Lab 3: Dynamic Network Addressing & Troubleshooting

CNIT 24000-005

Group 12

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Executive Summary

In this lab session, the purpose was to create a network architecture with a DHCP server installed on it to assign automatic IP to each host, just like an enterprise environment. The major phases in this project were separated into five different phases. First, the initial DHCP was installed on VLAN 10's host PCs and the IPv4 assignment was turned into automatic where DHCP packets were captured in the process. Second, it was about extending the scope to multiple scopes by configuring VLAN 20 and DHCP relay agent on the router but this task was not completed successfully during this lab time. Third, the DHCP service was extended more to multiple scopes and servers where the TP-LINK was configured as a DHCP server for VLAN 20 and disabling the scope for VLAN 10 but was not completed successfully. Fourth, the extension of the DHCP service to a single server and multiple scopes were configured by editing only the router configurations by giving it two separate pools for the hosts and the DHCP packets were captured also for this step. Fifth, the ICMP ping, traceroute, and pathping were sent from the hosts to various destinations in order to confirm that communication between source and destinations were functioning. Critical problems in this lab were that one of the switches was not functioning well so only one switch was used in this lab, but the hosts were still separated into two VLANs. The major recommendation for this lab is to understand the differences between multiple and single scopes and servers which makes the lab easier to configure. Another recommendation is to alter the whole network subnet mask to /25 right after starting the lab because /24 addresses can cause bad subnet errors. The business scenario justifies the rationale behind this project in an enterprise situation, the procedure lists the steps in order to successfully complete the lab as explained in the results part. Conclusion and recommendations are about suggestions for future lab students and appendix A talks about the problem resulted during the lab and appendix record the machine configurations made to complete the lab.

Business Scenario

A large business organization named InK has planned to hire 10,000 employees in its company campus. Before the entrance of the employees, the technicians in the business had to configure the network settings of all employee computers readily set for the employees. To complete this job as efficient as possible, the company had decided to use DHCP as a network protocol to automatically pass on network configuration information to hosts on a TCP/IP network. The technology team on the company tried extending the DHCP service to multiple scopes, multiple servers, and a single server but figured that a single DHCP server with multiple scopes would be the most suitable choice for enterprise infrastructure. To initiate the DHCP deployment in the company, the network architecture had to be set properly. The Cisco 2950 switches were set to vtp mode transparent and shared VLANs 10 and 20, where VLAN 10 is assigned to the financial department and VLAN 20 is assigned to the management department. Every host was connected to an interface in a switch and the switches were connected to a ProCurve 2900-24G where it was connected to the Cisco 1900 router which led it to the company's network. The DHCP server was set in a VM in one of the hosts which were using a static IP address where it could set IP ranges and addresses to other hosts that were connected to the switch. The Cisco 1900 router directed the DHCP server packets to the 10,000 PC's where the networks were all configured to a /25 subnet and IP addresses were obtained automatically. The router was configured into two pools each with two distinct IP ranges on the same network to make sure the isolation between departments was bordered. The IP addresses assigned were 192.168.12.0/25 for VLAN 10 and 192.168.12.128/25 for VLAN 20. To make sure that the network was configured flawlessly, the technology crew used ICMP tools such as ping, traceroute, pathping from hosts in VLAN 10 and 20 each to router gateway, network gateway, and other major addresses. The applications that were utilized in the process of the DHCP network architecture deployment were Putty, cmd, VMware Player, and Windows. The pre-lab network architecture had a similar physical diagram with the current lab but with a subnet of /24 and without the DHCP server installed on it. The logical diagram of the pre-lab is pasted in the figure below:

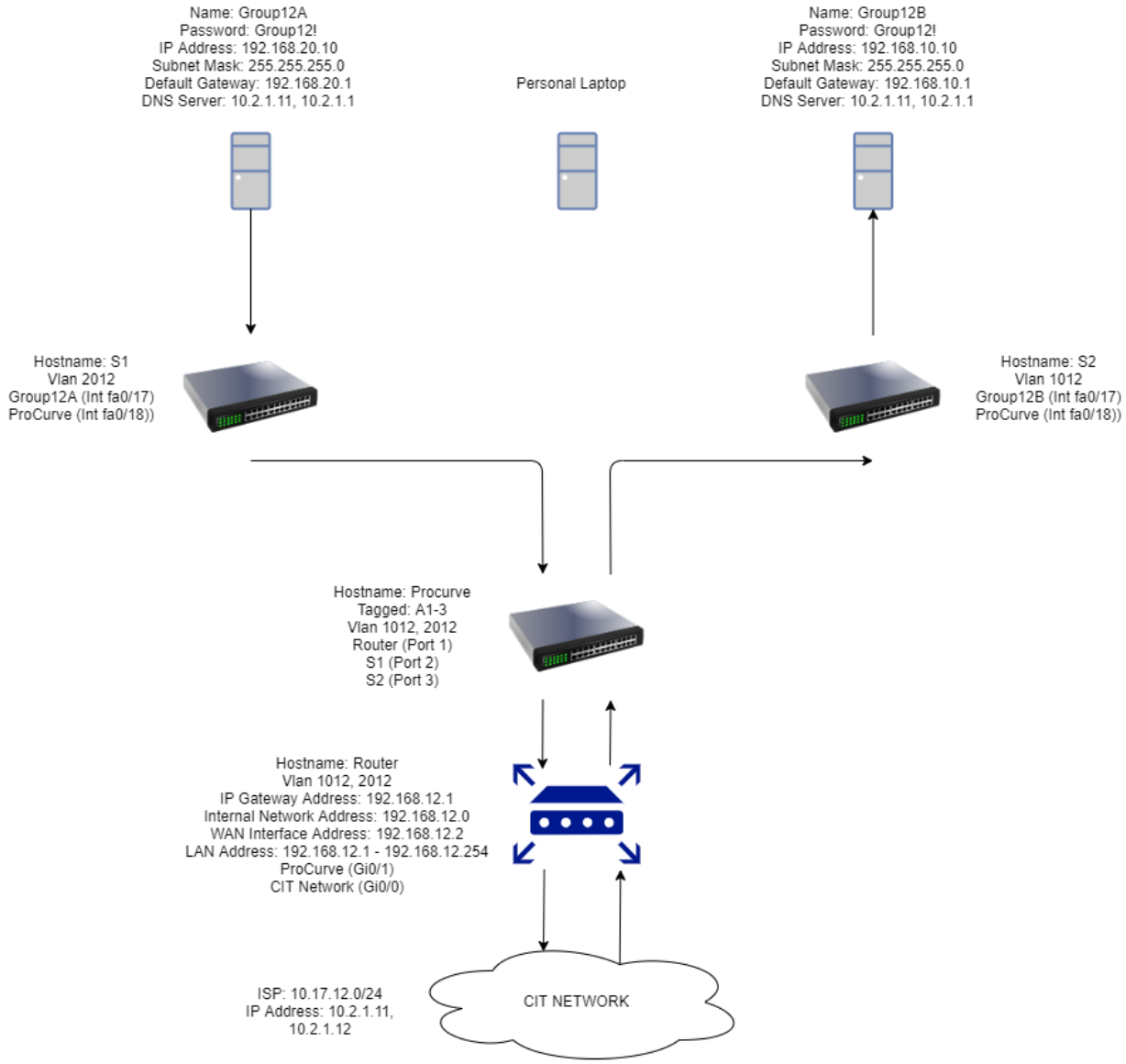

Figure 1: Pre-lab Logical Network Diagram

Procedure

This procedure phase is separated by the list of tasks shown chronologically in the check-off sheet. The format for the procedure is according to: **buttons** are bold, *options* are italicized, text entered into the computer is in Courier New, menu navigation is by the pipe symbol and italic words: *Start* | *Programs* | *MS Office* | *Word*.

Deployed Initial DHCP

1. Logged in to Group12B host using credentials:
    a. Password: `Group12!`
2. Typed `File Explorer` in Windows search bar and pressed **Enter**
    a. Clicked the File Explorer browser and typed `//rtfm.cit.lcl`
    b. Logged in with personal credentials
    c. Selected Pub | CNIT24000 | Lab3.DHCPServers | Virtual Machines Applications | VMware-player-6.0.7-2844087
    d. Clicked **Yes** when User Access Control warning popped up
        i. Clicked **Next**
        ii. Selected the radio button next to *I accept the terms in the license agreement* and clicked **Next**
        iii. Kept on clicking **Next** until installation was initiated
3. Typed `File Explorer` in Windows search bar and pressed **Enter**
    a. Clicked the File Explorer browser and typed `//rtfm.cit.lcl`
    b. Logged in with personal credentials
    c. Selected Pub | CNIT24000 | Lab3.DHCPServers | ubuntu-16.04.4-server-i386
    d. Dragged the ubuntu-16.04.4-server-i386 file to Group12B Desktop

4. Typed in `VMware Player` in Windows search bar and pressed **Enter**
    a. Clicked **Open Virtual Machine**
    b. Navigated to This PC | Desktop | ubuntu-16.04.4-server-i386 and pressed **Enter**
5. When asked for credentials, typed:
    a. Username: `cnit240`
    b. Password: `cnit240`
6. Typed `sudo nano /etc/dhcp/dhcp.conf` to type the range, subnet mask, subnet, DNS servers, and gateway for VLAN 10 configurations for the DHCP server network properties:

```
a. subnet 192.168.10.0 netmask 255.255.255.128 {
b. range 192.168.10.0 192.168.10.128;
c. option domain-name-servers 10.2.1.11, 10.2.1.12;
d. option domain-name "cnit240";
e. option routers 192.168.10.1;
f. option broadcast-address 192.168.10.128;
g. default-lease-time 600;
h. max-lease-time 7200;
i. }
```

7. Typed `sudo nano /etc/network/interfaces` to type the primary network interface configurations for the DHCP server network properties:

```
a. auto eth0
b. iface eth0 inet static
c. address 192.168.10.20
d. netmask 255.255.255.128
e. network 192.168.10.0
f. broadcast 192.168.10.128
g. gateway 192.168.10.1
```

```
h. dns-nameservers 10.2.1.11
```

8. Grabbed a console cable and connected it with the Cisco 1900 router and a USB port in Group12B to configure the router
    a. On Group12B typed `Device Manager` in Windows search bar and pressed **Enter**
        i. Expanded *Ports* by clicking on the arrow pointing downwards beside **Ports**
        ii. Recorded which port number was shown other than *COM1*
    b. On Group12B typed `putty` in Windows search bar and pressed **Enter**
        i. Selected the radio button next to *Serial*
        ii. Entered recorded `COM#` on the search box
        iii. Clicked **Load** on the bottom of the GUI
9. Typed the following into the router configuration to configure the subnet mask to /25 and to set the IP address range in VLAN 10 and 20 for hosts.

```
a. en
b. conf t
c. int gi0/0
    i.   ip address 10.17.12.2 255.255.255.128
   ii.   ip nat outside
  iii.   duplex auto
   iv.   speed auto
d. int gi0/1
    i.   ip address 10.17.12.1 255.255.255.0
   ii.   ip nat inside
  iii.   duplex auto
   iv.   speed auto
e. int gi0/1.1012
    i.   encapsulation dot1Q 1012
```

ii. ip address 192.168.10.1 255.255.255.128

iii. ip helper-address 192.168.10.20

iv. ip nat inside

f. int gi0/1.2012

i. encapsulation dot1Q 2012

ii. ip address 192.168.10.254 255.255.255.128

iii. ip helper-address 192.168.10.128

iv. ip nat inside

10. Allowed protocols nd, udp bootps, and udp bootps to router and block other protocols that are not needed. Excluded addresses that are already reserved in the static IP:

a. ip forward-protocol nd

b. no ip foward-protocol udp domain

c. no ip foward-protocol udp time

d. no ip foward-protocol udp netbios-ns

e. no ip foward-protocol udp netbios-dgm

f. no ip foward-protocol udp tacacs

g. ip foward-protocol udp bootps

h. ip foward-protocol udp bootps

i. no ip http server

j. no ip http secure-server

k. ip dhcp excluded-address 192.168.10.1 192.168.10.20

l. ip dhcp excluded-address 192.168.10.254

m. ip dhcp excluded-address 192.168.10.128

n. ip dhcp excluded-address 192.168.20.1 192.168.20.20

o. ip dhcp excluded-address 192.168.20.254

p. ip dhcp excluded-address 192.168.20.128

Extended DHCP Service - Multiple Scopes & Single Servers

1. Following up from the previous step, created two distinct DHCP pools for the IP addresses in the VLANs by setting the range from 192.168.10.0/25 in one pool and 192.168.10.128/25 in the second pool:

```
a. ip dhcp pool LAN-POOL-1
    i.   network 192.168.10.0 255.255.255.128
   ii.   default-router 192.168.10.1
  iii.   domain-name span.com
b. ip dhcp pool LAN-POOL-2
    i.   network 192.168.10.128 255.255.255.128
   ii.   default-router 192.168.10.254
  iii.   domain-name span.com
```

Pinged through ICMP

1. Logged in to Group12A and Group12B host with credentials:
    a. Password: `Group12!`
2. Grabbed a console cable and connected it with the Cisco 1900 router and a USB port in Group12B to configure the router
    a. On Group12B typed `Device Manager` in Windows search bar and pressed **Enter**
        i. Expanded *Ports* by clicking on the arrow pointing downwards beside **Ports**
        ii. Recorded which port number was shown other than *COM1*
    b. On Group12B typed `putty` in Windows search bar and pressed **Enter**
        i. Selected the radio button next to *Serial*

ii. Entered recorded `COM#` on the search box

iii. Clicked **Load** on the bottom of the GUI

c. Configured static route for 10.17.112.1 and typed:

i. `en`

ii. `conf t`

iii. `ip route 10.17.112.0/25 gi0/1.2012 10.17.112.1`

3. On Group12B typed `cmd` in Windows search bar and pressed **Enter**

a. Typed `ping 192.168.10.1`

b. Typed `ping 192.168.10.254`

c. Typed `ping 10.0.1.242`

d. Typed `ping slash.org`

e. Typed `ping 10.17.112.21`

4. On Group12A typed `cmd` in Windows search bar and pressed **Enter**

a. Typed `ping 192.168.12.244`

Tracerouted through ICMP

1. Logged in to Group12A and Group12B host with credentials:

a. Password: `Group12!`

2. On Group12B typed `cmd` in Windows search bar and pressed **Enter**

a. Typed `tracert 192.168.10.1`

b. Typed `tracert 192.168.10.254`

c. Typed `tracert 10.0.1.242`

d. Typed `tracert slash.org`

e. Typed `tracert 10.17.112.21`

3. On Group12A typed `cmd` in Windows search bar and pressed **Enter**

a. Typed `tracert 192.168.12.244`

Path pinged through ICMP

1. Logged in to Group12A and Group12B host with credentials:
    a. Password: `Group12!`
2. On Group12B typed `cmd` in Windows search bar and pressed **Enter**
    a. Typed `pathping 10.0.1.242`
    b. Typed `pathping slash.org`
    c. Typed `pathping 10.17.112.21`

Results

In this lab session, some requirements were not met successfully such as the extension of DHCP service to multiple scopes and/or servers, but the remaining objectives were met. The completed objectives of this lab are isolated into three goals. First, the initial DHCP deployment was created successfully by installing the DHCP server (Ubuntu) on a host and configuring it for VLAN 10. The network architecture was configured to subnet /25 on the Cisco 1900 router and the range of the IP addresses was set to 192.168.10.0 for VLAN 10 and 192.168.20.128 for VLAN 20 respectively. Then, the DHCPDiscover, DHCPOffer, DHCPRequest, and DHCPPAck (DORA) were captured by Wireshark from the Group12B host PC. Second, the extension of the DHCP service to a single server and multiple scopes were completed by configuring the Cisco 1900 router by setting DHCP two different pools ranging it to 192.168.10.0 for VLAN 10 and 192.168.20.128 for VLAN 20 respectively. The default gateway for the router was set to 192.168.10.1 for VLAN 10 and 192.168.10.254 for VLAN 20 each. The DHCP addresses that were already reserved by the router's addresses and unnecessary network protocols such as udp time, netbios-ns, netbios-dgm, and tacas were excluded by the router to improve traffic performance. Third, by utilizing the ICMP tools, ping, traceroute, and pathping were offered to provide feedback about network operations and the delivery of datagrams. The network architecture that was created at the end of this lab was a full client to the DHCP server network with the configuration of different scopes and different numbers of servers. By doing this, the DHCP server could assign distinct IP addresses to hosts by changing the host ID of the IP within the given range on a TCP/IP network which creates a client/server architecture and adds the capability of extra configuration options.

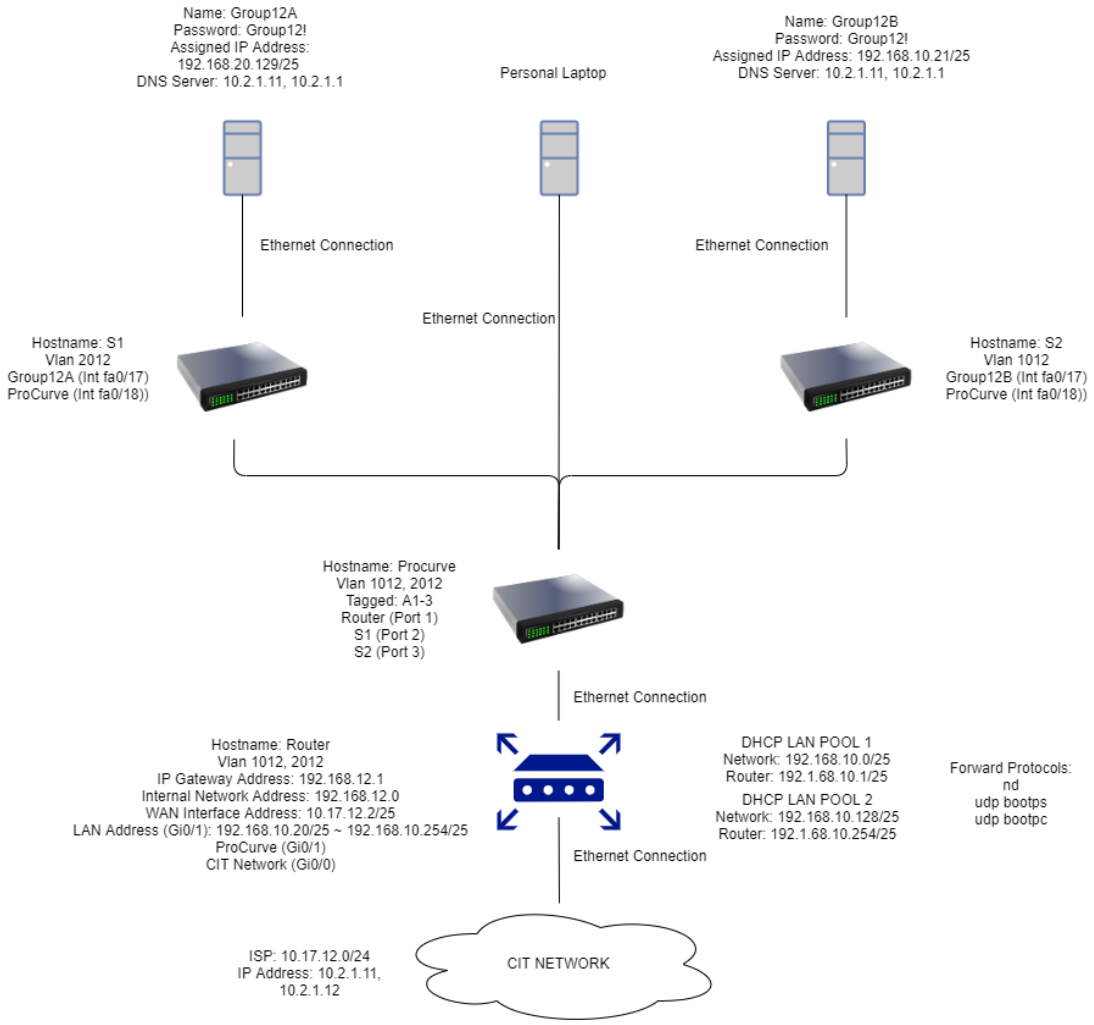

Figure 3: Physical Network Diagram

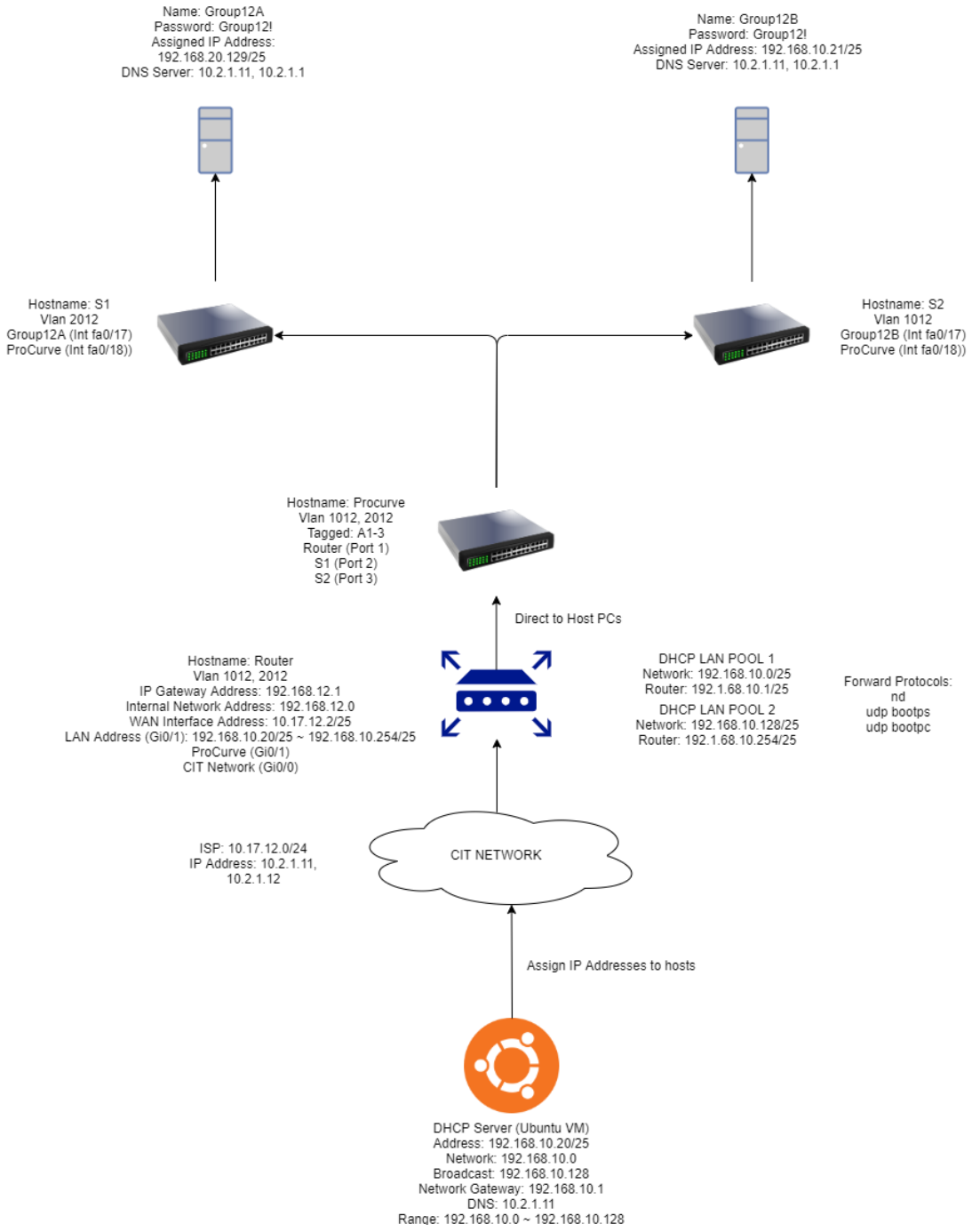

Figure 4: Logical Network Diagram (DHCP IP Assignment)

Conclusions and Recommendations

According to the business scenario mentioned above, this project did not meet all the requirements and expectations that were given to do. The business scenario required numbers of scopes and servers to be extended from the DHCP server in order to entertain a suitable network environment for the organization, but this lab project only fulfilled a single server and multiple scopes and deployed the DHCP server which was two out of four primary objectives. However, the rest of the objectives were met successfully according to the procedure and the results section in this lab report. There is no mention of the uncompleted parts in the procedure and results due to zero configurations of it.

Recommendations

Recommendation 1: Before starting the lab work, understanding how the number of scopes and servers differ in situations and what kind of situations are the number of scopes and servers used for is critical before starting the lab. This can ease the lab work because understanding the logic behind the lab can give a clear image of how to configure the router and DHCP server.

Recommendation 2: Before setting up the DHCP server, all the router configurations should be set to a subnet mask of /25 from /24 in order to create a suitable network architecture for the lab work. There are going to be configuration errors or bad subnet mask errors if all the network subnet mask is not changed to /25 in the current lab work.

Recommendation 3: Understanding the provided network architecture by the lab is critical for creating a complete network architecture. In this lab, the VLAN 10 was supposed to be configured as 192.168.10.0 and VLAN 20 as 192.168.10.128 so if this information was not checked carefully, the IP range assignment of the DHCP router would not function properly.

Recommendation 4: The unfinished parts for this lab are extending the DHCP server to multiple scopes and multiple scopes & servers. To ensure that there are no uncomplete tasks in future labs, the lab objectives should be done while taking time to concern because most unsuccessful tasks occur due to time constraints.

Bibliography

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APPENDIX A: Problem Solving

Problem 1: Switch does not provide internet for Group12A

Problem Description: The switch connected to Group12A host with a VLAN 20 does not provide internet for the host even the configurations were accurate.

Problem Solution: The potential solutions for this problem are to ask the TA or the professor about this issue with the switch, searching for troubleshoots on the internet, try plugging in the cable to another interface, resetting the switch, and plugging in Group12A's ethernet cable to Group12B's switch but separated with VLANs.

Solution Attempted: The solutions attempted for this problem was to ask the TA or the professor about the problem with the switch, searching for troubleshoots on the internet, try plugging the cable to another port, and plugging in Group12A's ethernet cable to Group12B's switch but separated with VLANs.

Final Solution: The final solution was to plug in the Group12A's ethernet cable to Group12B's switch but keeping Group12A host on VLAN 20 because in this lab only the VLANs have to be separated by hosts.

Problem 2: Issue installing DHCP server on VMware Ubuntu

Problem Description: DHCP server on VMware Ubuntu, which was retrieved from rtfm.cit.lcl on the CIT network had issues functioning its job.

Problem Solution: The possible solutions to this issue was to ask the TA or Justin about this problem or to search the internet for DHCP server full configurations on an Ubuntu platform.

Solution Attempted: The solutions attempted were to ask the TA or Justin about this issue and to search the internet for DHCP server full configurations on an Ubuntu platform.

Final Solution: The final solution was to ask Justin about this issue who provided a solution with a link that has the rest of the DHCP server configurations to make the server fully functioning.

Problem 3: Issue configuring LAN pools on Cisco 1900 router

Problem Description: The problem here was that there was an issue configuring the LAN pools on the Cisco 1900 router when trying to complete the fourth objective in the lab.

Problem Solution: The potential solutions to this was to ask the TA or Justin about this issue, to search for solutions on the internet, and to watch Justin's video posted on Blackboard to clarify the current lab work process.

Solution Attempted: The solutions attempted were to ask the TA or Justin about this issue, search for solutions on the internet, and to watch Justin's video posted to Blackboard.

Final Solution: The final solution to this issue was to watch Justin's video that was posted on Blackboard which was very helpful to successfully configure the router's LAN pool addresses which directed the DHCP to the hosts linked to the router.

APPENDIX B: Router and Switch Configurations

Cisco 1900 Router

```
en
conf t
!
int gi0/0
ip address 10.17.12.2 255.255.255.128
ip nat outside
duplex auto
speed auto
!
int gi0/1
ip address 10.17.12.1 255.255.255.0
ip nat inside
duplex auto
speed auto
!
int gi0/1.1012
encapsulation dot1Q 1012
ip address 192.168.10.1 255.255.255.128
ip helper-address 192.168.10.20
ip nat inside
!
int gi0/1.2012
```

```
encapsulation dot1Q 2012
ip address 192.168.10.254 255.255.255.128
ip helper-address 192.168.10.128
ip nat inside
!
ip forward-protocol nd
no ip foward-protocol udp domain
no ip foward-protocol udp time
no ip foward-protocol udp netbios-ns
no ip foward-protocol udp netbios-dgm
no ip foward-protocol udp tacacs
ip foward-protocol udp bootps
ip foward-protocol udp bootps
!
no ip http server
no ip http secure-server
!
ip dhcp excluded-address 192.168.10.1 192.168.10.20
ip dhcp excluded-address 192.168.10.254
ip dhcp excluded-address 192.168.10.128
ip dhcp excluded-address 192.168.20.1 192.168.20.20
ip dhcp excluded-address 192.168.20.254
ip dhcp excluded-address 192.168.20.128
!
ip dhcp pool LAN-POOL-1
network 192.168.10.0 255.255.255.128
```

```
default-router 192.168.10.1
domain-name span.com
!
ip dhcp pool LAN-POOL-2
network 192.168.10.128 255.255.255.128
default-router 192.168.10.254
domain-name span.com
```

DHCP Server (Ubuntu)

```
sudo nano /etc/dhcp/dhcp.conf
#option definition common to all supported networks...
default-lease-time 600;
max-lease-time 7200;
#If this DHCP server is the official DHCP server for the local
network,
#the authoritative directive should be uncommented.
authoritative;
#Use this to send dhcp log messages to a different log file (you also
log-facility local7;

subnet 192.168.10.0 netmask 255.255.255.128 {
range 192.168.10.0 192.168.10.128;
option domain-name-servers 10.2.1.11, 10.2.1.12;
option domain-name "cnit240";
option routers 192.168.10.1;
```

```
option broadcast-address 192.168.10.128;
default-lease-time 600;
max-lease-time 7200;
}

sudo nano /etc/network/interfaces
#The loopback network interfaces
auto lo
iface lo inet loopback

#The primary network interface
auto eth0
iface eth0 inet static
address 192.168.10.20
netmask 255.255.255.128
network 192.168.10.0
broadcast 192.168.10.128
gateway 192.168.10.1
dns-nameservers 10.2.1.11
```