



# East West University

**Course Title:** Computer Networks

**Course Code:** Cse405

**Section:** 1

**Semester:** Fall 2022

Report on

## A Full-fledged Network of an Organization with Multiple Subnet

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## Problem Statement:

University of Scholars, is an enterprise like East West University, owns many computers, with a complex network infrastructure. Apart from wired internet access to all classrooms, labs, employee PCs, library and other administrative and academic wings, the university also provides wireless internet access for every campus. On top of that the university runs complex networked systems to support several of its business processes like admissions, advising, results, eTender, library management, accounts and so on.

This complex network infrastructure is subnetter and switching/routing mechanisms are in practice.

## Tasks:

Your task is to create a complete model of a complex network by discovering the interconnectivity of the systems and subnetworks, which will reflect the University's structure and facilities, features within the network will include the followings:

- Web page of the university will reflect the University of Professionals' web page.
- A single DNS server needs to be installed to locate web server - meaning people will browse University's website with the following address: <http://www.scholars.edu.bd>
- Configure the whole network in such a way that IP for the hosts of different campuses will be automatically assigned by a single DHCP server. If a single DHCP is not doable by you, then use multiple DHCP servers; however, that will be discredited.
- Among the hosts in a network make sure some wireless hosts are added in addition to wired hosts.
- University's full network has covered its seven campuses with seven routers; Connections between the campus routers are given at figure 0; you will have to follow the exact topology.
- Connectivity between all the hosts needs to be established.

While designing, keep the issue of future expansion/ growth in mind for each of the subnets (if required) and preserve spaces. In the physical design, it is a good practice to have a server room where all the servers are located in one LAN segment.

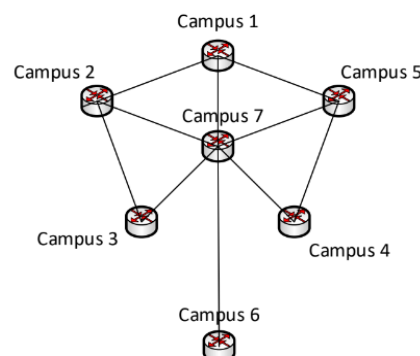


Figure 0: topology of the campuses

## Implementation:

## Requirements:

Software used for this simulation is 'cisco packet tracer'.

Number of components used is given below.

- 20 routers
- 48 switches
- 7 wireless access points
- 132 end devices
- 3 servers (DHCP, DNS, WEB)

## Specifications:

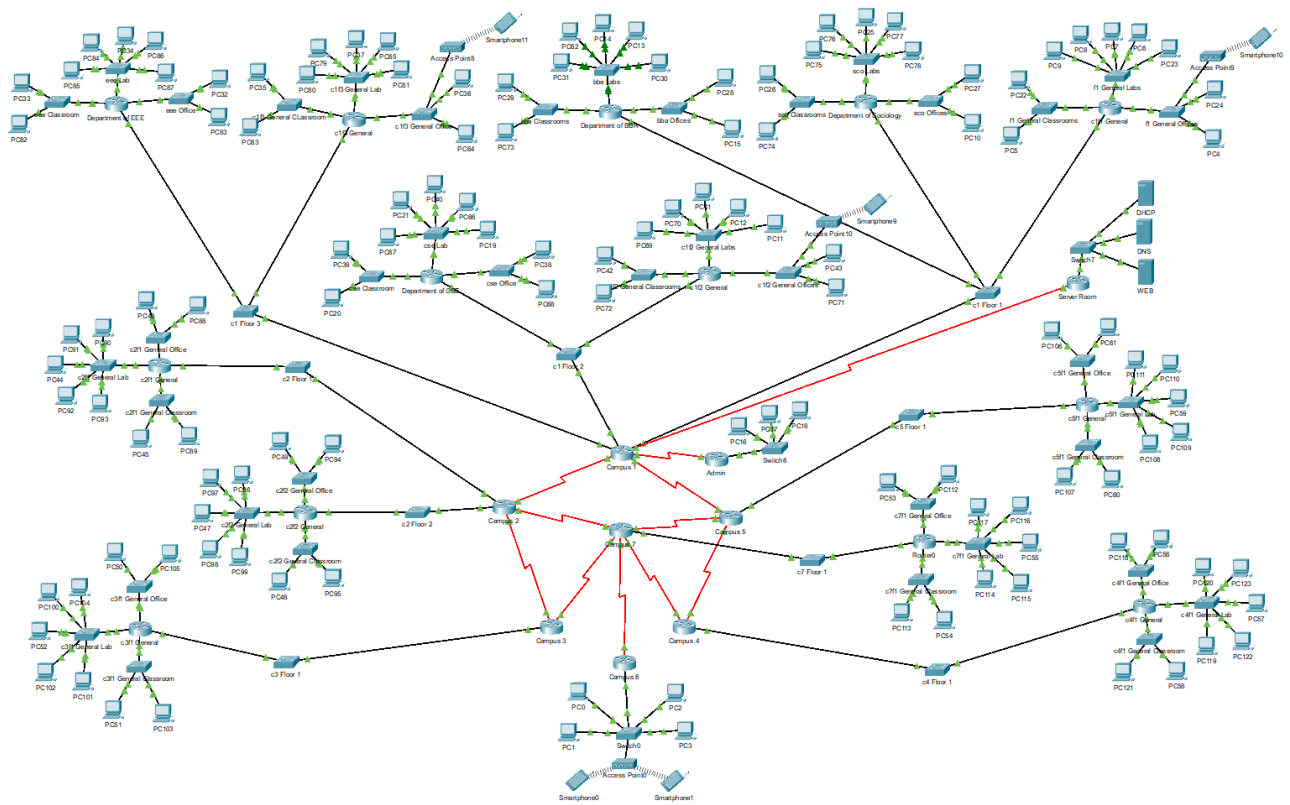


Figure 1: Demo Design of the entire network of University of Scholars.

In my implementation Campus 1 is assumed to be the main campus. Campus 2, 3, 4, 5 and 7 follows the same structure as Campus 1. Campus 6 is assumed to have the library and common rooms etc. Core parts such as the admin sector and server room are kept under main campus.

## IP and Subnetting Scheme:

Campus 1,2,3,4,5,7:

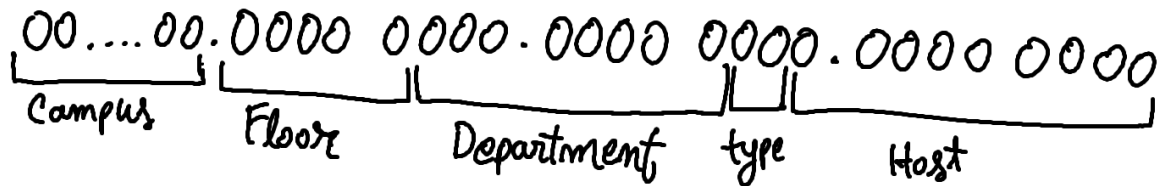


Figure 2: separated bits for subnetting

Class 'A' IP is used. The network bit is used for identifying campuses. Next 15 bits are used for subnetting.

Among them, the first 5 bits identify the floor number. So there can be approximately  $2^5$  or 32 floors in each campus. In the given demo, up to 3 floors are shown in a single campus.

Next 8 bits are used to identify departments. There can be at most  $2^8$  or 256 departments. There are 4 shown here. In each floor, 1111 1111 is used for general rooms that don't fall under any departments. Note: even though department bits can be duplicated if under different floors/ campuses, it is encouraged to keep them completely unique. I.e. if there's a department with id 0000 1010, there shouldn't be another one in a different subnet/ network even though the network will allow it.

Next 2 bits are used as flags to identify the type of room. 01, 10 and 11 refers to office, class and lab rooms respectively.

Remaining 9 bits are used for hosts. So there can be at most  $2^9$  or 512 hosts in each subnet.

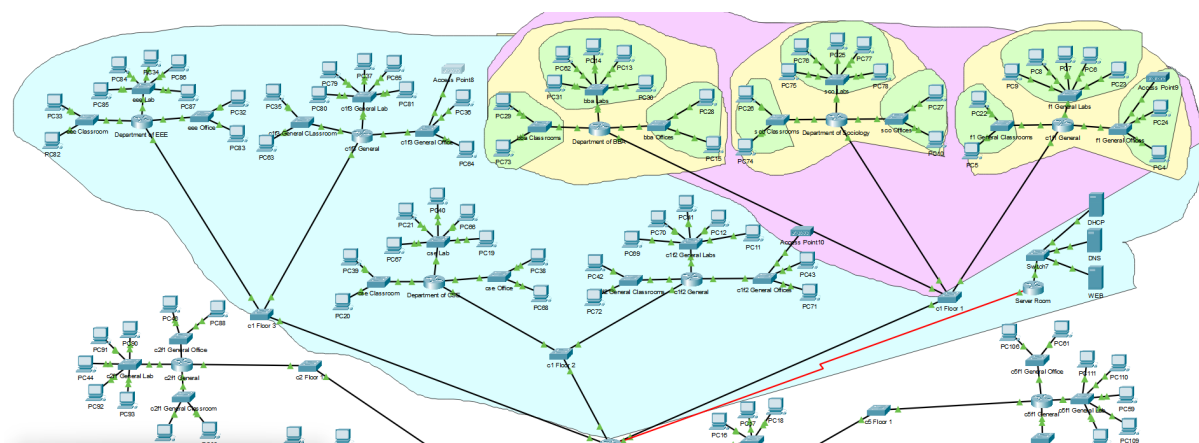


Figure 3: basic structure of a single floor of a campus with two departments.

Even though no departments are shown in the other campuses, the options are there if the need ever arises to open branches or departments in other campuses.

## Campus 6:

Class 'B' IP is used for campus 6 as it is only used as a common room for students. There is no subnetting either.

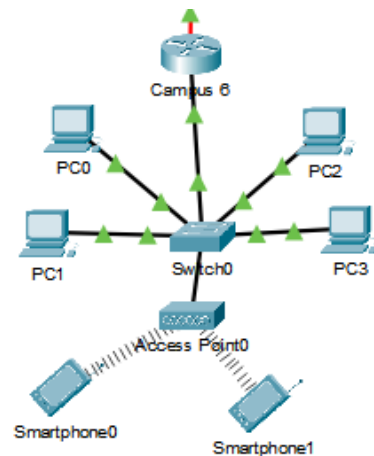


Figure 4: campus 6

## Admin and Server room:

Admin and server rooms are kept under the main campus. Server room consists of 3 servers, DHCP, DNS and WEB. A single DHCP and DNS servers are used for the entire university.

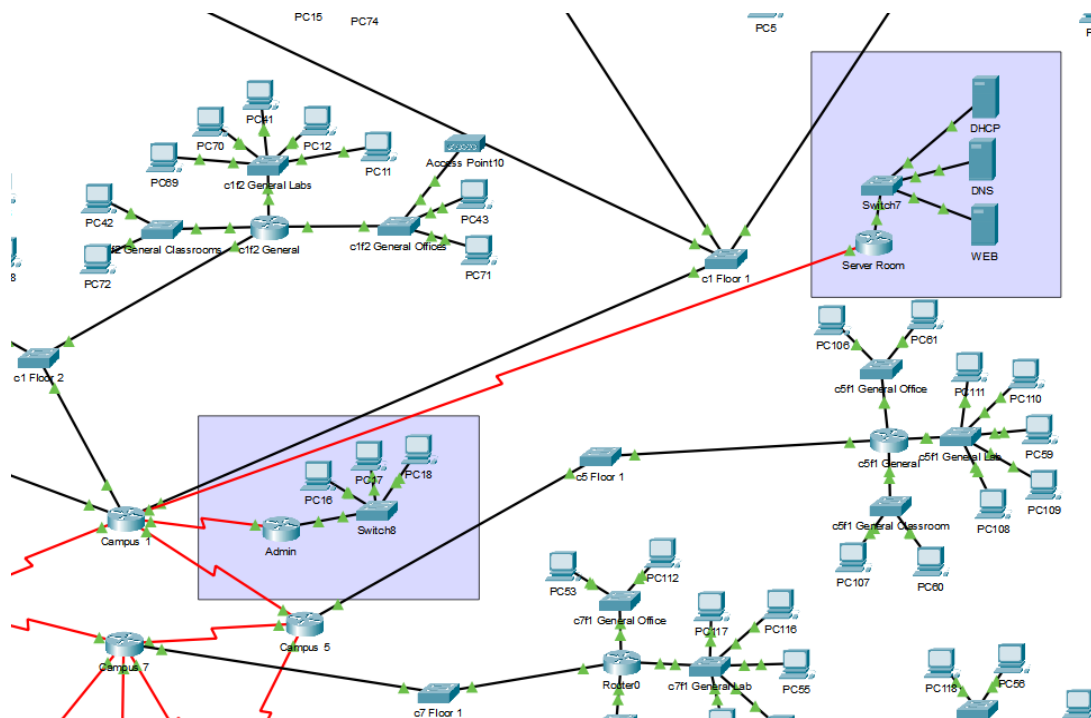


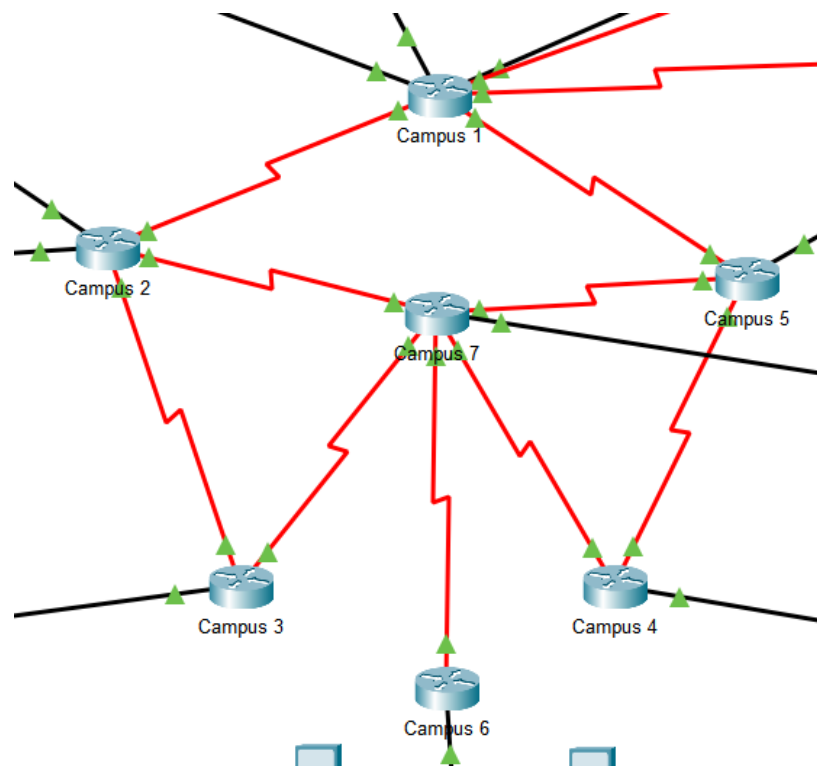
Figure 5: Server rooms

## Interconnectivity of Campuses:

Class 'C' IP is used for interconnectivity between the campuses. The ip scheme is as follows,

***192.<start>.<end>.0***

So if the connection is between campus 1 and 2, and their network IP is 192.1.2.0; it means the connection is from campus 1 to 2 and the clock pulse is at campus 1.



*Figure 6: Connection between the campuses*

## Router Configuration Code:

Campus 1:

```
interface se0/0
```

```
ip address 192.1.2.1 255.255.255.0
```

```
clock rate 64000
```

no shut

do wr

exit

interface se1/0

ip address 192.1.5.1 255.255.255.0

clock rate 64000

no shut

do wr

exit

interface se2/0

ip address 1.248.0.1 255.255.254.0

clock rate 64000

no shut

do wr

exit

interface se3/0

ip address 1.240.0.1 255.255.254.0

clock rate 64000

no shut

do wr

exit

interface fa4/0



```
ip address 1.8.0.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface fa5/0
```

```
ip address 1.16.0.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface fa6/0
```

```
ip address 1.24.0.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
router ospf 1
```

```
network 1.0.0.0 0.0.1.255 area 1
```

```
network 192.1.2.0 0.0.0.255 area 1
```

```
network 192.1.5.0 0.0.0.255 area 1
```

```
exit
```

## Campus 2:

```
interface se0/0
```

```
ip address 192.1.2.2 255.255.255.0
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface se1/0
```

```
ip address 192.2.3.1 255.255.255.0
```

```
clock rate 64000
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface se2/0
```

```
ip address 1.7.2.2 255.255.254.0
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface fa8/0
```

```
ip address 2.8.0.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface fa9/0

ip address 2.16.0.1 255.255.254.0

ip helper-address 1.255.253.254

no shut

do wr

exit
```

```
router ospf 2

network 2.0.0.0 0.0.1.255 area 1

network 192.1.2.0 0.0.0.255 area 1

network 192.2.3.0 0.0.0.255 area 1

network 192.7.2.0 0.0.0.255 area 1

exit
```

### Campus 3:

```
interface se0/0

ip address 192.2.3.2 255.255.255.0

no shut

do wr

exit
```

```
interface se1/0

ip address 192.7.3.2 255.255.255.0

no shut

do wr
```

```
exit
```

```
interface fa9/0
```

```
ip address 3.8.0.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
router ospf 3
```

```
network 3.0.0.0 0.0.1.255 area 1
```

```
network 192.7.3.0 0.0.0.255 area 1
```

```
network 192.2.3.0 0.0.0.255 area 1
```

```
exit
```

## Campus 4:

```
interface se0/0
```

```
ip address 192.5.4.2 255.255.255.0
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface se1/0
```

```
ip address 192.7.4.2 255.255.255.0
```

```
no shut
```

```
do wr
```

exit

interface fa8/0

ip address 4.8.0.1 255.255.254.0

ip helper-address 1.255.253.254

no shut

do wr

exit

router ospf 4

network 4.0.0.0 0.0.1.255 area 1

network 192.5.4.0 0.0.0.255 area 1

network 192.7.4.0 0.0.0.255 area 1

exit

## Campus 5:

interface se0/0

ip address 192.1.5.2 255.255.255.0

no shut

do wr

exit

interface se1/0

ip address 192.5.4.1 255.255.255.0

clock rate 64000

no shut

```
do wr
```

```
exit
```

```
interface se2/0
```

```
ip address 1.7.5.2 255.255.254.0
```

```
clock rate 64000
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface fa8/0
```

```
ip address 5.8.0.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
router ospf 5
```

```
network 5.0.0.0 0.0.1.255 area 1
```

```
network 192.1.5.0 0.0.0.255 area 1
```

```
network 192.5.4.0 0.0.0.255 area 1
```

```
network 192.7.5.0 0.0.0.255 area 1
```

```
exit
```

Campus 6:

```
interface fa0/0
```

```
ip address 169.169.0.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface se2/0
```

```
ip address 192.7.6.2 255.255.254.0
```

```
no shut
```

```
do wr
```

```
exit
```

```
router ospf 6
```

```
network 6.0.0.0 0.0.1.255 area 1
```

```
network 192.7.6.0 0.0.0.255 area 1
```

```
exit
```

## Campus 7:

```
interface se0/0
```

```
ip address 192.7.2.1 255.255.255.0
```

```
clock rate 64000
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface se1/0
```

```
ip address 192.7.3.1 255.255.255.0
```

```
clock rate 64000
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface se2/0
```

```
ip address 1.7.5.1 255.255.254.0
```

```
clock rate 64000
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface se3/0
```

```
ip address 1.7.4.1 255.255.254.0
```

```
clock rate 64000
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface se4/0
```

```
ip address 1.7.6.1 255.255.254.0
```

```
clock rate 64000
```

```
no shut
```

```
do wr
```

```
exit
```



```
interface fa7/0

ip address 7.8.0.1 255.255.254.0

ip helper-address 1.255.253.254

no shut

do wr

exit
```

```
router ospf 7

network 7.0.0.0 0.0.1.255 area 1

network 192.7.2.0 0.0.0.255 area 1

network 192.7.3.0 0.0.0.255 area 1

network 192.7.5.0 0.0.0.255 area 1

network 192.7.4.0 0.0.0.255 area 1

network 192.7.6.0 0.0.0.255 area 1

exit
```

### c1f1 General:

```
interface fa0/0

ip address 1.8.0.2 255.255.254.0

ip helper-address 1.255.253.254

no shut

do wr

exit
```

```
interface fa1/0
```

```
ip address 1.15.250.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface fa4/0
```

```
ip address 1.15.252.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface fa5/0
```

```
ip address 1.15.254.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
router ospf 8
```

```
network 1.0.0.0 0.0.1.255 area 1
```

```
exit
```

c1f2 General:

```
interface fa0/0
```

```
ip address 1.16.0.2 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface fa1/0
```

```
ip address 1.23.250.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface fa6/0
```

```
ip address 1.23.252.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface fa7/0
```

```
ip address 1.23.254.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
router ospf 9  
network 1.0.0.0 0.0.1.255 area 1  
exit
```

### c1f3 General:

```
interface fa0/0  
ip address 1.24.0.2 255.255.254.0  
ip helper-address 1.255.253.254  
no shut  
do wr  
exit
```

```
interface fa1/0  
ip address 2.31.250.1 255.255.254.0  
ip helper-address 1.255.253.254  
no shut  
do wr  
exit
```

```
interface fa6/0  
ip address 2.31.252.1 255.255.254.0  
ip helper-address 1.255.253.254  
no shut  
do wr  
exit
```

```
interface fa7/0

ip address 2.31.254.1 255.255.254.0

ip helper-address 1.255.253.254

no shut

do wr

exit
```

```
router ospf 10

network 1.0.0.0 0.0.1.255 area 1

exit
```

#### c2f1 General:

```
interface fa0/0

ip address 2.8.0.2 255.255.254.0

ip helper-address 1.255.253.254

no shut

do wr

exit
```

```
interface fa1/0

ip address 2.15.250.1 255.255.254.0

ip helper-address 1.255.253.254

no shut

do wr

exit
```

```
interface fa6/0

ip address 2.15.252.1 255.255.254.0

ip helper-address 1.255.253.254

no shut

do wr

exit
```

```
interface fa7/0

ip address 2.15.254.1 255.255.254.0

ip helper-address 1.255.253.254

no shut

do wr

exit
```

```
router ospf 11

network 2.0.0.0 0.0.1.255 area 1

exit
```

## c2f2 General:

```
interface fa0/0

ip address 2.16.0.2 255.255.254.0

ip helper-address 1.255.253.254

no shut

do wr

exit
```

```
interface fa1/0

ip address 2.23.250.1 255.255.254.0

ip helper-address 1.255.253.254

no shut

do wr

exit
```

```
interface fa6/0

ip address 2.23.252.1 255.255.254.0

ip helper-address 1.255.253.254

no shut

do wr

exit
```

```
interface fa7/0

ip address 2.23.254.1 255.255.254.0

ip helper-address 1.255.253.254

no shut

do wr

exit
```

```
router ospf 12

network 2.0.0.0 0.0.1.255 area 1

exit
```

## c3f1 General:

```
interface fa0/0
```

```
ip address 3.8.0.2 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface fa1/0
```

```
ip address 3.15.250.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface fa6/0
```

```
ip address 3.15.252.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface fa7/0
```

```
ip address 3.15.254.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```



do wr

exit

router ospf 13

network 3.0.0.0 0.0.1.255 area 1

exit

c4f1 General:

interface fa0/0

ip address 4.8.0.2 255.255.254.0

ip helper-address 1.255.253.254

no shut

do wr

exit

interface fa1/0

ip address 4.15.250.1 255.255.254.0

ip helper-address 1.255.253.254

no shut

do wr

exit

interface fa6/0

ip address 4.15.252.1 255.255.254.0

ip helper-address 1.255.253.254

no shut

do wr

exit

interface fa7/0

ip address 4.15.254.1 255.255.254.0

ip helper-address 1.255.253.254

no shut

do wr

exit

router ospf 14

network 4.0.0.0 0.0.1.255 area 1

exit

c5f1 General:

interface fa0/0

ip address 5.8.0.2 255.255.254.0

ip helper-address 1.255.253.254

no shut

do wr

exit

interface fa1/0

ip address 5.15.250.1 255.255.254.0

ip helper-address 1.255.253.254

no shut

```
do wr
```

```
exit
```

```
interface fa6/0
```

```
ip address 5.15.252.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface fa7/0
```

```
ip address 5.15.254.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
router ospf 15
```

```
network 5.0.0.0 0.0.1.255 area 1
```

```
exit
```

c7f1 General:

```
interface fa0/0
```

```
ip address 7.8.0.2 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

do wr

exit

interface fa1/0

ip address 7.15.250.1 255.255.254.0

ip helper-address 1.255.253.254

no shut

do wr

exit

interface fa6/0

ip address 7.15.252.1 255.255.254.0

ip helper-address 1.255.253.254

no shut

do wr

exit

interface fa7/0

ip address 7.15.254.1 255.255.254.0

ip helper-address 1.255.253.254

no shut

do wr

exit

router ospf 16

network 7.0.0.0 0.0.1.255 area 1

exit

## Department of Sociology:

interface fa0/0

ip address 1.8.0.3 255.255.254.0

ip helper-address 1.255.253.254

no shut

do wr

exit

interface fa1/0

ip address 1.8.14.1 255.255.254.0

ip helper-address 1.255.253.254

no shut

do wr

exit

interface fa6/0

ip address 1.8.12.1 255.255.254.0

ip helper-address 1.255.253.254

no shut

do wr

exit

interface fa7/0

ip address 1.8.10.1 255.255.254.0

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
router ospf 17
```

```
network 1.0.0.0 0.0.1.255 area 1
```

```
exit
```

## Department of BBA:

```
interface fa0/0
```

```
ip address 1.8.0.4 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface fa1/0
```

```
ip address 1.8.18.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface fa6/0
```

```
ip address 1.8.20.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface fa7/0
```

```
ip address 1.8.22.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
router ospf 18
```

```
network 1.0.0.0 0.0.1.255 area 1
```

```
exit
```

Department of CSE:

```
interface fa0/0
```

```
ip address 1.16.0.3 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface fa1/0
```

```
ip address 1.16.26.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface fa6/0
```

```
ip address 1.16.28.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface fa7/0
```

```
ip address 1.16.30.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
router ospf 19
```

```
network 1.0.0.0 0.0.1.255 area 1
```

```
exit
```

Department of EEE:

```
interface fa0/0
```

```
ip address 1.24.0.3 255.255.254.0
```



```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface fa1/0
```

```
ip address 1.24.34.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface fa6/0
```

```
ip address 1.24.36.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface fa7/0
```

```
ip address 1.24.38.1 255.255.254.0
```

```
ip helper-address 1.255.253.254
```

```
no shut
```

```
do wr
```

```
exit
```

```
router ospf 20
```

```
network 1.0.0.0 0.0.1.255 area 1
```

```
exit
```

## Limitations:

- The most glaring issue in the network is the limitations on the number of end devices, especially on the number of possible devices in the lab section. Solvable by using ipv6 protocol
- Even though we can identify that a device is from the lab/ office/ class of a floor/ department, we can't pinpoint the exact room.
- Routers sometimes can't seem to find their ways though that might be more of an issue with the *Cisco packet tracer* software than the routing algorithm.