CST 337: Network Configurations and Protocols

Assignment 1

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1.0 Introduction

As a network engineer, my team and I have been approached by Lemon Corporation to set up a network that interconnects the branches and HQ. So, we decided to use a combination topology to design the network infrastructure. Before deciding to design the network, we must focus on network architecture that includes reliability, scalability, and functionality. The network must include a security aspect that is safe, resilient, and fully functional. The design of the network that we approached is reliable, secure, and scalable for the company in order to protect the data and information of the company on the network.

2.0 Network design concepts, plan, and implementation

2.1 IP Addressing Scheme for Branches and HQ

Device	Interface	Connected To	Ip address
R1	G0/0/0	R2	10.10.0.1/30
	G0/0/1	R3	10.20.0.1/30
	Lo0		10.0.1.1/24
R2	G0/0/0	R1	10.10.0.2/30
	G0/0/1	R4	10.30.0.1/30
	G0/0/2.10	VLAN 10	202.168.168.0/24, 1st subnet-
	G0/0/2.20	VLAN 20	202.168.168.0/24, 2nd subnet
	G0/0/2.30	VLAN 30	202.168.168.0/24, 3rd subnet
	G0/0/2.40	VLAN 40	202.168.168.0/24, 4th subnet
	Lo0		10.0.2.2/24
R3	G0/0/0	R1	10.20.0.2/30
	G0/0/1.10	VLAN 10	202.168.169.0/25, 1st subnet
	G0/0/1.20	VLAN 20	202.168.169.0/25, 2nd subnet
	G0/0/2.30	VLAN 30	202.168.169.0/25, 3rd subnet
	G0/0/2.40	VLAN 40	202.168.168.0/24, 5th subnet
R4	G0/0/0	R2	10.30.0.2/30
	G0/0/1	R5	10.40.0.1/30
	G0/0/2	R6	10.50.0.1/30
	Lo0		10.0.4.4/24
R5	G0/0/0	R4	10.40.0.2/30
	G0/0/1	R7	10.60.0.1/30
	Lo0		10.0.5.5/24
R6	G0/0/0	R4	10.50.0.2/30
	G0/0/1	R7	10.70.0.1/30
	Lo0		10.0.6.6/24
R7	G0/0/0	R5	10.60.0.2/30
	G0/0/1	R6	10.70.0.2/30
	G0/0/2.10	VLAN 10	202.168.169.128/25, 1st subnet
	G0/0/2.20	VLAN 20	202.168.169.128/25, 2nd subnet
	G0/0/2.30	VLAN 30	202.168.169.128/25, 3rd subnet
	G0/0/2.40	VLAN 40	202.168.169.128/25, 4th subnet

There two type of IP addresses, private IP addresses and public IP addresses. A private IP address is used connect devices within the same private network. A public IP address is needed by a host to connect to the internet (external network) and the address must be unique. The public IPv4 address block that can be used in this network is 202.168.168.0/23 which can be assign to 510 hosts (minus network address and broadcast address). Because of this limitation, we assign private IP addresses to routers and loopback interface because these devices will not connect to the internet. Every host (PCs) are assigned public IP addresses from the available IPv4 addresses block.

2.2 IP address allocation for VLAN in Branches and HQ

HQ

VLAN	Department	Network IP	Host IP range	Size	Gateway
10	Engineering	202.168.168.0/25	202.168.168.1 - 202.168.168.126	128	202.168.168.1
20	IT	202.168.168.128/27	202.168.168.129 - 202.168.168.158	32	202.168.168.129
30	SALES	202.168.168.160/28	202.168.168.161 - 202.168.168.174	16	202.168.168.161
40	ADMIN	202.168.168.176/28	202.168.168.177 - 202.168.168.190	16	202.168.168.177

BRANCH 1

VLAN	Department	Network IP	Host IP range	Size	Gateway
10	Engineering	202.168.169.0/26	202.168.169.1 - 202.168.169.62	64	202.168.169.1
20	IT	202.168.169.64/27	202.168.169.65 - 202.168.169.94	32	202.168.169.65
30	SALES	202.168.169.96/27	202.168.169.97 - 202.168.169.126	32	202.168.169.97
40	ADMIN	202.168.168.192/28	202.168.168.193 - 202.168.168.206	16	202.168.168.193

BRANCH 2

VLAN	Department	Network IP	Host IP range	Size	Gateway
10	Engineering	202.168.169.128/26	202.168.169.129 - 202.168.169.190	64	202.168.169.129
20	IT	202.168.169.192/28	202.168.169.193 - 202.168.169.206	16	202.168.169.193
30	SALES	202.168.169.208/28	202.168.169.209 - 202.168.169.222	16	202.168.169.209
40	ADMIN	202.168.169.224/28	202.168.169.225 - 202.168.169.238	16	202.168.169.225

When assigning IP addresses to a VLAN, the subnet assigned will often have more IP addresses that it can accommodate than the number of hosts connected to the subnet. For an example, in VLAN10 (Engineering) for HQ, a subnet with mask of 25 is assigned to the VLAN. The number of IP addresses that can be assigned to hosts is 126 but only 101 is used. In the future, if an expansion of department happened where several pc will be added to the VLAN, the design of the network doesn't have to be changed. The new added pcs just need to be assigned any available addresses from the subnet.

2.3 Creating Loopback interface

Router with no hosts(pcs) attach to it will have the configuration for loopback interfaces. Loopback interface is used in debugging process to determine if a router is connectable from another host in another router.

2.4 Use 4 VLAN

The major reason a VLAN is suitable for this organizational usage is that it can be used to divide a bigger network into more manageable groups. We used 4 VLANs for 4 separate department (VLAN10 – Engineering, VLAN20 - IT, VLAN30 – Sales and Marketing, VLAN40 - Admin) to separate and isolate physical LAN into multiple broadcast domains. Since the number of multiple domains increases, it can greatly reduce security threats as the number of hosts is decrease on the specific broadcast domain. It enables people to access the internet and utilize a separate network. By separating traffic on a network, it can reduce threats, risks and secures sensitive data by preventing unauthorized users and devices from using that network.

2.5 Interface based VLAN

We used Interface based VLAN because it is the easiest and effective method. Interfaces are used to assign VLANs. An interface can forward packets from a VLAN once it has been joined to the VLAN. Broadcast packets are restricted to a single VLAN due to interface based VLAN assignment, which permits communication between hosts in the same VLAN but limits communication between hosts in different VLANs.

2.6 Trunk interface configuration connect switch to router

We used trunk interface configuration to connect the switch to the router. A trunk interface separates the transmissions using the 802.1Q tag and allows frames from various VLANs to pass through. The trunk will let us to expand the VLANs over an entire network by carrying the traffic of the 4 VLAN over a single connection. By do a trunk interface, the data network bandwidth will be expanded and allows various users to establish a link with the same network node. This structure will make the network to better manage the direct traffic and avoiding congestion that would slow down data processing.

2.7 Implementation of MSTP - Load Balancing for scalability

We decide to use MSTP for our network since the main objective of MSTP is to decrease the overall number of spanning-tree instances to fit the network's physical topology and hence decrease the workload on a switch. It also provides various pathways to load balance VLAN traffic and has the ability to quickly converge traffic. So, it is suitable to improve the network scalability.

2.8 Link aggregation between switches

We also implement a link aggregation between switches since it is dependable. If one of the physical links in the link aggregation group fails, the traffic is automatically reassigned to the other physical links. By doing link aggregation, it can also increase the link bandwidth without spending much money. We used LACP as the protocol to form a link aggregation group. We also establish an ethernet link aggregation (Eth-trunk) on SW1, SW2, SW3, and SW4 which is eth-trunk1 in SW1 and SW3, eth-trunk2 in SW1 and SW2, and eth-trunk 3 in SW2 and SW4. By doing the eth-trunk, it can improve the link reliability by providing the link backup method. When the conditions for link aggregation change, LACP modifies or disables the link aggregation. LACP mode is also capable of identifying member link failures, link layer errors, and invalid link connections.

2.9 Inter VLAN Communication

Inter VLAN communication allow communication between a VLAN with other VLAN or another subnet. Without Inter VLAN Communication, engineering team cannot communicate with IT team, and engineering team within different branches will not be able to communicate. As all host will be assign a VLAN, Inter VLAN communication is implemented on HQ, branch 1 and branch 2 to allow host to connect to another host in different branch.

2.10 OSPF

The routing protocol used is Open Shortest Path First (OSPF), since it provides several advantages for network architecture, for high effectiveness and efficiency. Due to the fact that the loop-free protocol takes very little time to send updates to the completely autonomous system in the router, the network's performance is enhanced. In addition to this advantage, this protocol also reduces network overhead, which results in less network disturbance and more efficiency.

3.0 Network Design