HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY
FALCULTY OF COMPUTER SCIENCE AND ENGINEERING

Computer Network

REPORT
ASSIGNMENT 2

INSTRUCTOR: NGUYEN LE DUY LAI
STUDENTS: Huỳnh Nhật Quang – 1952112
Trần Kim Tùng – 1953087
Bùi Vĩnh Trung - 1953046

Ho Chi Minh City,
May 2022

Table of Contents

I. INTRODUCTION

- CCC (Computer & Construction Concept) was tasked with designing a computer network for a BBB (BB Bank) under construction headquarters and two branches. The following are the important characteristics of this Bank's IT usage:
    - The building has seven levels, with one IT room and Cabling Central Local on the first floor (for the gathering of wires and patch panels).Small-scale BBB: 100 workstations, 5 Servers, 10 Network devices.
    - Using advanced network infrastructure technologies such as 100/1000 Mbps wired and wireless connections.
    - The VLAN structure is used to organize the network..
    - The network has two leased lines and one ADSL connection to the outside, with a load balancing mechanism.
    - High security requirements, robustness when problems arise, and ease of system upgrade
- The bank must establish connections with two branches in major cities such as Nha Trang and Da Nang. Each branch is designed in the same manner as the headquarters, but on a lesser scale:
    - The structure is two stories high, with one IT room and Cabling Central Local on the first floor.
    - 50 workstations, 3 servers, and 5 network devices at BBB Branch.

❖ We can choose one of the technologies utilized for this link based on the cost of the solution while implementing the connection between the headquarters and the branch via WAN lines.

- Analyze the benefits and drawbacks of the chosen solution.

❖ The system's flows and load parameters (about 80% at peak hours 9g-11g and 15g-16g) can be communicated between the Head Office and the Branch as follows:

- Update servers, web servers, and database servers. The entire upload and download capacity per day is approximately 500 MB.

- Web browsing, document downloads, customer transactions, and so on are all done on each workstation. Each workstation has a daily upload and download capability of roughly 100 MB.
- Customers will have access to around 50 MB per day via a Wi-Fi linked laptop.

❖ In five years, the Computer Network of BB Bank is expected to develop by 20% (in terms of users, network load, branch extensions, etc.).

II. REQUIREMENTS

❖ 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 five departments, each of which will require at least 20 PCs and an access point so that staff can connect to the network using their laptops:

+ IT department and Cabling Central Local (for gathering wires and patch panels): first floor

+ Finance department: second and third floors

+ Customer service department: fourth and fifth floors

+ Accounting department: sixth floor

+ Administrative department: seventh floorTwo branches in Nha Trang and Da Nang have the same structure with all the departments listed but with the different location:

+ IT, Cabling Central Local, and Finance departments are on the first floor.

+ Customer service, accounting, and administrative departments are on the second floor.

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

- Headquarters:

+ 1 router: link the two branches

+ Each floor has seven switches.

+ 1 switch to connect to each floor's router and switches

+ Another ADSL router for Internet access.

+ For customer laptops, a wireless router.

- Branches:

+ 1 router for connecting to the headquarters, plus 2 switches for each floor

+ 1 switch to connect to each floor's router and switches

+ Another ADSL router for Internet access.

+ For customer laptops, a wireless router.

❖ Step 2: List of minimum equipment, IP diagram and wiring diagram

1. List of recommended equipment and typical specifications

Components for designing:

- 2960-24TT Switch
- 2811 Router
- Servers (DNS servers, google.com, mail, backup, ...)
- Wi-fi router WRT300N
- PC and customer's laptop
- Internet cloud (20.110.24.0)
- ISP router
- DSL modem

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. Design

- Headquarters:

VLAN	IP	Subnet mask	Floor
10	192.168.10.1	255.255.255.0	1
20	192.168.20.1	255.255.255.0	2
30	192.168.30.1	255.255.255.0	3
40	192.168.40.1	255.255.255.0	4
50	192.168.50.1	255.255.255.0	5
60	192.168.60.1	255.255.255.0	6
70	192.168.70.1	255.255.255.0	7

- Branch Nha Trang

VLAN	IP	Subnet mask	Floor
10	192.168.10.1	255.255.255.0	1
20	192.168.20.1	255.255.255.0	2

- Branch Da Nang

VLAN	IP	Subnet mask	Floor
11	192.168.11.1	255.255.255.0	1
21	192.168.21.1	255.255.255.0	2

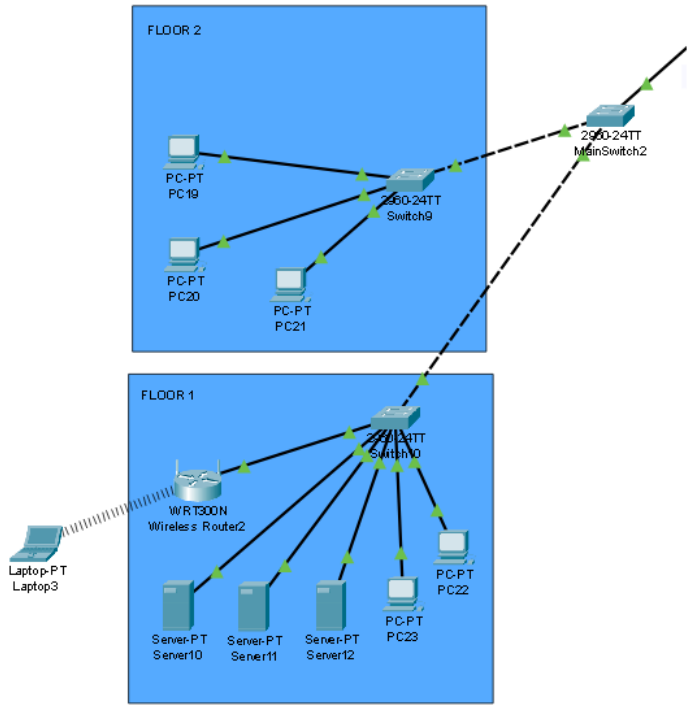
- DNS server and Google server

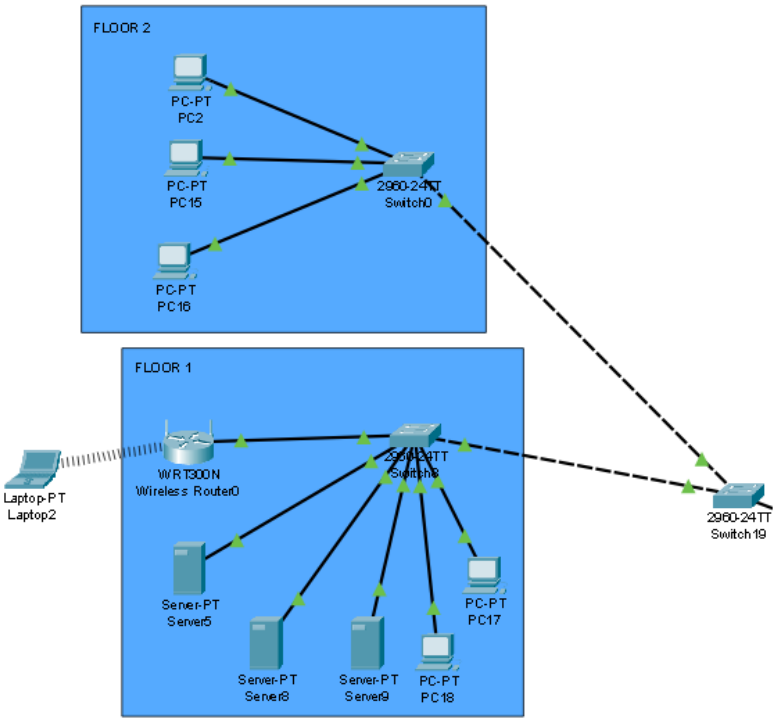
VLAN	IP	Subnet mask	Server
8	8.8.8.1	255.255.255.0	DNS
10	10.10.10.1	255.255.255.0	Google

3. Schematic physical setup of the system

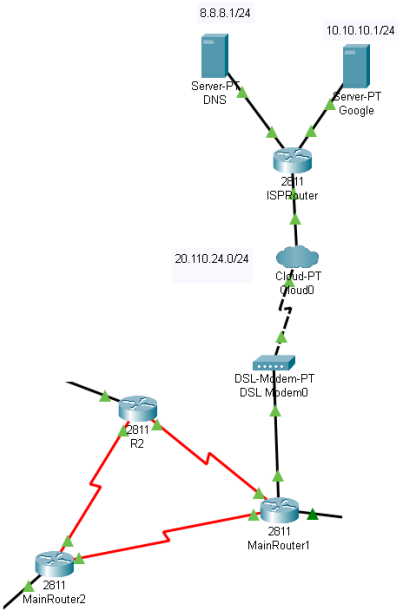
a/ Headquarters schematic physical setup:

b/ Branches:


FLOOR 2
2960-24TT
MainSwitch2
PC-PT
PC19
2960-24TT
Switch9
PC-PT
PC20
PC-PT
PC21
FLOOR 1
2960-24TT
Switch0
WRT300N
Wireless Router2
Laptop-PT
Laptop3
PC-PT
PC22
Server-PT
Server10
Server-PT
Server11
Server-PT
Server12
PC-PT
PC23


FLOOR 2
PC-PT
PC2
PC-PT
PC15
2960-24TT
Switch0
PC-PT
PC16
FLOOR 1
2960-24TT
Switch8
WRT300N
Wireless Router0
Laptop-PT
Laptop2
2960-24TT
Switch19
Server-PT
Server5
PC-PT
PC17
Server-PT
Server8
Server-PT
Server9
PC-PT
PC18

c/ Connection between headquarters and branches:



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

1. Headquarter

a) <u>Wired network</u>

+ 5 servers: Total upload and download capacity of each server is 500 MB/day

Peak hours: 9h-11h and 15h-16h (total 3 hours, 80% data exchanged in day). Suppose standard working time is 8 hours per day.

⇨ Bandwidth = (5 x 500 x 80%) / (3 x 60 x 60) = 0.185 (MB/s)

⇨ Throughput = (5 x 500) / (8 x 60 x 60) = 0.087 (MB/s)

+ 100 workstations: Total upload and download capacity of each workstation is 100 MB/day. Peak hours: 9h-11h and 15h-16h (total 3 hours, 80% data exchanged in day).

⇨ Bandwidth = (100 x 100 x 80%) / (3 x 60 x 60) = 0.926 (MB/s)

⇨ Throughput = (100 x 100) / (8 x 60 x 60) = 0.347 (MB/s)

⇨ Total bandwidth = 0.185 + 0.926 = 1.111 (MB/s)

⇨ Total throughput = 0.087 + 0.347 = 0.434 (MB/s)

b) Wireless network

+ Customer's laptop: Total upload and download capacity of each laptop is 50 MB/day. Peak hours: 9h-11h and 15h-16h (total 3 hours, 80% data exchanged in day).

Suppose the number of internet access is about 200 times per day and 80 times in peak hours.

⇨ Bandwidth = (80 x 50 x 80%) / (3 x 60 x 60) = 0.296 (MB/s)

⇨ Throughput = (200 x 50) / (8 x 60 x 60) = 0.347 (MB/s)

2. Branches

a) Wired network

+ 3 servers: Total upload and download capacity of each server is 500 MB/day

Peak hours: 9h-11h and 15h-16h (total 3 hours, 80% data exchanged in day). Suppose standard working time is 8 hours per day.

⇨ Bandwidth = (3 x 500 x 80%) / (3 x 60 x 60) = 0.111 (MB/s)

⇨ Throughput = (3 x 500) / (8 x 60 x 60) = 0.052 (MB/s)

+ 50 workstations: Total upload and download capacity of each workstation is 100 MB/day. Peak hours: 9h-11h and 15h-16h (total 3 hours, 80% data exchanged in day).

⇨ Bandwidth = (50 x 100 x 80%) / (3 x 60 x 60) = 0.37 (MB/s)

⇨ Throughput = (50 x 100) / (8 x 60 x 60) = 0.174 (MB/s)

⇨ Total bandwidth = 0.111 + 0.37 = 0.481 (MB/s)

⇨ Total throughput = 0.052 + 0.174 = 0.226 (MB/s)

b) Wireless network

+ Customer's laptop: Total upload and download capacity of each laptop is 50 MB/day

Suppose the number of internet access is about 100 times per day and 50 times in peak hours. Peak hours: 9h-11h and 15h-16h (total 3 hours, 80% data exchanged in day).

⇨ Bandwidth = (50 x 50 x 80%) / (3 x 60 x 60) = 0.185 (MB/s)

⇨ Throughput = (100 x 50) / (8 x 60 x 60) = 0.174 (MB/s)

3. **Total**

Total workstations = 100 + 50 + 50 =200

Total servers = 5 + 3 + 3 =11

Total upload and download capacity of each workstation is 100 MB/day
Total upload and download capacity of each server is 500 MB/day
WIFI -connected laptop for customers to access about 50 MB/day

Total upload and download capacity of whole bank: 200 x 100 + 11 x 500 + 50 x 200= 35500(MB)

The total capacity at peak hours (3 hours, 80% exchanged data in day) of whole bank: 35500 x 80% = 28400(MB)

⇨ Bandwidth = (35500 x 80%) / (3 x 60 x 60) = 2.63 (MB/s)

⇨ Throughput = 35500/(8 x 60 x 60) = 1.233(MB/s)

Design for expanding in future (growth rate 20% in 5 years):

⇨ Bandwidth = 2.63 x 120% = 3.156 (MB/s)

⇨ Throughput = 1.233 x 120% = 1.48 (MB/s)

❖ Step 4: Design the network map using Packet Tracer

See the assignment2.pkt file

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

1. Ping to computer in the same network

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

FastEthernet0 Connection:(default port)

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.....: FE80::2E0:A3FF:FE18:43BE
   IPv6 Address.....: ::
   IPv4 Address.....: 192.168.10.4
   Subnet Mask.....: 255.255.255.0
   Default Gateway.....: ::
                                 192.168.10.1

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 192.168.10.3

Pinging 192.168.10.3 with 32 bytes of data:

Reply from 192.168.10.3: bytes=32 time<1ms TTL=128
Reply from 192.168.10.3: bytes=32 time<1ms TTL=128
Reply from 192.168.10.3: bytes=32 time<1ms TTL=128
Reply from 192.168.10.3: bytes=32 time=1ms TTL=128

Ping statistics for 192.168.10.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

2. Ping to a computer in other branch from headquarters

```
Cisco Packet Tracer SERVER Command Line 1.0
C:\>ipconfig

FastEthernet0 Connection:(default port)

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.....: FE80::260:47FF:FE28:968C
   IPv6 Address.....: ::
   IPv4 Address.....: 192.168.10.9
   Subnet Mask.....: 255.255.255.0
   Default Gateway.....: ::
                                 192.168.10.1

C:\>ping 192.168.11.5

Pinging 192.168.11.5 with 32 bytes of data:

Request timed out.
Reply from 192.168.11.5: bytes=32 time=2ms TTL=126
Request timed out.
Reply from 192.168.11.5: bytes=32 time=1ms TTL=126

Ping statistics for 192.168.11.5:
    Packets: Sent = 4, Received = 2, Lost = 2 (50% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 2ms, Average = 1ms
```

3. Ping from a branch to another branch

```
C:\>ipconfig

FastEthernet0 Connection:(default port)

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.....: FE80::230:F2FF:FE99:8C4
   IPv6 Address.....: ::
   IPv4 Address.....: 192.168.20.2
   Subnet Mask.....: 255.255.255.0
   Default Gateway.....: ::
                                 192.168.20.1

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 192.168.11.5

Pinging 192.168.11.5 with 32 bytes of data:

Request timed out.
Reply from 192.168.11.5: bytes=32 time=11ms TTL=126
Request timed out.
Reply from 192.168.11.5: bytes=32 time=10ms TTL=126

Ping statistics for 192.168.11.5:
    Packets: Sent = 4, Received = 2, Lost = 2 (50% loss),
Approximate round trip times in milli-seconds:
    Minimum = 10ms, Maximum = 11ms, Average = 10ms
```

4. Connect to Google server

5. Ping from Customer's laptop to Google server

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

Wireless0 Connection:(default port)

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.....: FE80::203:E4FF:FE96:2771
   IPv6 Address.....: ::
   IPv4 Address.....: 192.168.0.100
   Subnet Mask.....: 255.255.255.0
   Default Gateway.....: ::
                                 192.168.0.1

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 10.10.10.1

Pinging 10.10.10.1 with 32 bytes of data:

Reply from 10.10.10.1: bytes=32 time=81ms TTL=253
Reply from 10.10.10.1: bytes=32 time=72ms TTL=253
Reply from 10.10.10.1: bytes=32 time=49ms TTL=253
Reply from 10.10.10.1: bytes=32 time=123ms TTL=253

Ping statistics for 10.10.10.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 49ms, Maximum = 123ms, Average = 81ms
```

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

1. Security when problems come up

a) <u>Determine protected resources</u>

+ Hardware: server, network devices, stations

+ Software: OS, applications for managing system of accounts, credits, accounting programs, ATM,..

+ Database system: client's data, accounting data, …

b) <u>Threats can harm to system</u>

+ Illegal access: Access to resources of network must classify suitably for each group of people

+ Exploit widely information: Information can be invasive if it is stored on the local storage as computers, data transmitted from system to system, info stored in copied files, ...

+ Probability of being attacked by hackers, leaking info.

+ Internal employees trying to access to restricted data.

c) Solutions when problems come up

+ There are 2 kinds of problems:

- Network infrastructure problems

- Network security problems

+ The possible solutions are:

- Always backup data.

- Technical team for solving network problems

- Backup devices

d) System upgrade

The network design must consider about the expanding later. The bandwidth we have taken into account for 20% redundancy should be able to meet the safety index. Use of network equipment's Cisco will make it stable and easy to upgrade.

2. Constraints of projects

+ We haven't implemented any kind of firewall to protect Servers.

+ One main router means that there is whole system downtime when it is under maintenance. In the future, we hope to implement another backup router.

+ Using quite a lot of switches. Although one switch with more ports is better, it is very expensive so we settle for the proposed design.

3. Development in the future

+ Improve server, especially backup server.

+ Enhance network equipment for replacement in case of damage.

III. CONCLUSION

1. Achievement

- Design the network structure for BB Bank.
- Determine suitable network devices for the structure.
- Come up with solutions to connect computers.
- Calculate the bandwidth, throughput for the network.
- Simulate sending packets, pinging at different locations, destinations to make sure the network is working.

2. Experience

- Understand the basic network structure of a bank company.
- Acknowledge the difficulties in the process of designing a network system.
- Know how to connect network devices.

3. Limitations

- Limits of space and network devices.
- Lacking knowledge of many network structures (DMZ, VLAN).