



Network Management & High Availability
Group Justification report – Part D

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Part 4: Group Justification Report	3
<u>Addresses Table</u>	4
<u>Main Dublin Office</u>	6
<u>WAN</u>	11
<u>Galway office</u>	12

Part 4: Group Justification Report Justify the design choices you made in Part 3. Use screen shots to provide key samples of why you did things for your implemented parts a) – j) (in part 3 above). Note: Five additional marks can be scored if other best practice configuration and security is completed in part 3 and documented in part 4.

To make the decision of the more suitable network design for the new data center of Dublin Computer School (DCS), we consider the following specification provided in the description of the project:

- The fact that the business is home grown in Dublin and the organization is expanding rapidly both in Dublin and in many sites around Ireland,
- The growth expected by the Infrastructure Manager,
- The need of a new Moodle system and a CRM system for the Marketing department

We can see that Dublin Computer School (DCS) is, without any doubt, expecting a significant growth for the next years. Therefore, based on this fact, and after evaluating the budget, we decided to go for an ambitious design that ensure not only availability and reliability but also scalability of the network. We have to take into consideration that this Data Center is going to be used for all the sites around Ireland, where the company is also expecting growing.

Addresses Table

	Device	Interface	IP Address	Subnet Mask	Default Gateway	Comments
Dublin	R1	G0/1.1	172.16.1.1	255.255.255.0		
		G0/1.10	172.16.10.1	255.255.255.0		
		G0/1.20	172.16.20.1	255.255.255.0		
		G0/1.30	172.16.30.1	255.255.255.0		
		G0/1.40	172.16.40.1	255.255.255.0		
		G0/.1.99	172.16.99.1	255.255.255.0		
		S0/0/0 DCE	10.16.1.1	255.255.255.252		
		S0/0/1	10.16.2.1	255.255.255.252		
		S0/1/0 DCE	10.16.3.1	255.255.255.252		
		MS1	VLAN 99	172.16.99.11	255.255.255.0	
	MS2	VLAN 99	172.16.99.12	255.255.255.0		Root secondary for VLAN 1, 10, 20
	MS3	VLAN 99	172.16.99.13	255.255.255.0		Root secondary for VLAN 30, 40, 99
	S1	VLAN 99	172.16.99.21	255.255.255.0		
	S2	VLAN 99	172.16.99.22	255.255.255.0		
	S3	VLAN 99	172.16.99.23	255.255.255.0		
	S4	VLAN 99	172.16.99.24	255.255.255.0		
	Server1	G0 (vlan99)	172.16.99.80	255.255.255.0	172.16.99.1	
		G1 (vlan99)				
	Server2	G0 (vlan99)	172.16.99.82	255.255.255.0	172.16.99.1	
		G1 (vlan99)				
	PC1	NIC (vlan10)	172.16.10.51	255.255.255.0	172.16.10.1	
	PC2	NIC (vlan20)	172.16.20.52	255.255.255.0	172.16.20.1	
	PC3	NIC (vlan30)	172.16.30.53	255.255.255.0	172.16.30.1	
	PC4	NIC (vlan40)	172.16.40.54	255.255.255.0	172.16.40.1	
	Wireless router0	Internet setup	172.16.10.101	255.255.255.0	172.16.10.1	
		Network setup	172.16.50.1	255.255.255.0		
	Laptop1					
Laptop2						

Limerik	R2	S0/0/0	10.16.1.2	255.255.255.252		
		S0/0/1				
		DCE	10.16.4.1	255.255.255.252		
	PC7	NIC	172.18.1.57	255.255.255.0	172.18.1.1	
-						
Galway	R3	S0/0/1	10.16.4.2	255.255.255.252		Standby router in HSRP Slow path
		S0/1/1	10.16.5.1	255.255.255.252		
		G0/1	172.17.1.1	255.255.255.0		
	R4	S0/0/0				Active router in HSRP (Because the other path is slow)
		DCE	10.16.6.1	255.255.255.252		
	Switch0	VLAN 1	172.17.1.6	255.255.255.0	172.17.1.254 (virtual IP for HSRP)	172.17.1.1
	Switch1	VLAN 1	172.17.1.7	255.255.255.0	172.17.1.254 (virtual IP for HSRP)	172.17.1.2
	PC5	NIC	172.17.1.55	255.255.255.0	172.17.1.254 (virtual IP for HSRP)	172.17.1.1
PC6	NIC	172.17.1.56	255.255.255.0	172.17.1.254 (virtual IP for HSRP)	172.17.1.2	
-						
Cork	R5	S0/0/0	10.16.6.2	255.255.255.252		
		S0/0/1				
		DCE	10.16.2.2	255.255.255.252		
	PC8	NIC	172.19.1.58	255.255.255.0	172.19.1.1	
-						
Sligo	R6	S0/1/0	10.16.3.2	255.255.255.252		
		S0/1/1				
		DCE	10.16.5.2	255.255.255.252		
	PC9	NIC	172.20.1.59	255.255.255.0	172.20.1.1	

Main Dublin Office

As we have already mentioned, in the Dublin LAN we are going to place the new Data Center; but also, this network has to be designed to provide end user devices communication (Wired and Wireless).

In general, our design is based on the concepts described in the «Campus LAN and Wireless LAN Design Guide» of Cisco [1]. We built a hierarchical Three-Tier Design (See Figure2): Core, Distribution and Access layers.

At the beginning of the project, we thought a Two-Tier Design was the most suitable option, but after considering many factors, the expected growing of the network tipped the scale in favour of the Three-Tier Design (See Figure1 and 2).

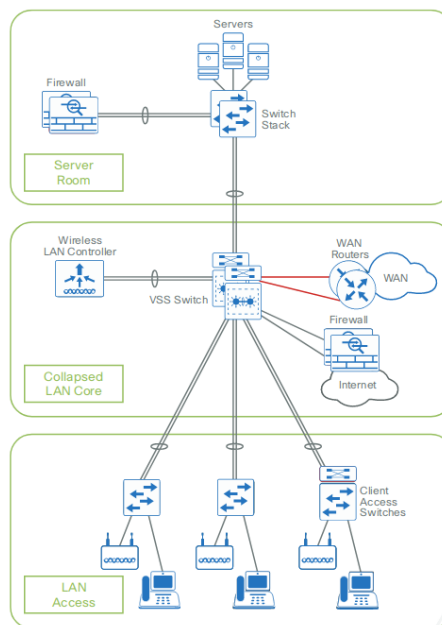


Figure 1 - Two-tier design Distribution layer functioning as collapsed core

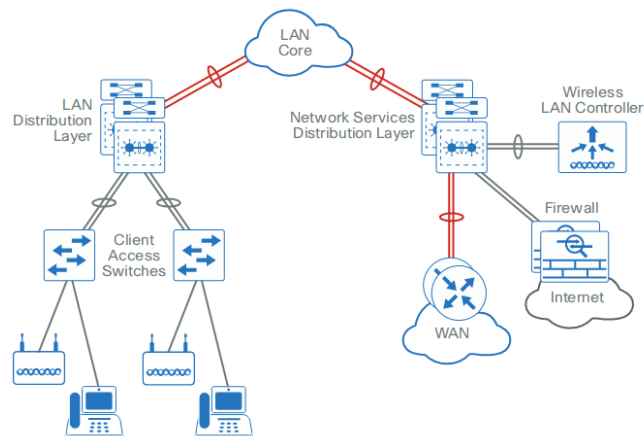


Figure 2 - Three-tier design with a network-services distribution layer

In (Figure 3) see we show the design for the Dublin network. Our design is composed by:

- A layer 3 switch in the core.
- Two layer 3 distribution switches.
- Four access switches.

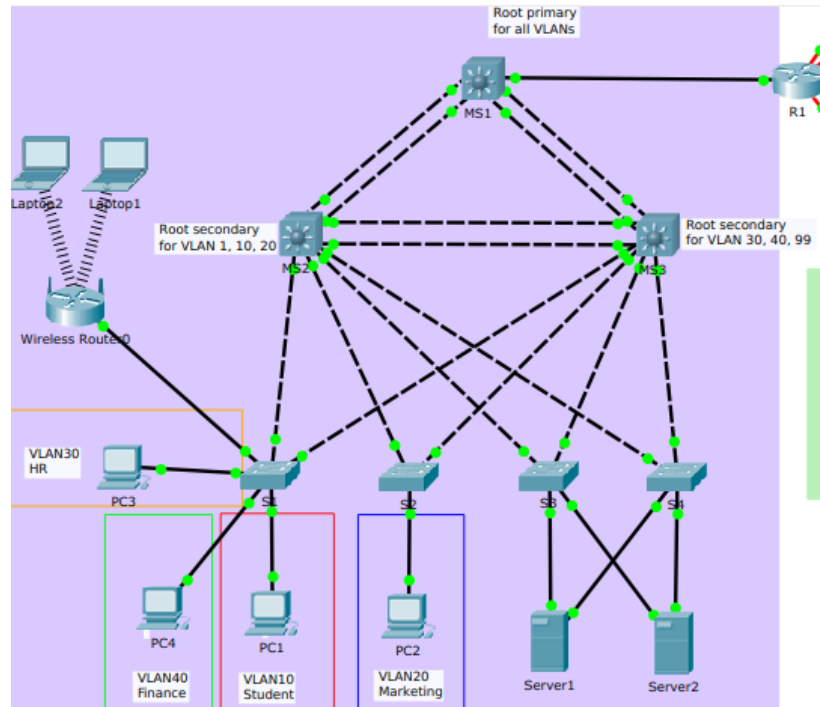


Figure 3 - Dublin Office Network

VLANs

We created 4 VLANs:

- VLAN10 (Student)
- VLAN20 (Marketing)
- VLAN30 (HR)
- VLAN40 (Finance)
- VLAN99 (Management)

We perform the following settings:

- We configure the management interface (VLAN99) in every switch with an IP address
- 802.1Q Trunk Between the Switches (Manually configuration)
- In the access switches, we configured access ports for the end user devices and servers and assigned VLANs to the correct switch interfaces (See Figure 3). The server's interfaces were assigned to the Management VLAN99.

Rapid spanning tree between switches

In our implementation, we made sure root bridge is in a suitable position. To do so, we manually configuring priority to influence the root election:

- We placed the root bridge in to core of our design for all VLANs
- We placed the root secondary in the distribution level of the network and configure Load Balancing sharing the root secondary between the 2 distribution switches.

```

MS1(config)#spanning-tree vlan 1,10,20,30,40,99 root primary
MS2(config)#spanning-tree vlan 1,10,20 root secondary
MS3(config)#spanning-tree vlan 30,40,99 root secondary

```

With this configuration, RSTP is avoiding redundant by blocking port mostly in the access layer.

Because we did load balancing sharing the root secondary between the 2 distribution switches, and because we are doing «Per-Vlan rapid spanning tree», the port blocked would depend on the VLAN. For example, if we consider **S4**. The rapid spanning tree protocol is blocking the **F0/18** port for the VLANs where the **root secondary** is **MS2**. However, for the VLANs where the **root secondary** is **MS3**, rapid spanning is blocking the **Fa0/14** port. That is why all the ports are shown in green in our network (none of the port in blocked for all VLANs) (See Figures 4 and 5).

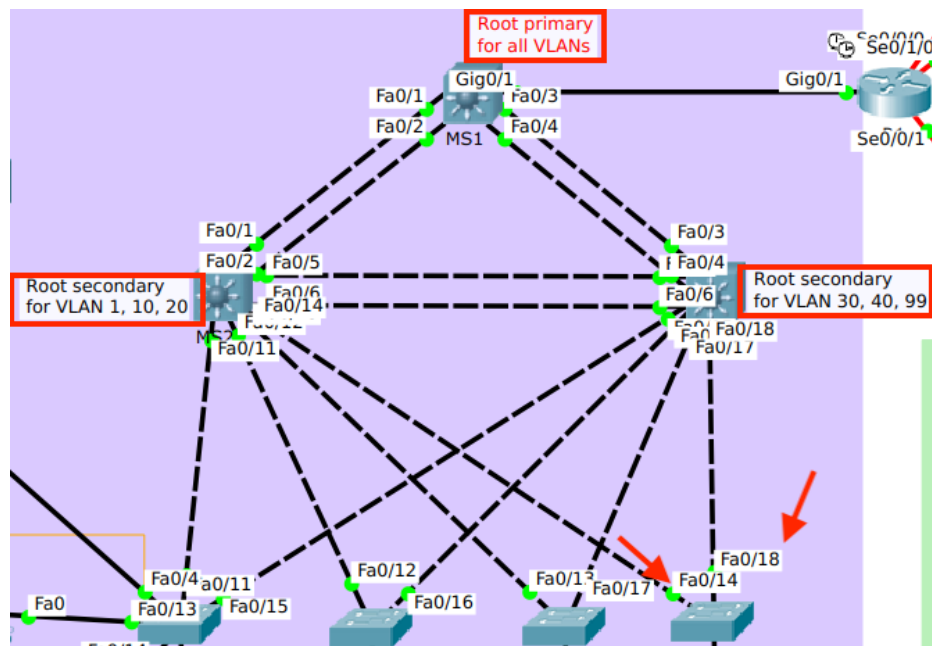


Figure 4 - Port Blocked Per-Vlan rapid spanning tree

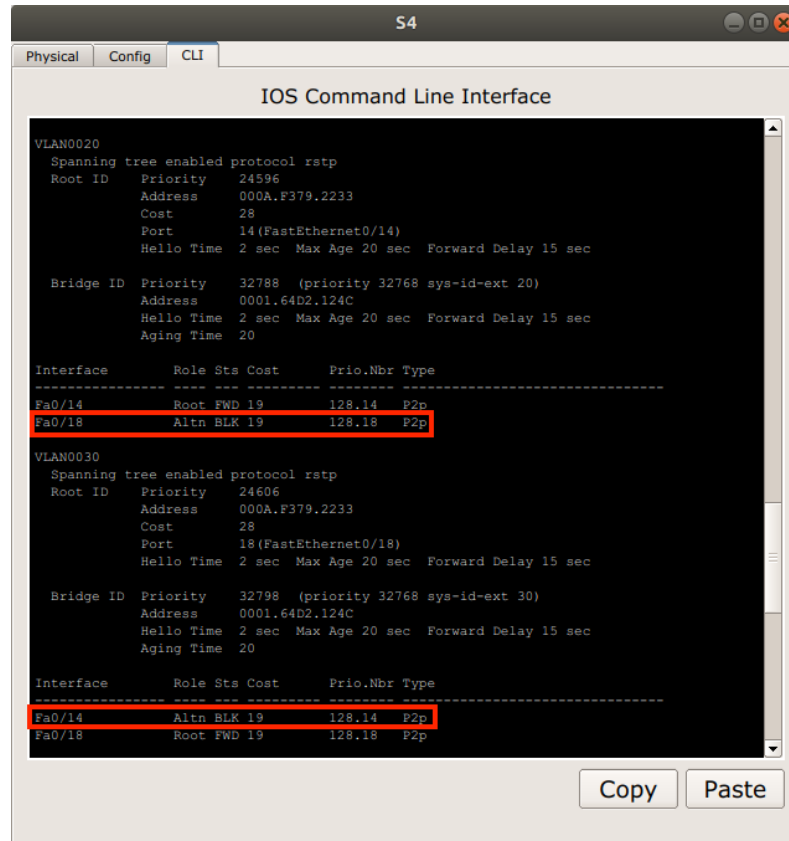


Figure 5 - Port Blocked Per-Vlan rapid spanning tree

Configuring 802 1Q trunk-based inter-VLAN routing

No key decisions had to be taken in this part, we just configure 802 1Q trunk-based inter-VLAN routing to provide routing for our multiple VLANs. You can verify all IP addresses and interfaces configured in the Addressing table.

Wireless access for a GUEST wifi network

The GUEST wifi network was configured using a wireless router attached to one of the access switches. In (Figure 6) we show the configuration performed. We attached the wireless router to VLAN10 and created a new wifi network. A DHCP server was also enabled in the wireless router so the devices were able to request an IP via DHCP (Figure 7)

Some security configurations were also performed:

- We configured a passphrase for the GUEST network: duboffice2019
- Enable encryption.

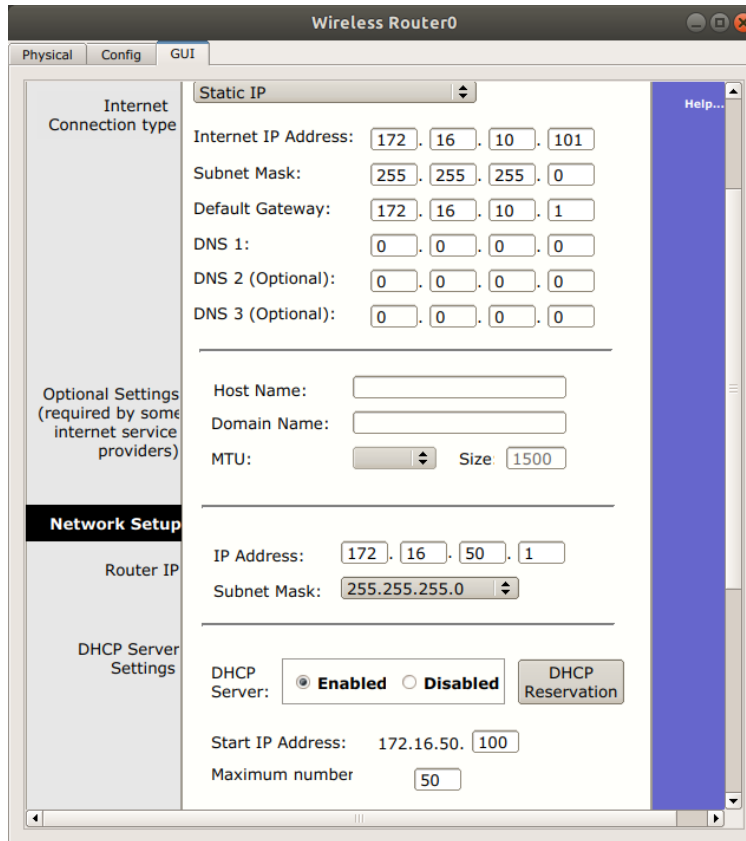


Figure 6 - Wireless Router Configuration

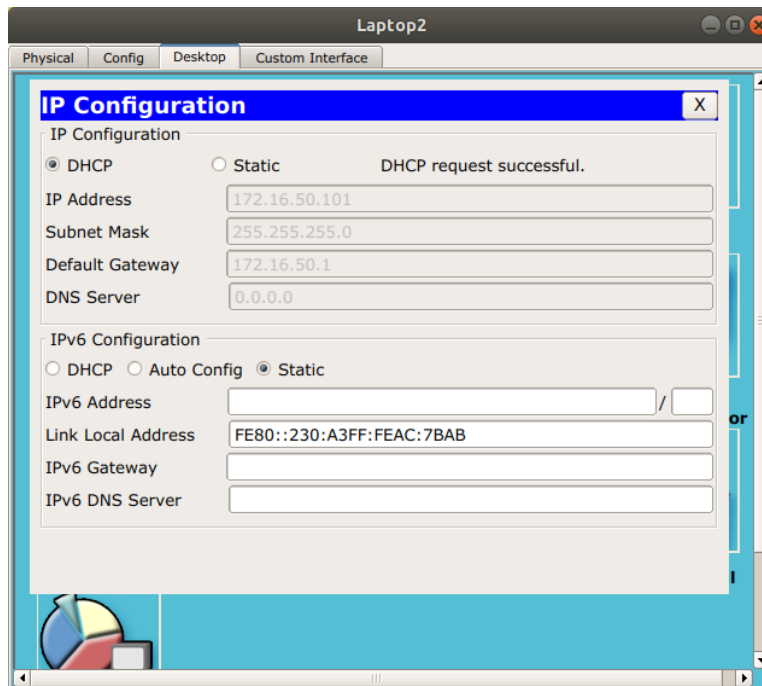


Figure 7 - DHCP Request From Laptop2

WAN

We created a WAN network connecting a total of 5 sites: Dublin, Galway, Limerick, Cork and Sligo. You can see the IP addresses in the Addressing table. They correspondent to the 10.0.0.0 network.

We make sure to include redundant paths between Dublin and Galway, which is the main concern of our WAN.

We configured OSPF Routing Protocol. OSPF is a widely used protocols with one of the lower Administrative Distance (110). That is why, in case of multiple routing protocols configured in a router (such as RIP or IS-IS), OSPF would be the default one and used to route packets. OSPF is able to determine the shortest path to a destination by adding the costs of each path to reach a destination.

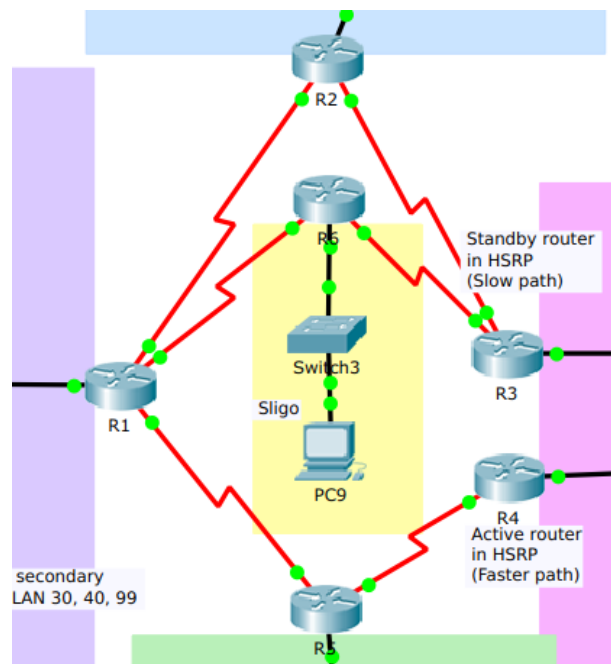


Figure 8 - WAN Design Network

Galway office

For the Galway network as it does not have much resources nor have to be a considerable network a simpler design would fit best also right now the company is concentrating in the Dublin network.

In the case this network, where we had to do a HSRP also known as Hot-Standby Router Protocol, this is a is managing fault redundancy at the network gateway by routing traffic directed from one router to another on the network in the event of an outbreak.

For example, the main gateway, L3 switch, or router will fail and be down. In this case, the secondary gateway will take action and assume the role of leaving the network. We chose to use only two routers as we found unnecessary the usage of 3 in order to do the HSRP and to connect to the other networks.

If the first or active router (R4) fails, the standby router (R3) takes over as the active router. If the standby router fails or becomes the active router, another router is elected as the standby router, for this reason the HSRP creates a redundancy on the gateways for all end devices.

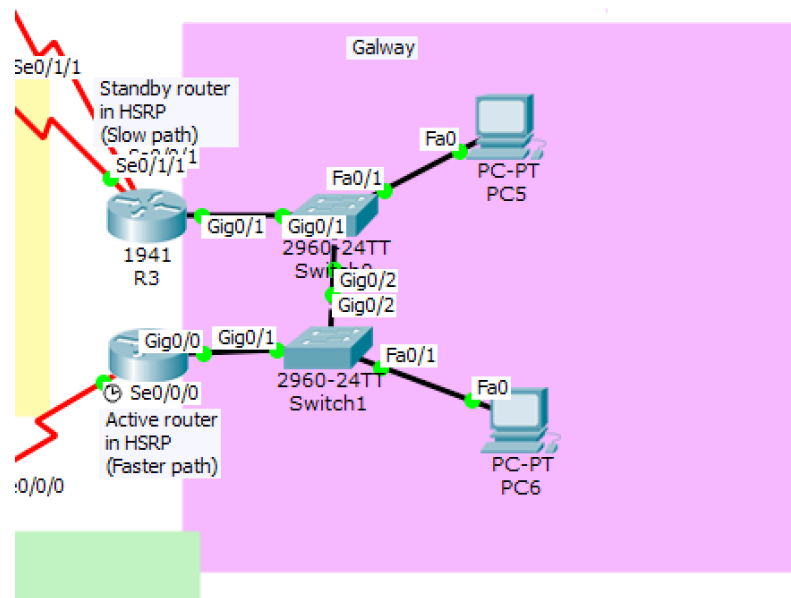


Figure 9 - Galway Office Network

Reference

[1] Cisco (2018) *Campus LAN and Wireless LAN Design Guide*. Available at: <https://www.cisco.com/c/dam/en/us/td/docs/solutions/CVD/Campus/CVD-Campus-LAN-WLAN-Design-Guide-2018JAN.pdf>).