East West University

CSE405

Computer Networks

Project Report

Design of a Full-Fledged Network with Multiple Subnets

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Title:

Design a full-fledged network for an organization with multiple subnets.

Preface:

With seven campuses, the University of Scholars needs a robust network infrastructure to support its academic and administrative operations. Wired and wireless connectivity, centralized DHCP and DNS services, secure routing with OSPF, and scalability for future expansion are all goals of the network design. On top of that the university runs a complex networked systems to support several of its business process like admissions, advising, results, eTender, library management, accounts and so on.

Objective:

The major objective was to build a complete model of a complicated network by figuring out how the systems and sub-networks connected to each other, representing the architecture and resources of the University of Professionals.

Additionally, a website for the University of Professionals was to be created and could be accessed at http://www.Professionals.edu. In order to access the network, a wireless access point was also provided to each campus.

Physical Diagram:

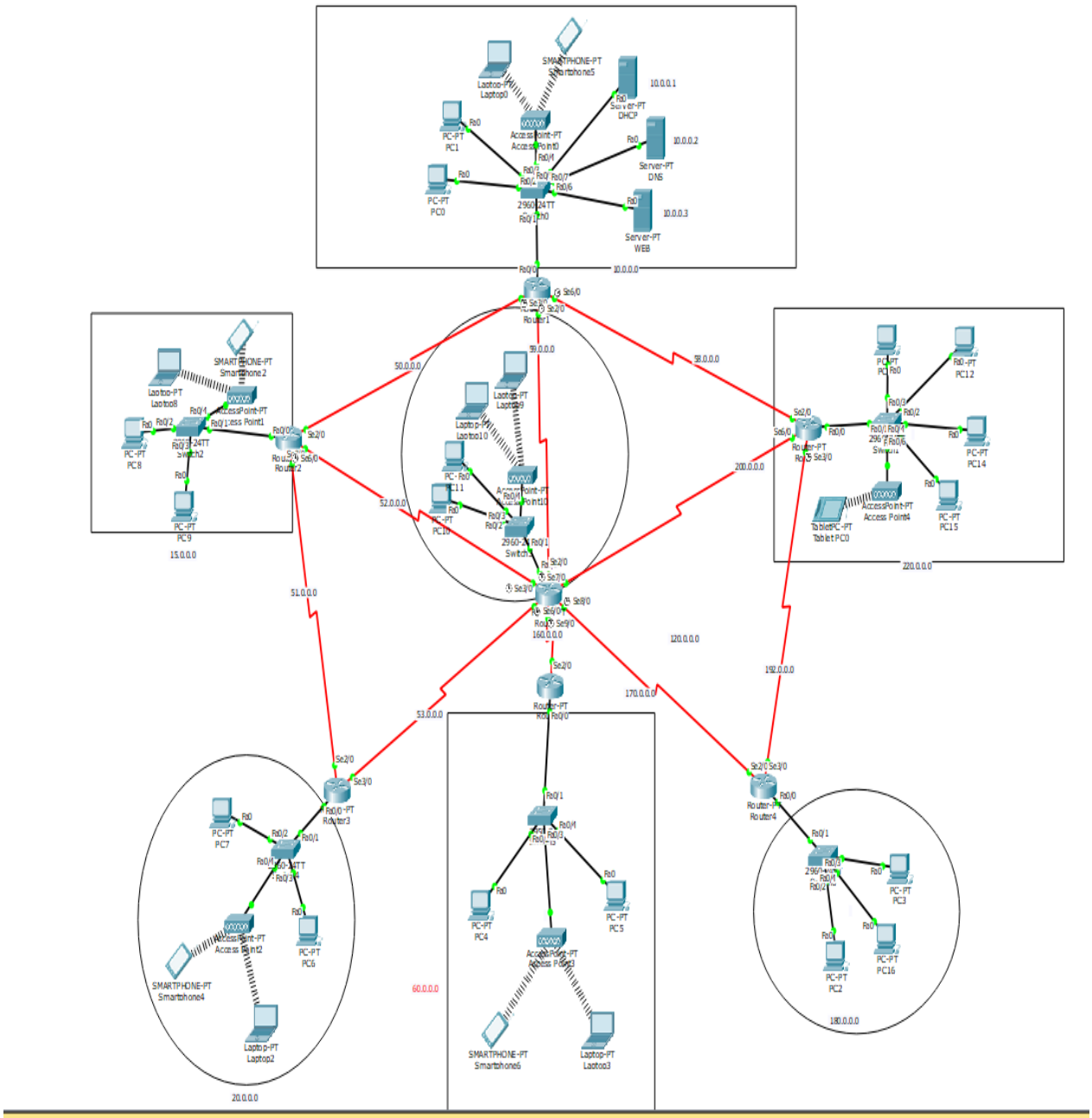

Figure: Diagram of a Full-Fledged Network with Multiple Subnet

Design Details:

In Cisco Packet Tracer, the network design was put into practice. To include all 7 campuses, campus 1 is also used as a server room, housing the DNS, DHCP, and Web servers. The router network was heptagonal. In order to offer backup routes in the event that one or more of the routers fail, two of the heptagon's diagonal lines were also connected. Two sub-nets were given to each school in order to separate the administration PCs from the student PCs. Each campus has a wireless Access Point that allows other devices to connect to the network wirelessly.

The Network elements used in the project were:

1. PCs
2. Routers
3. Switches
4. Servers (DNS, DHCP, WEB)
5. Straight Through Cable and Serial DCE
6. Smart Phones
7. Laptops
8. Wireless Access points

Design Criteria and Explanation

Subnetting Scheme

The network is divided into several subnets to efficiently manage IP addresses and ensure security. Each campus has its subnet, and further subnets are allocated for specific purposes like classrooms, labs, employee PCs, and library.

DHCP Server Configuration

A single DHCP server is configured to provide automatic IP address assignment to hosts in different campuses. This ensures ease of management and efficient IP allocation. Failover mechanisms may be implemented for redundancy.

DNS Server Configuration

A single DNS server is deployed to resolve the university's website (http://www.scholars.edu.bd) from any campus. This DNS server is responsible for name resolution within the university's network.

Wireless Access Points

Wireless access points (WAPs) are strategically placed across the campuses to provide wireless internet access to both students and staff. These WAPs are integrated into the existing subnets.

Campus Routers and Topology

Seven routers, one for each campus, are interconnected according to the provided topology. This ensures seamless communication between campuses and enables efficient routing.

Host Connectivity

Hosts in each subnet, including wired and wireless devices, are connected through switches. VLANs are configured to separate wireless and wired traffic for security and management purposes.

Dynamic Routing with OSPF

Open Shortest Path First (OSPF) is implemented as the dynamic routing protocol to ensure efficient routing within the university's network. OSPF enables routers to discover the network topology and calculate the best paths.

Server Room Design

A centralized server room is established to house critical servers, such as the DHCP server, DNS server, and application servers. This enhances security and simplifies maintenance.

Future Expansion Considerations

The design allows for future expansion by reserving IP address ranges and subnets for additional campuses or services. The network design is modular, making it easy to scale as the university grows. In each of the campuses, the host PCs received their IP addresses dynamically through the single DHCP server. The hosts also received information about the DNS server through the DHCP.

Thus, the entire network was properly connected and communications between any devices in the complex network was established.

Network Limitations

While the designed network is robust, there are certain limitations to consider:

- Bandwidth and traffic congestion: As the university's network traffic grows, bandwidth management and QoS policies may be needed to prevent congestion.
- Security: Additional security measures, such as firewalls and intrusion detection systems, may be required to protect against cyber threats.
- Redundancy: While redundancy is considered, a full disaster recovery plan should be developed for critical systems.
- Maintenance: Network administrators should have the necessary skills and training to manage and troubleshoot the complex network.

Configuration Details

Router configurations:

Router 1

```
interface fa0/0
ip address 10.0.0.254 255.0.0.0
no shut
do wr
exit

interface se3/0
ip address 50.0.0.1 255.0.0.0
clock rate 64000
no shut
do wr
exit

interface se6/0
ip address 58.0.0.2 255.0.0.0
clock rate 64000
no shut
do wr
exit

interface se2/0
ip address 59.0.0.1 255.0.0.0
no shut
do wr
exit
```

Router 2

```
interface fa0/0
ip address 150.0.0.254 255.0.0.0
no shut
do wr
exit

interface se3/0
ip address 51.0.0.1 255.0.0.0
clock rate 64000
no shut
do wr
exit

interface se6/0
ip address 52.0.0.1 255.0.0.0
clock rate 64000
no shut
do wr
exit

interface se2/0
ip address 50.0.0.2 255.0.0.0
no shut
do wr
exit
```

Router 3

```
interface fa0/0
ip address 20.0.0.254 255.255.0.0
no shut
do wr
exit

interface se2/0
ip address 51.0.0.2 255.255.0.0
no shut
do wr
exit

interface se3/0
ip address 53.0.0.1 255.255.255.0
no shut
do wr
exit
```

Router 4

```
interface fa0/0
ip address 180.0.0.254 255.255.0.0
no shut
do wr
exit

interface se2/0
ip address 170.0.0.1 255.255.0.0
no shut
do wr
exit

interface se3/0
ip address 192.0.0.1 255.255.255.0
no shut
do wr
exit
```

Router 5

```
interface fa0/0
ip address 220.0.0.254 255.255.255.0
no shut
do wr
exit

interface se2/0
ip address 58.0.0.5 255.0.0.0
no shut
do wr
exit

interface se3/0
ip address 192.0.0.5 255.255.255.0
clock rate 64000
no shut
do wr
exit

interface se6/0
ip address 200.0.0.1 255.255.255.0
no shut
do wr
exit
```

Router 6

```
interface fa0/0
ip address 60.0.0.254 255.0.0.0
no shut
do wr
exit

interface se2/0
ip address 160.0.0.1 255.255.0.0
no shut
do wr
exit
```

Router 7

```
interface fa0/0
ip address 120.0.0.254 255.0.0.0
no shut
do wr
exit

interface se2/0
ip address 59.0.0.5 255.0.0.0
clock rate 64000
no shut
do wr
exit

interface se3/0
ip address 52.0.0.5 255.0.0.0
clock rate 64000
no shut
do wr
exit

interface se6/0
ip address 53.0.0.5 255.0.0.0
clock rate 64000
no shut
do wr
exit

interface se9/0
ip address 160.0.0.6 255.255.0.0
clock rate 64000
no shut
do wr
exit

interface se8/0
ip address 170.0.0.6 255.255.0.0
clock rate 64000
no shut
do wr
exit

interface se7/0
ip address 200.0.0.6 255.255.255.0
clock rate 64000
no shut
do wr
exit
```

Routing Tables:

Router 1 routing table

router ospf 1
network 10.0.0.0 0.255.255.255 area 1
network 50.0.0.0 0.255.255.255 area 1
network 59.0.0.0 0.255.255.255 area 1
network 58.0.0.0 0.255.255.255 area 1
exit

Router 2 routing table

router ospf 2
network 15.0.0.0 0.255.255.255 area 1
network 50.0.0.0 0.255.255.255 area 1
network 52.0.0.0 0.255.255.255 area 1
network 51.0.0.0 0.255.255.255 area 1
exit

Router 3 routing table

router ospf 3
network 20.0.0.0 0.255.255.255 area 1
network 51.0.0.0 0.255.255.255 area 1
network 53.0.0.0 0.255.255.255 area 1
exit

Router 4 routing table

router ospf 4
network 180.0.0.0 0.255.255.255 area 1
network 170.0.0.0 0.255.255.255 area 1
network 192.0.0.0 0.255.255.255 area 1
exit

Router 5 routing table

router ospf 5
network 220.0.0.0 0.255.255.255 area 1
network 192.0.0.0 0.255.255.255 area 1
network 200.0.0.0 0.255.255.255 area 1
network 58.0.0.0 0.255.255.255 area 1
exit

Router 6 routing table

router ospf 6
network 60.0.0.0 0.255.255.255 area 1
network 160.0.0.0 0.255.255.255 area 1
exit

Router 7 routing table

router ospf 7
network 59.0.0.0 0.255.255.255 area 1
network 52.0.0.0 0.255.255.255 area 1
network 53.0.0.0 0.255.255.255 area 1
network 160.0.0.0 0.255.255.255 area 1
network 170.0.0.0 0.255.255.255 area 1
network 200.0.0.0 0.255.255.255 area 1
network 120.0.0.0 0.255.255.255 area 1
exit

DHCP configurations:

Router 1

ip dhcp pool serverPool
network 10.0.0.0 255.0.0.0
default-router 10.0.0.254
dns-server 10.0.0.2
exit

Router 2

ip dhcp pool serverPool
network 15.0.0.0 255.0.0.0
default-router 10.0.0.254
dns-server 10.0.0.2
exit

Router 3

ip dhcp pool serverPool
network 20.0.0.0 255.0.0.0
default-router 10.0.0.254
dns-server 10.0.0.2
exit

Router 4

ip dhcp pool serverPool
network 180.0.0.0 255.255.0.0
default-router 10.0.0.254
dns-server 10.0.0.2
exit

Router 5

ip dhcp pool serverPool
network 220.0.0.0 255.255.255.0
default-router 10.0.0.254
dns-server 10.0.0.2
exit

Router 6

ip dhcp pool serverPool
network 60.0.0.0 255.0.0.0
default-router 10.0.0.254
dns-server 10.0.0.2
exit

Router 7

ip dhcp pool serverPool
network 120.0.0.0 255.0.0.0
default-router 10.0.0.254
dns-server 10.0.0.2
exit

Screenshots:

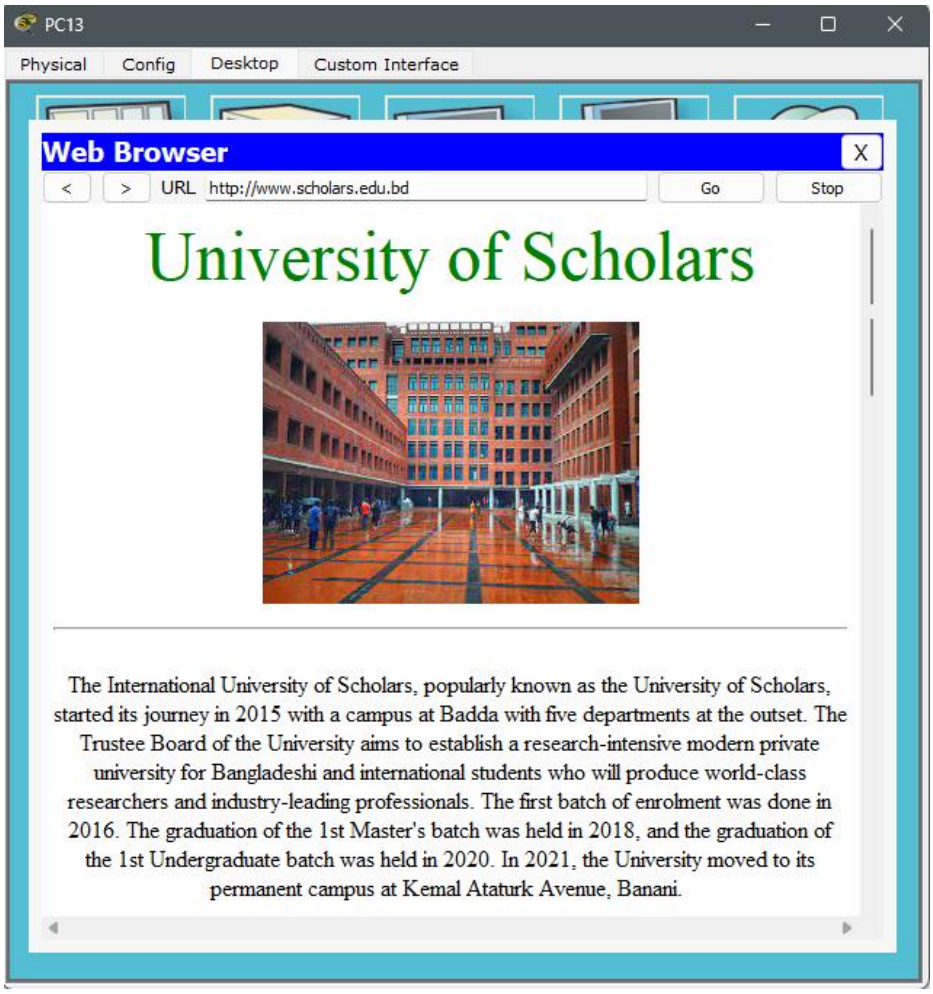

Figure: University of professionals is accessed by Campus2-PC13 host through the web server

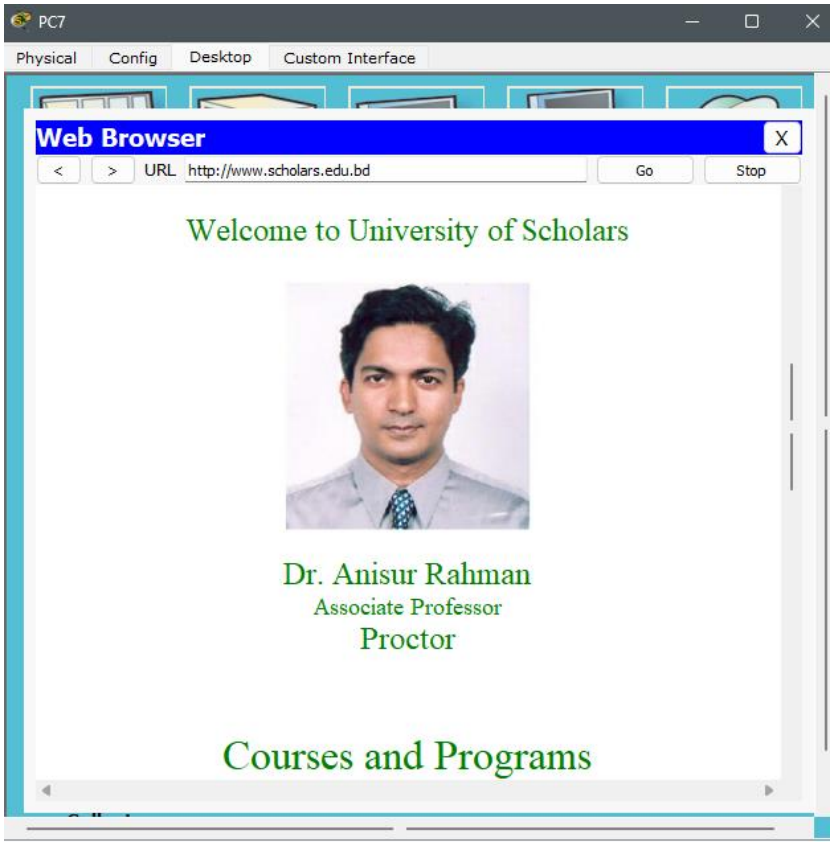

Figure: University of professionals is accessed by Campus3-PC17 host through the web server

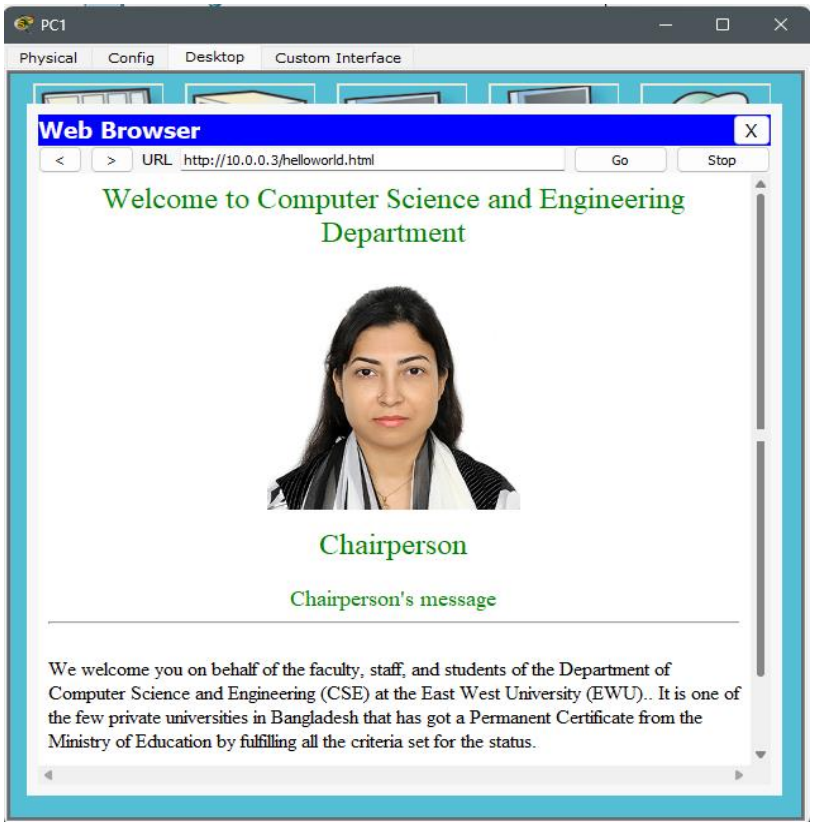

Figure: University of Professionals is accessed by Campus1-PC1 host through the web server

Special Requirements:

- Only a single DHCP server is used to dynamically provide ip address for all the pc and other component in the network.
- Network addresses were used from all three classes.
- Incorporate with different subnets.

Conclusion:

The University of Scholars' network is built with scalability for future growth, stable connectivity, and effective IP management. The institution may maintain a strong and adaptable network infrastructure to serve its academic and administrative tasks by deploying a centralized DHCP and DNS infrastructure, as well as dynamic routing utilizing OSPF.