [90/25625856] via 192.168.2.188, 02:59:01, Vlan30
                   [90/25625856] via 192.168.3.124, 02:59:01, Vlan70
                   [90/25625856] via 192.168.3.188, 02:59:01, Vlan50
                   [90/25625856] via 192.168.3.92, 02:59:00, Vlan80
                   [90/25625856] via 192.168.1.252, 02:59:00, Vlan10
                   [90/25625856] via 192.168.2.124, 02:59:00, Vlan40
                   [90/25625856] via 192.168.3.60, 02:58:59, Vlan100
                   [90/25625856] via 192.168.7.252, 02:58:59, Vlan110
                   [90/25625856] via 192.168.3.28, 02:58:59, Vlan90
                   [90/25625856] via 192.168.3.156, 02:58:58, Vlan60
                   [90/25625856] via 192.168.2.252, 02:58:58, Vlan20
       10.0.0.0/24 [90/3072] via 20.0.0.2, 02:59:01, GigabitEthernet0/1
    20.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
D
       20.0.0.0/8 is a summary, 08:34:09, Null0
    30.0.0.0/24 is subnetted, 1 subnets
D
       30.0.0.0 [90/2170112] via 20.0.0.2, 02:59:01, GigabitEthernet0/1
     40.0.0.0/24 is subnetted, 1 subnets
D
       40.0.0.0 [90/2170112] via 20.0.0.2, 02:59:01, GigabitEthernet0/1
     172.168.0.0/24 is subnetted, 1 subnets
D
       172.168.1.0 [90/3072] via 20.0.0.2, 02:59:01, GigabitEthernet0/1
    192.168.2.0/24 is variably subnetted, 4 subnets, 3 masks
D
       192.168.2.0/24 is a summary, 08:34:09, Null0
    192.168.3.0/24 is variably subnetted, 7 subnets, 2 masks
       192.168.3.0/24 is a summary, 08:34:09, Null0
     192.168.4.0/24 [90/2170368] via 20.0.0.2, 02:59:01, GigabitEthernet0/1
D
D
     192.168.5.0/24 [90/2170368] via 20.0.0.2, 02:59:01, GigabitEthernet0/1
```

Describe all routing table parameters (E.g. Destination network, next hop, cost, etc.) in one routing entry in one routing table. Use an entry for a remote network.

```
Router>
Router>enab
Router#show ip
Router#show ip ro
Router#show ip route ei
Router#show ip route eigrp
    10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
      10.0.0.0/8 [90/27770368] via 40.0.0.1, 02:13:41, Serial0/0/0
       10.0.0.0/24 [90/2170112] via 40.0.0.1, 02:13:43, Serial0/0/0
    20.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
       20.0.0.0/8 [90/27770368] via 40.0.0.1, 02:13:41, Serial0/0/0
       20.0.0.0/24 [90/2170112] via 40.0.0.1, 02:13:43, Serial0/0/0
    30.0.0.0/24 is subnetted, 1 subnets
       30.0.0.0 [90/2681856] via 40.0.0.1, 02:13:42, Serial0/0/0
    172.168.0.0/24 is subnetted, 1 subnets
       172.168.1.0 [90/2170112] via 40.0.0.1, 02:13:43, Serial0/0/0
    192.168.0.0/23 [90/27770112] via 40.0.0.1, 02:13:42, Serial0/0/0
    192.168.2.0/24 [90/27770112] via 40.0.0.1, 02:13:42, Serial0/0/0
    192.168.3.0/24 [90/27770112] via 40.0.0.1, 02:13:41, Serial0/0/0
    192.168.4.0/24 is variably subnetted, 2 subnets, 2 masks
    192.168.5.0/24 [90/2682112] via 40.0.0.1, 02:13:42, Serial0/0/0
    192.168.6.0/23 [90/27770112] via 40.0.0.1, 02:13:41, Serial0/0/0
```

Eg: D 10.0.0/8 [90/27770868] via 40.0.0.1 02:13:41, Serial 10/0/0

Router Source

This identifies how router is learned about directly connected interfaces.

Destination

Identify the address of remote network.

Next hop

Next closest router a packet can go through. When series of networks are connected to the network, next hop means the next possible destination for a data packet.

$$E.g. - 40.0.0.1$$

❖ Administrative distance

Administrative distance is used by the router, for determining the best path when there is 2 concurrent paths for the destination.

Cost

Routers assigns a cost for each route so that the highest cost-effective path can be chosen.

"EIGRP Metric= 256*((K1*Bandwidth) + (K2*Bandwidth)/(256-Load) + K3*Delay)*(K5/(Reliability + K4)))"[1]

Route Time stamp

"Identifies from when the route was last heard"[2]

Interface

The outgoing networks interface of a router, that use, when packet is forwarded into the destination.

E.g. - Serial 10/0/0

Router Homagama

```
LOODDACK INTERFACE
 Serial
                   Serial
 Tunnel
                   Tunnel interface
                   Virtual Access interface
 Virtual-Access
 Virtual-Template Virtual Template interface
 Vlan
                   Catalyst Vlans
                   Brief summary of IP status and configuration
 brief
                   Output Modifiers
 <cr>
Router#show ip interface brief
                      IP-Address
                                     OK? Method Status
GigabitEthernet0/0
                      10.0.0.2
                                     YES manual up
                                                                      up
                     20.0.0.2
GigabitEthernet0/1
                                     YES manual up
                                                                      up
GigabitEthernet0/2
                     172.168.1.2
                                     YES manual up
                                                                      up
                     40.0.0.1
                                    YES manual up
Serial0/0/0
Serial0/0/1
                                     YES manual up
                      30.0.0.1
Serial0/1/0
                                     YES unset administratively down down
                     unassigned
                     unassigned
Serial0/1/1
                                     YES unset administratively down down
                                     YES unset up
FastEthernet0/2/0
                      unassigned
FastEthernet0/2/1
                     unassigned
                                     YES unset up
FastEthernet0/2/2
                     unassigned
unassigned
                                      YES unset up
                                                                      down
                                     YES unset up
FastEthernet0/2/3
                                                                      down
Vlan1
                      unassigned YES unset administratively down down
Router#
Router#
Router#
Router#
Router#
Router#
Router#
```

Router Colombo

```
Router>
Router>
Router>
Router>enab
Router#show ip int
Router#show ip interface bi
Router#show ip interface br
Router#show ip interface brief
Interface
                     IP-Address
                                   OK? Method Status
                                                                    Protocol
GigabitEthernet0/0
                    unassigned
                                   YES unset administratively down down
GigabitEthernet0/1
                    192.168.4.254 YES manual up
                    unassigned YES unset administratively down down
GigabitEthernet0/2
Serial0/0/0
                     40.0.0.2
                                   YES manual up
Serial0/0/1
                                    YES unset administratively down down
                     unassigned
                                   YES unset administratively down down
Vlan1
                     unassigned
Router#
Router#
Router#
```

• Router Kandy

```
Router>
Router>
Router>
Router>
Router>ena
Router#show ip in
Router#show ip interface b
Router#show ip interface brief
                        IP-Address OK? Method Status Proto
unassigned YES unset administratively down down
192.168.5.254 YES manual up up
Interface
GigabitEthernet0/0
GigabitEthernet0/1
                           30.0.0.2
                                               YES manual up
Serial0/0/0
                            unassigned YES unset administratively down down unassigned YES unset administratively down down
Serial0/0/1
Vlan1
Router#
```

• Multilayer Switch 0

core1#show ip interface	e brief					
Interface	IP-Address	OK?	Method	Status	Protocol	^
FastEthernet0/1	unassigned	YES	unset	up	up	
FastEthernet0/2	unassigned		unset	up	up	
FastEthernet0/3	unassigned	YES	unset	up	up	
FastEthernet0/4	unassigned	YES	unset	up	up	
FastEthernet0/5	unassigned	YES	unset	up	up	
FastEthernet0/6	unassigned	YES	unset	down	down	
FastEthernet0/7	unassigned	YES	unset	down	down	
FastEthernet0/8	unassigned	YES	unset	down	down	
FastEthernet0/9	unassigned	YES	unset	down	down	
FastEthernet0/10	unassigned	YES	unset	down	down	
FastEthernet0/11	unassigned	YES	unset	down	down	
FastEthernet0/12	unassigned	YES	unset	down	down	
FastEthernet0/13	unassigned	YES	unset	down	down	
FastEthernet0/14	unassigned	YES	unset	down	down	
FastEthernet0/15	unassigned	YES	unset	down	down	
FastEthernet0/16	unassigned	YES	unset	down	down	
FastEthernet0/17	unassigned	YES	unset	down	down	
FastEthernet0/18	unassigned	YES	unset	down	down	
FastEthernet0/19	unassigned	YES	unset	down	down	
FastEthernet0/20	unassigned	YES	unset	down	down	
FastEthernet0/21	unassigned	YES	unset	down	down	
FastEthernet0/22	unassigned	YES	unset	down	down	
FastEthernet0/23	unassigned	YES	unset	down	down	
FastEthernet0/24	unassigned	YES	unset	down	down	
GigabitEthernet0/1	10.0.0.1	YES	manual	up	up	
GigabitEthernet0/2	unassigned	YES	unset	down	down	
Vlan1	unassigned	YES	unset	administratively down	down	
Vlan10	192.168.1.252	YES	manual	up	up	
Vlan20	192.168.2.252	YES	manual	up	up	
Vlan30	192.168.2.188	YES	manual	up	up	
Vlan40	192.168.2.124	YES	manual	up	up	
Vlan50	192.168.3.188	YES	manual	up	up	
Vlan60	192.168.3.156	YES	manual	up	up	
Vlan70	192.168.3.124	YES	manual	up	up	
Vlan80	192.168.3.92		manual	-	up	
Vlan90	192.168.3.28	YES	manual	up	up	
Vlan100	192.168.3.60	YES	manual	up	up	
Vlan110	192.168.7.252	YES	manual	up	up	
core1#						Y

• Multilayer switch 1

corestanom ib incertace	e prier			
Interface	IP-Address	OK? Method	Status	Protocol
FastEthernet0/1	unassigned	YES unset	up	up
FastEthernet0/2	unassigned	YES unset	up	up
FastEthernet0/3	unassigned	YES unset	up	up
FastEthernet0/4	unassigned	YES unset	up	up
FastEthernet0/5	unassigned	YES unset	up	up
FastEthernet0/6	unassigned	YES unset	down	down
FastEthernet0/7	unassigned	YES unset	down	down
FastEthernet0/8	unassigned	YES unset	down	down
FastEthernet0/9	unassigned	YES unset	down	down
FastEthernet0/10	unassigned	YES unset	down	down
FastEthernet0/11	unassigned	YES unset	down	down
FastEthernet0/12	unassigned	YES unset	down	down
FastEthernet0/13	unassigned	YES unset	down	down
FastEthernet0/14	unassigned	YES unset	down	down
FastEthernet0/15	unassigned	YES unset	down	down
FastEthernet0/16	unassigned	YES unset	down	down
FastEthernet0/17	unassigned	YES unset	down	down
FastEthernet0/18	unassigned	YES unset	down	down
FastEthernet0/19	unassigned	YES unset	down	down
FastEthernet0/20	unassigned	YES unset	down	down
FastEthernet0/21	unassigned	YES unset	down	down
FastEthernet0/22	unassigned	YES unset	down	down
FastEthernet0/23	unassigned	YES unset	down	down
FastEthernet0/24	unassigned	YES unset	down	down
GigabitEthernet0/1	20.0.0.1	YES manual	l up	up
GigabitEthernet0/2	unassigned	YES unset	down	down
Vlan1	unassigned	YES unset	administratively down	down
Vlan10	192.168.1.253	YES manual	l up	up
Vlan20	192.168.2.253	YES manual	l up	up
Vlan30	192.168.2.189	YES manual	l up	up
Vlan40	192.168.2.125	YES manual	l up	up
Vlan50	192.168.3.189	YES manual	l up	up
Vlan60	192.168.3.157	YES manual	l up	up
Vlan70	192.168.3.125	YES manual	l up	up
Vlan80	192.168.3.93	YES manual	l up	up
Vlan90	192.168.3.29	YES manual	l up	up
Vlan100	192.168.3.61	YES manual	l up	up
Vlan110	192.168.7.253	YES manual	l up	up
core2#				~

Multilayer Switch O load balancing (Standby and active)

- Vlan10 to Vlan50 Active (Priority 150)
- Vlan50 to Vlan110 Standby (Priority 120)

```
Local Virtual MAC address is 0000.0007.AC01 (VI default)
 Hello time 3 sec, hold time 10 sec
   Next hello sent in 0.37 secs
 Preemption enabled
 Active router is local
 Standby router is 192.168.3.189
 Priority 150 (configured 150)
core1#show standby BR
core1#show standby BRief
                   P indicates configured to preempt.
Interface Grp Pri P State
                            Active
                                           Standby
                                                           Virtual IP
                                           192.168.1.253 192.168.1.254
V110
         1 150 P Active local
               150 P Active local
150 P Active local
                                           192.168.2.253 192.168.2.254
192.168.2.189 192.168.2.190
V120
          1
V130
          1
          1 150 P Active local
                                           192.168.2.125 192.168.2.126
V140
V150
          1 150 P Active local
                                           192.168.3.189 192.168.3.190
         1 120 P Standby 192.168.3.157 local
V160
                                                          192.168.3.158
         1 120 P Standby 192.168.3.125 local
                                                          192.168.3.126
V170
          1
V180
               120 P Standby 192.168.3.93
                                            local
                                                           192.168.3.94
                                           local
                                                          192.168.3.30
               120 P Standby 192.168.3.29
V190
         1 120 P Standby 192.168.3.61 local
                                                          192.168.3.62
V1100
V1110
         1 120 P Standby 192.168.7.253 local
                                                          192.168.7.254
core1#
```

Multilayer Switch 1 load balancing (Standby and Active)

- Vlan10 to Vlan50 –Standby (Priority 120)
- Vlan50 to Vlan110 Active (Priority 130)

```
State is Standby
   10 state changes, last state change 05:35:16
 Virtual IP address is 192.168.2.254
 Active virtual MAC address is 0000.0C07.AC01
   Local virtual MAC address is 0000.0C07.AC01 (v1 default)
 Hello time 3 sec, hold time 10 sec
   Next hello sent in 1.621 secs
core2#show standby bri
core2#show standby brief
                   P indicates configured to preempt.
Interface Grp Pri P State
                                           Standby
                                                         Virtual IP
                           Active
                                                         192.168.1.254
         1 120 P Standby 192.168.1.252 local
V110
                                                         192.168.2.254
V120
          1
              120 P Standby 192.168.2.252 local
                                                          192.168.2.190
V130
         1 120 P Standby 192.168.2.188 local
                                          local
                                                          192.168.2.126
V140
         1 120 P Standby 192.168.2.124
                                                          192.168.3.190
V150
         1
              120 P Standby 192.168.3.188 local
                                          192.168.3.156 192.168.3.158
V160
          1
               150 P Active
                             local
V170
          1
               150 P Active
                             local
                                           192.168.3.124 192.168.3.126
V180
                                           192.168.3.92
          1
               150 P Active
                             local
                                                          192.168.3.94
                                           192.168.3.28
V190
         1
               150 P Active
                             local
                                                          192.168.3.30
                                           192.168.3.60
V1100
         1
               150 P Active
                             local
                                                          192.168.3.62
V1110
               150 P Active
                             local
                                           192.168.7.252
                                                         192.168.7.254
core2#
```

IP protocols

Multilayer 0

```
core1#
core1#
corel#show ip pr
core1#show ip protocols ?
 <cr>
corel#show ip protocols
Routing Protocol is "eigrp 10 "
 Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Default networks flagged in outgoing updates
  Default networks accepted from incoming updates
  EIGRP metric weight K1=1, K2=0, K3=1, K4=0, K5=0
  EIGRP maximum hopcount 100
 EIGRP maximum metric variance 1
Redistributing: eigrp 10
 Automatic network summarization is in effect
  Automatic address summarization:
   10.0.0.0/8 for Vlan10, Vlan20, Vlan30, Vlan40, Vlan50, Vlan60, Vlan70, Vlan80, Vlan90, Vlan100, Vlan110
     Summarizing with metric 2816
   192.168.2.0/24 for Vlan10, Vlan50, Vlan60, Vlan70, Vlan80, Vlan90, Vlan100, Vlan110, GigabitEthernet0/1
     Summarizing with metric 25625600
   192.168.3.0/24 for Vlan10, Vlan20, Vlan30, Vlan40, Vlan110, GigabitEthernet0/1 Summarizing with metric 25625600
  Maximum path: 4
  Routing for Networks:
    10.0.0.0/24
    192.168.0.0/23
    192.168.2.128/26
    192.168.2.192/26
    192.168.3.0/27
    192.168.3.32/27
    192.168.3.64/27
    192.168.3.96/27
    192.168.3.128/27
    192.168.3.160/27
core1#
core1#
core1#
```

Multilayer I

```
core2#show ip protocols
Routing Protocol is "eigrp 10 "
 Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Default networks flagged in outgoing updates
 Default networks accepted from incoming updates
 EIGRP metric weight K1=1, K2=0, K3=1, K4=0, K5=0
 EIGRP maximum hopcount 100
 EIGRP maximum metric variance 1
Redistributing: eigrp 10
 Automatic network summarization is in effect
 Automatic address summarization:
   20.0.0.0/8 for Vlan10, Vlan20, Vlan30, Vlan40, Vlan50, Vlan60, Vlan70, Vlan80, Vlan90, Vlan100, Vlan110
      Summarizing with metric 2816
    192.168.2.0/24 for Vlan10, Vlan50, Vlan60, Vlan70, Vlan80, Vlan90, Vlan100, Vlan110, GigabitEthernet0/1
   Summarizing with metric 25625600
192.168.3.0/24 for Vlan10, Vlan20, Vlan30, Vlan40, Vlan110, GigabitEthernet0/1
      Summarizing with metric 25625600
 Maximum path: 4
 Routing for Networks:
    20.0.0.0/24
     192.168.0.0/23
     192.168.2.0/25
     192.168.2.128/26
     192.168.2.192/26
    192.168.3.0/27
     192.168.3.32/27
    192 168 3 64/27
     192.168.3.96/27
     192.168.3.128/27
     192.168.3.160/27
     192.168.4.0/23
    192.168.6.0/23
 Routing Information Sources:
   Gateway Dis
192.168.2.124 90
192.168.7.252 90
                    Distance
                                   Last Update
                                   20105100
                                   20105100
    192.168.3.60
                    90
                                   20105100
    192.168.1.252 90
```

```
20.0.0.0/8 for Vlan10, Vlan20, Vlan30, Vlan40, Vlan50, Vlan60, Vlan70, Vlan80, Vlan90, Vlan100, Vlan110
    Summarizing with metric 2816 192.168.2.0/24 for Vlan10, Vlan50, Vlan60, Vlan70, Vlan80, Vlan90, Vlan100, Vlan110, GigabitEthernet0/1
   Summarizing with metric 25625600
192.168.3.0/24 for Vlan10, Vlan20, Vlan30, Vlan40, Vlan110, GigabitEthernet0/1
      Summarizing with metric 25625600
 Maximum path: 4
  Routing for Networks:
     20.0.0.0/24
     192.168.0.0/23
     192.168.2.0/25
     192.168.2.128/26
     192.168.2.192/26
     192.168.3.0/27
     192.168.3.32/27
     192.168.3.64/27
192.168.3.96/27
     192.168.3.128/27
     192.168.3.160/27
     192.168.4.0/23
     192.168.6.0/23
  Routing Information Sources:
   Gateway Dis
192.168.2.124 90
                    Distance
                                     Last Update
                                     20105100
    192.168.7.252 90
                                      20105100
    192 168 3 60
                     90
                                     20105100
    192.168.1.252
                                      20105100
    192.168.3.92
                     90
                                     20105100
    192.168.3.124
                     90
                                     20106812
    192.168.3.188
                     90
                                     20106812
    192.168.2.188
                     90
                                     20106812
    20.0.0.2
    192.168.3.28
                     90
                                     20109950
   192.168.3.156 90
192.168.2.252 90
                                     20110179
                                      20110285
 Distance: internal 90 external 170
core2#
core2#
core2#
```

PING command output from each router to other two routers for verifying the connectivity. Provide screenshots

• Ping from Homagama to Colombo

```
Router#
Router#ping 40.0.0.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 40.0.0.2, timeout is 2 seconds:
Success rate is 100 percent (5/5), round-trip min/avg/max =
1/8/23 ms
Router#
Router#
Router#
Router#
Router#
Router#
Router#
```

• Ping From Homagama to Kandy

```
Router#
Router#ping 30.0.0.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 30.0.0.2, timeout is 2 seconds:
11111
Success rate is 100 percent (5/5), round-trip min/avg/max =
1/5/13 ms
Router#
Router#
Router#
Router#
Router#
Router#
Router#
```

• Ping Form Multi layer 0 to Homagama Router

```
core1>
core1>
core1>
core1>ena
core1*ping 10.0.0.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.0.0.2, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max =
0/3/15 ms

core1*
core1*
core1*
```

Ping From Multi-Layer 1 to Homagama

```
core2>
core2>
core2>
core2>ena
core2#ping 20.0.0.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 20.0.0.2, timeout is 2 seconds:
11111
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0
core2#
```

• Ping From Colombo To Homagama

```
%DUAL-5-NBRCHANGE: IP-EIGRP 10: Neighbor 40.0.0.1 (Serial0/0/0)
is up: new adjacency
Router(config-if) #exit
Router(config) #interface GigabitEthernet0/0
Router(config-if)#
Router(config-if) #exit
Router(config) #interface Serial0/0/0
Router(config-if) #ex
Router(config) #ex
%SYS-5-CONFIG_I: Configured from console by console
Router#
Router#
Router#ping 30.0.0.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 30.0.0.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 2/4/7
Router#
```

Verify connectivity from one PC in one of the LANs to a PC in each of other LANs using PING command (screenshots).

Computing Labs VLAN To Computing Staff VLAN

```
ommand Prompt
Pinging 192.168.2.193 with 32 bytes of data:
Request timed out.
Reply from 192.168.2.193: bytes=32 time=53ms TTL=127
Reply from 192.168.2.193: bytes=32 time=26ms TTL=127
Reply from 192.168.2.193: bytes=32 time=1ms TTL=127
Ping statistics for 192.168.2.193:
Packets: Sent = 4, Received = 3, Lost = 1 (25% loss), Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 53ms, Average = 26ms
C:\>ping 192.168.2.193
Pinging 192.168.2.193 with 32 bytes of data:
Reply from 192.168.2.193: bytes=32 time<1ms TTL=127
Reply from 192.168.2.193: bytes=32 time<1ms TTL=127
Reply from 192.168.2.193: bytes=32 time=1ms TTL=127
Reply from 192.168.2.193: bytes=32 time=1ms TTL=127
Ping statistics for 192.168.2.193:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = Oms, Maximum = 1ms, Average = Oms
```

Computing Labs VLAN To School Of Business Lab VLAN

```
Command Prompt
Pinging 192.168.2.3 with 32 bytes of data:
Request timed out.
Reply from 192.168.2.3: bytes=32 time=11ms TTL=127 Reply from 192.168.2.3: bytes=32 time<1ms TTL=127
Reply from 192.168.2.3: bytes=32 time=11ms TTL=127
Ping statistics for 192.168.2.3:
Packets: Sent = 4, Received = 3, Lost = 1 (25% loss), Approximate round trip times in milli-seconds:
    Minimum = Oms, Maximum = 11ms, Average = 7ms
C:\>ping 192.168.2.3
Pinging 192.168.2.3 with 32 bytes of data:
Reply from 192.168.2.3: bytes=32 time=3ms TTL=127
Reply from 192.168.2.3: bytes=32 time<1ms TTL=127
Reply from 192.168.2.3: bytes=32 time<1ms TTL=127
Reply from 192.168.2.3: bytes=32 time=1ms TTL=127
Ping statistics for 192.168.2.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 3ms, Average = 1ms
```

Computing Lab To School Of Business Staff VLAN

```
Command Prompt
                                                                                                              Χ
Pinging 192.168.2.129 with 32 bytes of data:
Request timed out.
Reply from 192.168.2.129: bytes=32 time<1ms TTL=127
Reply from 192.168.2.129: bytes=32 time=10ms TTL=127
Reply from 192.168.2.129: bytes=32 time=1ms TTL=127
Ping statistics for 192.168.2.129:
   Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 3ms
C:\>ping 192.168.2.129
Pinging 192.168.2.129 with 32 bytes of data:
Reply from 192.168.2.129: bytes=32 time<1ms TTL=127
Reply from 192.168.2.129: bytes=32 time=10ms TTL=127
Reply from 192.168.2.129: bytes=32 time<1ms TTL=127
Reply from 192.168.2.129: bytes=32 time=7ms TTL=127
Ping statistics for 192.168.2.129:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 4ms
C:\>
```

Computing Lab To School Of Administration division Marketing VLAN

```
ommand Prompt
                                                                                                                          Χ
C:\>
C:\>
C:\>
C:\>
C:\>
C:\>ping 192.168.3.161
Pinging 192.168.3.161 with 32 bytes of data:
Request timed out.
Reply from 192.168.3.161: bytes=32 time=10ms TTL=127
Reply from 192.168.3.161: bytes=32 time=1ms TTL=127
Reply from 192.168.3.161: bytes=32 time<1ms TTL=127
Ping statistics for 192.168.3.161:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 10ms, Average = 3ms
```

Computing Lab To School Of Administration division HR VLAN

```
ommand Prompt
                                                                                                                           Х
Pinging 192.168.3.132 with 32 bytes of data:
Request timed out.
Request timed out.
Reply from 192.168.3.132: bytes=32 time=1ms TTL=127
Reply from 192.168.3.132: bytes=32 time<1ms TTL=127
Ping statistics for 192.168.3.132:
Packets: Sent = 4, Received = 2, Lost = 2 (50% loss), Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
C:\>ping 192.168.3.132
Pinging 192.168.3.132 with 32 bytes of data:
Reply from 192.168.3.132: bytes=32 time<1ms TTL=127
Reply from 192.168.3.132: bytes=32 time=10ms TTL=127
Reply from 192.168.3.132: bytes=32 time=1ms TTL=127
Reply from 192.168.3.132: bytes=32 time<1ms TTL=127
Ping statistics for 192.168.3.132:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss), Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 2ms
```

Computing Lab To School Of Administration division Finance VLAN

```
Pinging 192.168.3.97 with 32 bytes of data:

Request timed out.

Reply from 192.168.3.97: bytes=32 time=2ms TTL=127

Reply from 192.168.3.97: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.3.97:

Packets: Sent = 4, Received = 2, Lost = 2 (50% loss),

Approximate round trip times in milli-seconds:

Minimum = 0ms, Maximum = 2ms, Average = 1ms

C:\ping 192.168.3.97

Pinging 192.168.3.97 with 32 bytes of data:

Reply from 192.168.3.97: bytes=32 time=1ms TTL=127

Reply from 192.168.3.97: bytes=32 time=1ms TTL=127

Reply from 192.168.3.97: bytes=32 time=1ms TTL=127

Reply from 192.168.3.97: bytes=32 time=5ms TTL=127

Ping statistics for 192.168.3.97:

Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),

Approximate round trip times in milli-seconds:

Minimum = 1ms, Maximum = 13ms, Average = 5ms

C:\>
```

Computing Lab To School Of Administration division Library VLAN

```
ommand Prompt
Pinging 192.168.3.65 with 32 bytes of data:
Request timed out.
Reply from 192.168.3.65: bytes=32 time<1ms TTL=127
Reply from 192.168.3.65: bytes=32 time=12ms TTL=127
Reply from 192.168.3.65: bytes=32 time=12ms TTL=127
Ping statistics for 192.168.3.65:
Packets: Sent = 4, Received = 3, Lost = 1 (25% loss), Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 12ms, Average = 8ms
C:\>ping 192.168.3.65
Pinging 192.168.3.65 with 32 bytes of data:
Reply from 192.168.3.65: bytes=32 time<1ms TTL=127
Reply from 192.168.3.65: bytes=32 time<1ms TTL=127
Reply from 192.168.3.65: bytes=32 time<1ms TTL=127
Reply from 192.168.3.65: bytes=32 time=1ms TTL=127
Ping statistics for 192.168.3.65:
  Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
C:\>
```

Computing Lab To School Of Administration division Examination VLAN

```
Command Prompt
                                                                                                              Χ
Pinging 192.168.3.33 with 32 bytes of data:
Request timed out.
Reply from 192.168.3.33: bytes=32 time=26ms TTL=127
Reply from 192.168.3.33: bytes=32 time=1ms TTL=127
Reply from 192.168.3.33: bytes=32 time=11ms TTL=127
Ping statistics for 192.168.3.33:
 Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 26ms, Average = 12ms
C:\>ping 192.168.3.33
Pinging 192.168.3.33 with 32 bytes of data:
Reply from 192.168.3.33: bytes=32 time=1ms TTL=127
Reply from 192.168.3.33: bytes=32 time=10ms TTL=127
Reply from 192.168.3.33: bytes=32 time=10ms TTL=127
Reply from 192.168.3.33: bytes=32 time=2ms TTL=127
Ping statistics for 192.168.3.33:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 10ms, Average = 5ms
C:\>
```

Computing Lab To School Of Administration division Maintenance VLAN

Do a trace route from a one location PC to another two location's PC and get the trace route output. Provide screenshots.

Trace Route From Homagama to Colombo

```
ommand Prompt
Packet Tracer PC Command Line 1.0 C:\>tracert 192.168.4.1
Tracing route to 192.168.4.1 over a maximum of 30 hops:
                0 ms
                           1 ms
                                      192.168.1.252
     0 ms
                           3 ms
                                     10.0.0.2
                1 ms
                                     40.0.0.2
      10 ms
                           11 ms
                1 ms
                           0 ms
                                     192.168.4.1
Trace complete.
C:\>tracert 192.168.4.1
Tracing route to 192.168.4.1 over a maximum of 30 hops:
      0 ms
                0 ms
                           1 ms
                                     192.168.1.252
                11 ms
                           10 ms
     0 ms
                                     10.0.0.2
      0 ms
                0 ms
                           1 ms
                                     40.0.0.2
                           10 ms
      12 ms
                28 ms
                                     192,168,4,1
Trace complete.
C:\>
```

Trace Route From Homagama To Kandy

```
Command Prompt
                                                                                                              Х
C:\>
C:\>
C:\>
C:\>tracert 192.168.5.1
Tracing route to 192.168.5.1 over a maximum of 30 hops:
                                    192.168.1.252
      0 ms
                0 ms
                          0 ms
  2
      0 ms
                0 ms
                          1 ms
                                    10.0.0.2
                                    30.0.0.2
                          0 ms
      0 ms
                11 ms
                16 ms
                                    192.168.5.1
      17 ms
                          1 ms
Trace complete.
C:\>tracert 192.168.5.1
Tracing route to 192.168.5.1 over a maximum of 30 hops:
      1 ms
                9 ms
                          0 ms
                                    192.168.1.252
                                    20.0.0.2
  2
      14 ms
                0 ms
                          0 ms
      10 ms
                1 ms
                          1 ms
                1 ms
                                   192.168.5.1
                          14 ms
      1 ms
Trace complete.
```

Trace Route From Kandy to Homagama

```
Command Prompt
                                                                                                                  X
Packet Tracer PC Command Line 1.0 C:\>tracert 192.168.0.1
Tracing route to 192.168.0.1 over a maximum of 30 hops:
                0 ms
                          0 ms
                                     192.168.4.254
      1 ms
    0 ms
                         1 ms
2 ms
  2
                0 ms
                                     40.0.0.1
                3 ms
  3
     0 ms
                                     10.0.0.1
                14 ms
                          0 ms
                                     192.168.0.1
Trace complete.
C:\>tracert 192.168.0.1
Tracing route to 192.168.0.1 over a maximum of 30 hops:
                                     192.168.4.254
     0 ms
                0 ms
                          0 ms
 2 0 ms
3 0 ms
                0 ms
                           1 ms
                                     40.0.0.1
                1 ms
                           0 ms
                                     10.0.0.1
                0 ms
                           10 ms
                                     192.168.0.1
Trace complete.
C:\>
```

Ping from Colombo To Homagama computing lab

Ping from Kandy To Homagama computing lab

```
Packet Tracer PC Command Line 1.0
C:\ping 192.168.0.1 with 32 bytes of data:

Reply from 192.168.0.1: bytes=32 time=10ms TTL=125
Reply from 192.168.0.1: bytes=32 time=6ms TTL=125
Reply from 192.168.0.1: bytes=32 time=5ms TTL=125
Reply from 192.168.0.1: bytes=32 time=5ms TTL=125
Reply from 192.168.0.1: bytes=32 time=5ms TTL=125
Ping statistics for 192.168.0.1:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 2ms, Maximum = 10ms, Average = 5ms

C:\>
```

Ping Form computing WIFI to Colombo Office

Ping Form School of Business WIFI to Colombo Office

```
ommand Prompt
Pinging 192.168.4.1 with 32 bytes of data:
Request timed out.
Reply from 192.168.4.1: bytes=32 time=7ms TTL=125
Reply from 192.168.4.1: bytes=32 time=9ms TTL=125
Reply from 192.168.4.1: bytes=32 time=13ms TTL=125
Ping statistics for 192.168.4.1:
Packets: Sent = 4, Received = 3, Lost = 1 (25% loss), Approximate round trip times in milli-seconds:
    Minimum = 7ms, Maximum = 13ms, Average = 9ms
C:\>ping 192.168.4.1
Pinging 192.168.4.1 with 32 bytes of data:
Reply from 192.168.4.1: bytes=32 time=14ms TTL=125
Reply from 192.168.4.1: bytes=32 time=6ms TTL=125
Reply from 192.168.4.1: bytes=32 time=9ms TTL=125
Reply from 192.168.4.1: bytes=32 time=18ms TTL=125
Ping statistics for 192.168.4.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 6ms, Maximum = 18ms, Average = 11ms
```

Ping Form Administration division WIFI to Colombo Office

```
Command Prompt
                                                                                                                           Х
Pinging 192.168.4.1 with 32 bytes of data:
Request timed out.
Reply from 192.168.4.1: bytes=32 time=18ms TTL=125
Reply from 192.168.4.1: bytes=32 time=14ms TTL=125
Reply from 192.168.4.1: bytes=32 time=6ms TTL=125
Ping statistics for 192.168.4.1:
Packets: Sent = 4, Received = 3, Lost = 1 (25% loss), Approximate round trip times in milli-seconds:
    Minimum = 6ms, Maximum = 18ms, Average = 12ms
C:\>ping 192.168.4.1
Pinging 192.168.4.1 with 32 bytes of data:
Reply from 192.168.4.1: bytes=32 time=6ms TTL=125
Reply from 192.168.4.1: bytes=32 time=15ms TTL=125
Reply from 192.168.4.1: bytes=32 time=7ms TTL=125
Reply from 192.168.4.1: bytes=32 time=7ms TTL=125
Ping statistics for 192.168.4.1:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss), Approximate round trip times in milli-seconds:
    Minimum = 6ms, Maximum = 15ms, Average = 8ms
C:\>
```

Justifying all configuration options we have chosen while comparing with possible alternatives.

1. Why did we use 192.168.0.0 – 192.168.255.255 16 bit IP range other than using 24 bit block or 20 bit block?

Since 192.168.0.0 IP range can be used for 65,536 IP addresses, and the host that are in the university is less than that number we can use that range. Since it is the most common private IP range, We thought of using that range.

2. Why did we use 6 switches in the administration division?

Since Administration division have only 150 hosts we can use 4 switches in total. But We thought of in case if the university wants to change the location of the office, Its easy to change the place if we put each office into a separate switch. So the office can be moved with the switch without doing many changes to the network.

3. Why did we use EIGRP without using OSPF, RIP or any other protocol?

EIGRP (Enhanced Interior Gateway Routing Protocol) is a both distance vector and link state routing protocol, Which uses CPU, RAM, Bandwidth more Efficiently than OSPF. When we think about the design, if you are using OSPF area planning must be done vary carefully according to the future developments. When it comes to EIGRP you don't want to perform any such area planning. But EIGRP is not good protocol for multi-vender environments. Since we are only using cisco devices that won't be a problem.

4. Why did we use Redundancy lines?

To increase the availability of the network, also the availability of data, we use redundancy lines. By using redundancy lines it also increases the reliability and performance of the network. Specially to reduce single point of failure, we came up with design; redundancy lines.

5. Why did we use VTP protocol?

Because it helps to reduce administrative overhead. When it comes to our case, in our network, there is more than 20 switches. Think if we are not going to use VTP, then we have to enter our VLANS to the each switches by configuring them one by one. But If we use VTP We can define our VLANS on the multilayer Switches then we have to set a VTP domain and the VTP mode as "Server". Then Other switches which stay below multilayer switches, must set the VTP mode to client. Then all the VLANs we entered will communicate through the network.

To increase the security we must set passwords to VTP. This will help to decrease VTP failures.

6. Why did we use multilayer Switches?

In our Network We thought of using redundancy protocols for HIGH AVAILABILITY So We added 2, layer 3 switches to our network. There are few number of redundancy protocols , like HSRP (HOT Standby Routing Protocol), VRRP(Virtual Router Redundancy protocol), GLBP (Gateway Load balancing protocol). By considering All those three protocols, We came up with idea to use HSRP. Because Its easy to configure. Also it does not affect for routing tables or host configuration. Efficient Use OF network Resources and Higher Availability are other advantages of HSRP.

In our Solution we have added 11 VLANS. To Balance the network Traffic flow We Keep first 5 VLAN networks Active on the multilayer switch 0 and others kept as standby. In Multilayer Switch 1 we assign first 5 networks Standby and Others Active. We assign different IPs for VLANS in both layer 3 switches and one VIRTUAL IP for each VLAN . So We can access those VLANs using that virtual IP.

EX -

```
interface Vlan10 interface Vlan90 mac-address 0001.c9b7.ec01 mac-address 0001.c9b7.ec09 ip address 192.168.1.252 255.255.254.0 ip address 192.168.3.28 255.255.255.224 standby 1 ip 192.168.1.254 standby 1 ip 192.168.3.30 standby 1 priority 150 standby 1 preempt standby 1 preempt
```

7. Why did we use Different VLAN for WIFI?

Because using that VLAN Any user can access internet through WIFI. As well we can set DHCP to that VLAN.

8. Why we use VLSM(variable length subnet masking).

Usage of VLSM reduces the IP address wastage. So proper usage of IPs we use VLSM. "VLSM allows network engineers to divide an IP address space into a hierarchy of subnets of different sizes, making it possible to create subnets with very different host counts without wasting large numbers of addresses." [3]

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