COURSE NAME: **COMPUTER COMMUNICATION NETWORKS (CCN)**

COURSE CODE: CT-376

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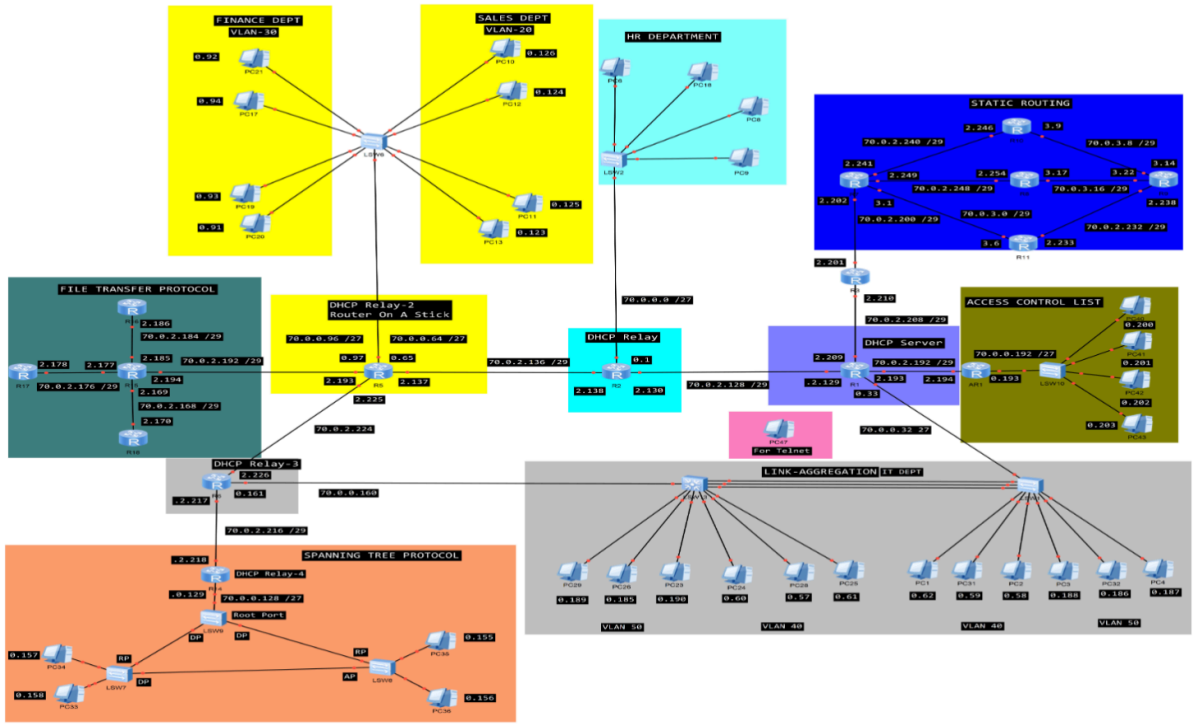
Complex Computing Problem Assessment Rubrics

Course Code: CT-376			**Course Title: Computer Communication Networks**
Criteria and Scales			
Excellent (3)	**Good (2)**	**Average (1)**	**Poor (0)**
Criterion 1: Understanding the Problem: How well the problem statement is understood by the student			
Understands the problem clearly and identify the underlying issues and functionalities.	Adequately understands the problem and identifies the underlying issues and functionalities.	Inadequately defines the problem and identifies the underlying issues and functionalities.	Fails to define the problem adequately and does not identify the underlying issues and functionalities.
Criterion 2: Research: The amount of research that is used in solving the problem			
Contains all the information needed for solving the problem	Good research leads to a successful solution	Mediocre research which may or may not lead to an adequate solution	No apparent research
Criterion 3: Code: How complete the code is along with the assumptions?			
Complete the code according to the selected functionalities of the given case with clear assumptions	Incomplete code according to the selected functionalities of the given case with clear assumptions	Incomplete code according to the selected functionalities of the given case with unclear assumptions	Wrong code and naming conventions
Criterion 4: Report: How thorough and well organized is the solution?			
All the necessary information is organized for easy use insolving the problem	Good information organized well could lead to a good solution	Mediocre information which may or may not lead to a solution	No report provided
Criterion 5: Labeling: How well defined and labeled is the solution?			
All the necessary information is labelled (i.e. port no.) for better understanding	Good information about the topology is labelled	Incomplete label according to the selected functionalities	Not Labelled

INTRODUCTION:

This report will give an in detail report on our Computer Communications Network's(CCN) CCP. Our objective was to design a network topology using the knowledge that we have gained throughout this course. In this report we will discuss the technologies that we have used, how we configured them and will also give justifications as to why we have used them.

TOPOLOGY:



SUBNETTING:

So first of all we started with an IP address of 70.0.0.0 with subnet mask 255.0.0.0 and sub-divided it into many networks using the VLSM method. We then further classified these networks into networks that will be used in between routers and also networks that will be used by different departments in our topology.

1. Human Resource(HR):

a. Ip: 70.0.0.1-70.0.0.30
b. Subnet Mask: 255.255.255.224
c. Gateway: 70.0.0.1

2. Sales Department:

a. Ip: 70.0.0.65-70.0.0.94
b. Subnet Mask: 255.255.255.224
c. Gateway:70.0.0.65

3. Finance Department:

a. Ip:70.0.0.97-70.0.0.126
b. Subnet Mask: 255.255.255.224
c. Gateway:70.0.0.97

4. IT Department:

a. Ip:70.0.33-70.0.0.62, 70.0.0.161-70.0.0.190
b. Subnet Mask: 255.255.255.224
c. Gateway:70.0.33, 70.0.0.161

5. Database Server:

a. Ip: 70.0.0.193 - 70.0.0.222
b. Subnet Mask: 255.255.255.224
c. Gateway:70.0.0.193

6. DHCP Server:

a. Ip: 70.0.2.129
b. Subnet Mask: 255.255.255.248
c. Gateway:70.0.2.129

7. FTP Server:

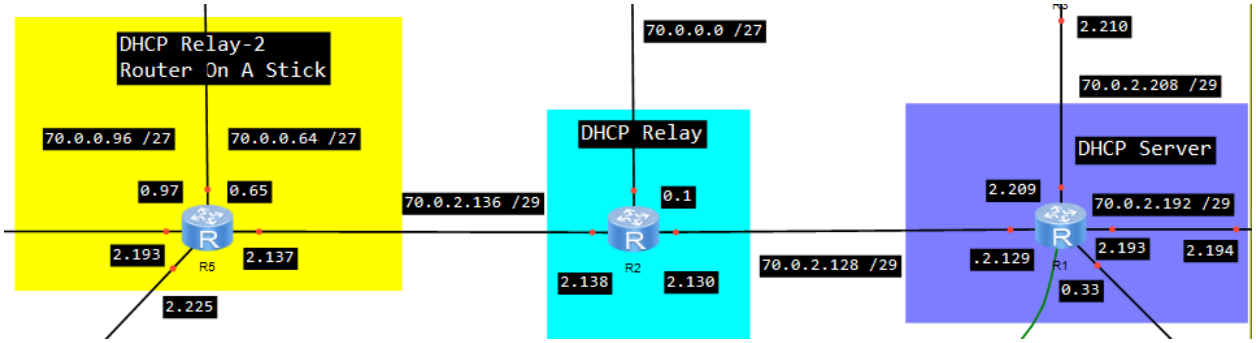
a. Ip: 70.0.2.194
b. Subnet Mask: 255.255.255.248
c. Gateway: 70.0.2.194

8. SPANNING TREE PROTOCOL:

a. Ip: 70.0.0.129-70.0.0.158
b. Subnet Mask:255.255.255.224
c. Gateway:70.0.0.129

DHCP-SERVER:

So after dividing the 70.0.0.0 /8 network into many sub networks we then decide to dynamically assign the Ip's using the Dynamic Host Configuration Protocol (DHCP) method. The DHCP method is a method for assigning the Ip's dynamically to all the connected computers. This simplifies the process of Ip assigning as any computer that is added newly to the network will be assigned an Ip automatically. For this we will use Router R1 as our DHCP Server. This R1 is responsible for assigning the Ip's dynamically as well as updating the Ip pool.

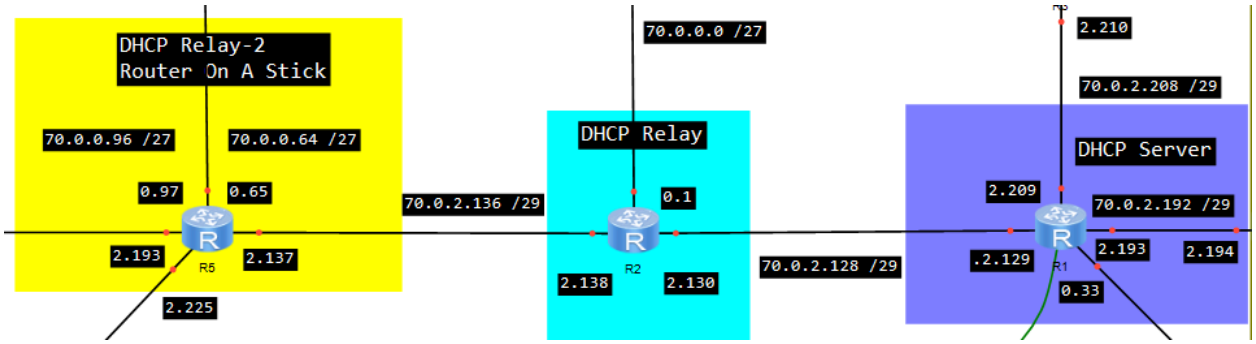


Configuration:

```
<DHCP Server>
<DHCP Server>display current configuration
#
sysname DHCP Server
#
dhcp enable
#
undo dhcp server trust option82
#
undo dhcp relay trust option82
#
ip pool 1
 gateway-list 70.0.0.1
 network 70.0.0.0 mask 255.255.255.224
 dns-list 1.1.1.1
#
ip pool 2
 gateway-list 70.0.0.33
 network 70.0.0.32 mask 255.255.255.224
 dns-list 1.1.1.1
```

DHCP-RELAY:

So now let's discuss the DHCP Relay. In our network topology we have multiple networks. The job of the DHCP Relay is to forward DHCP requests from clients in different subnets to the DHCP server, enabling IP address allocation across multiple network segments. So that is why we have created multiple DHCP Relays for effective Ip allocation. In our topology Routers R2, R5, R6 and R14 act as DHCP-Relay.



Configuration:

```
[DHCP Relay-Ethernet0/0/0]display this
#
interface Ethernet0/0/0
 ip address 70.0.0.1 255.255.255.224
 dhcp select relay
 dhcp relay server-ip 70.0.2.129
#
```

```
#
interface GigabitEthernet0/0/1.3
 dot1q termination vid 30
 ip address 70.0.0.65 255.255.255.224
 arp broadcast enable
 dhcp select relay
 dhcp relay server-ip 70.0.2.129
#
```

INTER VLAN COMMUNICATION USING VLANIF AND ROUTER ON A STICK:

Since the finance department and sales department communicate with each other frequently we wanted to have them on the same switch and have the Ip's assigned to them from the same Relay's but we wanted them to be on different networks to avoid any confusion or conflict. But

since they were on different network communication would become a bit difficult so that is why we used the concept of VLAN. Virtual Local Area Network or VLAN for short is a method of dividing the same physical network into multiple virtual networks. But implementing VLAN alone would not allow the sales and finance department to communicate with each other. That is why we also used the Router on a Stick concept. The Route on a Stick concept also known as ROAS is a network setup where a single router interfaces with multiple VLANs over a single physical link using sub-interfaces. Therefore DHCP-Relay 2 also known as R2 acts as the Router on a stick for our topology.

Configuration:

```
VID  Type    Ports
--------------------------------------------------------------------------------
1    common  UT:Eth0/0/9(D)      Eth0/0/10(D)     Eth0/0/11(D)     Eth0/0/12(D)
                Eth0/0/13(D)     Eth0/0/14(D)     Eth0/0/15(D)     Eth0/0/16(D)
                Eth0/0/17(D)     Eth0/0/18(D)     Eth0/0/19(D)     Eth0/0/20(D)
                Eth0/0/21(D)     Eth0/0/22(D)     GE0/0/1(D)       GE0/0/2(U)

20   common  UT:Eth0/0/1(U)      Eth0/0/2(U)      Eth0/0/3(U)      Eth0/0/4(U)

             TG:Eth0/0/9(D)      GE0/0/2(U)

30   common  UT:Eth0/0/5(U)      Eth0/0/6(U)      Eth0/0/7(U)      Eth0/0/8(U)

             TG:Eth0/0/9(D)      GE0/0/2(U)
```

```
#
interface GigabitEthernet0/0/1.2
 dot1q termination vid 20
 ip address 70.0.0.97 255.255.255.224
 arp broadcast enable
 dhcp select relay
 dhcp relay server-ip 70.0.2.129
#
```

The same logic was used for the IT Department where VLAN 50 would communicate with the database and VLAN 40 would communicate with the clients and the opposite would also be possible if needed. But in this department for achieving inter VLAN communication we used the switch as a layer 3 device and used the vlanif method for inter Vlan communication. We also used a trunk port for allowing packages with different Vlan Id to pass through the switch

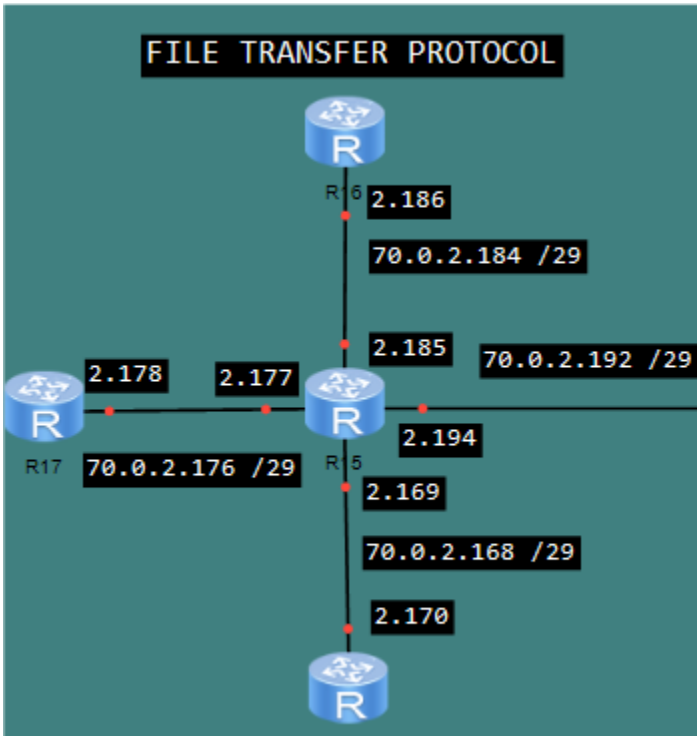
```
interface Vlanif40
 ip address 70.0.0.33 255.255.255.224
#
interface Vlanif50
 ip address 70.0.0.161 255.255.255.224
```

```
VID  Type    Ports
--------------------------------------------------------------------------------
1    common  UT:Eth0/0/10(U)     Eth0/0/11(D)     Eth0/0/12(D)     Eth0/0/13(D)
             Eth0/0/14(D)     Eth0/0/15(D)     Eth0/0/16(D)     Eth0/0/17(D)
             Eth0/0/18(D)     Eth0/0/19(D)     Eth0/0/20(D)     Eth0/0/21(D)
             Eth0/0/22(D)     GE0/0/1(D)       GE0/0/2(D)       Eth-Trunk1(U)

40   common  UT:Eth0/0/1(U)      Eth0/0/2(U)      Eth0/0/8(U)

             TG:Eth0/0/10(U)     Eth-Trunk1(U)

50   common  UT:Eth0/0/3(U)      Eth0/0/4(U)      Eth0/0/9(U)

             TG:Eth-Trunk1(U)
```

```
interface Ethernet0/0/1
 port link-type access
 port default vlan 40
#
interface Ethernet0/0/2
 port link-type access
 port default vlan 40
#
interface Ethernet0/0/3
 port link-type access
 port default vlan 50
#
interface Ethernet0/0/4
 port link-type access
 port default vlan 50
```

FILE TRANSFER PROTOCOL:

We also had to think of a method of sending files across the network therefore we used the File Transfer Protocol to accomplish this task. FTP (File Transfer Protocol) is a standard network protocol used to transfer files between a client and a server over a TCP/IP network. It uses the Client Server Architecture where the client logs onto the server and uploads from the client side or requests files from the server side. Therefore in our topology router R15 acts as the FTP Server while every other router acts as the FTP Client.



Configuration:

```
aaa
 authentication-scheme default
 authorization-scheme default
 accounting-scheme default
 domain default
 domain default_admin
 local-user admin password cipher ]pmv=Rk02~bL^B&WSBiQI1~#
 local-user admin service-type http
 local-user inshaal password cipher |JU(SqOpzCq\*_'WJ3#,I1~#
 local-user inshaal privilege level 3
 local-user inshaal service-type telnet
 local-user ftpserver password cipher `_>W4(RzRLbL^B&WSBiQI1~#
 local-user ftpserver privilege level 3
 local-user ftpserver ftp-directory flash:
 local-user ftpserver service-type ftp
```

TELNET:

Telnet is a network protocol used to provide a command-line interface for communication with a remote device or server over a TCP/IP network. This allows users to configure devices remotely without having to change their locations to configure a specific router and that is why we have configured telnet on all of our routers.

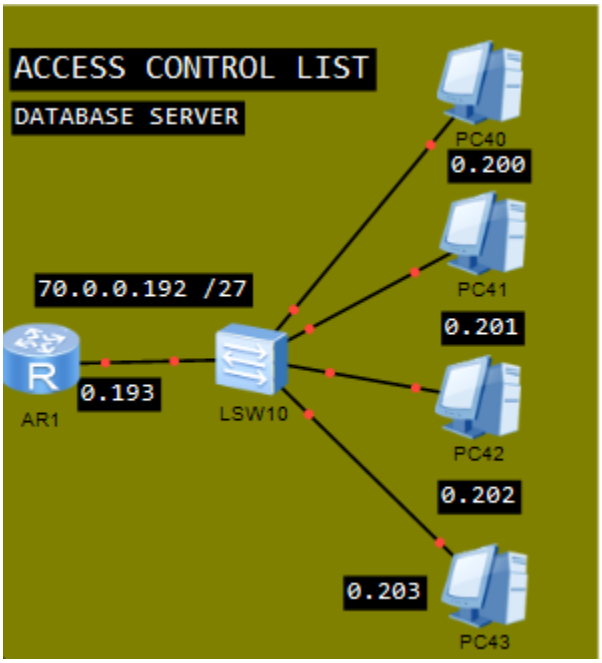
Configuration:

```
aaa
 authentication-scheme default
 authorization-scheme default
 accounting-scheme default
 domain default
 domain default_admin
 local-user admin password cipher "I.HG>~xuE;BH^68NhwOC2m#
 local-user admin service-type http
 local-user inshaal password cipher 63SnE%eV93.GCx={b4X'C2m#
 local-user inshaal privilege level 3
 local-user inshaal service-type telnet
```

```
user-interface con 0
user-interface vty 0 4
 authentication-mode aaa
user-interface vty 16 20
#
```

ACCESS CONTROL LIST:

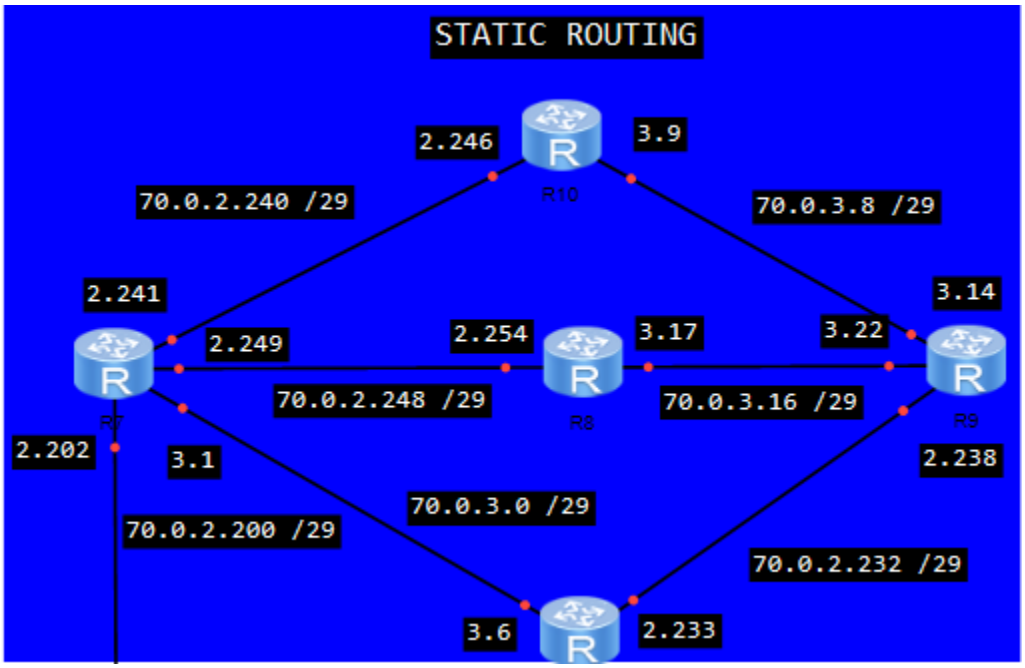
Access Control List (ACL) is a set of rules used to control network traffic and restrict access to resources by specifying which users or system processes can access certain network services and resources. Since we have created a database department we wanted to make sure that except the IT Department no one else could access the database server. And to implement this we used Access Control List also known as ACL as well as AR Routers.




```
acl number 2000
 rule 5 permit source 70.0.0.32 0.0.0.31
 rule 10 deny source 70.0.0.0 0.0.0.31
 rule 15 permit source 70.0.0.160 0.0.0.31
 rule 20 deny source 70.0.0.96 0.0.0.31
 rule 25 deny source 70.0.0.64 0.0.0.31
 rule 30 deny source 70.0.0.128 0.0.0.31
```

STATIC AND DYNAMIC ROUTING:

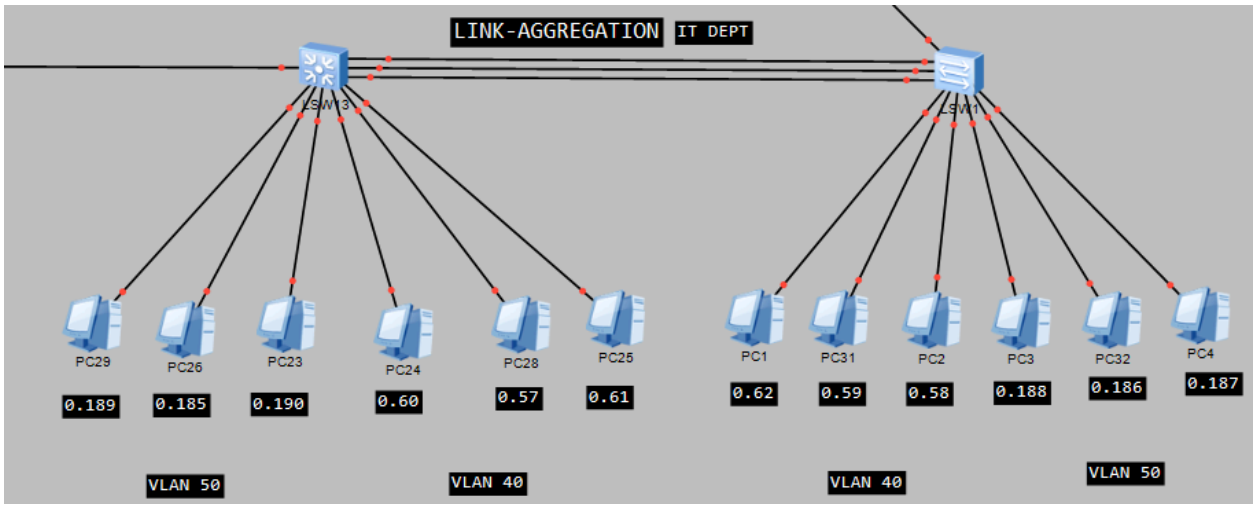
Since we needed routing information of all routers we used the static and dynamic routing protocols. In static routing we have to define each route and next hop address for each specific router. That is why we used Static Routing in our DHCP Relays. Now since RIP (Routing Information Protocol) does not work on subnet networks we could only use RIP if it was required.




```
rip 1
 version 2
 network 70.0.0.0
#
ip route-static 70.0.0.64 255.255.255.224 70.0.2.137
ip route-static 70.0.0.96 255.255.255.224 70.0.2.137
ip route-static 70.0.0.128 255.255.255.224 70.0.2.218
ip route-static 70.0.0.160 255.255.255.224 70.0.2.226
ip route-static 70.0.0.192 255.255.255.224 70.0.2.129
ip route-static 70.0.2.216 255.255.255.248 70.0.2.226
ip route-static 70.0.2.224 255.255.255.248 70.0.2.137
```

LINK AGGREGATION:

Link Aggregation is a technique used to combine multiple network connections into a single logical link, increasing bandwidth and providing redundancy. This improves network performance and reliability by balancing the traffic load across the aggregated links and maintaining connectivity if one link fails.Since our IT department was our most important department we had to take extra measures to make sure that there were no disturbances or network issues therefore we used the Link Aggregation Method to take care of these issues.



Configuration:

```
interface Eth-Trunk1
 port link-type trunk
 port trunk allow-pass vlan 40 50
#
```

```
#
interface Ethernet0/0/5
 eth-trunk 1
#
interface Ethernet0/0/6
 eth-trunk 1
#
interface Ethernet0/0/7
 eth-trunk 1
```

SPANNING TREE PROTOCOL:

Spanning Tree Protocol is a network protocol that ensures a loop-free topology in Ethernet networks. It prevents the formation of network loops that can cause broadcast storms and network failures. In this project, STP has been implemented to provide redundancy and maintain a stable environment within the Marketing Department only.