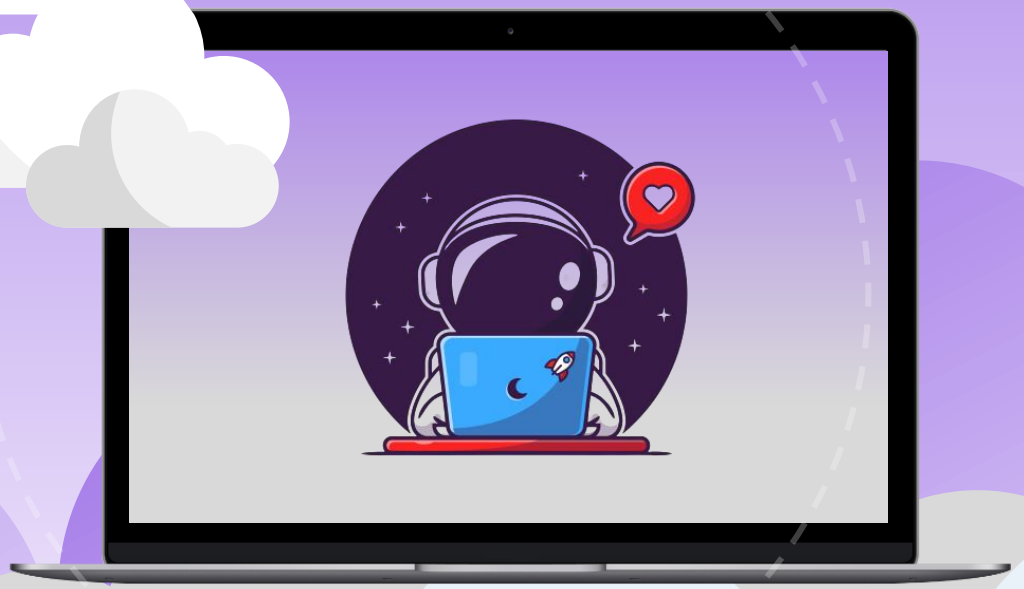
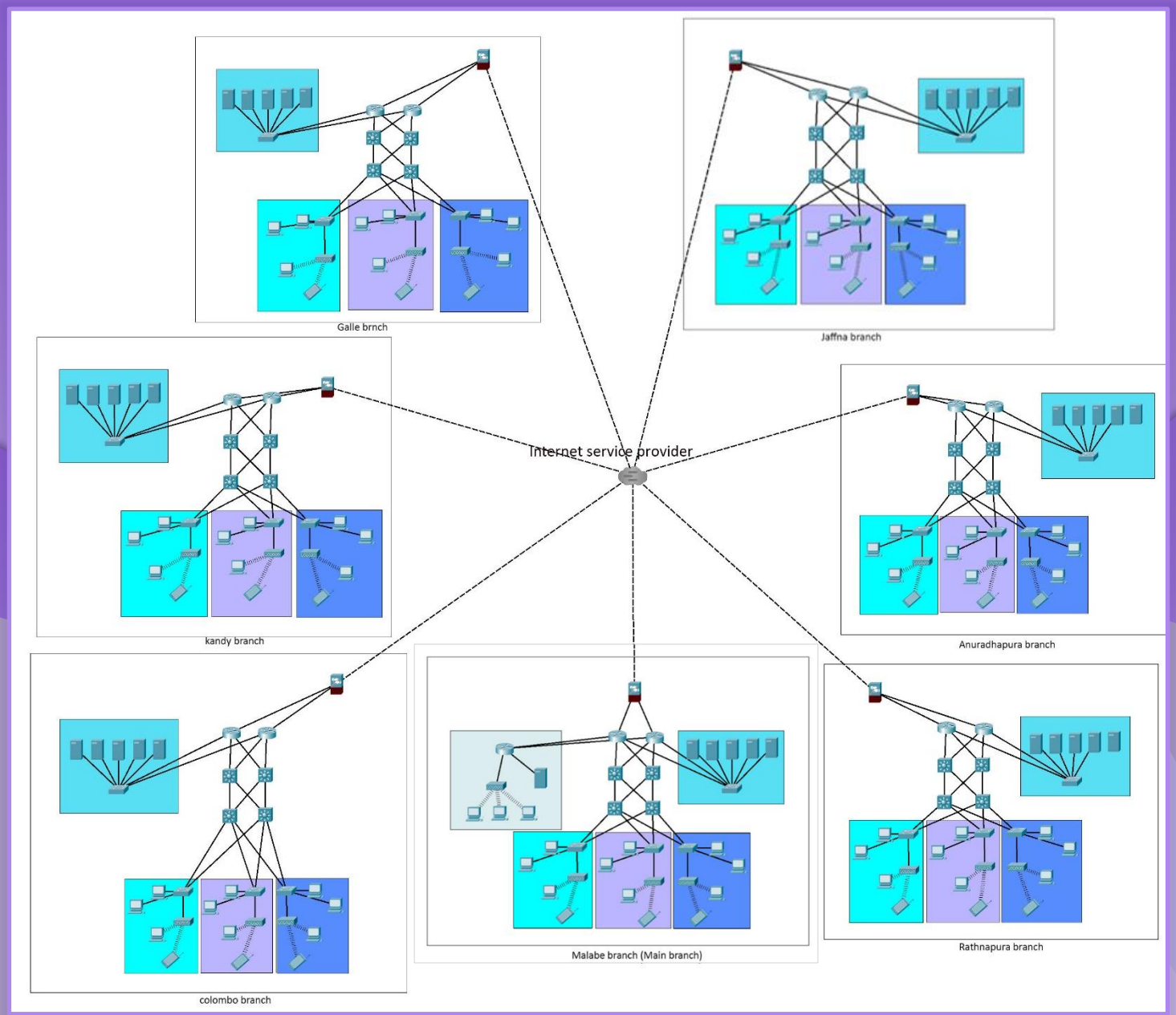
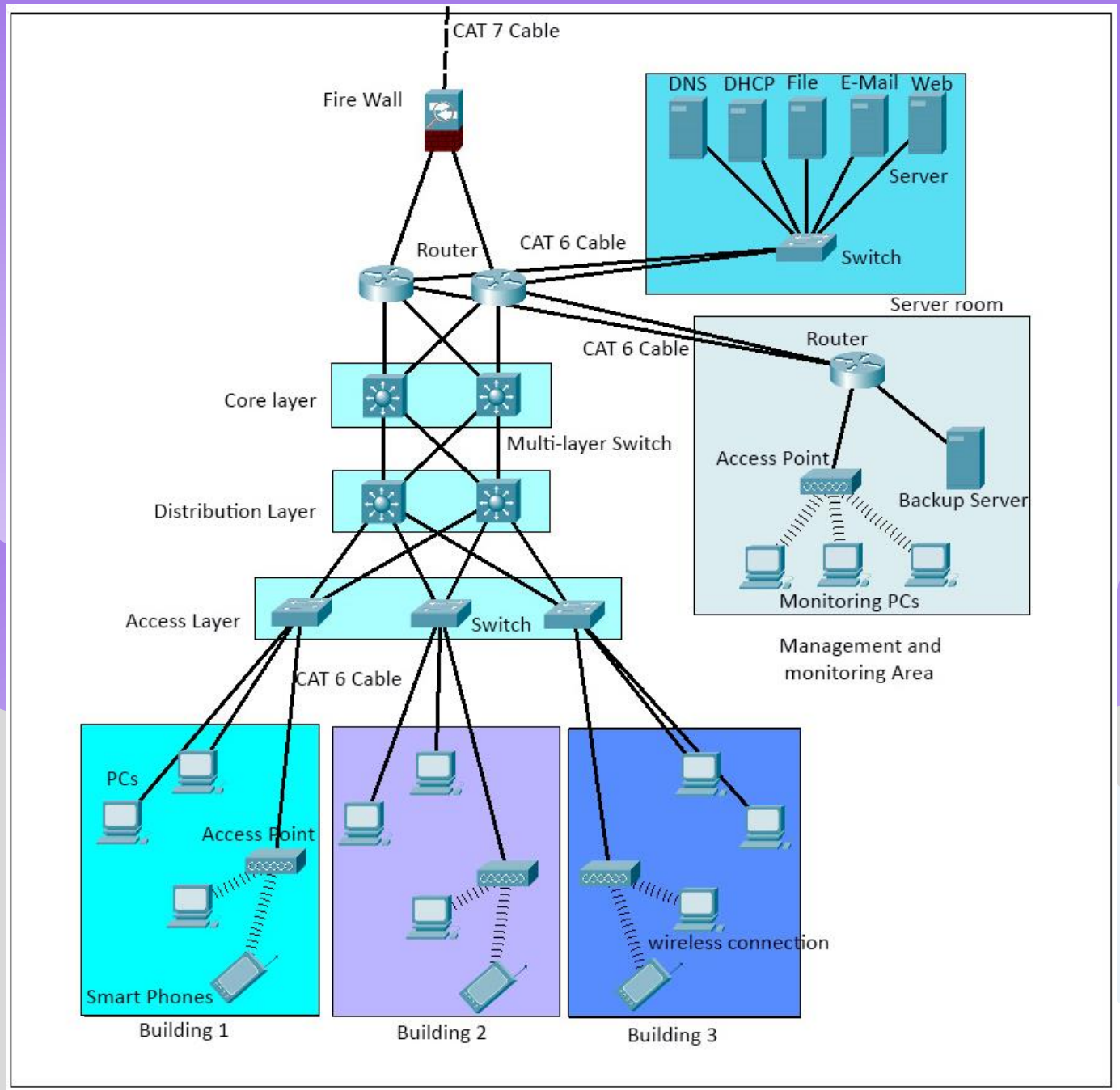
Network Design for XYZ University

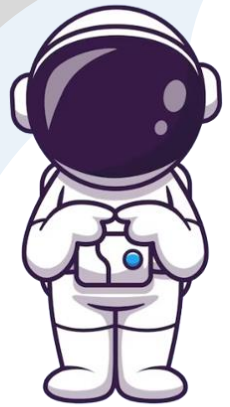


Topology Diagram

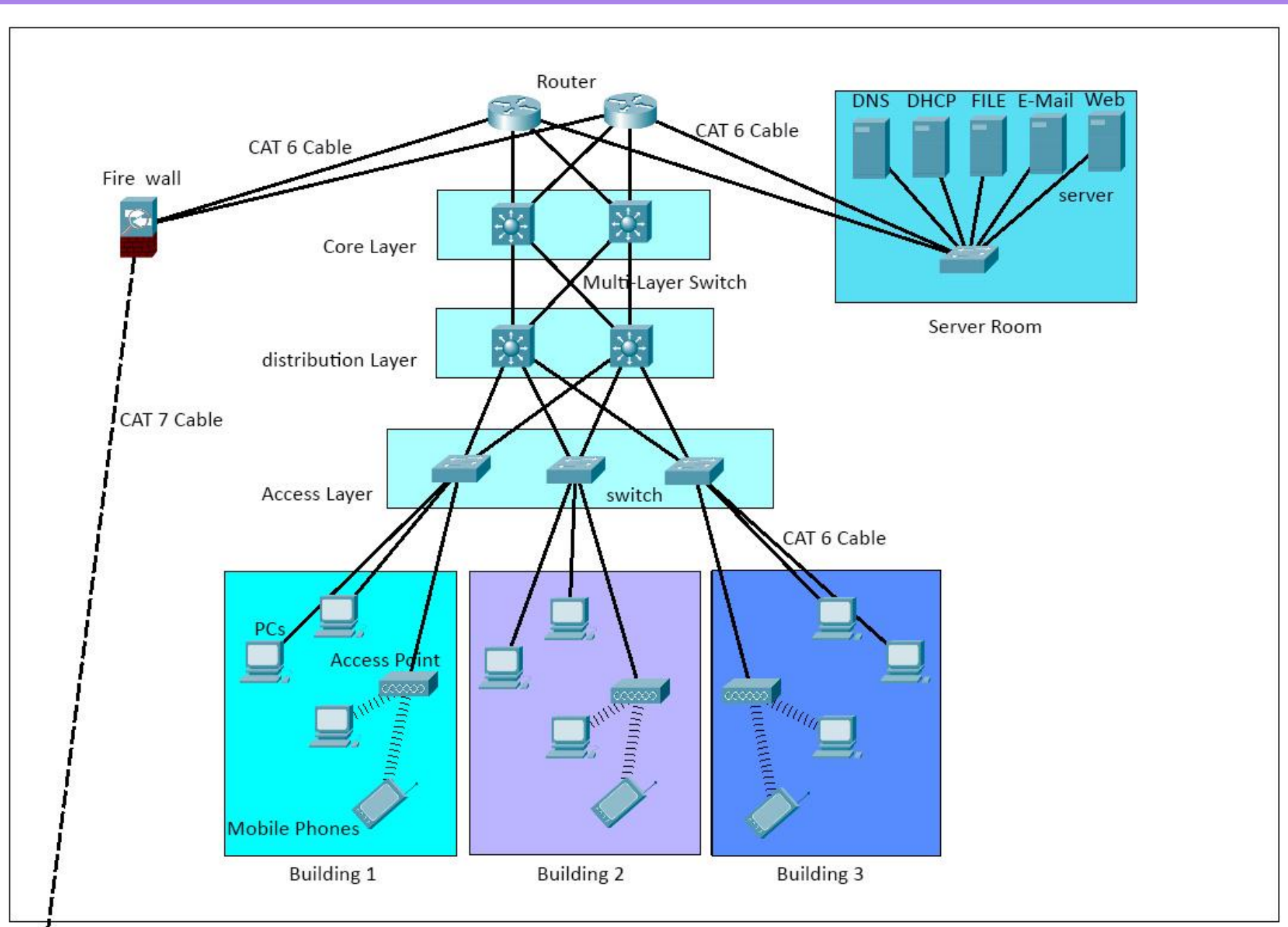


Main Branch (Malabe)

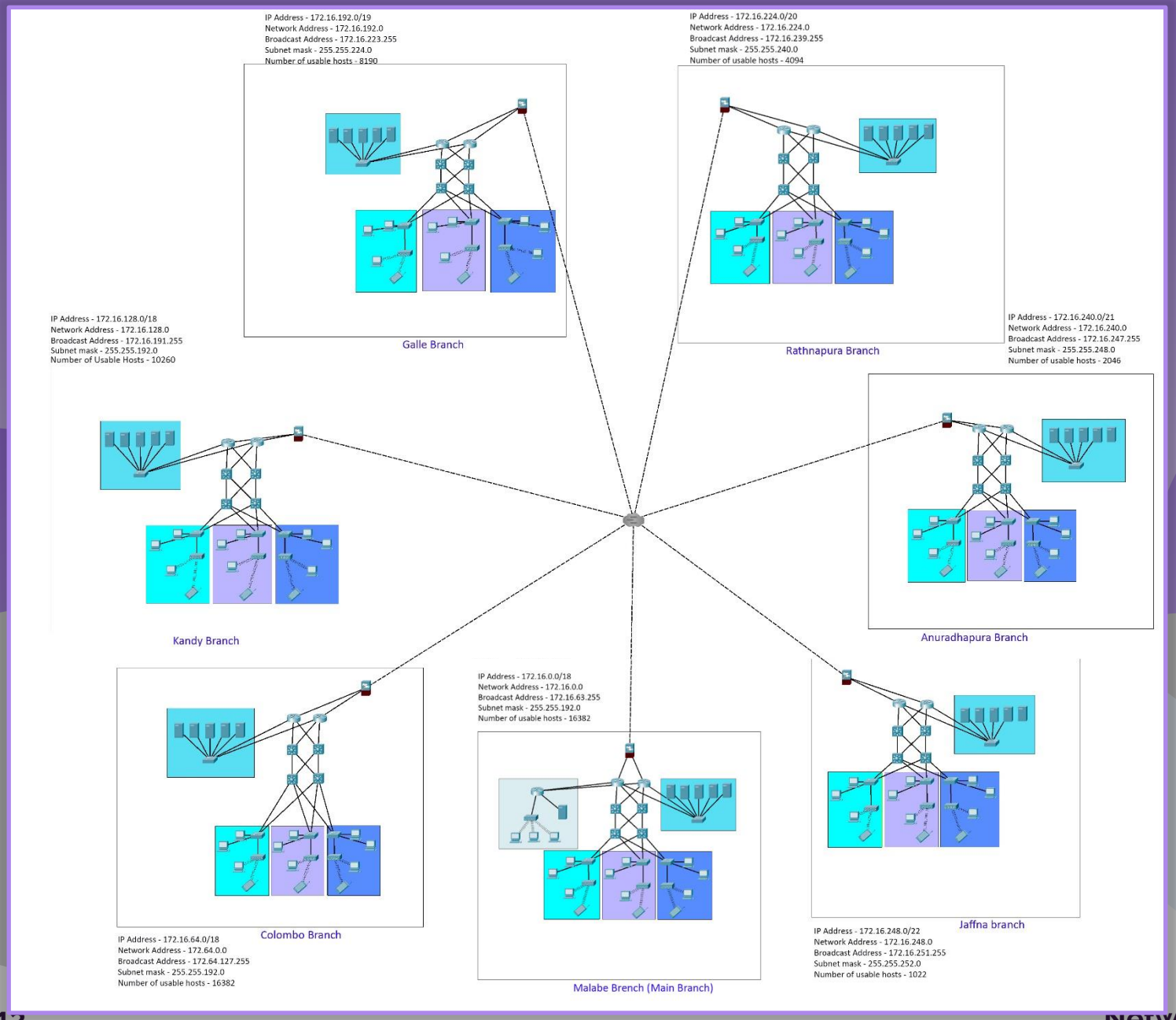


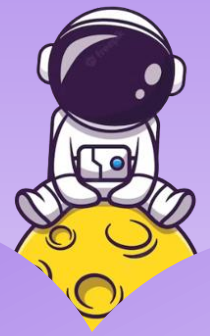


Regular Branch



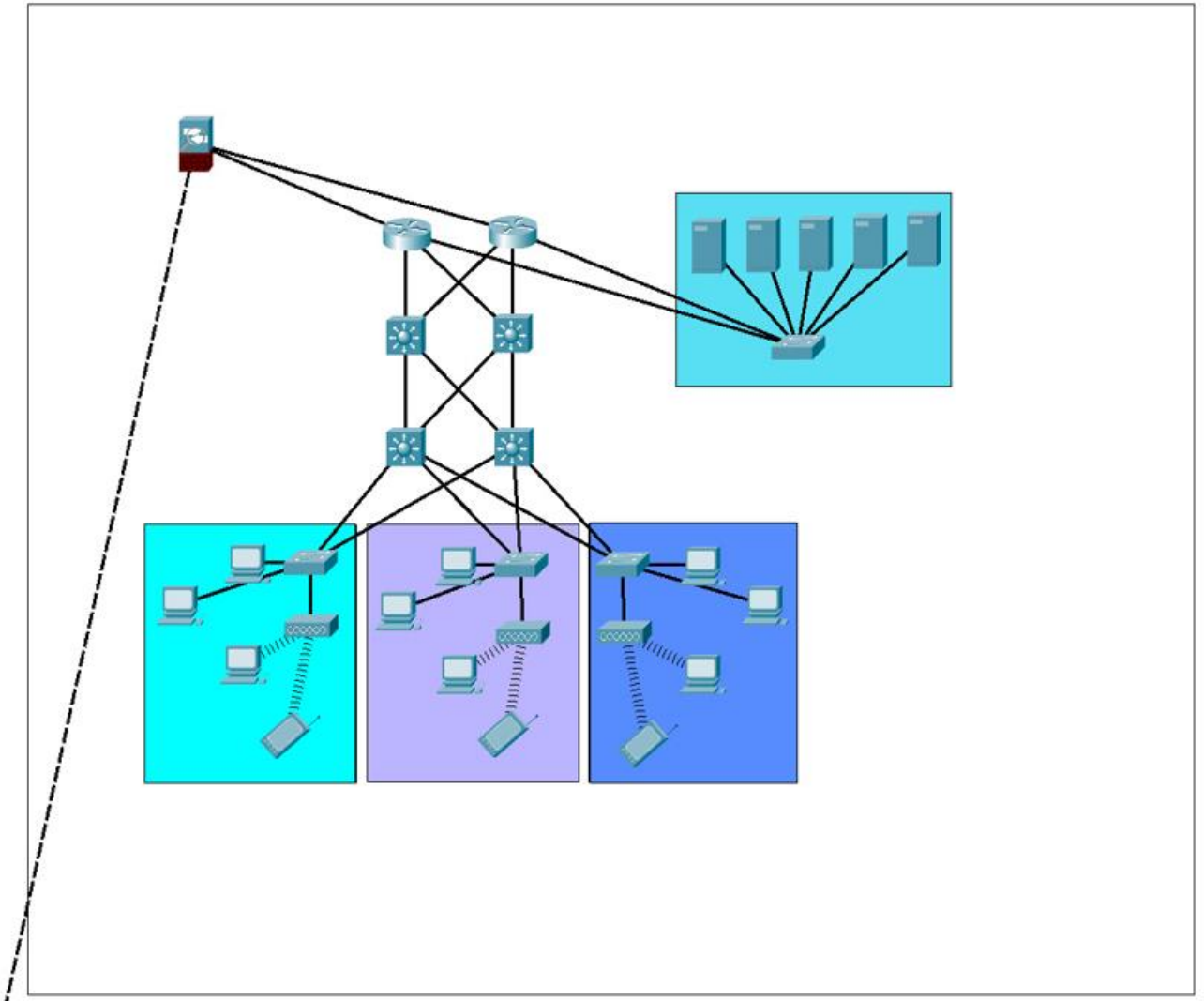
01. Logical Topology Diagram





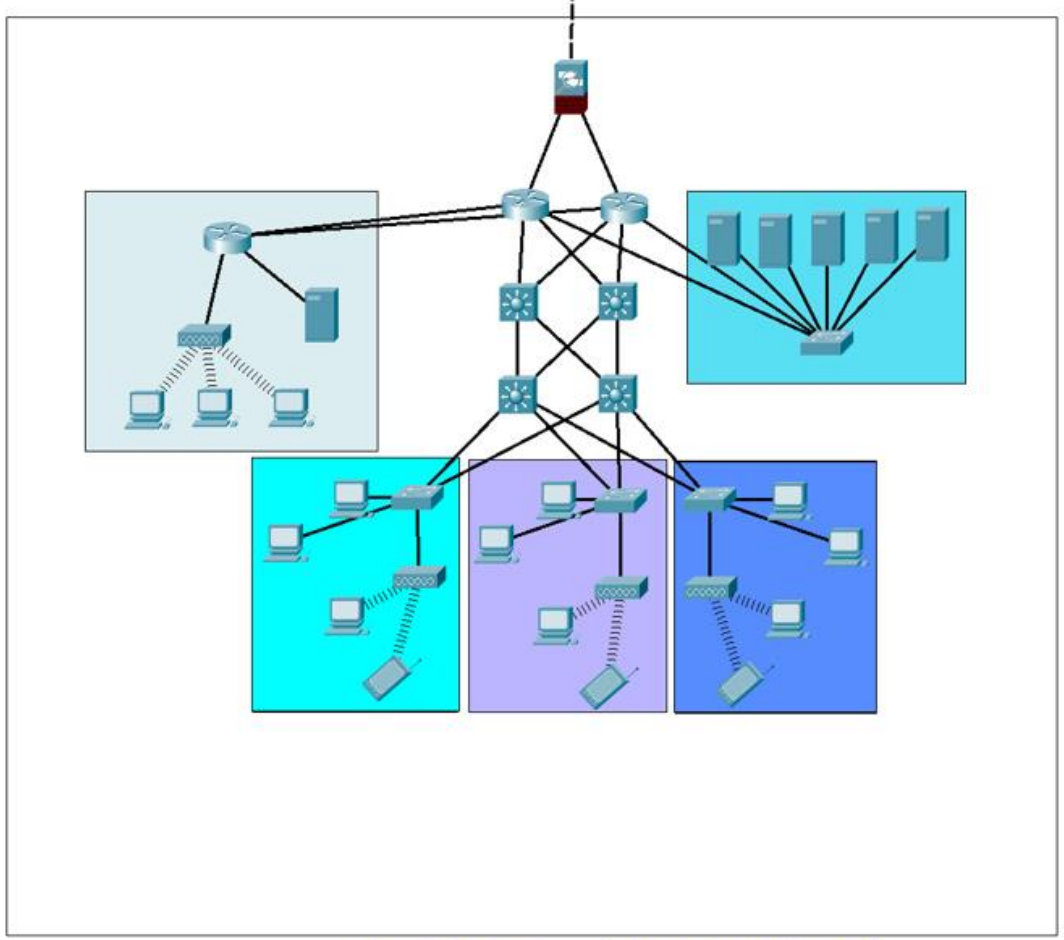
Logical - Regular Branch

IP Address - 172.16.224.0/20
Network Address - 172.16.224.0
Broadcast Address - 172.16.239.255
Subnet mask - 255.255.240.0
Number of usable hosts - 4094



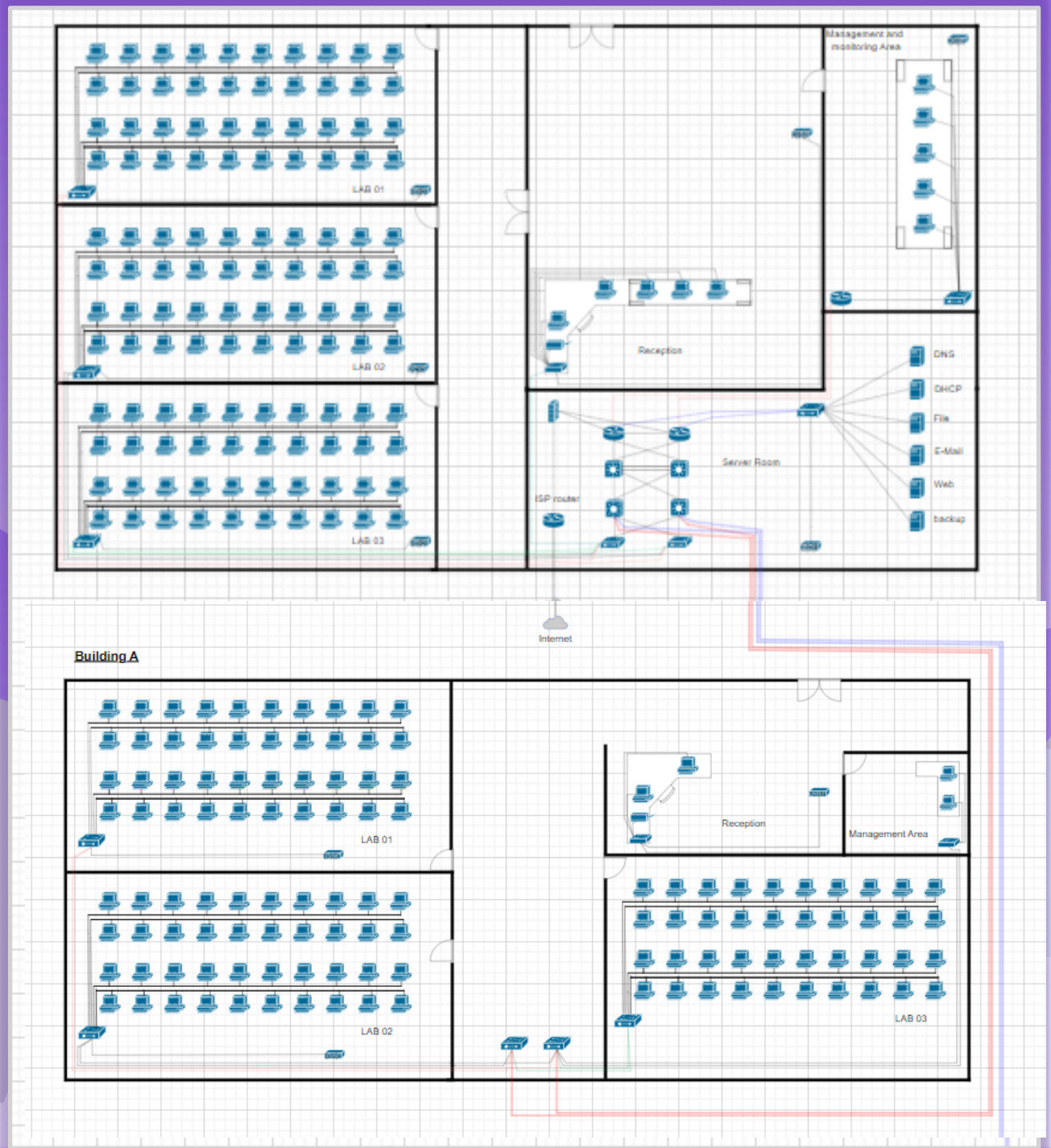
Logical - Main Branch

IP Address - 172.16.0.0/18
Network Address - 172.16.0.0
Broadcast Address - 172.16.63.255
Subnet mask - 255.255.192.0
Number of usable hosts - 16382

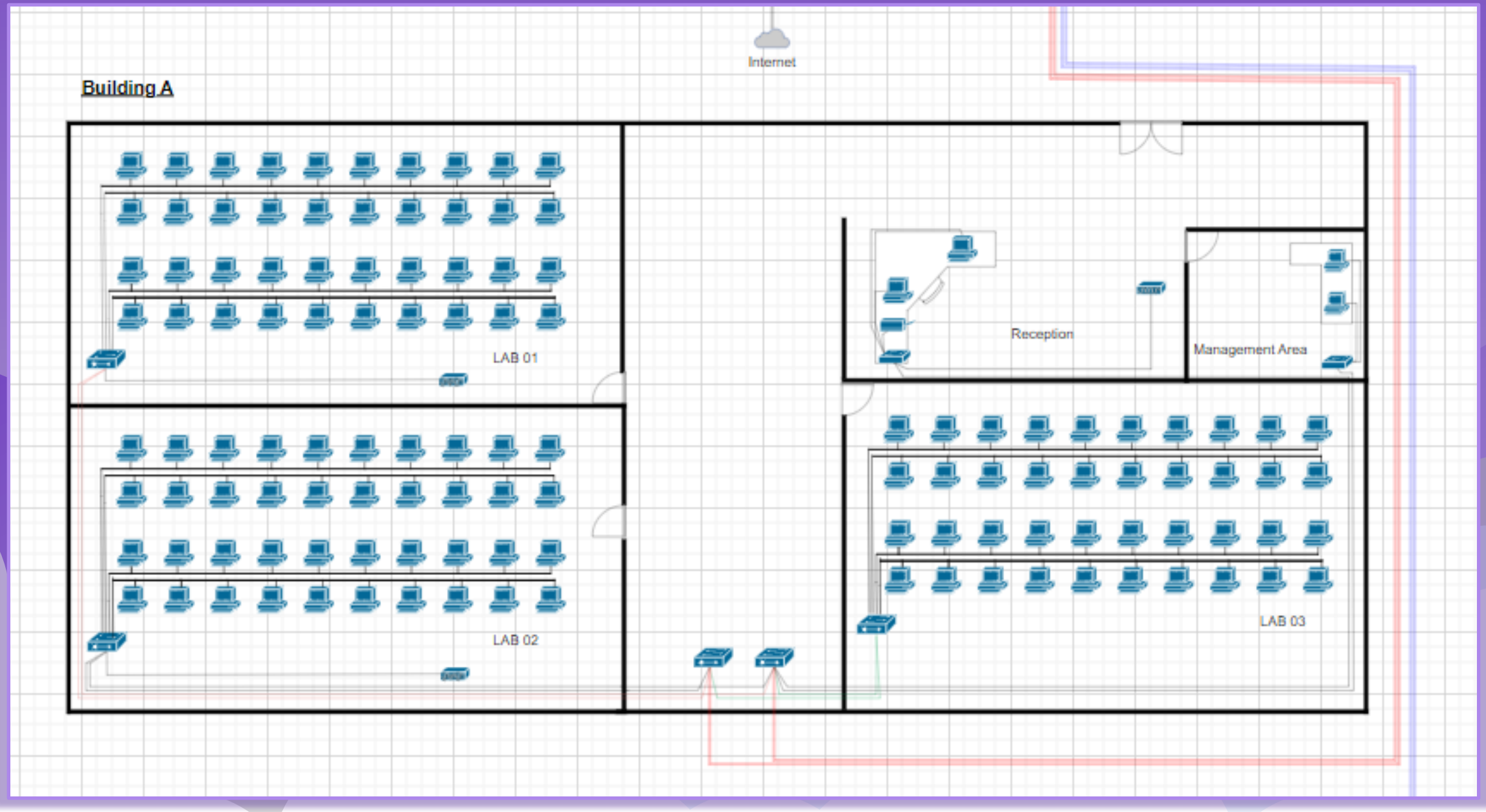


Malabe Brench (Main Branch)

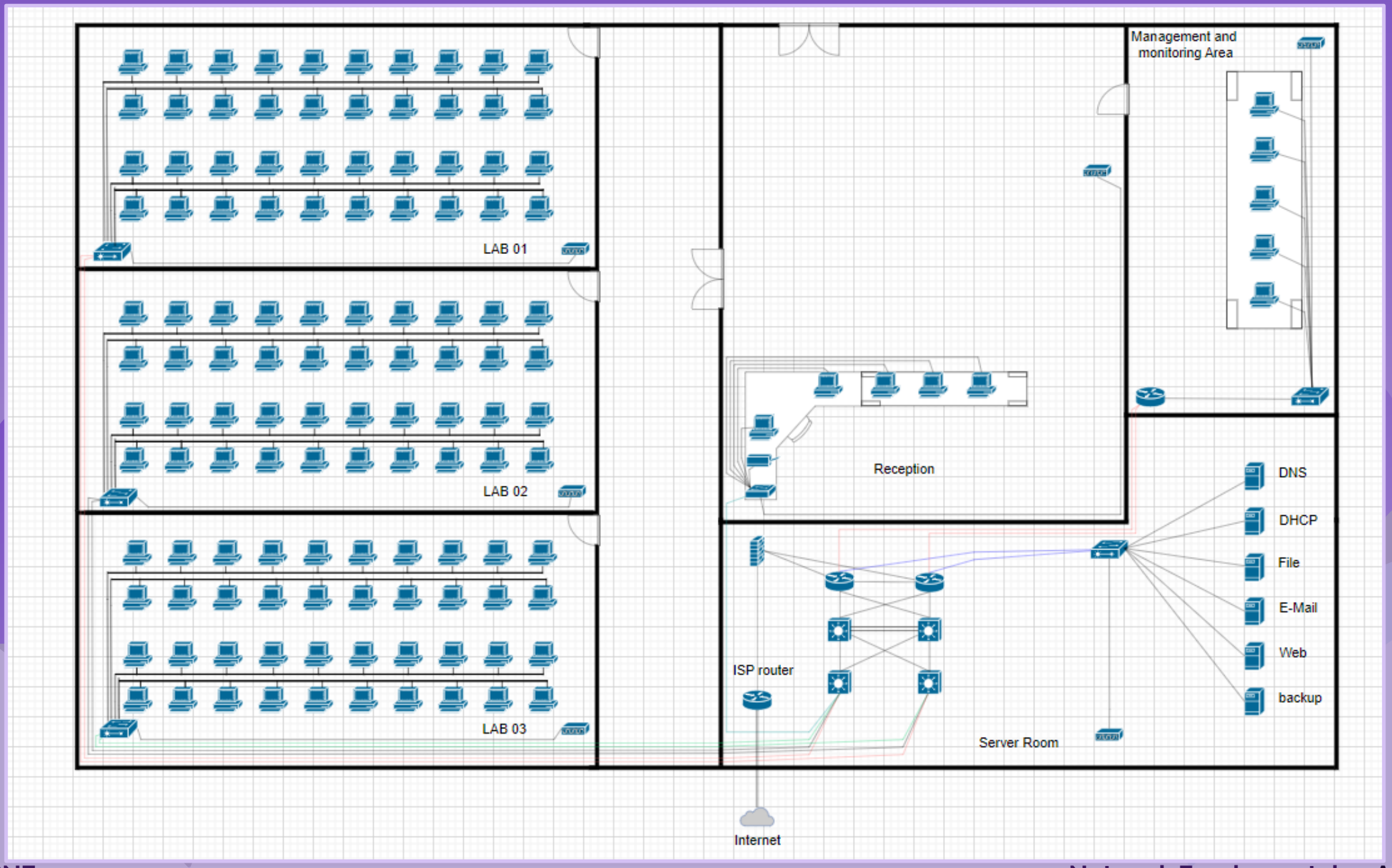
02.
Physical Diagram



Physical Sub Branch



02.Physical Diagram of Main branch main building



03. Appropriate devices for the design

Multilayer Switch

Switch C9500-24Y4C-A

Advanced Security

- ✓ These include integrated security features like TrustSec, MACsec encryption, Cisco DNA Center for policy-based security automation, and Secure Group Tagging (SGT) for segmentation and access control.

High Availability

- ✓ Features like Nonstop Forwarding (NSF) and Stateful Switchover (SSO) provide seamless failover and rapid convergence in case of hardware or software failures

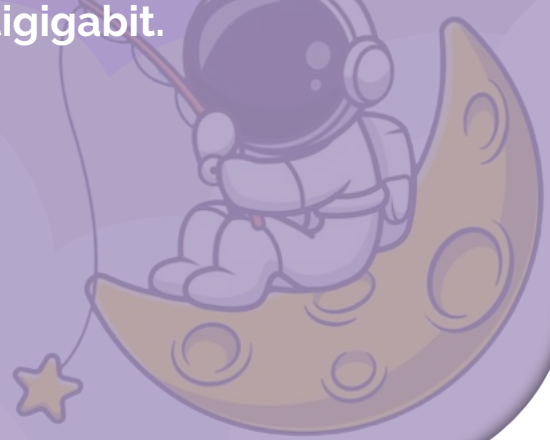
Software-Defined Networking (SDN) Support

- ✓ SD-Access enables policy-based network segmentation, automation of network configurations, and simplified management through Cisco DNA Center.

Regular Switch

Catalyst 9300X copper

- ✓ Designed for secure high-speed access, aggregation, and lean branch 24- or 48-port 10G multigigabit.



	Multilayer Switch	Regular Switch
• Layer Support	✓ Supports Layer 2 switching and Layer 3 routing	✓ Supports Layer 2 switching only
• Scalability	✓ Suitable for large networks with thousands of hosts	✓ Suitable for smaller networks with fewer hosts
• Quality Of Services (QoS)	✓ Advanced QoS features for traffic prioritization	✓ Basic QoS features or limited/no QoS support
• Security Features	✓ Offers more advanced security Features like ACLs	✓ Basic security features

Servers

DHCP Server

- Cisco IOS DHCP Server

DHCP is widely used in LAN environments to dynamically assign host IP addresses from a centralized server, which significantly reduces the overhead of administration of IP addresses. DHCP also helps conserve the limited IP address space because IP addresses no longer need to be permanently assigned to hosts; only those hosts that are connected to the network consume IP addresses.

- **Redundancy**
  - Evaluate whether data redundancy (RAID) is necessary for data protection and high availability.
- **Scalability**
  - Determine if the server or NAS device can accommodate future storage expansion as your data requirements increase.
- **Security**
  - Look for features such as access controls, encryption, and user authentication to secure the stored data.

DNS(Domain Name System) server

- OpenDNS is a paid DNS service that is offered by OpenDNS. It is a more expensive option than Google Public DNS or Cloudflare DNS, but it offers a wider range of features. OpenDNS offers a number of features that can improve the performance and security of your network, such as malware filtering, parental controls, and content filtering.

File Server

NetApp FAS :

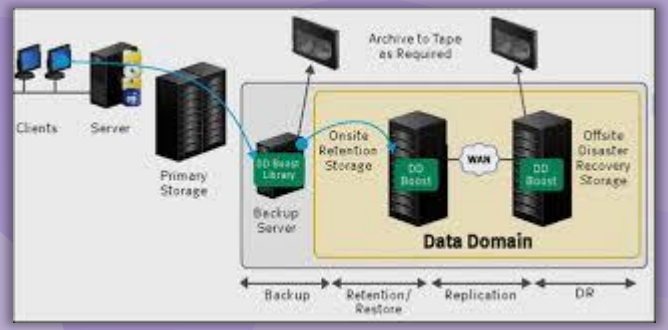
- ✓ NetApp FAS is a high-performance, scalable file server that is designed for enterprise environments. It offers a wide range of features, including high availability, data protection, and scalability.

Email Server

Microsoft Exchange Server

- Microsoft Exchange Server is a commercial email server that is integrated with other Microsoft products. It is a good choice for organizations that use Microsoft products.

Backup Server



Dell EMC Data Domain:

- Dell EMC Data Domain is a high-performance, scalable backup server that is designed for enterprise environments. It offers a wide range of features, including data deduplication, compression, and replication.

Web Server

IIS

- IIS is a web server developed by Microsoft and is used by many large organizations. It is known for its integration with other Microsoft products and its support for a wide range of web technologies

Router

Cisco ISR 4221 Router

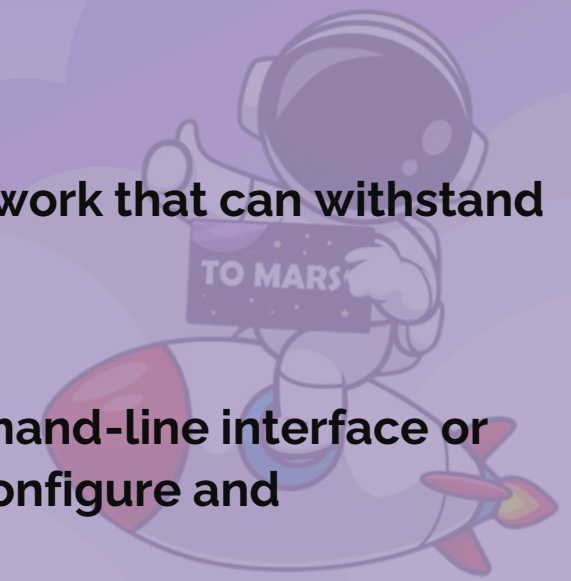
- Up to 75 Mbps of aggregate throughput
- Up to 8 GB of flash memory
- Up to 4 GB of RAM
- Supports multiple WAN interfaces
  - This allows you to connect to multiple ISPs or to create a resilient network that can withstand a single point of failure
- Easy to manage
  - The Cisco ISR 4221 Router is easy to manage using the Cisco IOS command-line interface or the Cisco Network Assistant graphical user interface. This makes it easy to configure and troubleshoot your network.

✓ **Security Features**

- VPN support: IPsec and SSL
- Firewall features: Stateful inspection, ACL support, and zone-based firewall

✓ **Routing and Protocol Support:**

- IPv4 and IPv6 support



Firewall

Cisco ASA Fire wall

- A hardware firewall is a physical device that sits between your internal network and the internet. It is designed to filter and block incoming and outgoing traffic , and to protect your network from unauthorized access.

- ✓ The Cisco ASA firewall is a security device that combines firewall, antivirus, intrusion prevention, and virtual private network (VPN) capabilities. It provides proactive threat defense that stops attacks before they spread through the network.

Access Point

Ruckus R610

- **Maximum Data Rates**
  - Up to 1.7 Gbps (combined)
- **Concurrent Users**
  - Up to 512 (recommended maximum)
- **Power over Ethernet**
  - PoE 802.3af/at
- **Security**
  - WPA2/WPA3 encryption, client isolation, rogue AP detection

04. Media Types

- **Copper Cables:**
  - Cost-effective and provide reliable connectivity over shorter distances.
  - Support high-speed data transfer rates
- **Wireless Antennas:**
  - useful for providing connectivity to devices that are difficult to connect with cables, such as IoT devices
  - secured with encryption and authentication to prevent unauthorised access and cyberattack

05. LAN Technologies

Ethernet

- Provide reliable and high-speed connectivity for devices within a local area network.
- Widely used and has proven effective in supporting many users and devices.

Wi-Fi

- Provide flexibility and mobility for devices within a local area network.
- Essential for supporting mobile devices such as laptops and smartphones.

05. WAN Technologies

MPLS

- Multi-Protocol Label Switching.
- provide reliable and secure connectivity
- It can prioritize traffic and ensure that data is delivered quickly and efficiently.

VPN

- Virtual Private Networks are a secure way to connect remote locations and users to the university's network
- provide encryption and authentication to prevent unauthorized access and cyberattacks.

06. Protocols for each Layer

01. Application Layer

- HTTP/HTTPS : for web browsing and online services
- SMTP/IMAP/POP3 : for email communication
- DNS : for domain name resolution

02. Presentation Layer

- SSL/TLS : for secure data transmission
- JPEG/PNG : for image compression and rendering
- MPEG : for video compression and rendering

03. Session Layer

- SIP : for session initiation and management
- RTP : for real-time multimedia transmission
- NetBIOS : for network communication between computers

06. Protocols for each Layer

04. Transport Layer

- TCP : for reliable and ordered transmission of data
- UDP : for fast and unreliable transmission of data

05. Presentation Layer

- IP : for addressing and routing of data packets
- ICMP : for error reporting and network troubleshooting
- OSPF : for dynamic routing and network topology discovery

06. Data Link Layer

- Ethernet : for wired network connectivity
- Wi-Fi : for wireless network connectivity
- PPP : for point-to-point network connections

07. Physical Layer

- Copper cables : for short-distance data transmission
- Wireless antennas : for wireless network connectivity

07. IP addressing schema to interconnect all the branches by using an appropriate private IP address range

Number of hosts in XYZ campuses - > 55700

Chosen major IP = class B -> 172.16.0.0 / 16

Branch Name	Allocated hosts
A	15350
B	14940
C	10260
D	8050
E	4070
F	2030
G	1000

Subnets	Required IPs	Required bits	Reason
A	15350	14	$2^{14} - 2 > 15350$
B	14940	14	$2^{14} - 2 > 14940$
C	10260	14	$2^{14} - 2 > 10260$
D	8050	13	$2^{13} - 2 > 8050$
E	4070	12	$2^{12} - 2 > 4070$
F	2030	11	$2^{11} - 2 > 2030$
G	1000	10	$2^{10} - 2 > 1000$

A branch

To get 15350 IP addresses need allocate 14 hosts bits.

172 . 16 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

Then there will be 2 subnet bits.

1. 172 . 16 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0
2. 172 . 16 . 0 1 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0
3. 172 . 16 . 1 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0
4. 172 . 16 . 1 1 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

We allocate 172 . 16 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0 to branch A.

We can allocate IP addresses for branches by using VLSM

A – 172.16.0000 0000.0000 0000 → 172.16.0.0 /18

B – 172.16.0100 0000.0000 0000 → 172.16.64.0 /18

C – 172.16.1000 0000.0000 0000 → 172.16.128.0 /18

D – 172.16.1100 0000.0000 0000 → 172.16.192.0 /19

E – 172.16.1110 0000.0000 0000 → 172.16.224.0 /20

F – 172.16.1111 0000.0000 0000 → 172.16.240.0 /21

G – 172.16.1111 1000.0000 0000 → 172.16.248.0 /22

Branch	Address	Available range	Broadcast domain
A	172.16.0.0 / 18	172.16.0.1 - 172.16.63.254	172.16.63.255
B	172.16.64.0 / 18	172.16.64.1 - 172.16.127.254	172.16.127.255
C	172.16.128.0 / 18	172.16.128.1 - 172.16.191.254	172.16.191.255
D	172.16.192.0 / 19	172.16.192.1 - 172.16.223.254	172.16.223.255
E	172.16.224.0 / 20	172.16.224.1 - 172.16.239.254	172.16.239.255
F	172.16.240.0 / 21	172.16.240.1 - 172.16.247.254	172.16.247.255
G	172.16.248.0 / 22	172.16.248.1 - 172.16.251.254	172.16.251.255

Thank You!

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