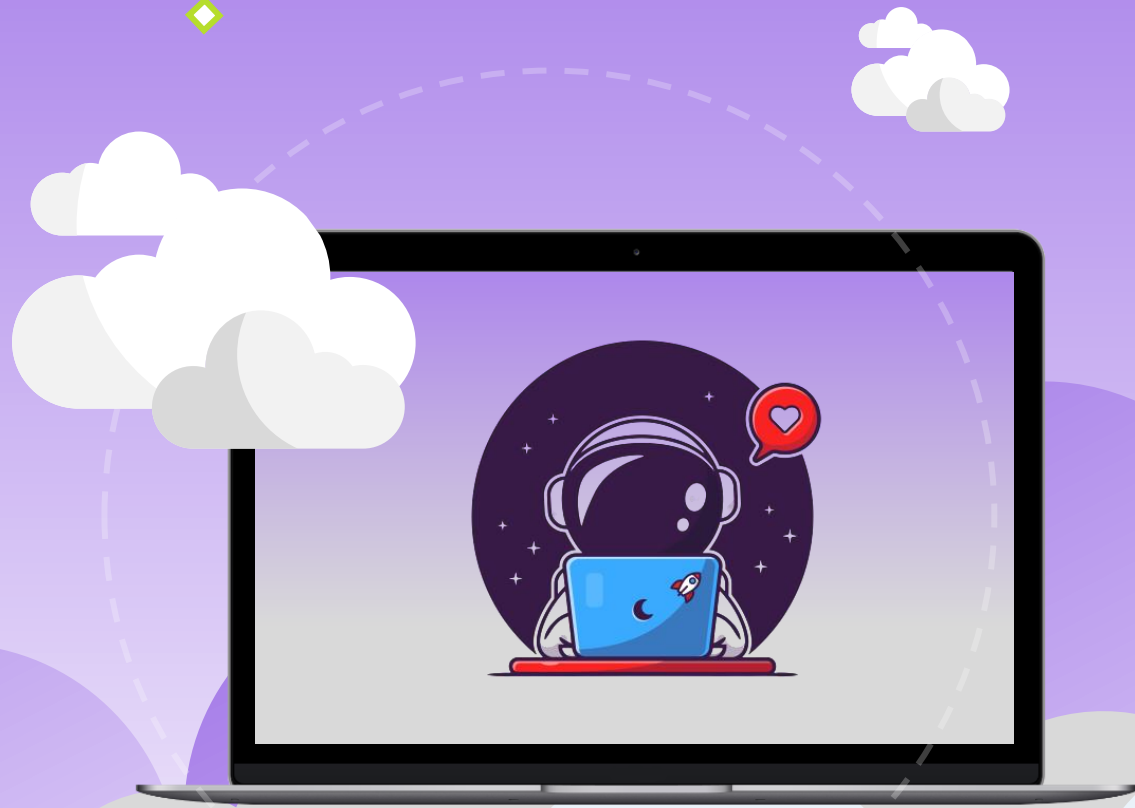


# Network Design for XYZ University

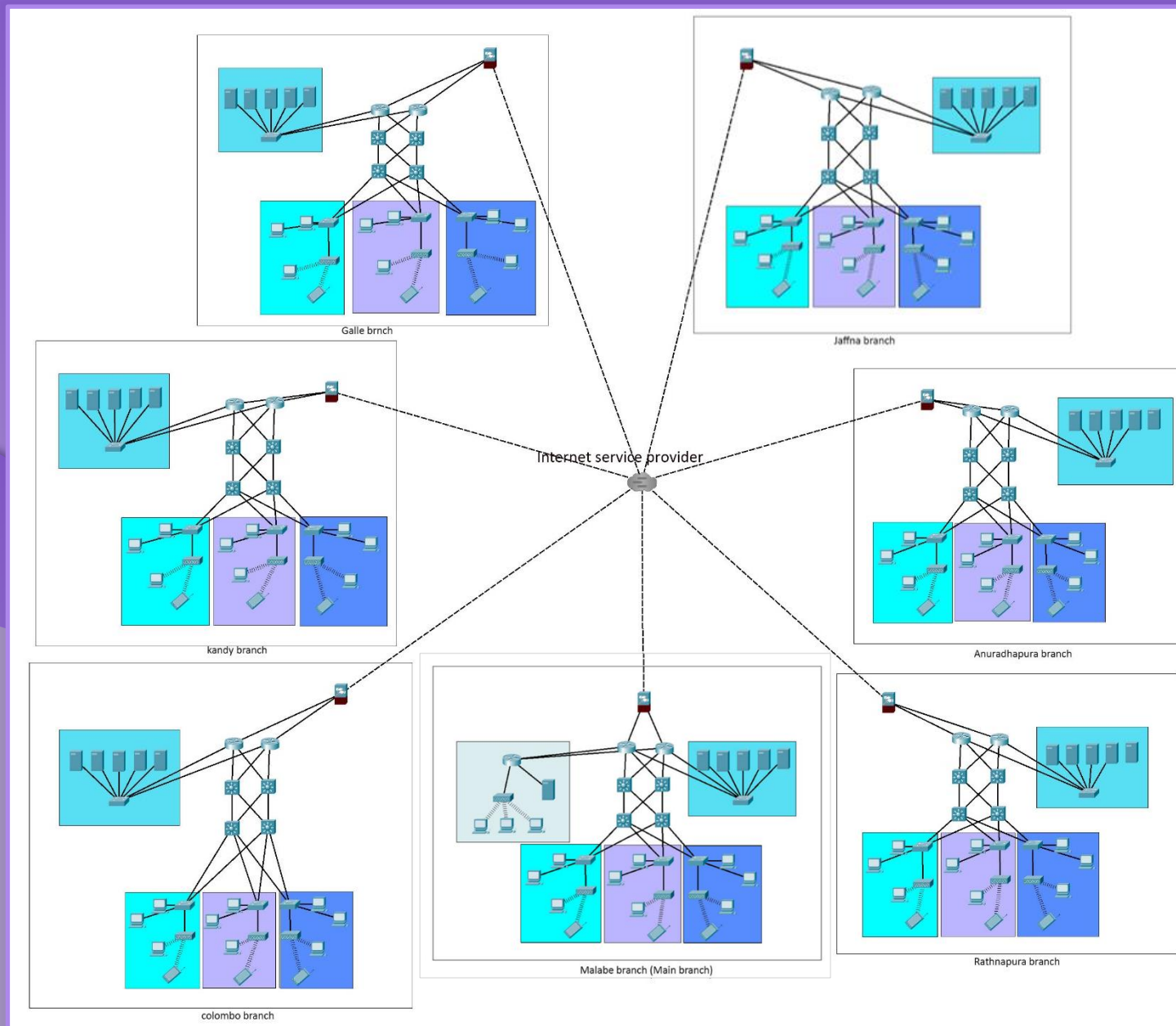


# Group Members 😎

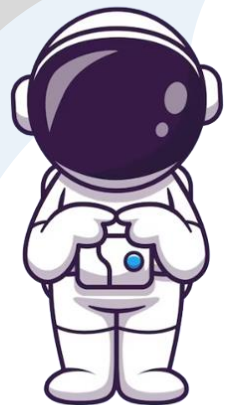
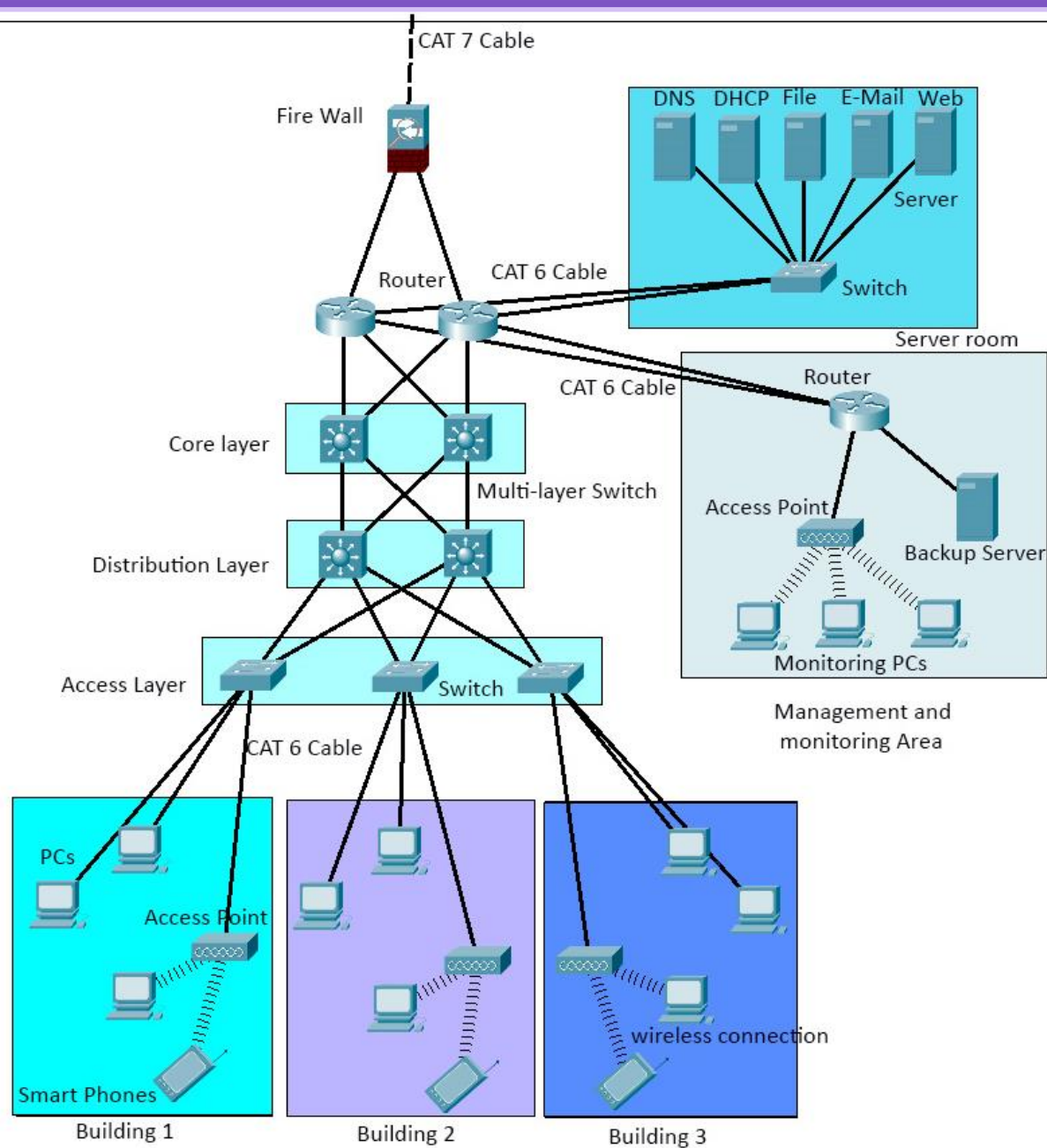
1. IT22360250 – Gavishka Sahan
2. IT22895264 – Kavisha Rajapaksha
3. IT22365200 – Ranagana Wijesinghe
4. IT22360328 – Chanika Gayashan
5. IT22344342 – Ravishka Lakshan



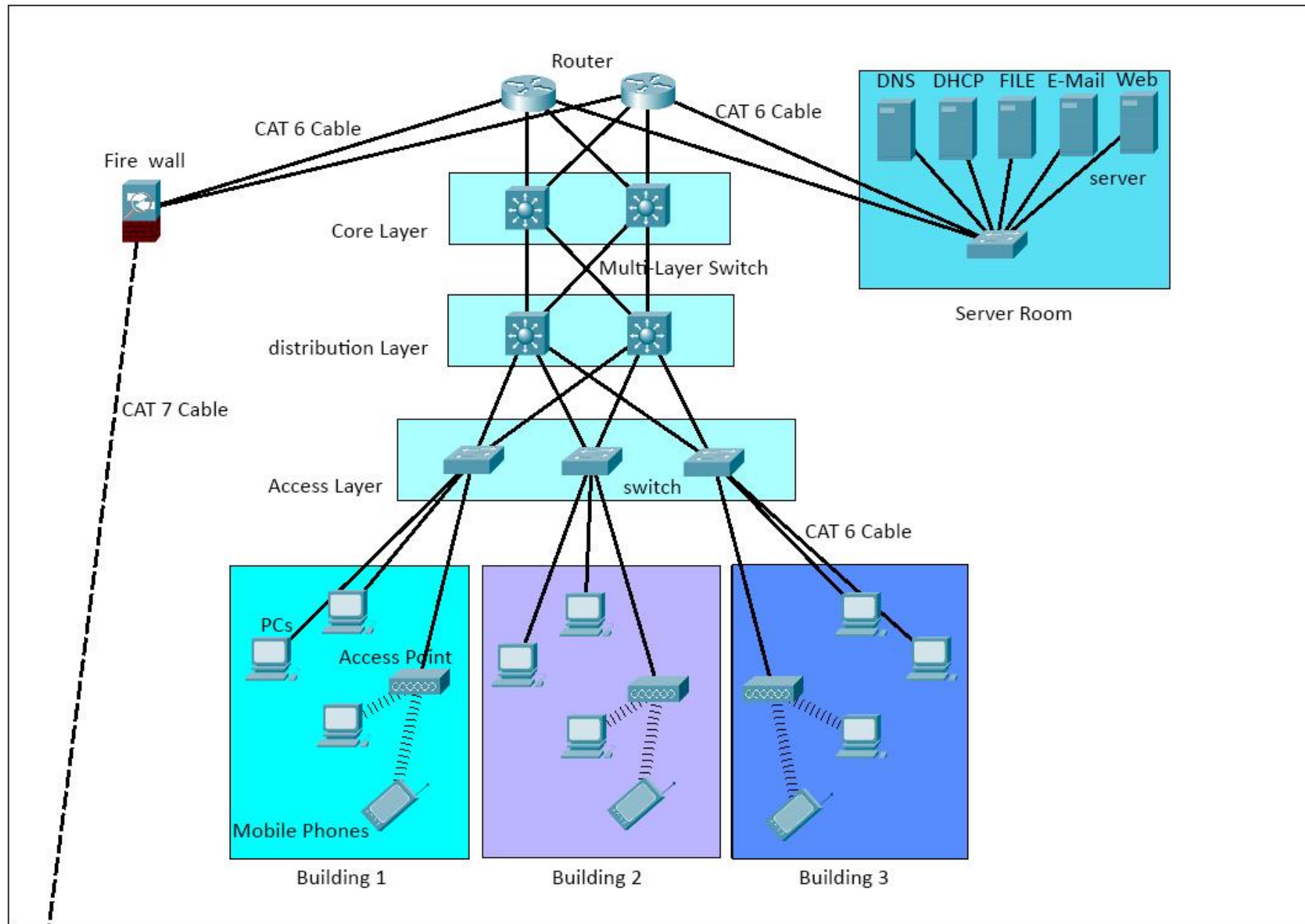
# Topology Diagram



# Main Branch (Malabe)

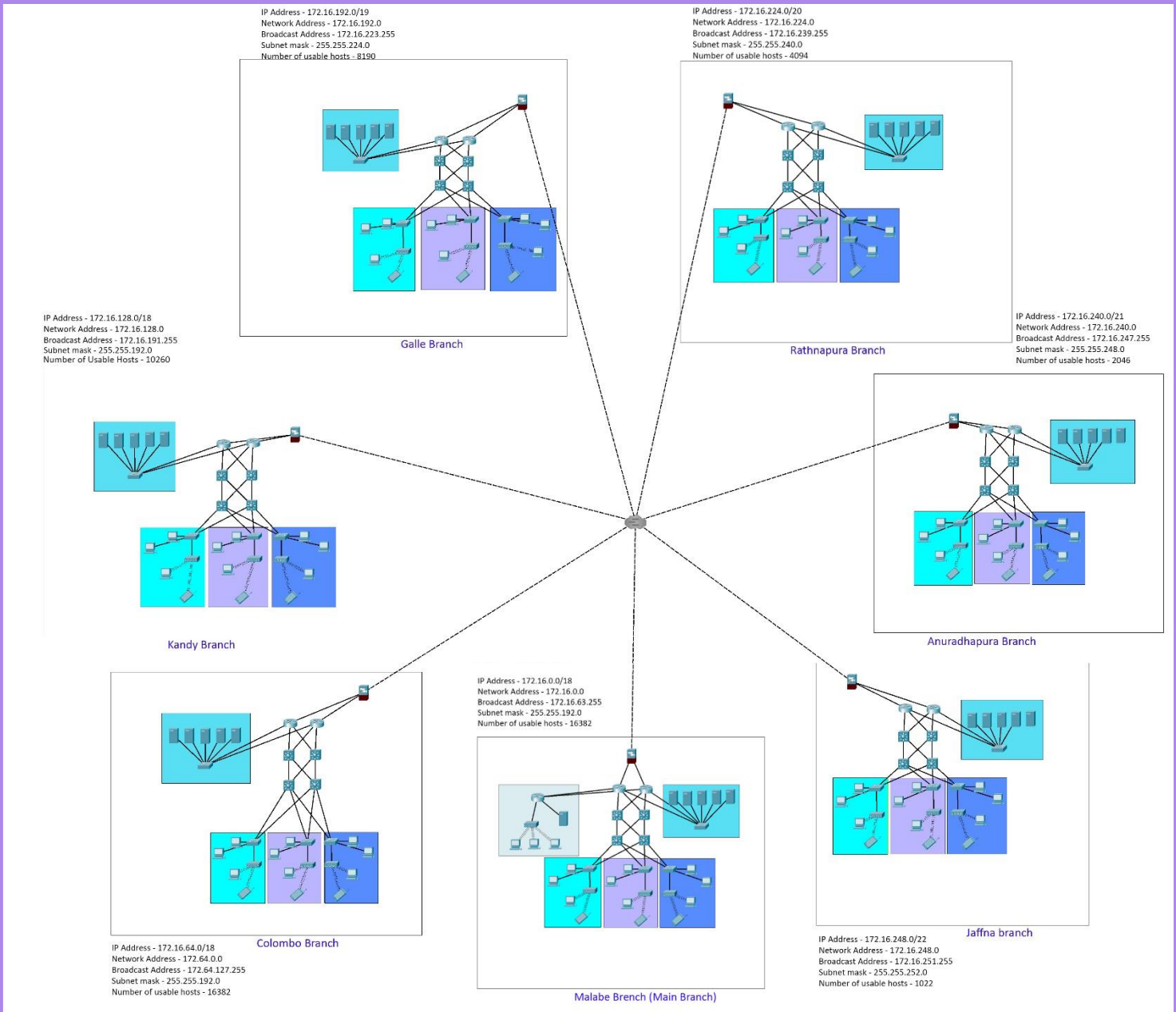


# Regular Branch





# 01. Logical Topology Diagram



# Logical - Regular Branch

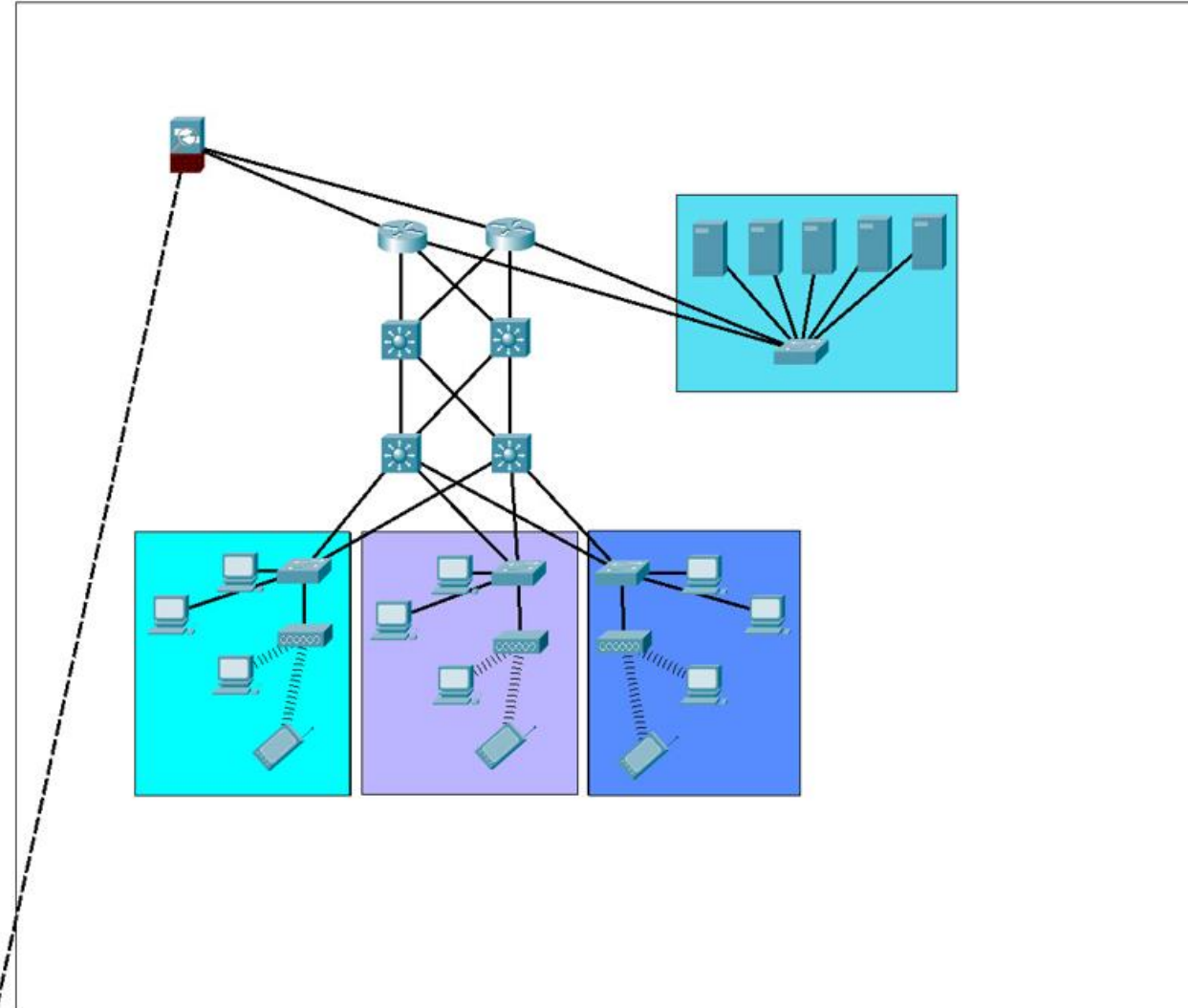
IP Address - 172.16.224.0/20

Network Address - 172.16.224.0

Broadcast Address - 172.16.239.255

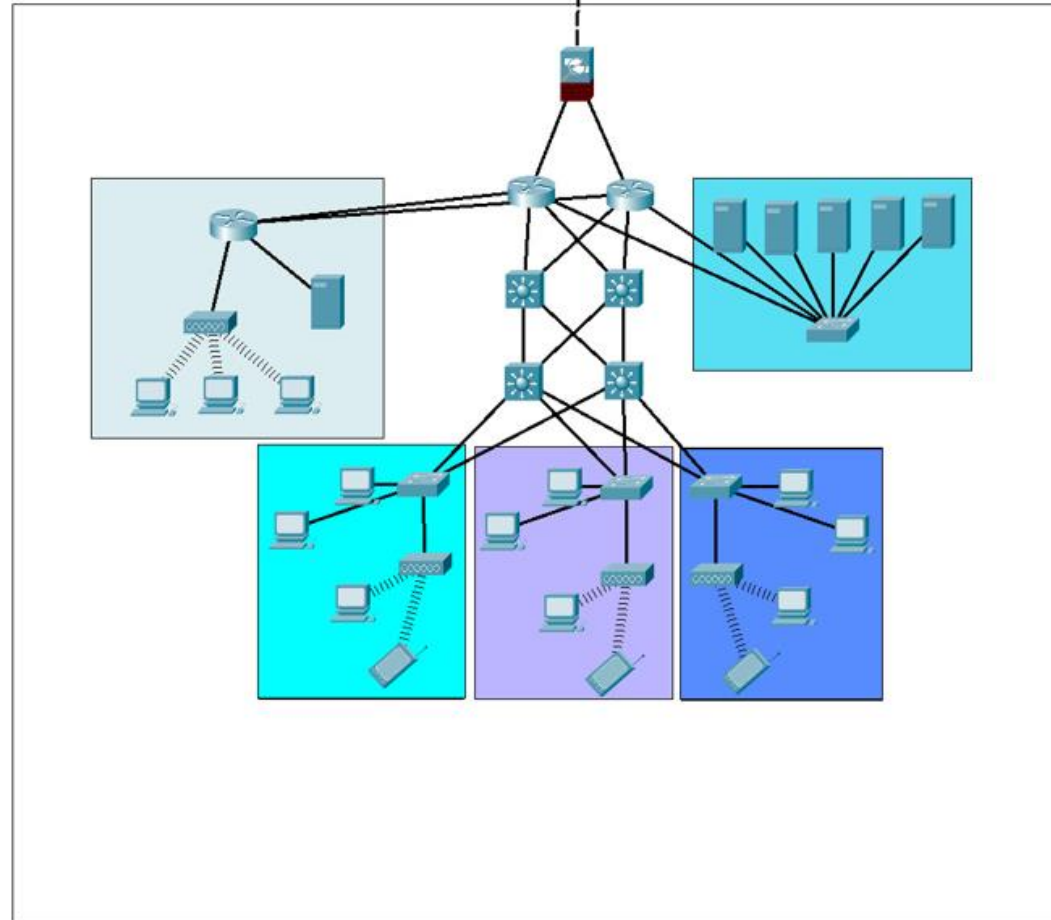
Subnet mask - 255.255.240.0

Number of usable hosts - 4094



# Logical - Main Branch

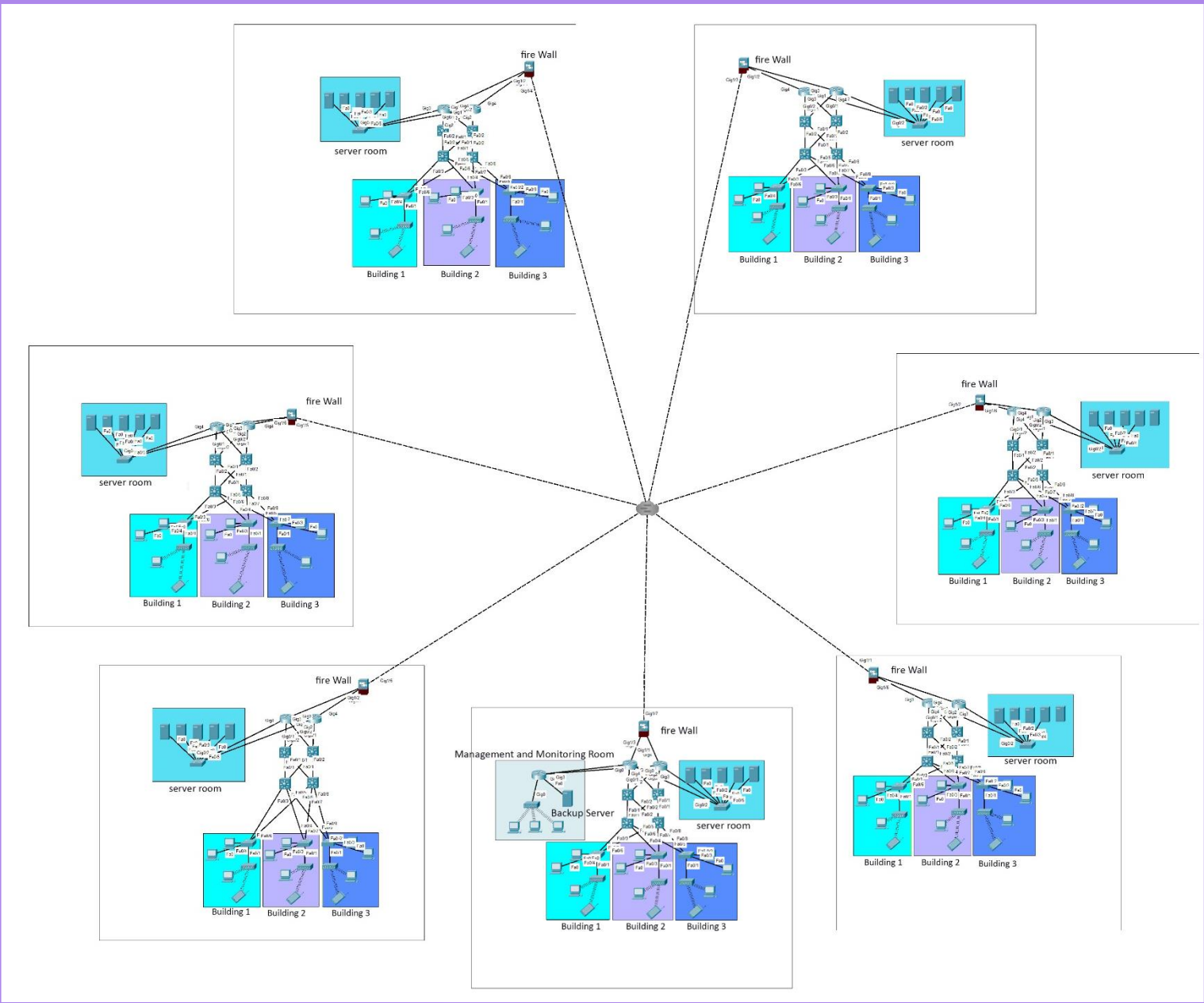
IP Address - 172.16.0.0/18  
Network Address - 172.16.0.0  
Broadcast Address - 172.16.63.255  
Subnet mask - 255.255.192.0  
Number of usable hosts - 16382



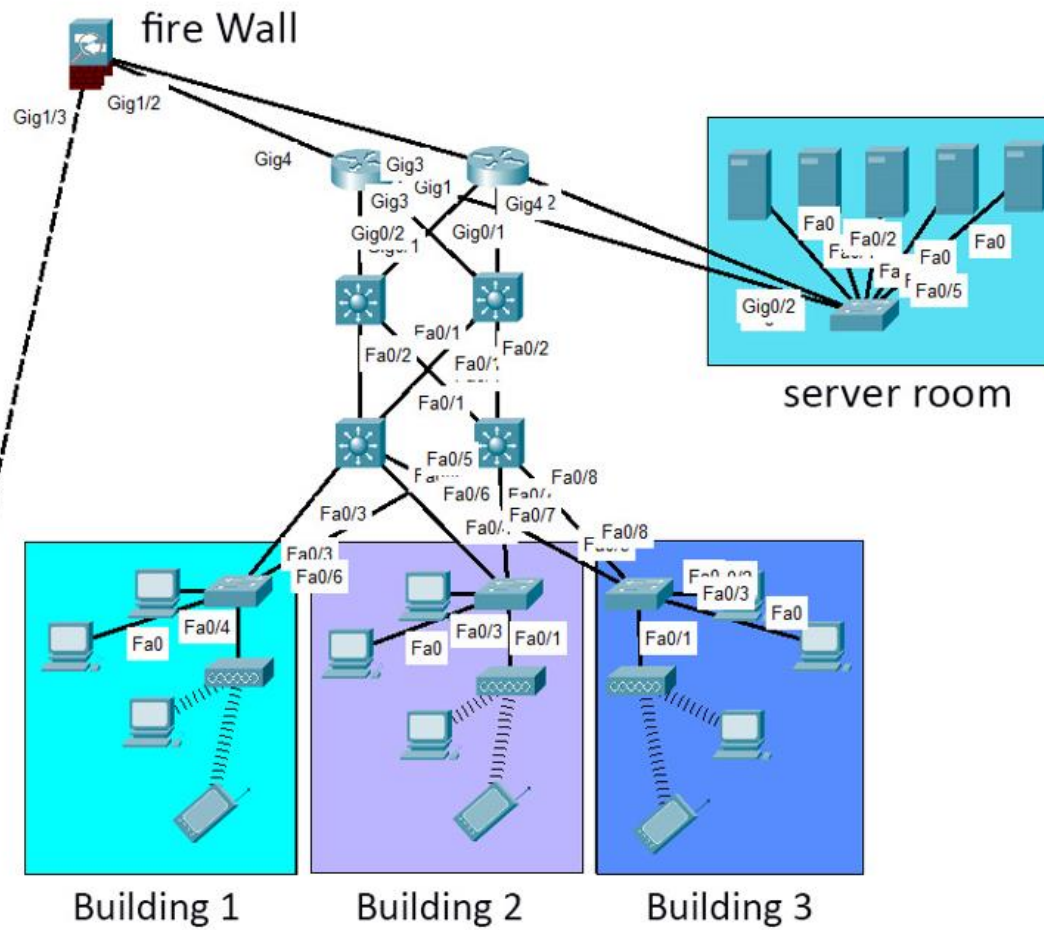
Malabe Branch (Main Branch)



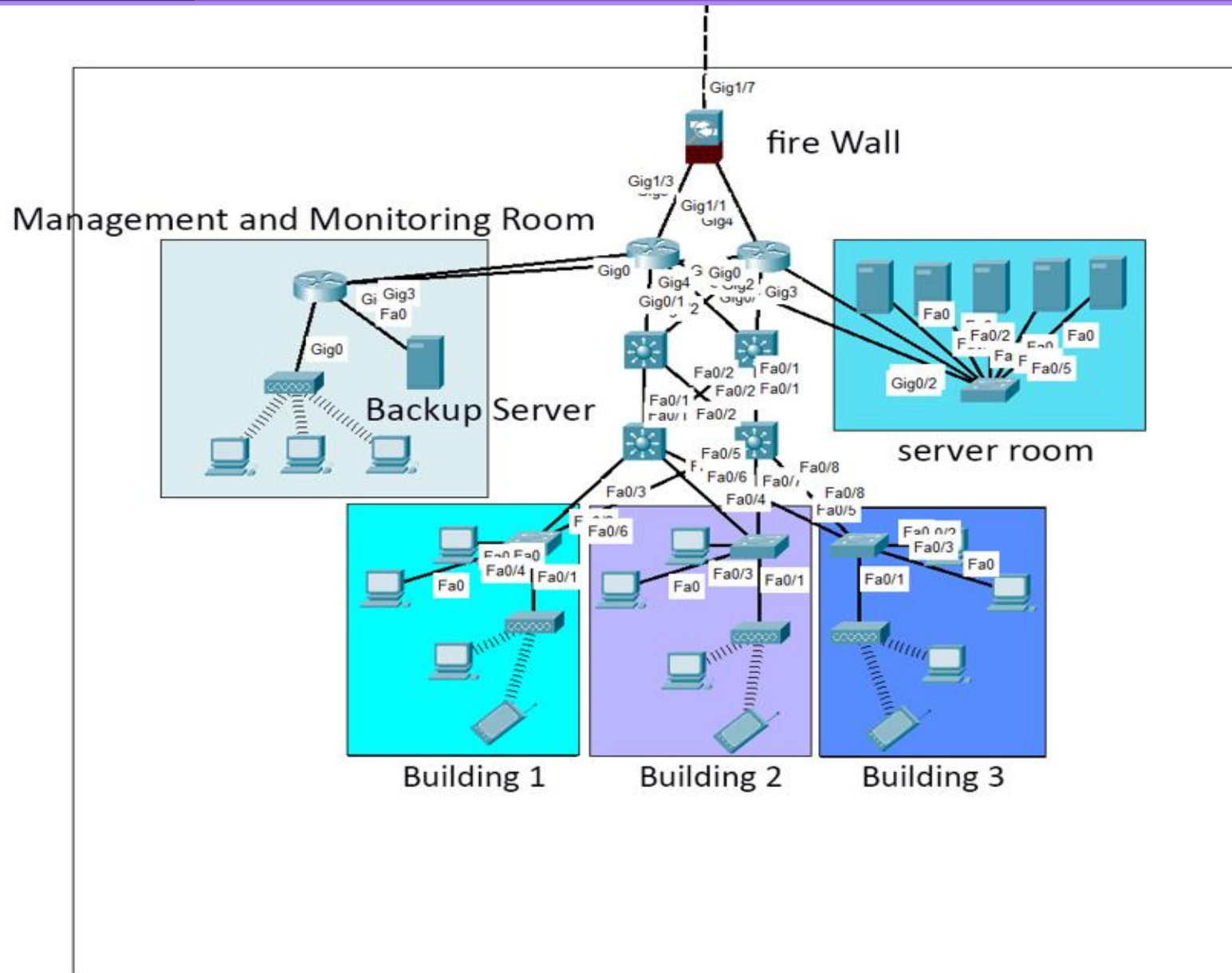
# 02.Physical Topology Diagram



# Physical - Regular Branch



# Physical - Main Branch



## 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

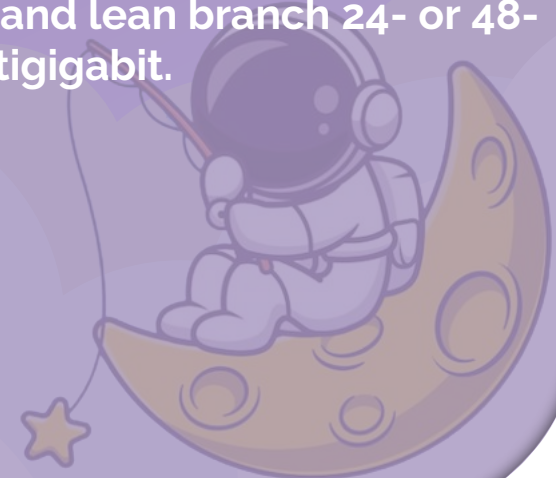
- ✓ SD-Access enables policy-based network segmentation, automation of network configurations, and simplified management through Cisco DNA Center.

### Regular Switch

Catalyst 9300X copper



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



## Multilayer Switch

- **Layer Support**
  - ✓ Supports Layer 2 switching and Layer 3 routing
- **Scalability**
  - ✓ Suitable for large networks with thousands of hosts
- **Quality Of Services (QoS)**
  - ✓ Advanced QoS features for traffic prioritization
- **Security Features**
  - ✓ Offers more advanced security Features like ACLs

## Regular Switch

- ✓ Supports Layer 2 switching only
- ✓ Suitable for smaller networks with fewer hosts
- ✓ Basic QoS features or limited/no QoS support
- ✓ 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**.



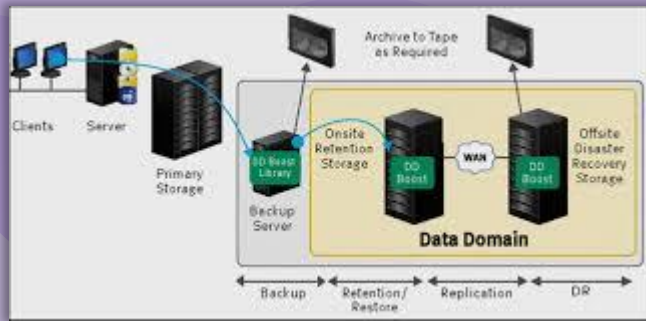
## Email Server



### 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



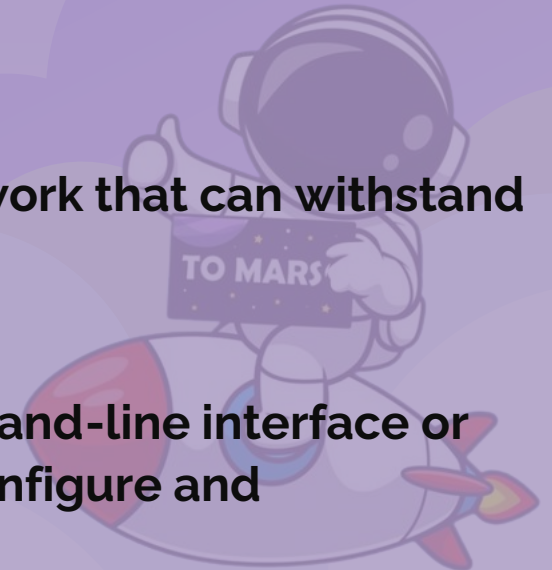
- Up to 75 Mbps of aggregate throughput
- Up to 8 GB of flash memory
- Up to 4 GB of RAM
- Supports multiple WAN interfaces
  - ▣ This allows you to connect to multiple ISPs or to create a resilient network that can withstand a single point of failure
- Easy to manage
  - ▣ The Cisco ISR 4221 Router 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**



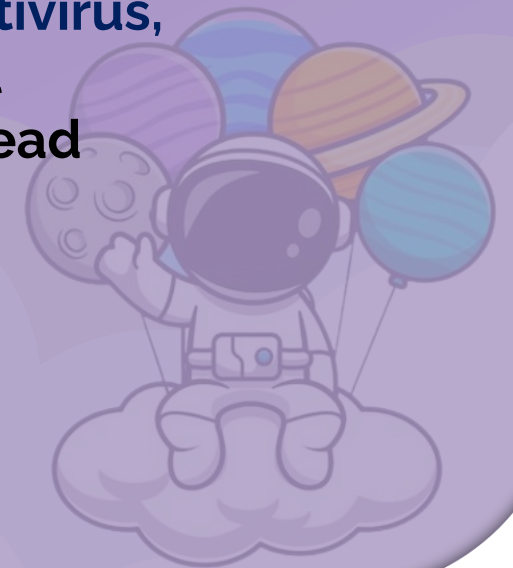
# Firewall

## 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. Network 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 . 00 00 0000 . 0000 0000

Then there will be 2 subnet bits.

1. 172 . 16 . 00 00 0000 . 0000 0000
2. 172 . 16 . 01 00 0000 . 0000 0000
3. 172 . 16 . 10 00 0000 . 0000 0000
4. 172 . 16 . 11 00 0000 . 0000 0000

We allocate 172 . 16 . 0000 0000 . 0000 0000 to branch A.



We can allocate IP addresses for branches by using **VLSM**

A - 172.16.**00**00 0000.0000 0000 → 172.16.0.0 /18

B - 172.16.**01**00 0000.0000 0000 → 172.16.64.0 /18

C - 172.16.**10**00 0000.0000 0000 → 172.16.128.0 /18

D - 172.16.**11****0**0 0000.0000 0000 → 172.16.192.0 /19

E - 172.16.**111****0** 0000.0000 0000 → 172.16.224.0 /20

F - 172.16.**1111****0** 0000.0000 0000 → 172.16.240.0 /21

G - 172.16.**1111****1**000.0000 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!



MLB\_WD\_CSNE\_01.01\_13