HO CHI MINH UNIVERSITY OF TECHNOLOGY

***Faculty*: Computer Science**

REPORT

Assignment 2:

Computer network design for building of the bank

Course: Computer Networks (LAB)
Lecturer: Nguyễn Lê Duy Lai, PhD

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INTRODUCTION

CCC (Computer & Construction Concept) was asked to design a computer network used in the headquarters and two branches of a BBB (BB Bank) under construction. The key characteristics of IT usage in this Bank are:

- The building consists of 7 floors, the first floor is equipped with one IT room and Cabling Central Local (for the gathering of wires and patch panels)
- Small-scale BBB: 100 workstations, 5 Servers, 10 Network devices
- Using new technologies for network infrastructure including 100/1000 Mbps wired and wireless connection
- The network is organized according to the VLAN structure
- The network connects to outside by 2 leased line and 1 ADSL with a load-balancing mechanism
- Using a combination of licensed and open-source software, office application, client-server, multimedia, database
- Requirements for high security, robustness when problems occur, easy to upgrade the system

The bank needs to connect to 2 branches in 2 big cities like Nha Trang and Danang. Each branch is also designed similarly to the headquarters but with a smaller scale:

- The building is about 2 floors high, the first floor is equipped with 1 IT room and Cabling Central Local.
- BBB Branch: 50 workstations, 3 servers, 5 network devices

Implementing the connection between the headquarters and the branch through the WAN links, we can choose one of the technologies used for this link according to the economy of the solution.

- Analyze the advantages and disadvantages of the selected solution.

The flows and load parameters of the system (about 80% at peak hours 9g-11g and 15g-16g) can be shared for Head Office and Branch as follows:

- Servers for updates, web access, database access, ... The total upload and download capacity is about 500 MB/day.
- Each workstation is used for Web browsing, document downloads, customer transactions, ... The total upload and download capacity is about 100 MB/day.
- WiFi-connected laptop for customers to access about 50 MB/day.

BB Bank's Computer Network is estimated for a growth rate of 20% in 5 years (in terms of the number of users, network load, branch extensions, ..).

CONTENT

Step 1: Find out suitable network structures for buildings

1.Analyze the network system requirements of Headquarters and Branches

The network system for Headquarters:

The headquarters will have 5 departments which are located on different floors and each department require at least 20 PCs and an access point so that employees can use their laptop to connect to the network

- IT (floor 1)
- Finance (floor 2 and 3)
- Credit (floor 4 and 5)
- Research and development (floor 6)
- Internation (floor 7)
- The servers are placed in the first floor together with the IT department for easy maintenance.
- To connect to the outside there is one router placed at 1st floor.
- Connect to the Internet with another ADSL router.

Two branches has the same structure with all the departments listed, however the location is different:

- Floor 1: Servers, IT department, Finance.
- Floor 2: Credit, Research and development, Internation
- To connect to the outside, we place a router at the first floor.

2.Make a checklist to be surveyed at the installation locations.

Headquarters:

- 1 router: connect to the outside
- 5 switches: for each department
- 1 switch for server room
- 4 access points:
    - on 1st floor for IT
    - 3rd floor for Finance department
    - 5th floor for Credit department
    - 7th floor for both Internation and R&D department
- Another ADSL router, to connect to Internet
- A switch and wifi router for customer laptops

Branches:

- 1 router: connect to the outside
- 2 switches: for each floor
- 1 access point
- Another ADSL router, to connect to Internet
- A switch and wifi router for customer laptops

Step 2: List of minimum equipment, IP diagram, and wiring diagram (cabling)

1. List of recommended equipment and typical specifications

Devices that we use this design are:

2960-24TT Switch	24 fast ethernet ports
2811 Router	USB : 2 x 2 x 10Base-T/100Base-TX - RJ-45 Management : 1 x console - RJ-45 Serial : 1 x auxiliary - RJ-45
Access Point PT	
Wifi router WRT300N	

Cables:

- Copper Cross over : connect router to switch.
- Copper straight through: connect switch to PCs, servers, access points.
- Serial DTE: connect routers between headquarters and branches.

2. Logical design

- Headquarter:

  Outside interface: 200.200.200.1 connect to Branch Da Nang; 200.200.201.1 connect to Branch HCMC

  We use 5 vlan for each department to assign IP to them on the router. Each vlan is also configured on separated switch.

Vlan number	IP	Subnet mask	Department
3	192.168.3.1	255.255.255.0	Server
4	192.168.4.1	255.255.255.0	IT
5	192.168.5.1	255.255.255.0	Finance
6	192.168.6.1	255.255.255.0	Credit
7	192.168.7.1	255.255.255.0	R&D
8	192.168.8.1	255.255.255.0	Internation

- Branch Da Nang city

  Outside interface: 200.200.200.2 connect to Headquarter

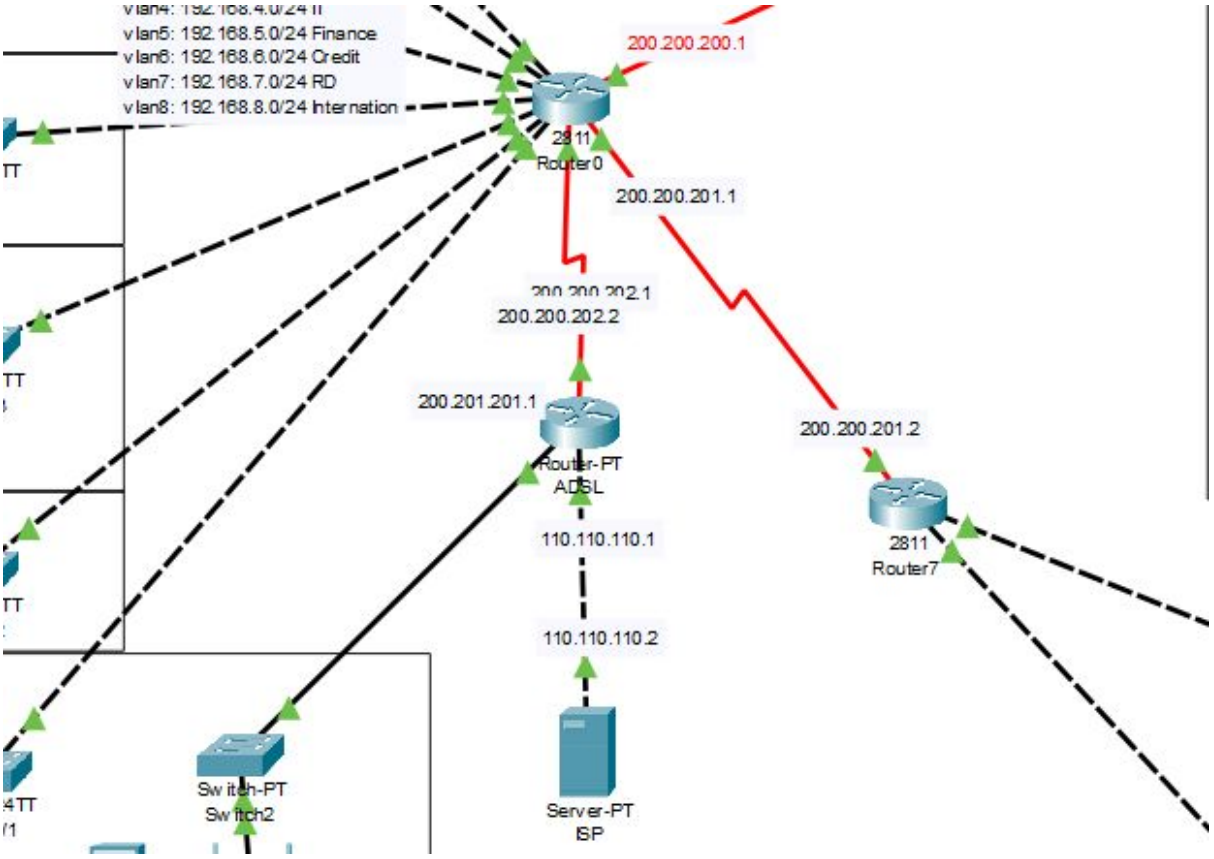
We also have 5 vlan: vlan 3,4,5 - switch 1; vlan 6,7,8 - switch 2

Vlan number	IP	Subnet mask	Department
3	172.16.3.1	255.255.255.0	Server
4	172.16.4.1	255.255.255.0	IT
5	172.16.5.1	255.255.255.0	Finance
6	172.16.6.1	255.255.255.0	Credit
7	172.16.7.1	255.255.255.0	R&D
8	172.16.8.1	255.255.255.0	Internation

- HCM city Branch
  Outside interface: 200.200.201.2 connect to Headquarter
  We also have 5 vlan: vlan 3,4,5 - switch 1; vlan 6,7,8 - switch 2

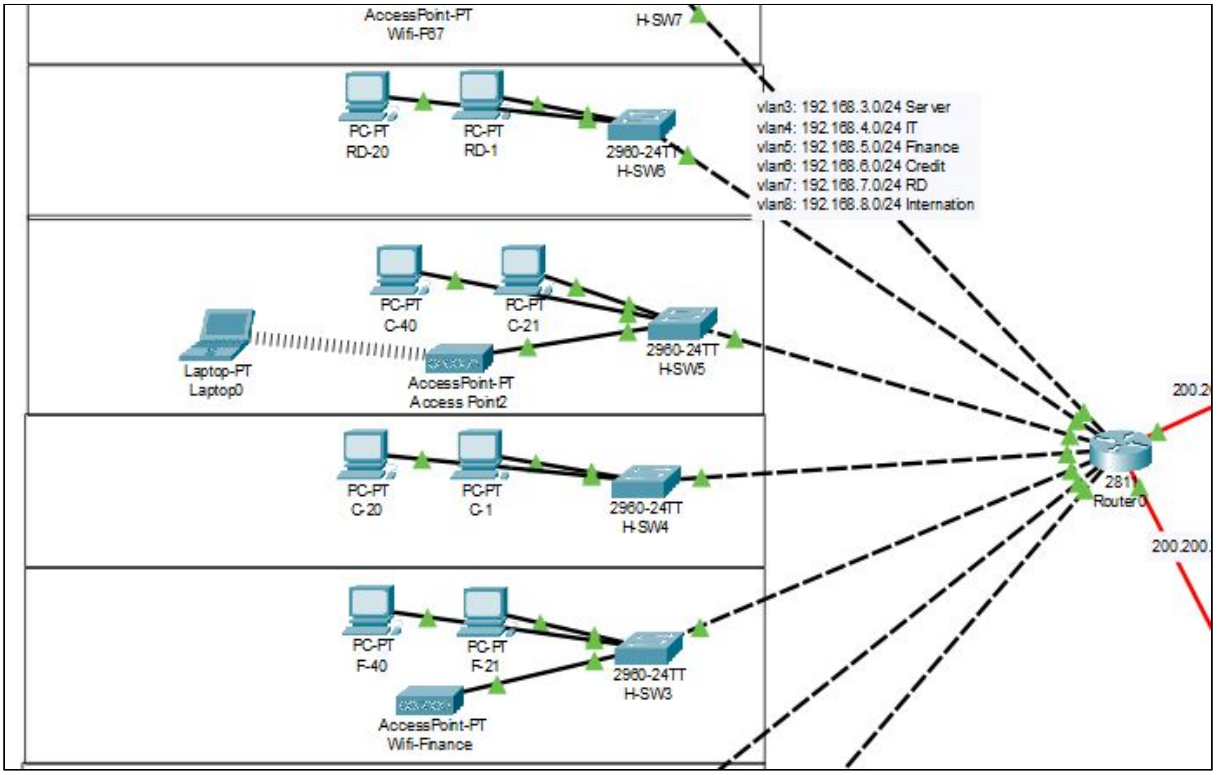
Vlan number	IP	Subnet mask	Department
3	10.0.3.1	255.255.255.0	Server
4	10.0.4.1	255.255.255.0	IT
5	10.0.5.1	255.255.255.0	Finance
6	10.0.6.1	255.255.255.0	Credit
7	10.0.7.1	255.255.255.0	R&D
8	10.0.8.1	255.255.255.0	Internation

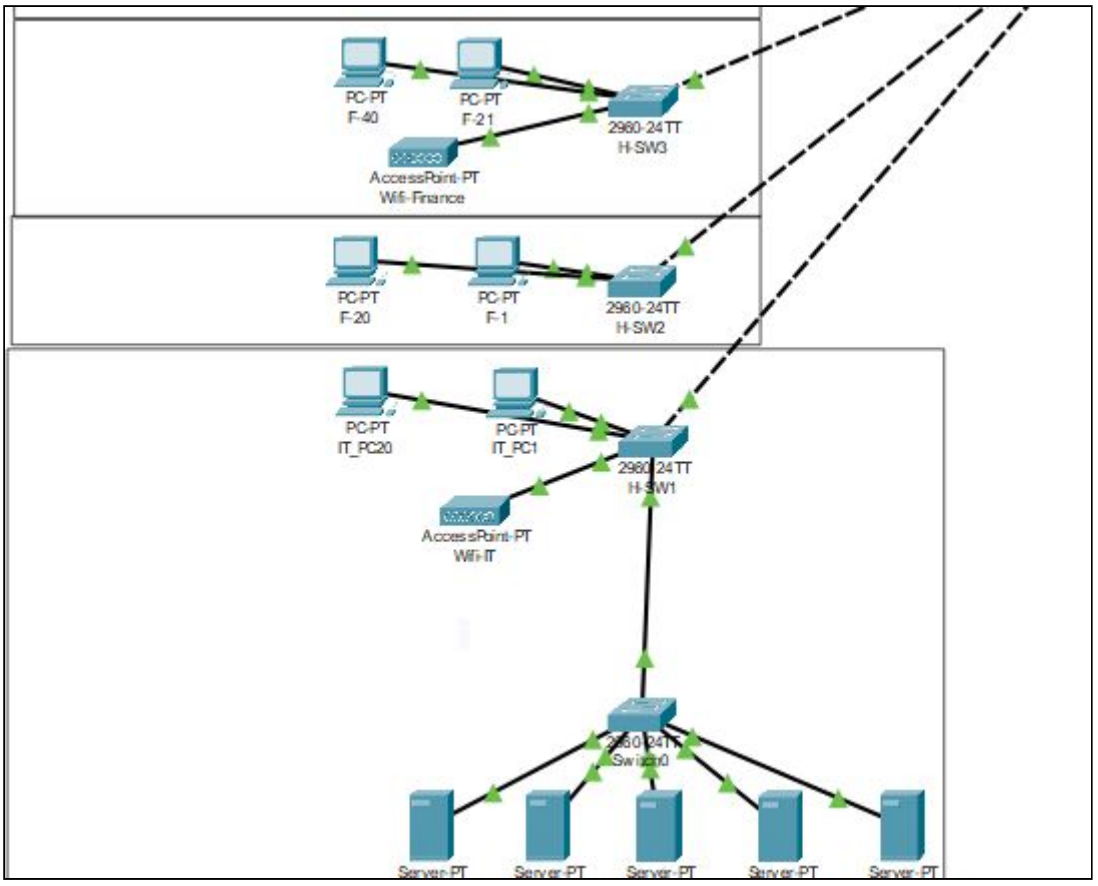
- ADSL line:



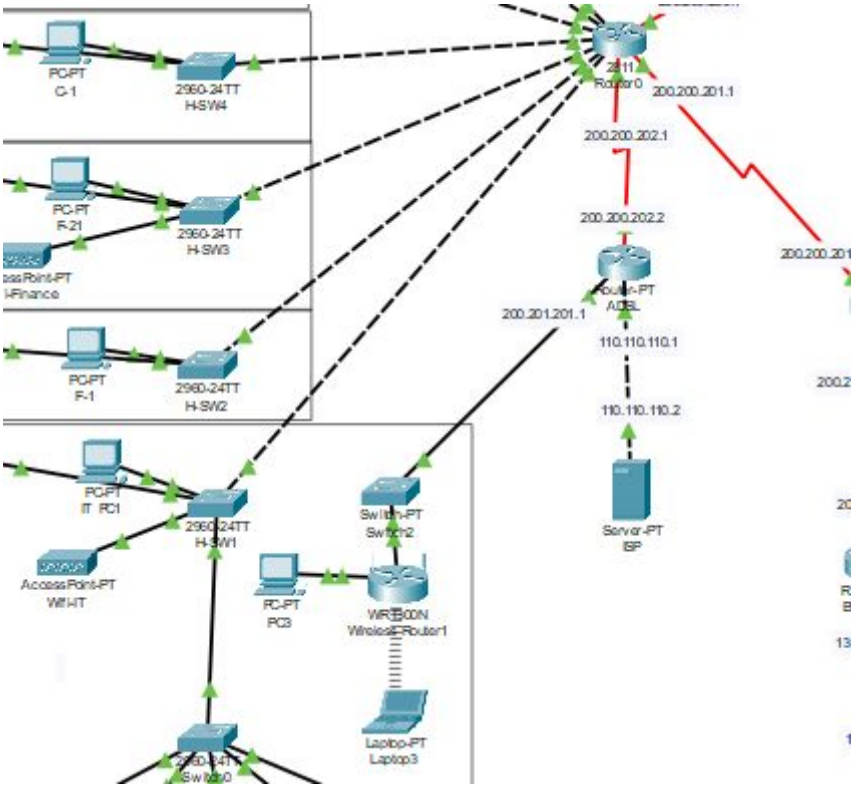
3. Schematic physical setup of the system

a/ Headquarters schematic physical setup:

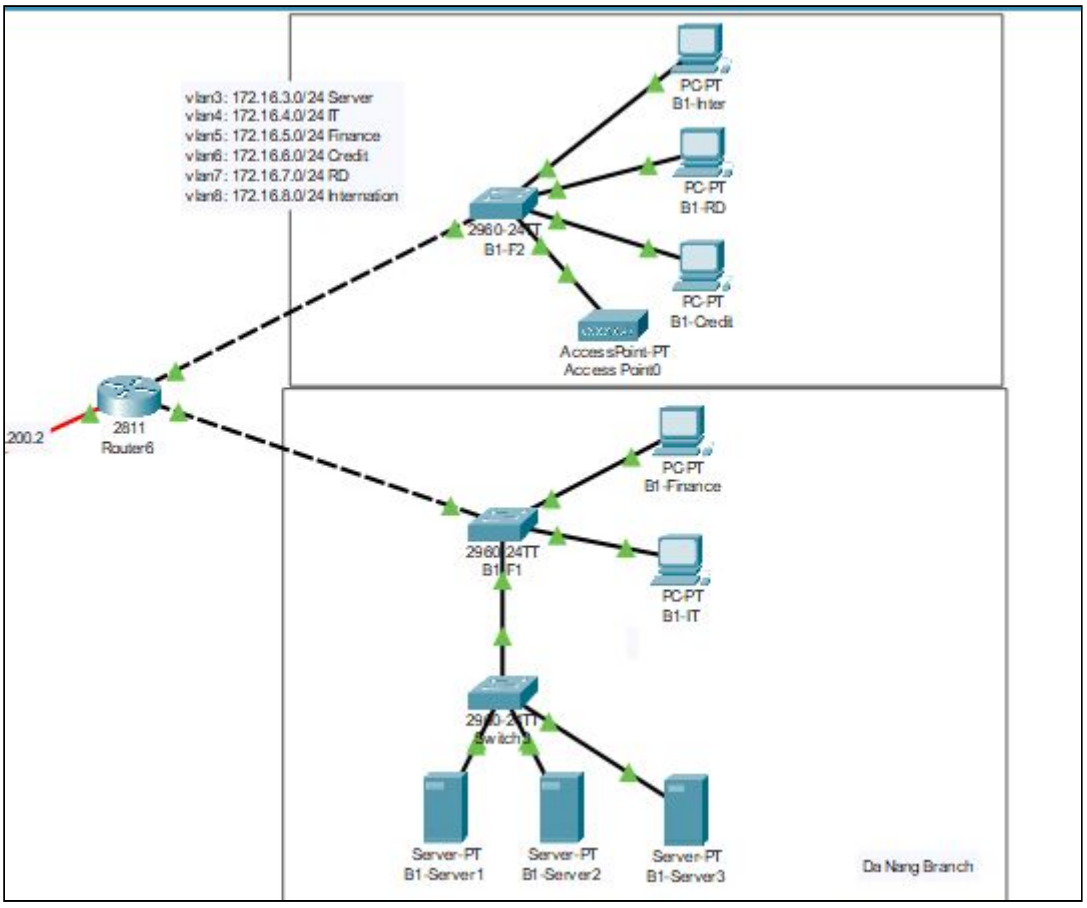




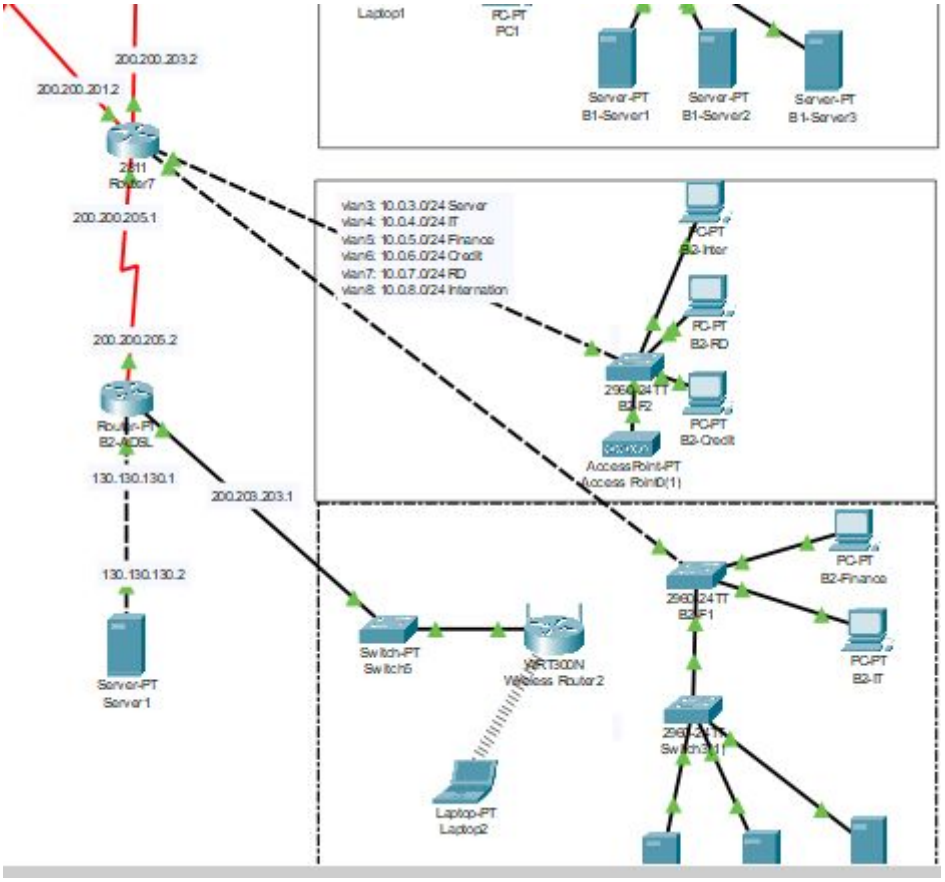
ADSL line and Wifi for customer:



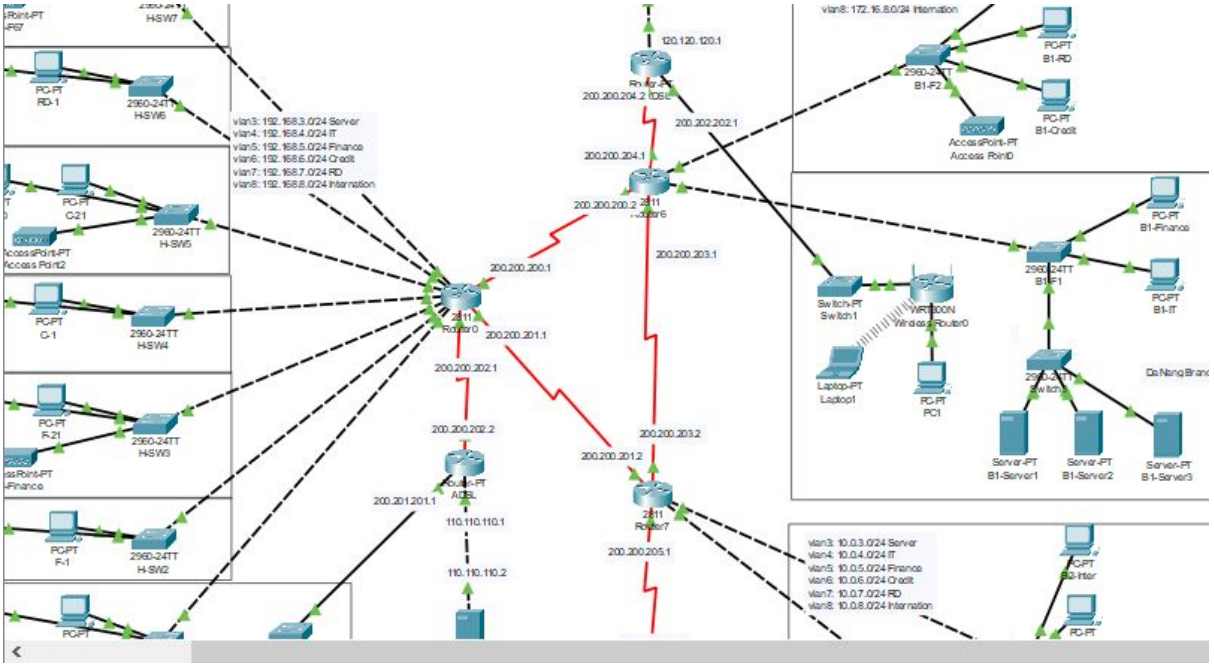
b/ Branch:



ADSL line and Wifi for customer:



c/ Connection between headquarters and branches



4. **WAN connection diagram between Headquarters and Branches (using OSPF protocol)**

We configure the OSPF on the routers by following commands. For example on the headquarters router with outside interface 200.200.200.1, 200.200.201.1

router ospf 10
network 200.200.200.0 0.0.0.255 area 0
network 200.200.201.0 0.0.0.255 area 0
network 192.168.0.0 0.0.255.255 area 0
To show ospf table. Go back to privilege mode: show ip route ospf

On the router of the branch. For example branch Da Nang:

router ospf 10
network 200.200.200.0 0.0.0.255 area 0
network 172.16.0.0 0.0.255.255 area 0

Step 3: Calculate throughput, bandwidth, and safety parameters for computer networks

Headquarters:

$$\frac{(100\ PCs\ x\ 100MB + 5\ x\ 500MB + 100\ Customer\ x\ 50\ MB)\ x\ 8\ bits\ x\ 0.8}{3\ hours\ x\ 60\ x\ 60} = 10.37Mbps$$

Branches:

$$\frac{(\,50\ PCs\ x\ 100MB + 3\ x\ 500MB + 50\ Customer\ x\ 50\ MB\,)\ x\ 8\ bits\ x\ 0.8}{3\ hours\ x\ 60\ x\ 60} = 6.67Mbps$$

Step 4: Design the network map using Packet Tracer or GNS3 simulation software

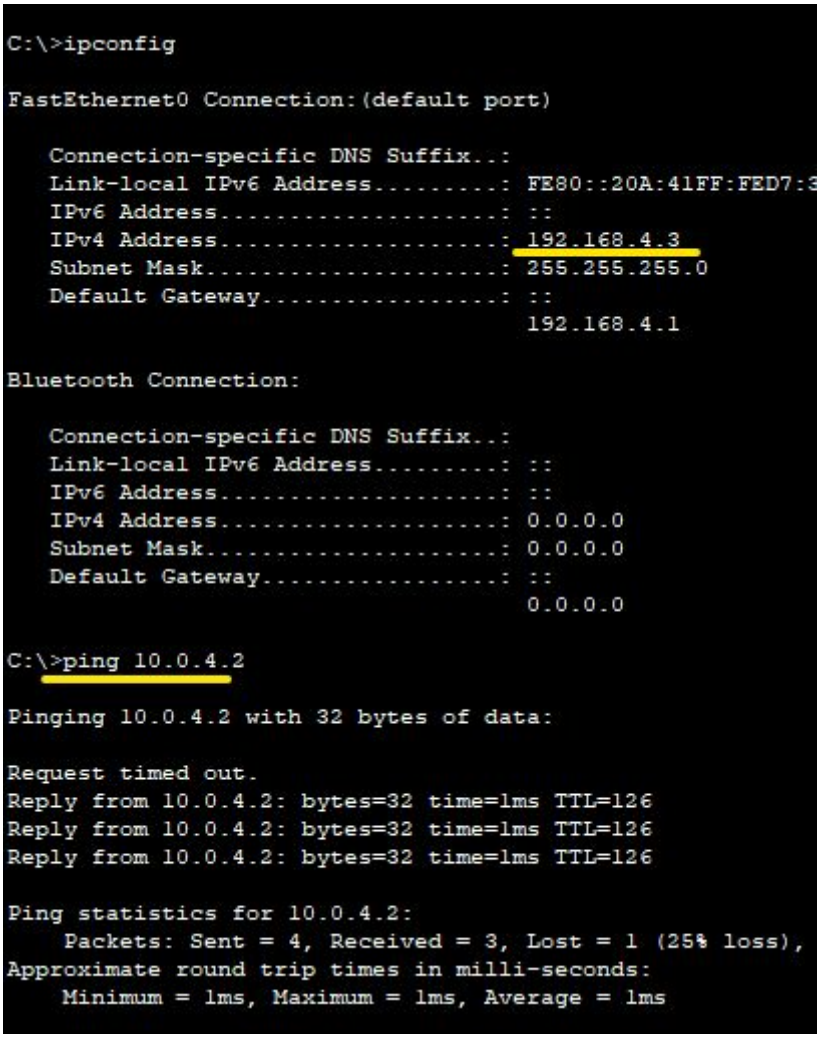
We used Cisco Packet Tracer to design the network map.

Step 5: Test the system with popular tools such as ping, traceroute, ... on the simulated system.

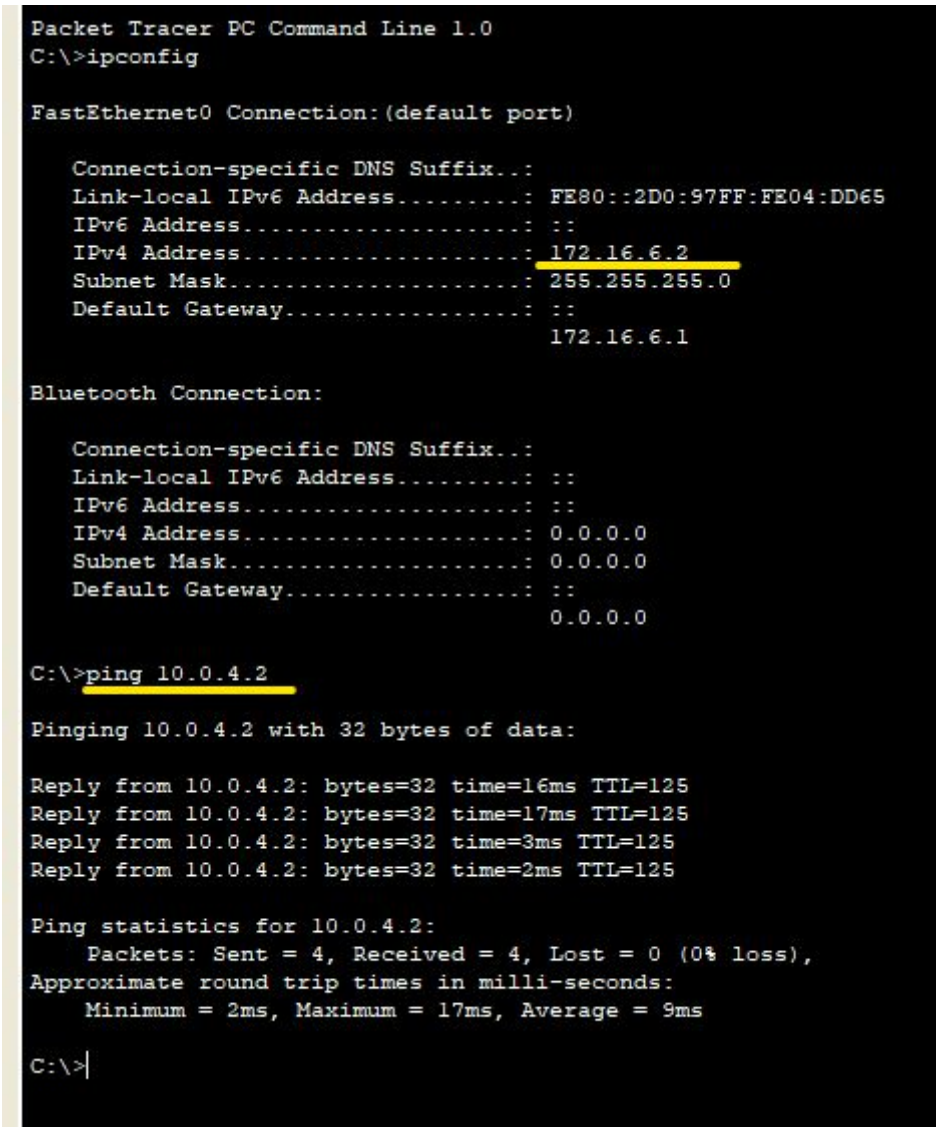
1. Ping to computer in the same network

```
Packet Tracer PC Command Line 1.0
C:\>ipconfig

FastEthernet0 Connection:(default port)

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.....: FE80::20A:41FF:FED7:3D67
   IPv6 Address.....: ::
   IPv4 Address.....: 192.168.4.3
   Subnet Mask.....: 255.255.255.0
   Default Gateway.....: ::
                                 192.168.4.1

Bluetooth Connection:

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.....: ::
   IPv6 Address.....: ::
   IPv4 Address.....: 0.0.0.0
   Subnet Mask.....: 0.0.0.0
   Default Gateway.....: ::
                                 0.0.0.0

C:\>
C:\>ping 192.168.5.2

Pinging 192.168.5.2 with 32 bytes of data:

Request timed out.
Reply from 192.168.5.2: bytes=32 time<1ms TTL=127
Reply from 192.168.5.2: bytes=32 time<1ms TTL=127
Reply from 192.168.5.2: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.5.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

2. Ping to a computer in other branch from head



3. Ping from a branch to another branch



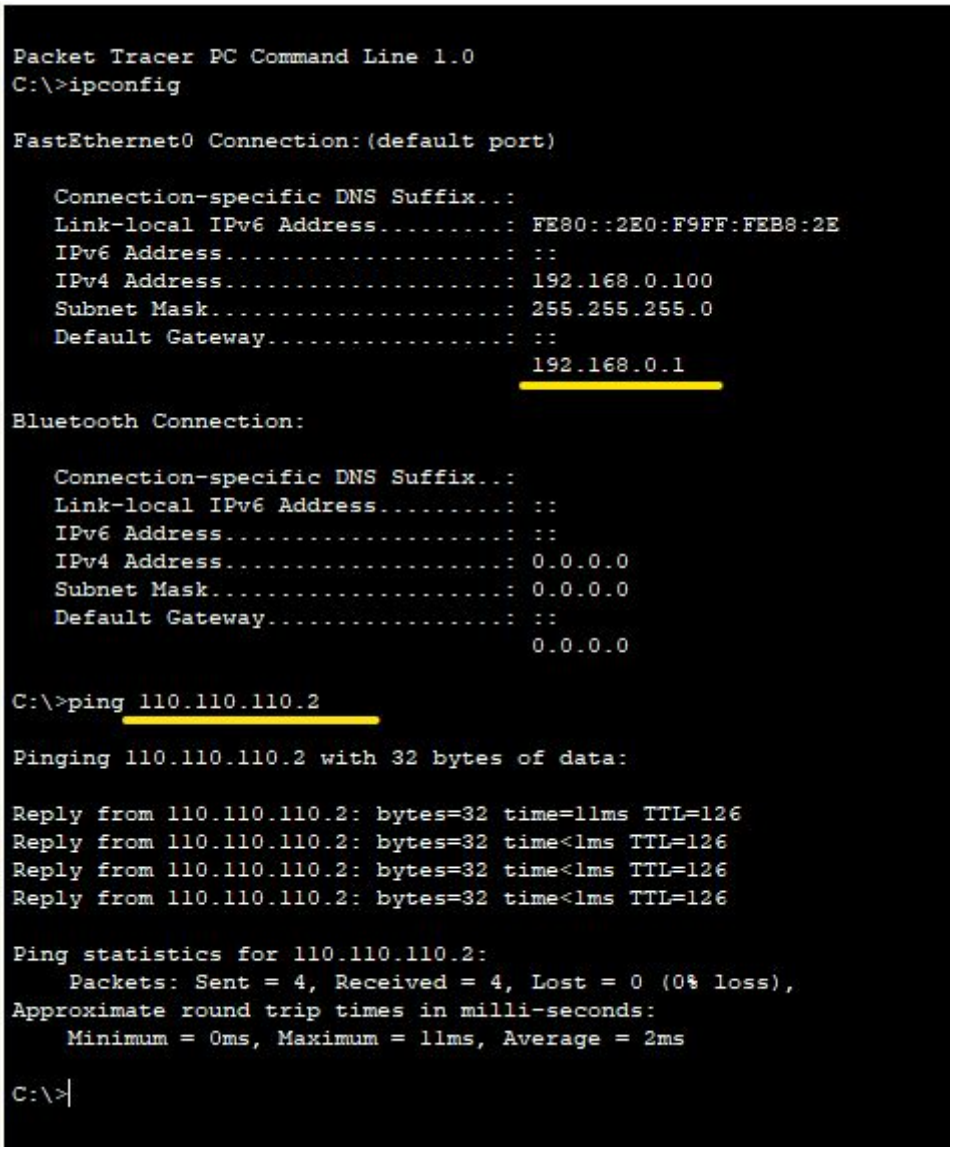
4. ADSL line ping to ISP server:

ISP server IP: 110.110.110.2

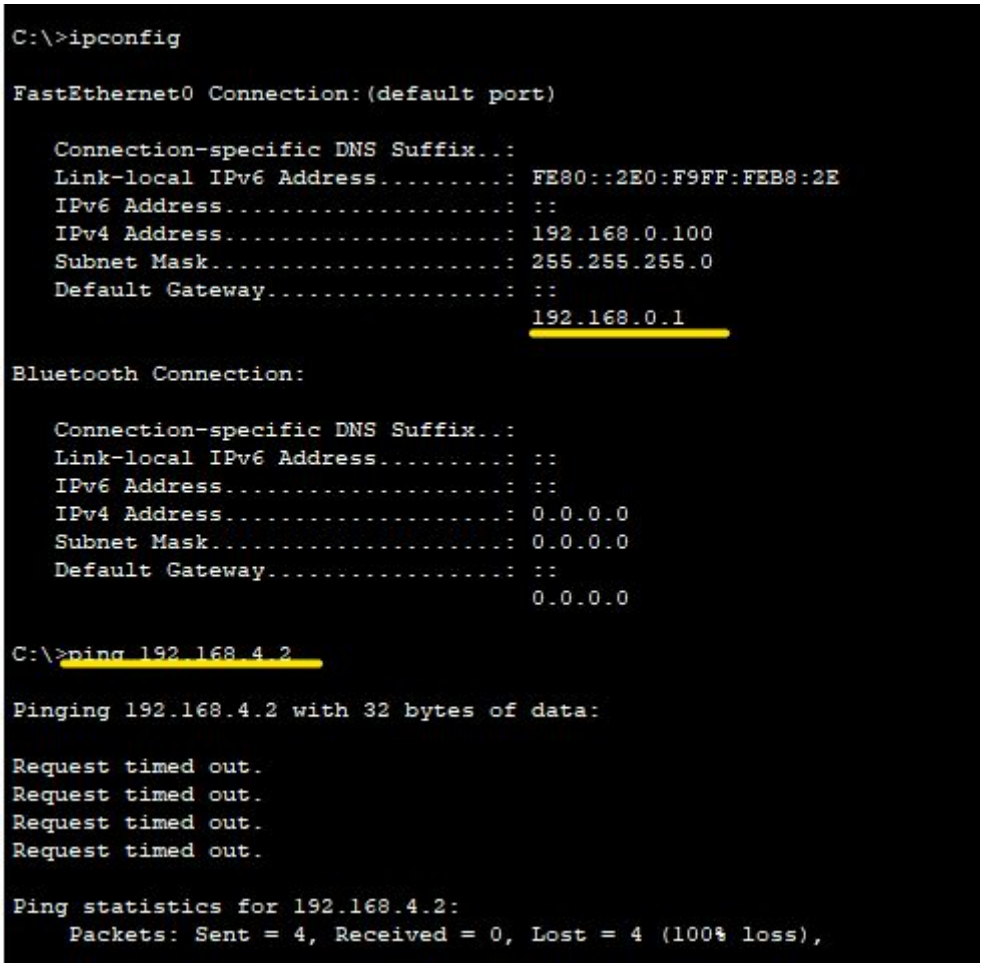
A workstation in any department can ping to ISP server.

```
Packet Tracer PC Command Line 1.0
C:\>ipconfig

FastEthernet0 Connection:(default port)

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.....: FE80::20A:41FF:FED7:3D6
   IPv6 Address.....: ::
   IPv4 Address.....: 192.168.4.2
   Subnet Mask.....: 255.255.255.0
   Default Gateway.....: ::
                                 192.168.4.1

Bluetooth Connection:

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.....: ::
   IPv6 Address.....: ::
   IPv4 Address.....: 0.0.0.0
   Subnet Mask.....: 0.0.0.0
   Default Gateway.....: ::
                                 0.0.0.0

C:\>ping 110.110.110.2

Pinging 110.110.110.2 with 32 bytes of data:

Reply from 110.110.110.2: bytes=32 time=33ms TTL=126
Reply from 110.110.110.2: bytes=32 time=2ms TTL=126
Reply from 110.110.110.2: bytes=32 time=2ms TTL=126
Reply from 110.110.110.2: bytes=32 time=1ms TTL=126

Ping statistics for 110.110.110.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 33ms, Average = 9ms

C:\>
```

- A customer’s laptop can ping to ISP server as well



However, he can not ping to a computer in the company



Step 6: Re-evaluate the designed network system through the following features:

✓ Reliability, easy to upgrade, diverse support software, safety, the security of data, ...

- The system can be added to more computers by adding a switch. Each vlan can have up to 250 computer IPs.
- We haven't implemented any kind of firewall to protect Servers.

✓ The remaining problems for the project.

✓ Development orientation in the future.