CSE 307: Internet Networking Essentials

(Project 2)

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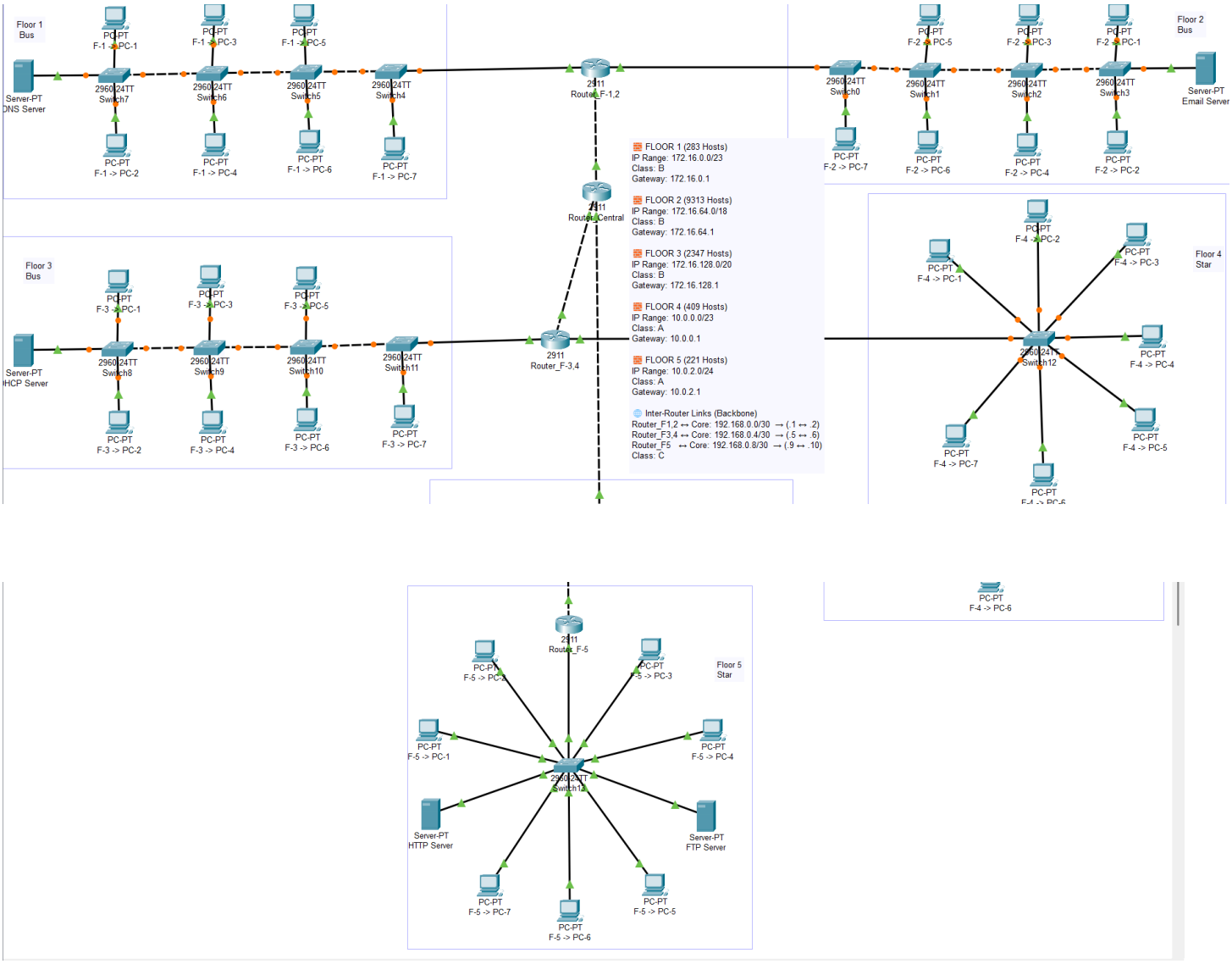
GitHub Link - https://github.com/Anytng-lan/Network-Project2

Luxor Network Scenario



Luxor Network Statistics Summary

METRIC	VALUE
TOTAL FLOORS	5
TOTAL HOSTS (DEVICES)	12,573
TOTAL SUBNETWORKS	8 (5 Floor LANs + 3 Inter-Router Links)
TOTAL ROUTERS	5 (3 Edge + 2 Intermediate/Core)

TOTAL SWITCHES	5 (1 per floor, central in star topology)
ROUTING TYPE	Static Routing
TOTAL DEFAULT GATEWAYS	5 (1 per floor)
TOTAL SERVERS	5 (DNS, DHCP, Email, HTTP, FTP)
IP CLASSES USED	Class B (Floors 1–3), Class A (Floors 4–5), Class C (Backbone)
TOPOLOGIES USED	Bus (Floors 1–3), Star (Floors 4–5)
IP ADDRESSING SCHEME	VLSM (Classless, Efficient Allocation)
BACKBONE IP SUBNETS	/30 for each router-to-core link
NETWORK SIZE RANGE	From /18 (for 9313 hosts) to /30 (P2P)
BROADCAST DOMAIN ISOLATION	5 (1 per floor)
SERVERS CENTRALIZED ON	Floors 1 (DNS), 2 (Email), 3 (DHCP), 5 (HTTP & FTP)

Luxor Solutions Enterprise Network Design Report

Overview

Luxor Solutions, a mid-sized enterprise operating across a 5-floor office building, required a scalable, secure, and fault-tolerant network infrastructure. The network is designed to support seamless communication, centralized routing, efficient server access, and optimized performance for a total of **12,573 hosts** distributed across the building.

Network Topologies

1. Floors 1, 2 & 3 – Bus Topology
A bus topology was selected for these floors due to its minimal cabling cost and straightforward installation. However, it comes with drawbacks such as reduced fault tolerance—if the main cable fails, the whole segment goes down—and limited scalability.

2. Floors 4 & 5 – Star Topology
This topology connects all devices to a central switch, improving fault tolerance and performance. While it requires more cabling and hardware, individual device failures do not affect the entire network, and troubleshooting becomes easier.

IP Addressing & Network Classes (VLSM Based)

To minimize IP wastage, VLSM (Variable Length Subnet Masking) was applied. Based on the number of hosts required on each floor, the following subnetworks were allocated:

Floor	Hosts	Network	CIDR	Subnet Mask	Gateway	Class
1	283	172.16.0.0	/23	255.255.254.0	172.16.0.1	B
2	9313	172.16.64.0	/18	255.255.192.0	172.16.64.1	B
3	2347	172.16.128.0	/20	255.255.240.0	172.16.128.1	B
4	409	10.0.0.0	/23	255.255.254.0	10.0.0.1	A
5	221	10.0.2.0	/24	255.255.255.0	10.0.2.1	A

These allocations ensure every device on each floor has a unique IP while conserving address space.

🛠️ Server Allocation

- **DNS Server** – Located on Floor 1, serves all name resolution needs.
- **Email Server** – Located on Floor 2, hosts enterprise mail services.
- **DHCP Server** – Located on Floor 3, dynamically assigns IP addresses.
- **HTTP & FTP Servers** – Located on Floor 5 for web hosting and file transfers.

🔗 Inter-Router Backbone Networks

Used to link edge routers from each floor to a centralized core router:

Connection	Network	CIDR	Subnet Mask	Devices
Router_F1,2 - Core	192.168.0.0/30	/30	255.255.255.252	.1 ↔ .2
Router_F3,4 - Core	192.168.0.4/30	/30	255.255.255.252	.5 ↔ .6
Router_F5 - Core	192.168.0.8/30	/30	255.255.255.252	.9 ↔ .10

/30 subnets were chosen here to reduce IP waste, as only two usable IPs are needed per point-to-point link.

Routing Scheme Explanation

Routing Type: *Static Routing*
Reason for Choice: Static routing was preferred over dynamic protocols like RIP or OSPF due to the relatively fixed structure of the network. It provides faster packet delivery and is easy to configure for this small to medium-sized enterprise.

How Static Routing Works Here:

1. Each floor's router is connected to a centralized core router via a /30 backbone subnet.
2. All routers are manually configured with routes to reach all subnets via the core.
3. If a packet from Floor 1 needs to reach Floor 4, Router_F1,2 sends it to the Core, which forwards it to Router_F3,4, and then onto Floor 4's network.
4. Each router only needs knowledge of the networks beyond its local subnet, minimizing the routing table size.

Best Practices Followed

- **VLSM** used to match IP allocations with host requirements.
- **Static Routing** chosen for deterministic and low-latency performance.
- **Subnet Segmentation** improves security and broadcast domain control.
- **Star Topology** enhances reliability for top floors with heavier server load.
- **Server Distribution** reduces inter-floor traffic congestion.
- **Scalability Consideration** with hierarchical network design.

Summary

- **Total Hosts Supported**: 12,573
- **Total Subnetworks**: 8
- **Topologies Used**: 3 Bus + 2 Star
- **Routing Strategy**: Static via centralized Core Router
- **Routers Deployed**: 5 (3 Floor Routers + 2 Edge Routers)
- **Design Objectives**: Efficient IP usage, Scalability, Fault-Tolerance, Simplicity

Screenshots

Ping PC to PC

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 172.16.64.7

Pinging 172.16.64.7 with 32 bytes of data:

Request timed out.
Reply from 172.16.64.7: bytes=32 time=10ms TTL=127
Reply from 172.16.64.7: bytes=32 time=1ms TTL=127
Reply from 172.16.64.7: bytes=32 time<1ms TTL=127

Ping statistics for 172.16.64.7:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 3ms

C:\>ping 172.16.128.2

Pinging 172.16.128.2 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Reply from 172.16.128.2: bytes=32 time=10ms TTL=125

Ping statistics for 172.16.128.2:
    Packets: Sent = 4, Received = 1, Lost = 3 (75% loss),
Approximate round trip times in milli-seconds:
    Minimum = 10ms, Maximum = 10ms, Average = 10ms

C:\>ping 172.16.128.2

Pinging 172.16.128.2 with 32 bytes of data:

Reply from 172.16.128.2: bytes=32 time=18ms TTL=125
Reply from 172.16.128.2: bytes=32 time<1ms TTL=125
Reply from 172.16.128.2: bytes=32 time<1ms TTL=125
Reply from 172.16.128.2: bytes=32 time<1ms TTL=125

Ping statistics for 172.16.128.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 18ms, Average = 4ms
```

Ping PC to Router

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 172.16.0.1

Pinging 172.16.0.1 with 32 bytes of data:

Reply from 172.16.0.1: bytes=32 time<1ms TTL=253
Reply from 172.16.0.1: bytes=32 time<1ms TTL=253
Reply from 172.16.0.1: bytes=32 time<1ms TTL=253
Reply from 172.16.0.1: bytes=32 time<1ms TTL=253

Ping statistics for 172.16.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.168.0.6

Pinging 192.168.0.6 with 32 bytes of data:

Reply from 192.168.0.6: bytes=32 time<1ms TTL=254
Reply from 192.168.0.6: bytes=32 time<1ms TTL=254
Reply from 192.168.0.6: bytes=32 time<1ms TTL=254
Reply from 192.168.0.6: bytes=32 time<1ms TTL=254

Ping statistics for 192.168.0.6:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Router to Router

Router_F-5

Physical Config CLI Attributes

IOS Command Line Interface

```
Compiled Wed 18-Jul-07 04:52 by pt_team
Image text-base: 0x2100F918, data-base: 0x24729040

This product contains cryptographic features and is subject to United
States and local country laws governing import, export, transfer and
use. Delivery of Cisco cryptographic products does not imply
third-party authority to import, export, distribute or use encryption.
Importers, exporters, distributors and users are responsible for
compliance with U.S. and local country laws. By using this product you
agree to comply with applicable laws and regulations. If you are unable
to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be found at:
http://www.cisco.com/wwl/export/crypto/tool/stqrg.html

If you require further assistance please contact us by sending email to
export@cisco.com.

Cisco CISCO2911/K9 (revision 1.0) with 491520K/32768K bytes of memory.
Processor board ID FTX152400KS
3 Gigabit Ethernet interfaces
DRAM configuration is 64 bits wide with parity disabled.
255K bytes of non-volatile configuration memory.
249856K bytes of ATA System CompactFlash 0 (Read/Write)

Press RETURN to get started!


%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up


Router>enable
Router#ping 192.168.0.10

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.0.10, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms
```