UTM
UNIVERSITI TEKNOLOGI MALAYSIA

SECR1213 NETWORK COMMUNICATIONS
SECTION 08
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TASK 6A

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Abstract

In this project, we are required to design the floor and network layout of the Faculty of Computing's new 2-storey building. We were given a budget of RM2.2 million to complete the building's requirements.

In the first task, we created the new building's layout and design based on given requirements. On the first floor, we included 2 hybrid classrooms, a student lounge, a cafeteria, a library, 2 meeting rooms, 2 video conferencing rooms, a server room, surau and toilets. On the second floor, we included 2 CISCO Network labs, 4 general purpose labs, and 2 Embedded labs as well as toilets. These layout designs are complete with measurements suited to the number of expected users and workstations in each room.

In the second task, we performed preliminary analysis on technical and environmental requirements of each of our labs. We created 12 questions and researched the necessary minimum requirements of each device in order to develop a suitable and up to date network plan. We also performed feasibility studies on economic, technical and legal feasibility to make sure that our design is attainable and reasonable.

In the third task, we performed further research on which devices we will be using in our network design. We compared different brands and types of devices by their performance and price. Through the comparison, we were able to determine the best device which suits our technical requirements and fit our budget frame.

In the fourth task, we were able to come up with complete network design for our floor layout. We determined how each workstation is connected to the switches and routers, as well as the length of cables needed for the whole network plan. Through this phase, we were able to identify the needed physical connection that is most suitable for our project.

Lastly, in task five, we explored the best way to divide the subnetwork within the whole building. As given, our Network Address is 192.18.0.0/8, and we utilized the subnets to best fit our labs and rooms. We identify the range of IP, Network and Broadcast addresses for each subnet, as well as range of IP addresses for each user type based on the area.

Overall, we were able to come up with detailed and complete network design for the new building of FC.

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1.0 Introduction

This project aims to create and design a network for the Faculty of Computing (FC) new building, which needs to facilitate 1800 students, 100 academic and 40 supporting staff, with anticipation of 15% growth. The Local Area Network (LAN) of the building should be able to accommodate general labs, CISCO network labs, embedded labs, video conferencing room, hybrid classrooms, and student lounge. These facilities should provide a stable network connection to support the functions of each lab and students Internet requirements.

In line with FC's goal of being future ready, the network design of the building should be equipped for future growth at best value possible. With budget of RM2.2 million, the building will utilize cutting edge technology and concept of 4th Industrial Revolution (4IR), providing a system that is easily manageable, improve overall performance of the building's network system, protection from network breaches such as Internet Worms, Denial-of-Service (DoS) attacks, and e-business application attacks, as well as provide the capability to support high-performance to the core backbone.

The expected outcome of this project is a complete floor layout to accommodate the different labs and rooms, effective network connection design plan, list of devices and physical links used for the network setup, overall calculation of budgets, as well as subnetting and IP assignment for each lab and rooms of the building.

Overall, this project will be able to support the expected growth in FC's network usage, and highlights the commitment of the faculty in providing the students and staff with an innovative, efficient, safe, and futuristic learning environment.

2.0 Project Background and an overview of the client's current status and issue

The Faculty of Computing (FC) is undergoing significant growth, with 1800 students, 100 academic staff, and 40 supporting staff who are currently utilizing its facilities. Over the next four years, the faculty anticipates a 15% increase in both student and staff populations, highlighting the need for infrastructure upgrades to support this expansion. To fulfill these requirements, the Faculty of Computing plans to construct a two-story building with various modern facilities, including general-purpose labs, specialized Cisco Network Labs, Embedded Labs, video conferencing rooms, hybrid classrooms, meeting rooms, student lounge and so on.

The current infrastructure of FC is not enough to prepare students and staff for advancements in line with the 4th Industrial Revolution (4IR), FC's current infrastructure faces scalability limitations, doesn't ensure connectivity with a high-speed internet connection, and has not enough support of high-performance educational tools (like IOT, digital, sensors, etc.). It also lacks protection against contemporary cybersecurity threats, doesn't support seamless virtual and hybrid learning environments, and is unable to make the required preparations to manage growing network demand in light of future population expansion.

Our project's objective, with a budget of RM2.2 million, is to install a cutting-edge Local Area Network (LAN) for the new building which is affordable, scalable, and simple to administer. Up to 30 workstations in each lab must have continuous connectivity, all users must have high-speed internet access, and the system must have specialized infrastructure for advanced computing requirements and virtual collaboration. To preserve the network's integrity, the design must also take into account defense against cybersecurity risks including Internet Worms, Denial-of-Service (DoS) attacks, and illegal access.

This project aims to create a sustainable and future-ready solution for FC by:

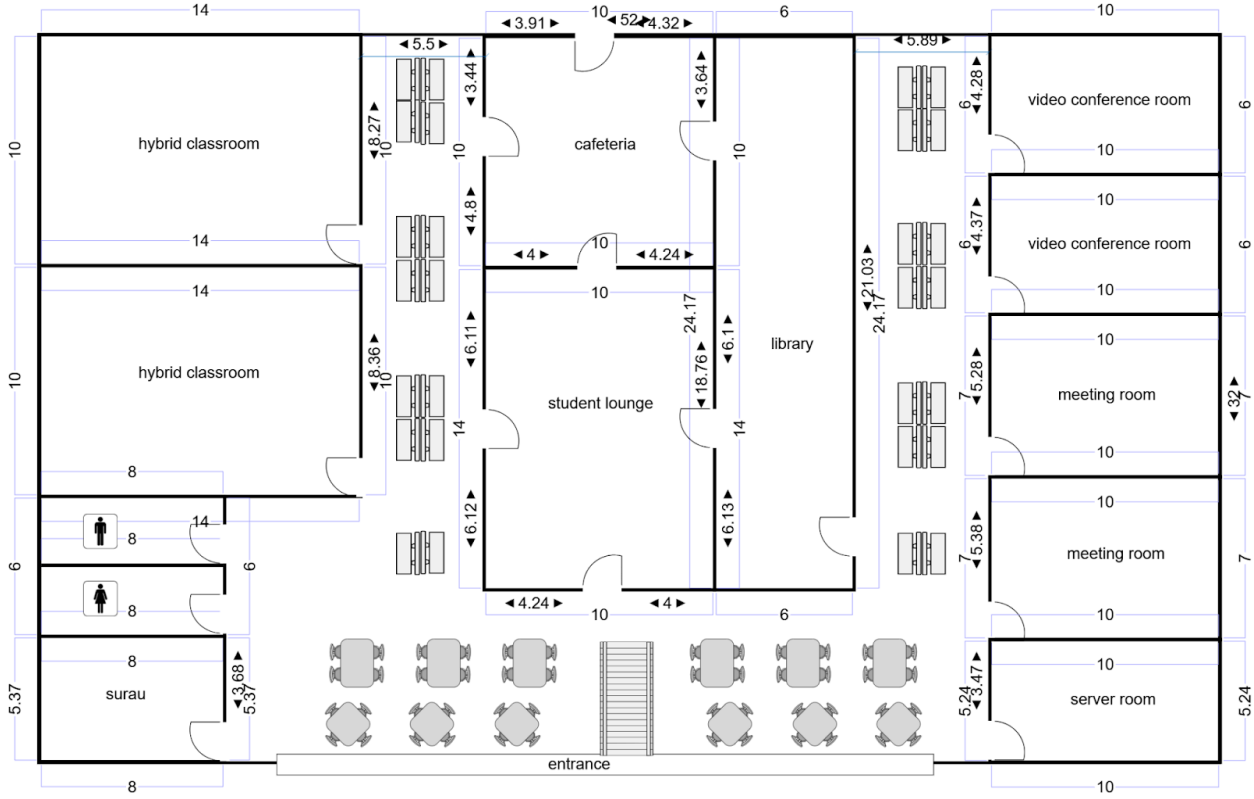
- Designing a floor layout optimized for the new labs and rooms.
- Developing a network design that supports both current and projected demands.
- Specifying the devices and physical links required for the setup.
- Implementing effective IP subnetting and assignments tailored to each facility.

In conclusion, this project underscores FC's commitment to fostering a modern, secure, and efficient learning environment that adapts to future technological advancements while addressing the current limitations of its network infrastructure.

3.1 Tasks 1

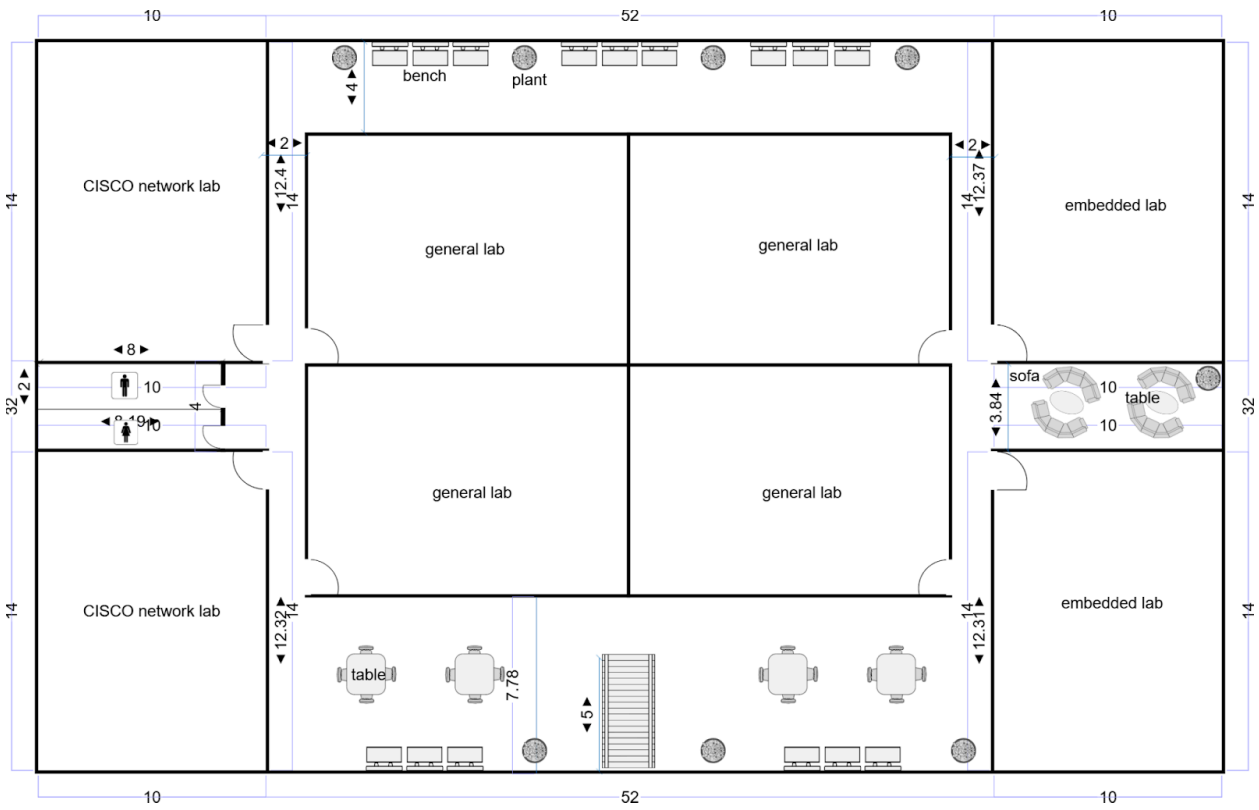
3.1.1 Floor Plan Design

Ground Floor's Floor Plan



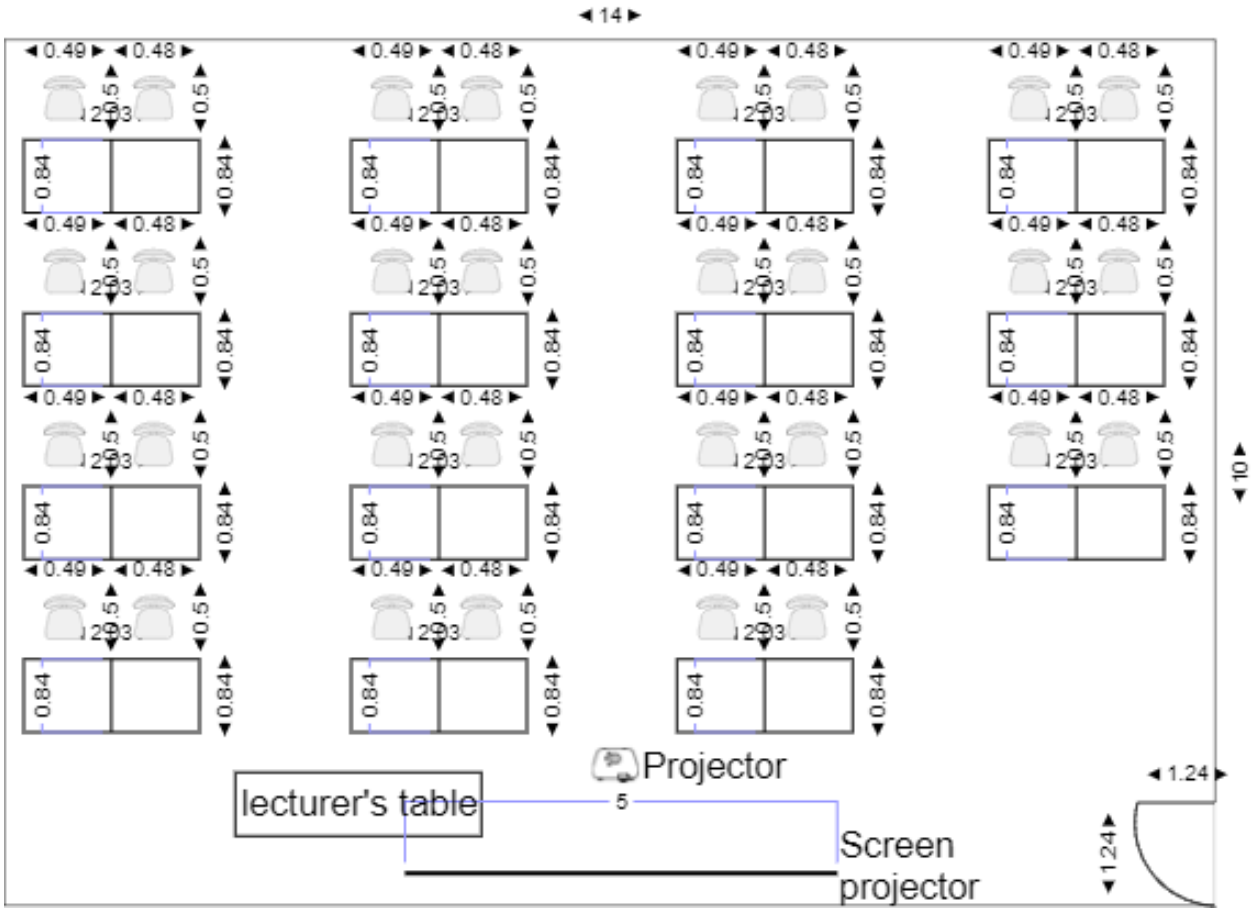
1 unit =1 meter

Second floor's Floor Plan



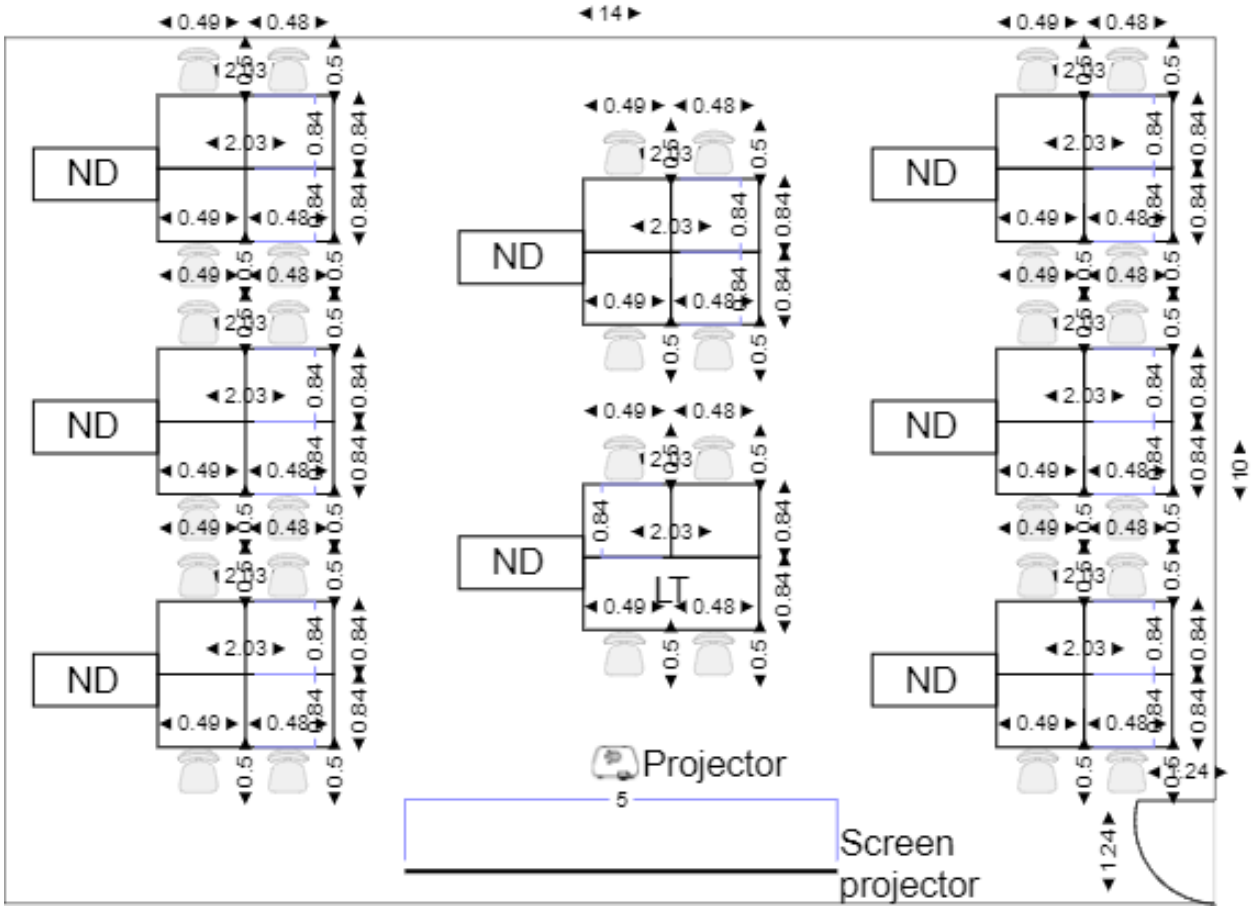
1 unit =1 meter

General Purpose Lab's Floor Plan



1 unit = 1 meter

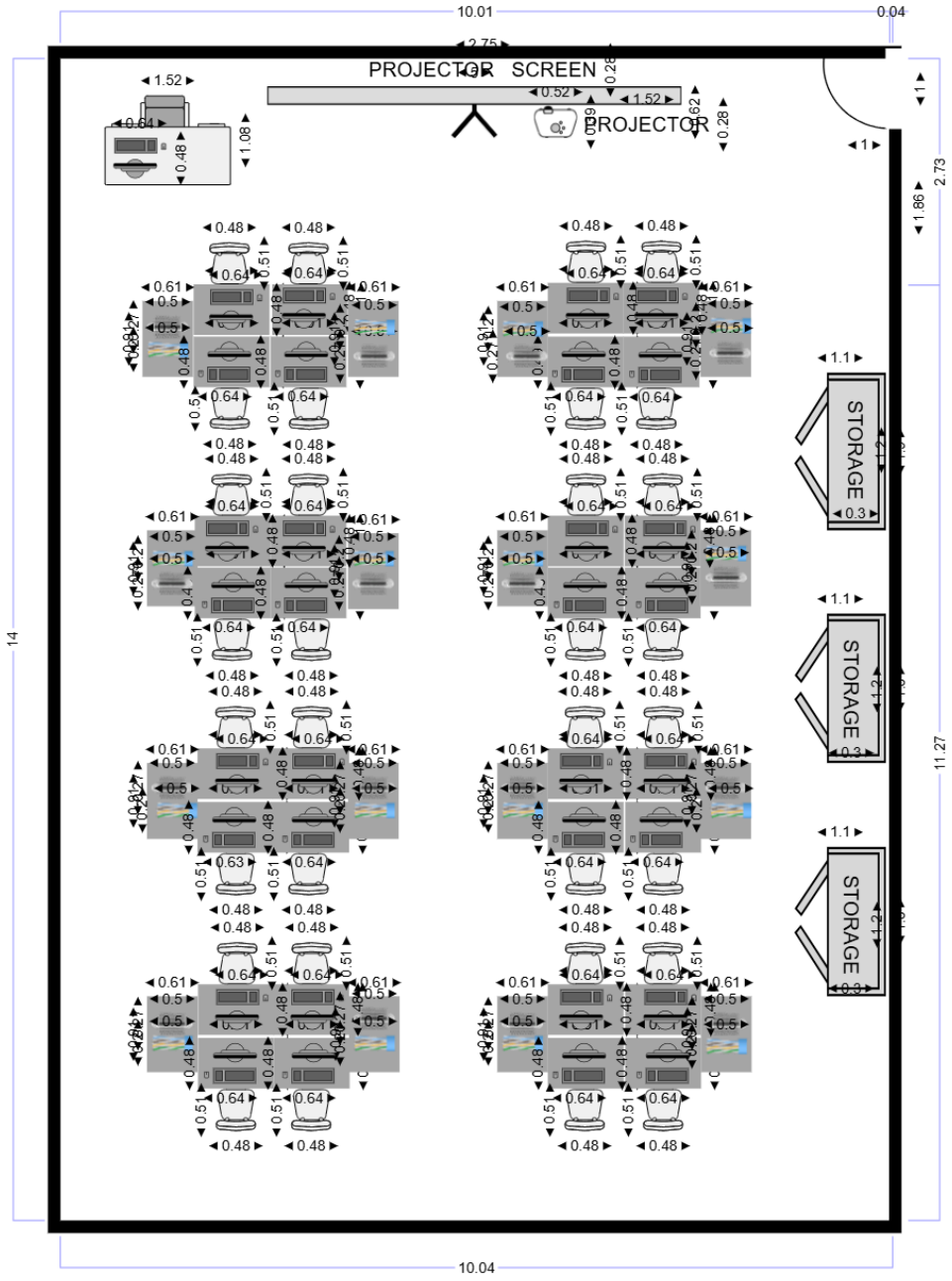
Cisco Network Lab's Floor Plan



ND = Network device
LT = Lecturer's table

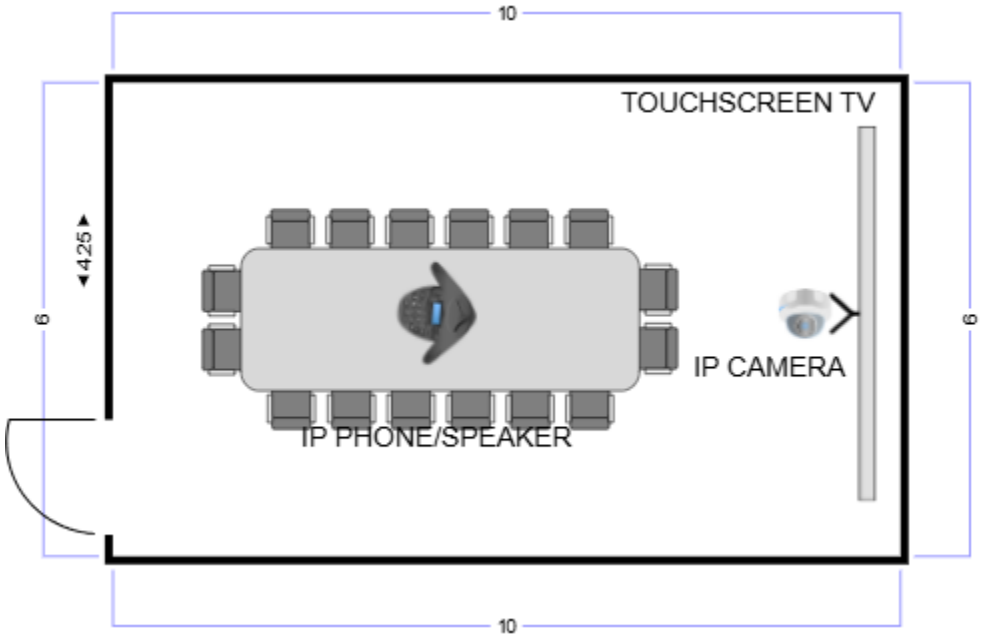
1 unit = 1 meter

Embedded Lab's Floor Plan



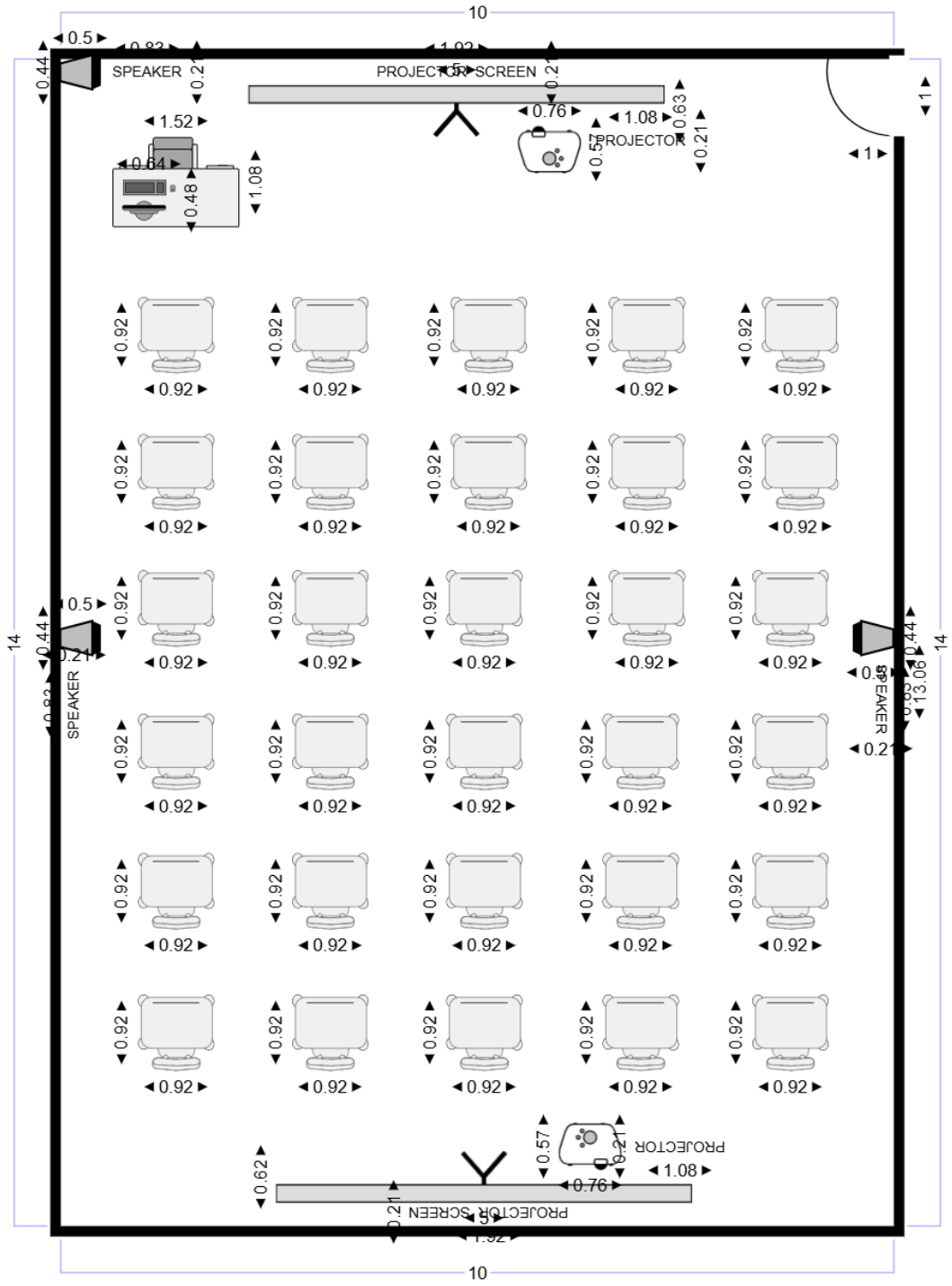
1 unit = 1 meter

Video Conferencing Room's Floor Plan



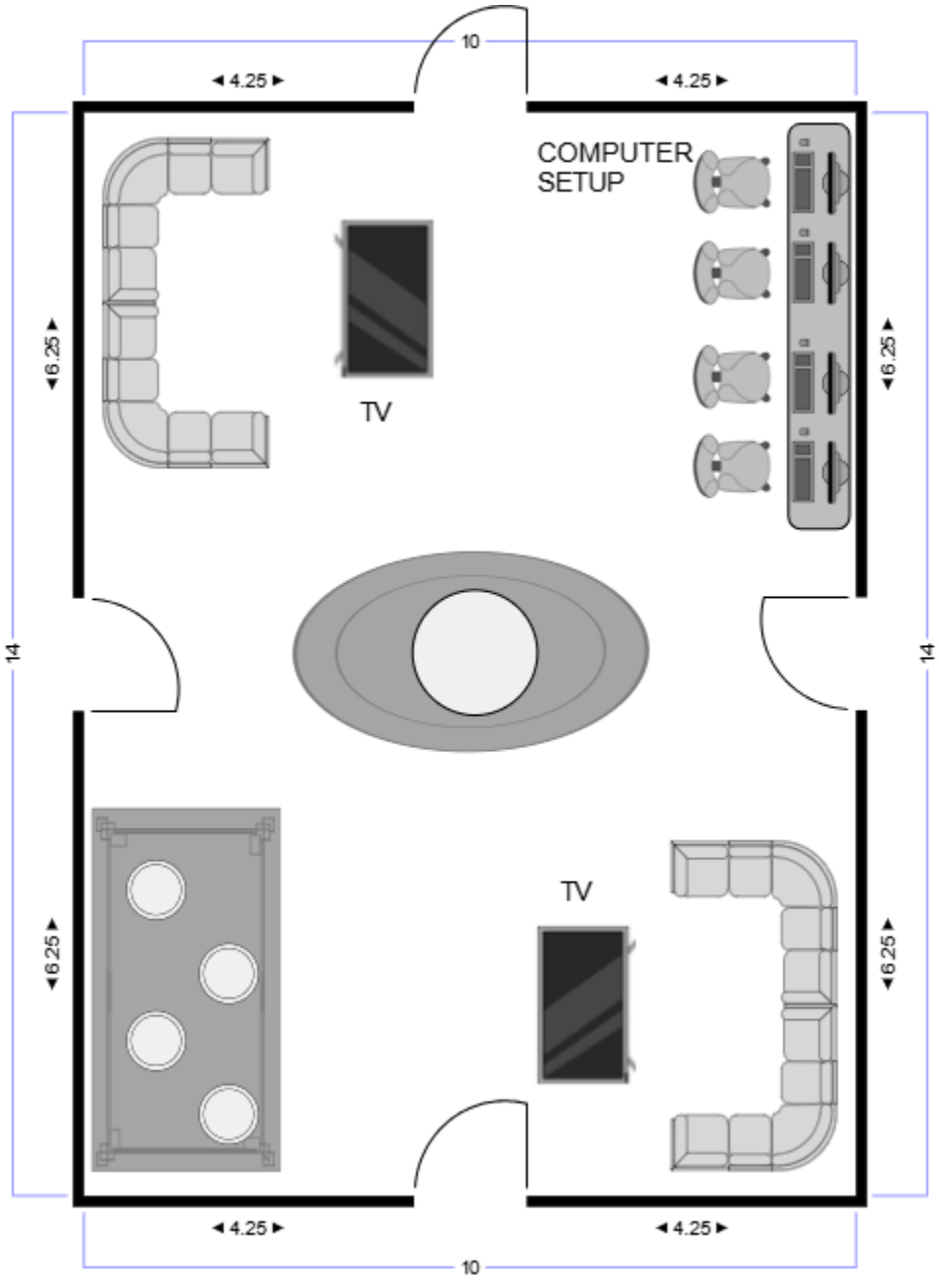
1 unit = 1 meters

Hybrid Classroom's Floor Plan



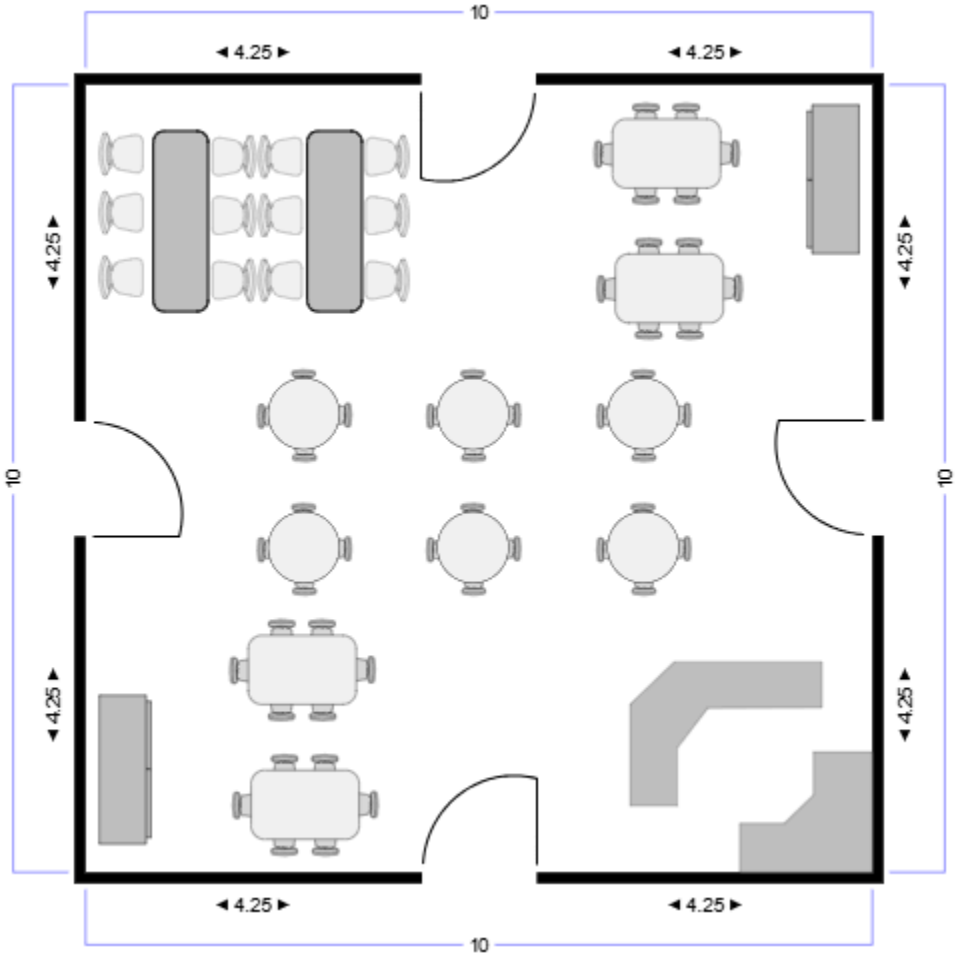
1 unit = 1 meter

Student Lounge's Floor Plan



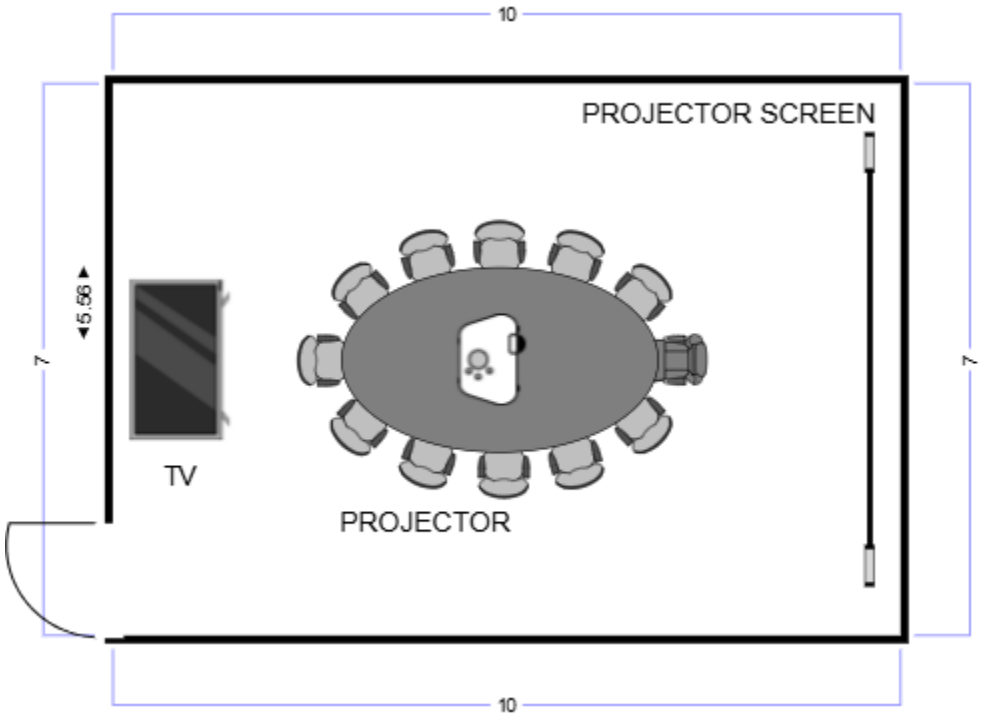
1 unit = 1 meter

Cafeteria's Floor Plan



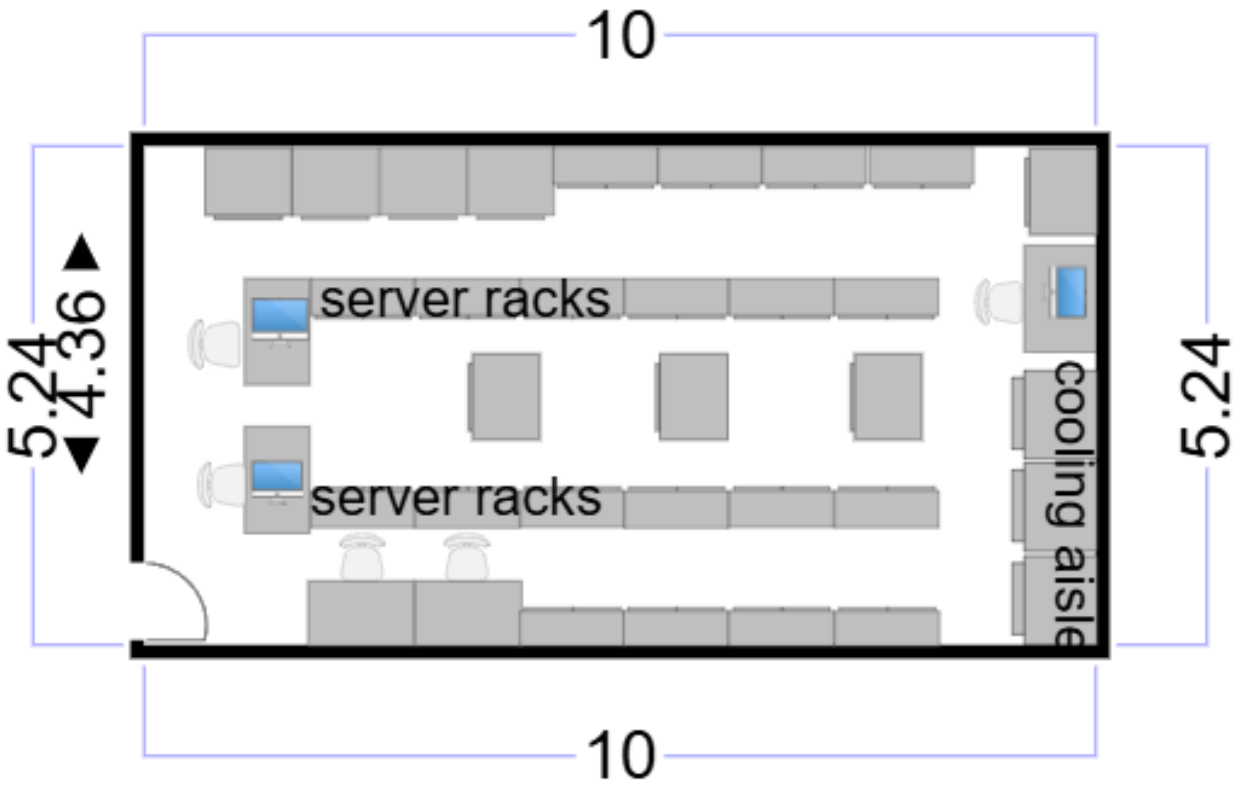
1 unit = 1 meter

Meeting Room Floor Plan



1 unit = 1 meter

Server Room Floor Plan



1 unit = 1 meter

3.2 Task 2

3.2.1 List of Questions and Answers

1. **What is the function of the server room, how important is this server room?**

   A server room is a specialized room built for a centralized data management system of an organization. It functions as a computing, storage and networking center while providing resources and services towards the clients. It is important for organizations to have a dedicated server room in their building to ensure seamless operation, effective services, maximize resource utilization, as well as provide security systems for the organization.[2]

2. **What are the specific environmental requirements for equipment in the labs and server room?**

   For a server room, it is essential to maintain low temperature and low humidity to control the heat generated by the servers due to its high performance processes. Air conditioners are important to make sure all computers are not overheating and able to perform to their best potential. Ventilation system is also a notable environment requirement for all rooms in the building to accommodate students, lecturers and staff are comfortable during their teaching and learning activities, as well as avoid dust and contaminants on our hardwares, which could easily be fire hazards.[2]

3. **What are the minimum speed and bandwidth requirements in the building for your applications to function effectively?**

   As this building is composed of multiple labs, meeting rooms, video conferencing rooms and lounge area, it is determined there will be different requirements for each room. For the student lounge and video conferencing room, minimum bandwidth needed is around 3Mbps for a high definition video quality, to stream videos of lectures or entertainment, live video streaming and calls.[14] However, for the labs, it needs much higher bandwidth to accommodate different activities for a great quantity of computers simultaneously.

4. **What user authentication methods will be used to access the network? Will we have different levels of access?**

   For network access, a one-step authentication method, with username and password can be used to simplify the access process. This will also help to ensure only authorized users get access to the network. We will also have different levels of access based on users' roles within the faculty, such as students, lecturers, staff and administrators. For example, students will have access to the internet and academic resources, faculties and staff will have additional access to administrative tools and resources and administrators will have full access to manage and troubleshoot the network infrastructure.[13]

5. **Will each lab have unique network requirements based on its function, such as dedicated bandwidth for the Cisco Network Lab?**

   Yes, each lab will have unique network requirements based on its function. Their unique requirements will be addressed by allocating specific bandwidth quotas and network segments (such as VLANs) to each lab and classroom, ensuring optimal performance based on their individual needs. For example,

   -The Cisco Network Lab will require dedicated and high-speed bandwidth due to the nature of its networking simulations and data-intensive activities.[10]

   -Hybrid Classrooms will require a stable and robust connection to ensure high-quality video streaming capabilities for remote students, as well as sufficient bandwidth to handle multiple devices for interactive activities.[11]

   -Embedded labs may require higher bandwidth and low-latency connections to handle the demands of real-time data processing and machine learning tasks.[12]

   -General-purpose labs may require moderate bandwidth, sufficient for standard student activities such as browsing, coding, and assignments.

6. **Are there specific areas within the building where higher network bandwidth is essential?**

   Yes, some specific areas within the building will need higher network bandwidth:

   -The Cisco Network Lab and the embedded lab will require higher bandwidth to support data-intensive tasks, simulations, and real-time applications.[10]

   - The hybrid classroom will need higher bandwidth to support live streaming and online meetings without any interruptions.[11]

   - The server room and administration offices may also require higher bandwidth, particularly for managing data backups, remote access, and handling administrative tasks efficiently.

   By prioritizing bandwidth in these areas, we can ensure smooth operations, reduce the risk of network congestion, and enhance the user experience for both staff and students.

7. **How will we manage network traffic to prevent bottlenecks, especially during peak usage times?**

   We can have network segmentation where the network is split into separate segments for students, staff, and specialized labs. We can isolate traffic by creating virtual LANs(VLANs) to reduce congestion in one area [6]. For example, areas like Cisco Network Lab can be assigned their own VLAN, reducing load on the main network. Secondly, we can set up the network with scalable bandwidth to support high-speed internet, as planned, and monitor usage patterns over time [7].If consistent congestion existed during a certain period, we can upgrade bandwidth capacity in key areas, especially in labs where data-intensive tasks like IoT labs. We can also apply high quality, efficient switches and routers to ensure redundancy in critical network paths which will help to maintain performance even when the network is high load.

8. **What criteria should we decide between wired and wireless connections in different areas of the building ?**

   Deciding between wired and wireless connections in the Faculty of Computing building will be based on each area's specific needs. Wired connections are ideal in high-data, high-security zones, like the Cisco Network Lab and server room, where stable, fast, and secure connections are crucial. Wireless connections, however, suit areas requiring mobility and flexibility, such as student lounges and common spaces, allowing easy access without physical restrictions [8].If the layout is fixed, using wired connections in high-density areas like general-purpose labs is ideal, as it ensures stable connections and prevents overcrowding on the wireless network. Wired connections can be more expensive and rigid, while wireless networks are cost-effective, easier to expand, and adapt well to changing layouts.

9. **What type of firewalls would be needed to protect the network, where should they be installed?**

   To protect the Faculty of Computing building's network, we would use a mix of network firewalls, application firewalls, and internal segmentation firewalls. A strong network firewall would be installed at the main entry point where the building's network connects to the internet, blocking unauthorized external access. Additional firewalls could be placed between critical areas, like the server room and labs, to protect internal traffic. Application firewalls would be installed on servers hosting sensitive applications, adding protection against specific attacks on student or staff portals. Finally, segmentation firewalls within the building would separate network sections for students, staff, and labs, securing sensitive data and resources [9]. This setup provides multiple layers of defense, safeguarding the network from both external and internal threats.

10. **Which equipment requires protection and what kind of security is needed in the building?**

    Servers, routers, switches, firewalls, and wireless access points should be prioritized. Any device housing sensitive data, such as departmental databases or research servers, also requires robust protection. Install and use antivirus software. Installing an antivirus software program and keeping it up-to-date is a critical step in protecting your computer. Many types of antivirus software can detect the presence of malware by searching for patterns in your computer's files or memory. Antivirus software uses signatures provided by software vendors to identify malware[3]. Use encryption for data in transit and at rest, along with regular backups and access controls. Implement multi-factor authentication (MFA) for network and resource access, particularly for high-privilege users.

11. **Should we implement a centralized management system for all connected devices within the building?**

    Yes, implementing a centralized management system is recommended. A centralized system will simplify monitoring, maintenance, and troubleshooting of the network. Centralized access control works by consolidating access control management into a central system.[4] It allows for real-time monitoring of all network devices from a single console helps quickly detect issues. Central management can enforce security policies, manage access rights, and log network activity centrally, improving the overall security posture. As your network grows, a centralized system makes expansion simpler by managing all new devices through a unified platform.

12. **How frequently do you expect to update or upgrade the network infrastructure to meet future needs?**

    It is ideal to conduct a major review and upgrade every 3-5 years. Enhanced performance, improved security, scalability, reliability, and support for remote work are all compelling reasons to consider making the move.[5] Rapid technological changes may require more frequent updates to stay current with best practices. Expansions in the number of users or bandwidth-intensive applications might necessitate upgrades sooner. Cybersecurity threats are evolving at an alarming rate. Older network infrastructure may lack the robust security features necessary to protect your business from today's sophisticated threats.[5] To address evolving cybersecurity threats, regular updates to firewalls, antivirus, and encryption protocols are essential.

3.2.2 Project Feasibility

Technical Feasibility

Our project is going to incorporate different devices and hardwares such as routers, switches, connection cables, computers, IP microphones/speakers and cameras, smart TVs, and projectors. These devices are essential to fulfill the requirements of our project to ensure seamless integration with existing network systems in UTM.

Through our research study, it is found that these devices can be found and bought by trusted vendors recommended by UTM, ensuring quality and reliability of the products. Referencing multiple different trusted vendors also allows us to survey for better functionality to price balance to optimize our budget without sacrificing the performance of the devices.

Our labs will also be equipped with provided Microsoft services for students to support the learning and teaching of the faculty students, as well as implementing firewalls to secure and safeguard the data of the faculty members. Thus, it is determined that this project is feasible technically as all devices are able to be obtained, used and integrated into FC's system.

Economic Feasibility

For this project, economic feasibility plays a crucial role, especially given the RM2.2M budget constraints and the necessity for high-quality infrastructure. Purchasing network hardware (such as routers, switches, and access points), installing software tools for centralized management and network security, and safeguarding the server room with the required environmental controls are all included in the anticipated expenditures. Through our research study, it is found that these devices can be found and bought by several trusted vendors recommended by UTM to ensure a cost-effective solution without compromising on quality.

To ensure sustainability, We will take into account devices that can be upgraded in the future to prevent frequent replacements and equipment with warranties. According to our financial analysis, the initial investment for this setup would be justifiable given the benefits of enhanced network performance, security, and support for teaching and learning activities within the faculty.We also plan to allocate a portion of the budget for regular maintenance, upgrades, and contingencies to handle unforeseen expenses. This approach ensures that the project remains economically viable in the long term.

Legal Feasibility

All hardware and software used will be original and in full fulfillment with intellectual property (IP) laws. Routers and other network devices will be legally obtained, and software licenses for programs such as Microsoft products, antivirus tools, and other necessary applications will be obtained through authorized channels, primarily managed by the UTM Digital Department. Additionally, firewalls and web filtering will be implemented to prevent access to illegal websites, ensuring the building’s network follows legal standards.

3.3 Task 3

3.3.1 List of devices

1. Modem

Modem, is a computer hardware device that converts data from a digital format into a format suitable for an analog transmission medium such as telephone or radio. A modem transmits data by modulating one or more carrier wave signals to encode digital information, while the receiver demodulates the signal to recreate the original digital information.[1] Modem, is a computer hardware device that converts data from a digital format into a format suitable for an analog transmission medium such as telephone or radio. A modem transmits data by modulating one or more carrier wave signals to encode digital information, while the receiver demodulates the signal to recreate the original digital information. Modems are classified according to the maximum data (bit/s) that they can send in a given time period.[2] The considerations that we need to take on when choosing a suitable modem in setting up the networking to maximize the performance in making Wi-Fi faster are the ports number, the prices, the channels like the upload speed and download speed, and DOCSIS (Data Over Cable Service Interface Specifications) Support. The channel specification is acting like a highway in a network which allows and provides the late or path for the data to be transmitted by permitting the bits passed through it. The more channels available, the faster the connection will be provided.[1] For DOCSIS is known as data over cable service interface specification which is a standard to allow the communication of data for cable systems, in terms of comparison, DOCSIS 3.1 is ten times faster at up to 10Gbps but DOCSIS 3.0 just performs up to 1Gbps.[5] The products used to build the network will be quantified based on a number of considerations and criteria, which are: NETGEAR CM700 High Speed Cable Modem, ARRIS SURFboard SBG10 Cable Modem and Motorola MB8611 Ultra-Fast DOCSIS 3.1 Cable Modem.

Product	NETGEAR CM700 High Speed Cable Modem	ARRIS SURFboard SBG10 Cable Modem	Motorola MB8611 Ultra-Fast DOCSIS 3.1 Cable Modem
Specification	• DOCSIS Support: DOCSIS 3.0 • Channels: 32x8 • Ports: 1x Gigabit Ethernet Port, 1x Coaxial Cable Port • Download Speed: 1.4Gbps • Upload Speed: Up to 0.8 Gb/s • IPv6 support	• DOCSIS Support: DOCSIS 3.0 • Channels: 16 x 4 • Ports: 2x Gigabit Ethernet Ports • Download Speed: 1.6Gbps • Upload Speed: Up to 0.4 Gb/s • IPv6 support	• DOCSIS Support: DOCSIS 3.1, 3.0, 2.0 and 1.1 service • Channels: 32 x 8 • Ports: 1x 2.5 Gigabit Ethernet Ports • Download Speed: 2.5Gbps • Upload Speed: Up to 0.8 Gb/s • IPv4 & IPv6 support
Price	RM 536.30 (119.99 USD)	RM 440.95 (99.00 USD)	RM 840.27 (188.00 USD)
Reference	https://www.netgear.com/home/wifi/modems/cm700/	https://www.surfboard.com/products/wi-fi-cable-modems/sbg10/	https://www.motorola.com/us/mb8611/p

2. Switch

A network switch is networking hardware that connects devices on a computer network by using packet switching to receive and forward data to the destination device. Multiple data cables are plugged into a switch to enable communication between different networked devices.[3] In a local area network (LAN) using Ethernet, a network switch determines where to send each incoming message frame by looking at the media access control (MAC) address. Switches maintain tables that match each MAC address to the port receiving the MAC address.[4] The Ethernet port numbers and performance provided (maximum forwarding rate and the switching capacity) will become the considerations in selecting the suitable switch since it was used to decide the numbers of wired connections that are possible to pass through the switch. Higher switching capacity and forwarding rate ensure smoother performance under moderate-to-heavy traffic. Low power consumption and heat dissipation are energy-efficient. The following are the switches we have chosen to be the most suitable for building a network which are 16-Port Gigabit Unmanaged Switch DGS-1016C, TL-SF1024D 24-port 10/100Mbps Desktop / Rackmount Switch and Cisco Catalyst 2960-24TT-L Switch.

Product	16-Port Gigabit Unmanaged Switch DGS-1016C	TL-SF1024D 24-port 10/100Mbps Desktop / Rackmount Switch	Cisco Catalyst 2960-24TT-L Switch
Specification	● Ports: 16xGigabit Ethernet Ports ● Maximum Power Consumption:9.3 W ● Maximum Heat Dissipation:33.55 4 BTU/h ● Switching Capacity: 32Gbps ● Maximum Forwarding Rate: 23.808 Mpps	● Ports: 24xGigabit Ethernet Ports ● Maximum Power Consumption:3.19 W ● Maximum Heat Dissipation:10.88 BTU/h ● Switching Capacity: 4.8Gbps ● Maximum Forwarding Rate: 3.57 Mpps	● Ports: 24xGigabit Ethernet Ports ● Maximum Power Consumption:24W ● Maximum Heat Dissipation: 81.92 BTU/h ● Switching Capacity: 16.8Gbps ● Maximum Forwarding Rate: 6.5 Mpps
Price	RM 299	RM 179	RM 471

Reference	https://www.dlink.com/en/products/dgs-1016c-16port-gigabit-unmanaged-switch	https://www.tp-link.com/my/business-networking/unmanaged-switch/tl-sf1024d/	https://www.server2u.com/shop/ws-c2960-24tt-l-cisco-catalyst-2960-24tt-l-switch-ws-c2960-24tt-l-54398?srsltid=AfmBOoqtCYFBkHmuqIo898kgrqkIi34tivQGoQ84qaDOXczTugJNQYEE#attr=

3. Router

A router is a physical device used to pass information within or to other computer networks. A router can perform its task using packet switching or circuit switching, both of which will use the IP address of the data packet to find its destination port. [8] Multiple types of routers exist, for example edge routers, which operate as a connection between LAN and WAN, or between a building and the Internet Service Provider(ISP). [9] Another example of a router is the core router, which acts as a connection within the building's networking devices, as well as the edge routers. [10] Routers are an important component in computer networking as it allow users to access the Internet to find informations, communicate with others, share files or data, as well as collaborate together virtually.

Product	TP-LINK Archer AX95	ASUS RT-BE88U	HUAWEI WiFi BE3
Specification	• Standard Wi-Fi 6 • Speed up to 7.8 Gbps: 5 GHz-1: 4804 Mbps 5 GHz-2: 2402 Mbps 2.4 GHz: 574 Mbps • Capacity: 4x4 MU-MIMO 8 WAN/LAN interfaces	• Standard Wi-Fi 7 • Speed up to 7.2 Gbps: 5 GHz: 5764 Mbps 2.4 GHz: 1376 Mbps • Capacity: 34G WAN & LAN interface 9 LAN interfaces	• Standard Wi-Fi 7 • Speed up to 3.6 Gbps: 5 GHz: 2882 Mbps 2.4 GHz: 688 Mbps • Capacity: 2.5Gbps WAN & LAN port 4 WAN/LAN interfaces 2x2 MIMO
Price	RM899.00	RM1,799.00	RM639.17
Reference	https://www.tp-link.com/my/home-networking/wifi-router/archer-ax95/	https://www.asus.com/networking-iot-servers/wifi-routers/asus-gaming-routers/rt-be88u/	https://consumer.huawei.com/en/routers/wifi-be3/

4. Network Cables

Network cables are the physical medium used to connect and enable communication between networking devices like switches, routers, and computers. They carry data in the form of electrical signals or light pulses, allowing devices in a Local Area Network (LAN) to exchange information efficiently. Network cables come in various types, such as twisted pair, coaxial, and fiber optic, each offering different capabilities in terms of speed, range, and resistance to interference [11]. Network cables play a critical role in creating a reliable network infrastructure. They are the medium through which data is transmitted between devices, such as switches, routers, and computers, in a Local Area Network (LAN). There are different types of network cables available, categorized primarily based on their data transfer speeds, shielding, and interference resistance.For instance, Cat6 cables offer a balance between affordability and performance for medium-speed networks[12], while Cat7 and Cat8 cables are ideal for environments that require high-speed data transmission and minimal interference. These cables are essential in academic institutions where efficient and high-speed data transfer is necessary for tasks such as video conferencing, digital learning, and research activities[13][14]. Proper selection of cables ensures optimal performance of the network, enabling seamless communication across devices. Below is a table highlighting some network cable options for the academic LAN setup:

Product	Cat6 Ethernet Cable - 10m	Cat7 Ethernet Cable - 15m	Cat8 Ethernet Cable - 20m
Specification	• Cable Type: Cat6 • Length: 10 meters • Data Transfer Speed: Up to 1Gbps • Bandwidth: 250 MHz • Connector Compatibility: RJ45	• Cable Type: Cat7 • Length: 15 meters • Data Transfer Speed: Up to 10Gbps • Bandwidth: 600 MHz • Connector Compatibility: RJ45	• Cable Type: Cat8 • Length: 20 meters • Data Transfer Speed: Up to 40Gbps • Bandwidth: 2000 MHz • Connector Compatibility: RJ45
Price	RM 30	RM 50	RM 100
Reference	https://www.dlink.com/en/products/cat6-ethernet-cable	https://www.tp-link.com/my/products/cat7-ethernet-cable	https://www.belkin.com/networking/cat8-ethernet-cable

5. Network Cable Connector

Network cable connectors are essential hardware components that attach network cables to devices such as switches, routers, and computers. These connectors ensure a secure and efficient connection, enabling stable data transmission across the network. The quality of connectors greatly influences the reliability of the entire network, as poor-quality connectors can lead to data loss or signal degradation [15]. Network cable connectors are crucial components that facilitate the secure connection of Ethernet cables to networking devices, ensuring a stable and efficient data transmission path. The RJ45 connector is the standard for Ethernet cables, widely used in LAN setups for its compatibility with twisted-pair cables and its reliable performance[16]. Connectors vary in features such as shielding, durability, and the quality of their gold plating, which ensures minimal signal loss and resistance to corrosion. Shielded RJ45 connectors, for instance, provide additional protection against electromagnetic interference, making them ideal for high-speed environments with sensitive data transfer[17]. High-speed RJ45 connectors are specifically designed for the latest cables like Cat7 and Cat8, supporting the increased demands of modern network infrastructures[18]. The following table provides a comparison of selected RJ45 connector products:

Product	Standard RJ45 Connector	Shielded RJ45 Connector	High-Speed RJ45 Connector
Specification	• Type: RJ45 • Compatibility: Cat5/Cat5e/Cat6 cables • Shielding: Unshielded • Gold-plated contacts	• Type: RJ45 • Compatibility: Cat6/Cat7 cables • Shielding: Shielded • Gold-plated contacts	• Type: RJ45 • Compatibility: Cat7/Cat8 cables • Shielding: Advanced shielding • 50-micron gold-plated contacts
Price	RM 10	RM 15	RM 25
Reference	https://www.dlink.com/en/products/standard-rj45-connector	https://www.tp-link.com/my/products/shielded-rj45-connector	https://www.belkin.com/networking/high-speed-rj45-connector

6. Wireless Access Point

Wireless Access Point (WAP) is a network device that provides data transmission and reception over wireless media in a WLAN. The device bridges the wireless LAN to a fixed, wired network, thereby allowing wireless devices to be integrated into the larger wired infrastructure effortlessly [6]. In other words, an WAP behaves like an Ethernet hub; instead of just forwarding LAN frames between the wired Ethernet devices, it deals with wireless frames, and forwards them to other devices whether connected wirelessly or through Ethernet in the same subnet. WAPs play an important role in extending connectivity over wide areas by allowing wireless devices to stay connected to the network as they are mobile. This is known as roaming, where a wireless device moving out of the range of one access point is automatically handed off to another access point within the network so that continuous connectivity can be ensured. These devices are fundamental to creating flexible and efficient network solutions for environments ranging from homes and offices to public spaces such as airports and coffee shops where consistent wireless access is critical[7].

Product	TP-Link EAP650 (AX3000)	Ubiquiti U6 Plus
Specification	Hardware Features ● Interface: 1Gb Ethernet (RJ-45) Port (supports IEEE 802.3at PoE) ● Power Supply: ○ 802.3at PoE ○ 12 V / 1.0 A DC (EU) ○ 12 V / 1.5 A DC (US) ● Power Consumption: ○ EU: 13.5 W ○ US: 14.7 W ● Antenna Type: Internal Omni ○ 2.4 GHz: 2× 4 dBi ○ 5 GHz: 2× 5	Hardware Features ● Interface: (1) Gb Ethernet (RJ-45) port ● Power method: PoE -Supported voltage range: 44–57V DC -Max. power consumption: 9W Wireless Performance ● Max. TX power: ○ 2.4 GHz: 23 dBm ○ 5 GHz: 23 dBm

	dBi ● Mounting Options: ○ Ceiling / Wall Mounting (Kits included) Wireless Features ● Wireless Standards: IEEE 802.11ax/ac/n/g/b/a ● Frequency Bands: 2.4 GHz and 5 GHz ● Signal Rate: ○ 5 GHz: Up to 2402 Mbps ○ 2.4 GHz: Up to 574 Mbps Wireless Security: ● Access Control ● Wireless MAC Address Filtering ● Wireless Isolation Between Clients ● 802.1X Support -System Requirements: Microsoft Windows XP, Vista, 7, 8, 10, Linux ● Environment: -Operating Temperature: 0–40 ℃ (32–104 ℉) -Storage Temperature: -40–70 ℃ (-40–158 ℉)	● Max. data rate: 2.4 GHz: 573.5 Mbps (BW40) 5 GHz: 2.4 Gbps (BW160) ● Antenna gain: ○ 2.4 GHz: 3 dBi ○ 5 GHz: 5.4 dBi Physical Features ● Mounting options: Wall, ceiling (Included) ● Ambient operating temperature: -30 to 60° C (-22 to 140° F) ● Ambient operating humidity: 5 to 95% non-condensing Software Specifications ● WiFi standards: 802.11a/b/g/n/ac/ax (WiFi 6) ● Wireless security: WPA-PSK, WPA-Enterprise (WPA/WPA2/WPA3) ● BSSID: 8 per radio ● VLAN: 802.1Q ● Advanced QoS: Per-user rate limiting ● Guest traffic isolation: Supported
Price	RM649	RM658

Reference	https://www.tp-link.com/my/business-networking/omada-sdn-access-point/eap650/#overview	https://sg.store.ui.com/sg/en/category/all-wifi/products/u6-plus

3.3.2 Expected Costs

No	Device	Quantity	Price/ Unit (RM)	Total Price (RM)
1	Motorola MB8611 Ultra-Fast DOCSIS 3.1 Cable Modem	2	840.27	1680.54
2	Cisco Catalyst 2960-24TT-L Switch	4	471	1884.00
3	ASUS RT-BE88U	2	1799	3598.00
4	Cat7 Ethernet Cable	40	50	2000.00
5	Shielded RJ45 Connector	50	15	750.00
6	TP-Link EAP650 (AX3000)	6	649	3894.00
Total cost (RM)				13802.54

3.3.3 Reflection

1. **Are you surprised by the prices? How were you surprised?**

   Yes, we are quite surprised by the prices, especially for modem and routers as the price range is close to RM1000 per unit. However, upon further study, as both devices provide high speed data transmission and Internet service, it is understandable for the devices to be priced as such. Each type of devices are also ranged closely despite being different in brand, such as the network cable connected which range between RM10 to RM25 only. The specification of each brand or type of devices also corresponds to the increase of price, better specification means higher price. The expected cost is RM 13802.54, which is well within our given budget for the project.

2. **Have you ever considered cost as a factor for choosing networking devices?**

   Cost of the hardwares is a major factor in choosing the suitable networking devices for our project as we have a fixed budget of RM2.2 Million. We need to make sure we are able to find the best deal devices that fit our budget frame, without sacrificing the performance of our network. Through comparison of multiple brands of the same devices, we are able to determine which brand suits the specification needs and cost of our project easily.

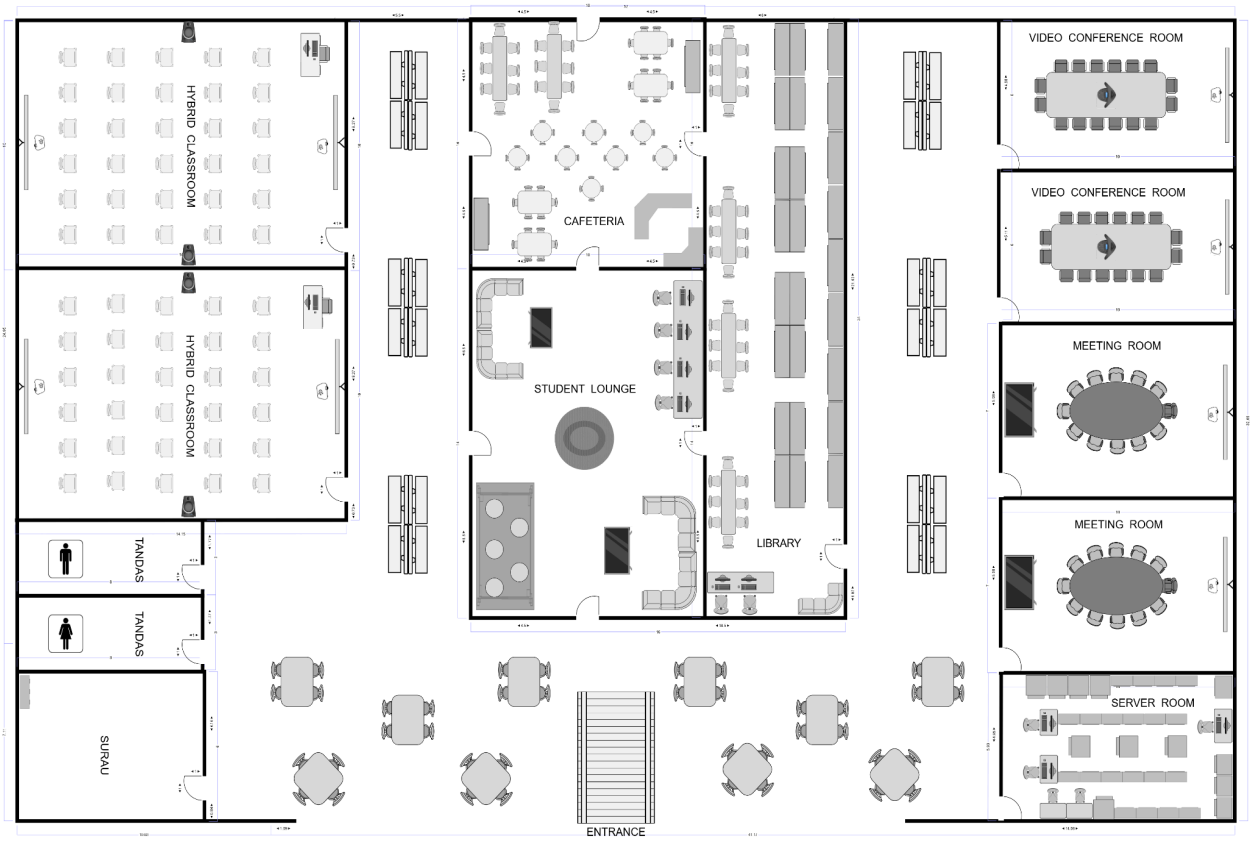
3. **What are the major differences between the same devices from different brands? For example, Cisco and Huawei Routers.**

   Hardware design, operating system, features, pricing, availability, and markets are some of the aspects that affect a customer's decision when comparing similar devices from various companies, such as Cisco and Huawei routers. Despite its high cost, Cisco maintains its reputation for providing high-end performance, innovative features, and a reliable support system, making it appropriate for large-scale construction. However, Huawei is a strong rival to Cisco since it focuses more on standard-based, affordable systems with high-performance components. To appeal to consumers on a tight budget, Huawei emphasizes standards-based features and user-friendly interfaces while concentrating on affordable solutions with competitive performance. Security, connectivity, and scalability are among areas where the two brands diverge, with Huawei providing more approachable alternatives and Cisco emphasizing sophisticated connections.

3.4 Task 4

3.4.1 Work areas on the floor plan

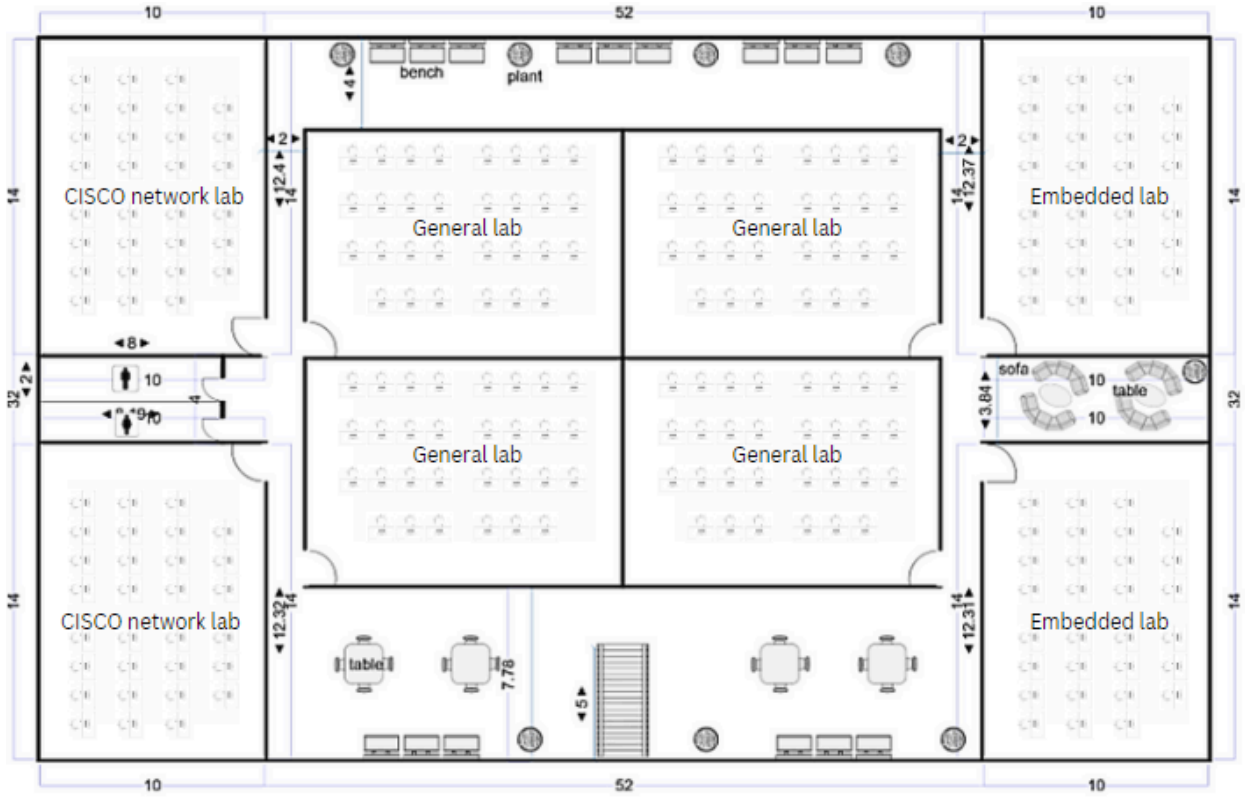
3.4.1.1 Ground Floor



1 unit = 1 meter

For the ground floor, there are a total 10 workspaces; 2 hybrid classrooms, 2 video conferencing rooms, 2 meeting rooms, 1 server room, 1 library, 1 student lounge and 1 cafeteria. Each of the hybrid classrooms have 1 workstation which is connected to a higher bandwidth. For the video conference room and meeting room, there is 1 workstation for monitoring and recording the whole discussion and purpose. Inside the server room, there are 3 workstations as network providers of the entire building, cooling fans to make sure all computers are not overheating and able to perform to their best potential. The student lounge is used to allow all the students to have a space to rest or any discussion conducted there. There are also 4 workstations in the student lounge area and 2 workstations in the library. A cafeteria is a place designed for all the students and staff to have their meals.

3.4.1.2 First Floor

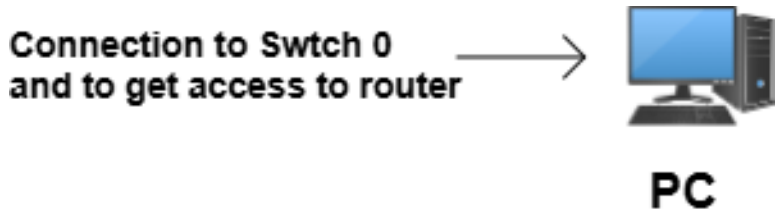


For the first floor, there are 8 workspaces; 2 CISCO network labs, 2 embedded labs, and 4 general labs. For each lab, there are going to be 30 workstations provided for students and faculty members. Each workstation in a lab will be connected to 1 switch, and every switch in every lab will be connected to a router, which will then be connected to an ISP. Other than the 3 types of labs, benches and sofas will be provided to ensure students always have space for discussion and rest.

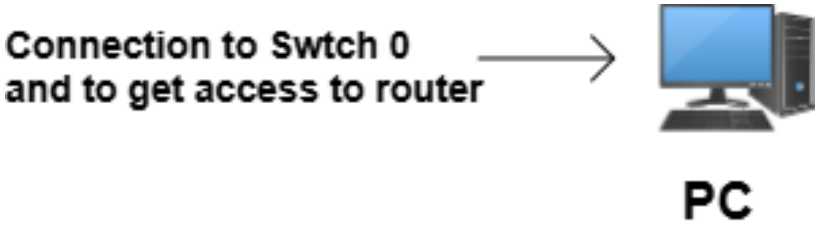
3.4.2 Network Diagram

Ground Floor

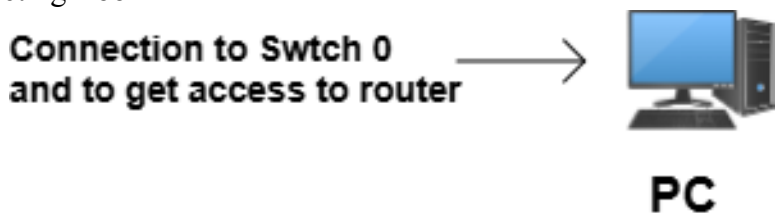
3.4.2.1 Hybrid Classroom



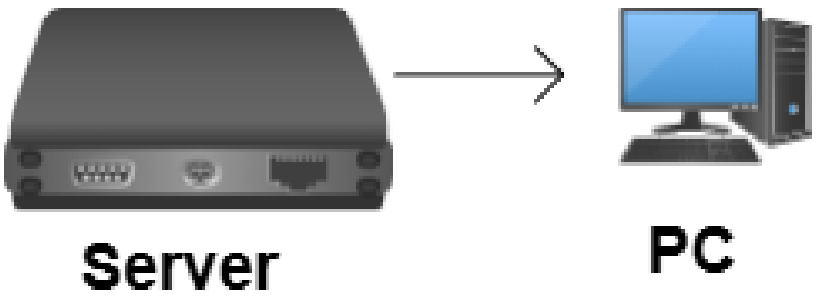
3.4.2.2 Video Conference Room



3.4.2.3 Meeting Room

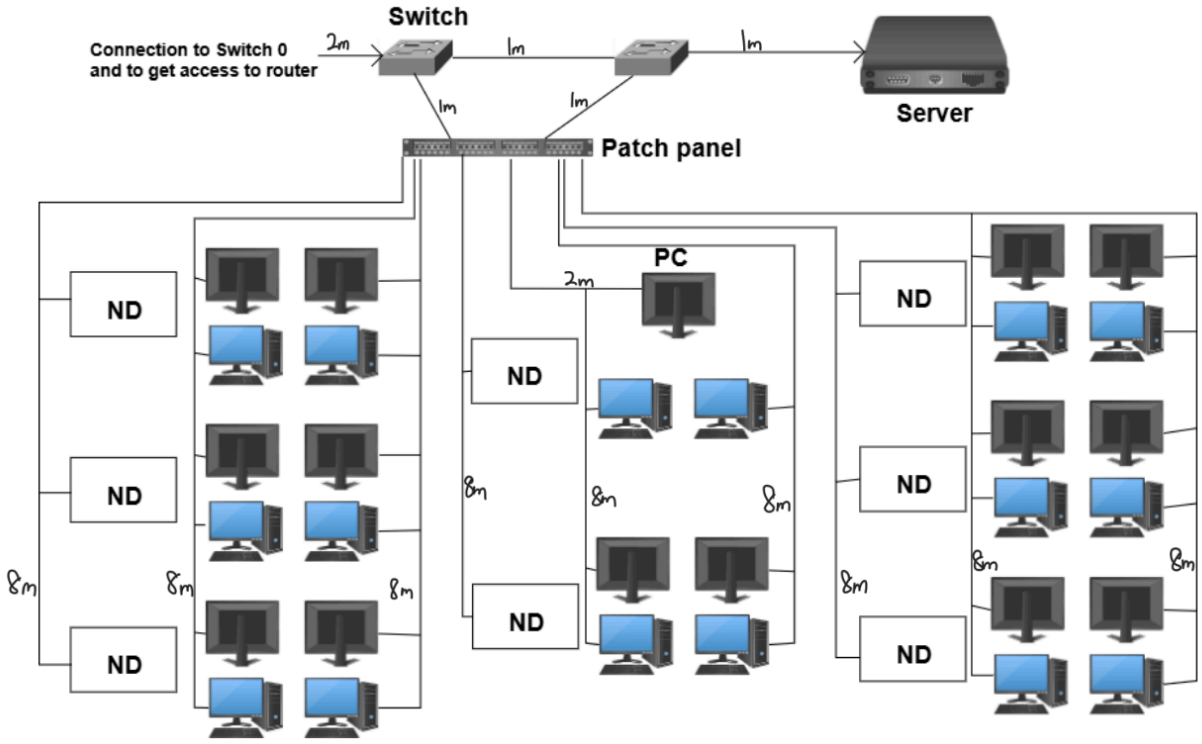


3.4.2.4 Server Room



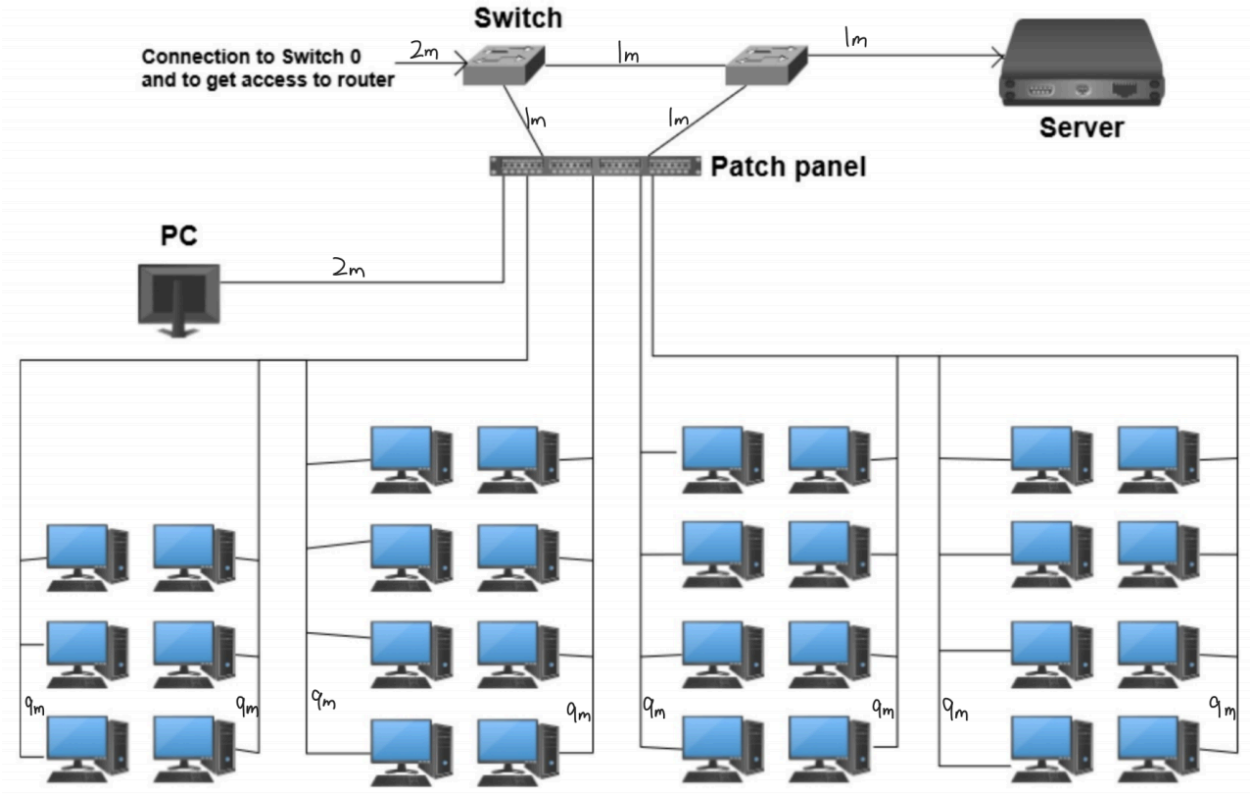
First Floor

3.4.2.5 CISCO Network Lab

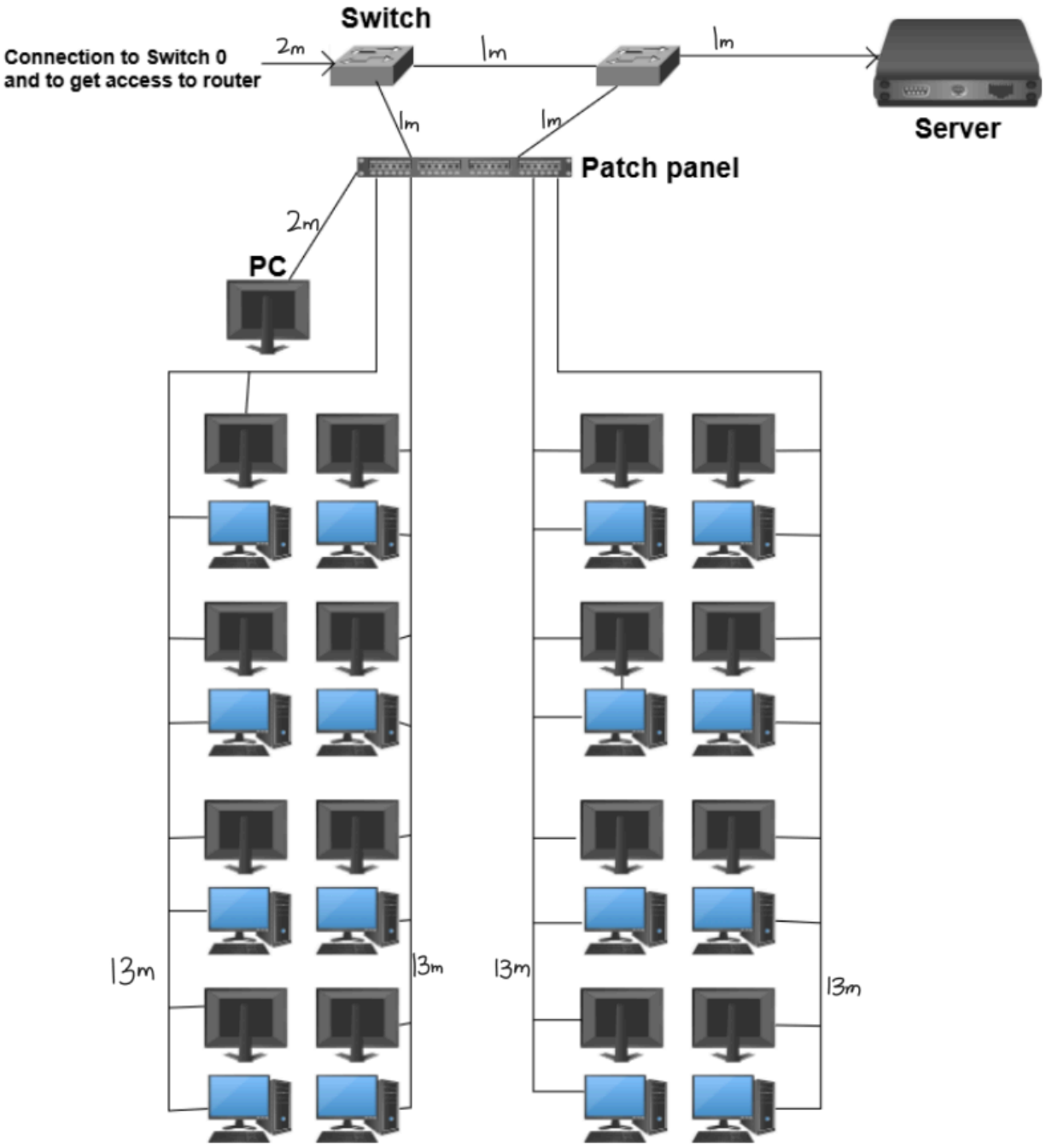


ND = Network devices

3.4.2.6 General Lab



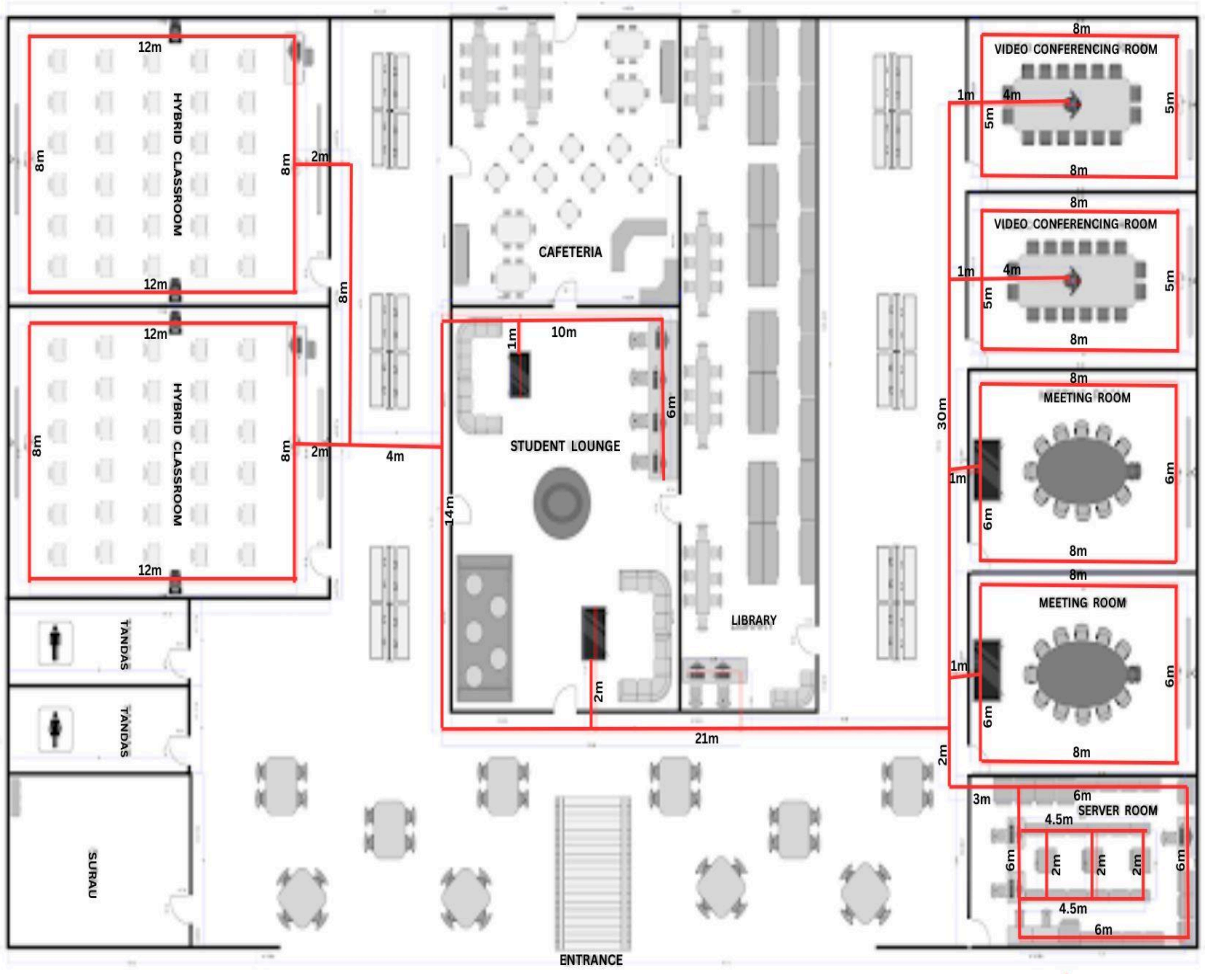
3.4.2.7 Embedded Lab



3.4.3 Cables & Connections

Floor cable plan

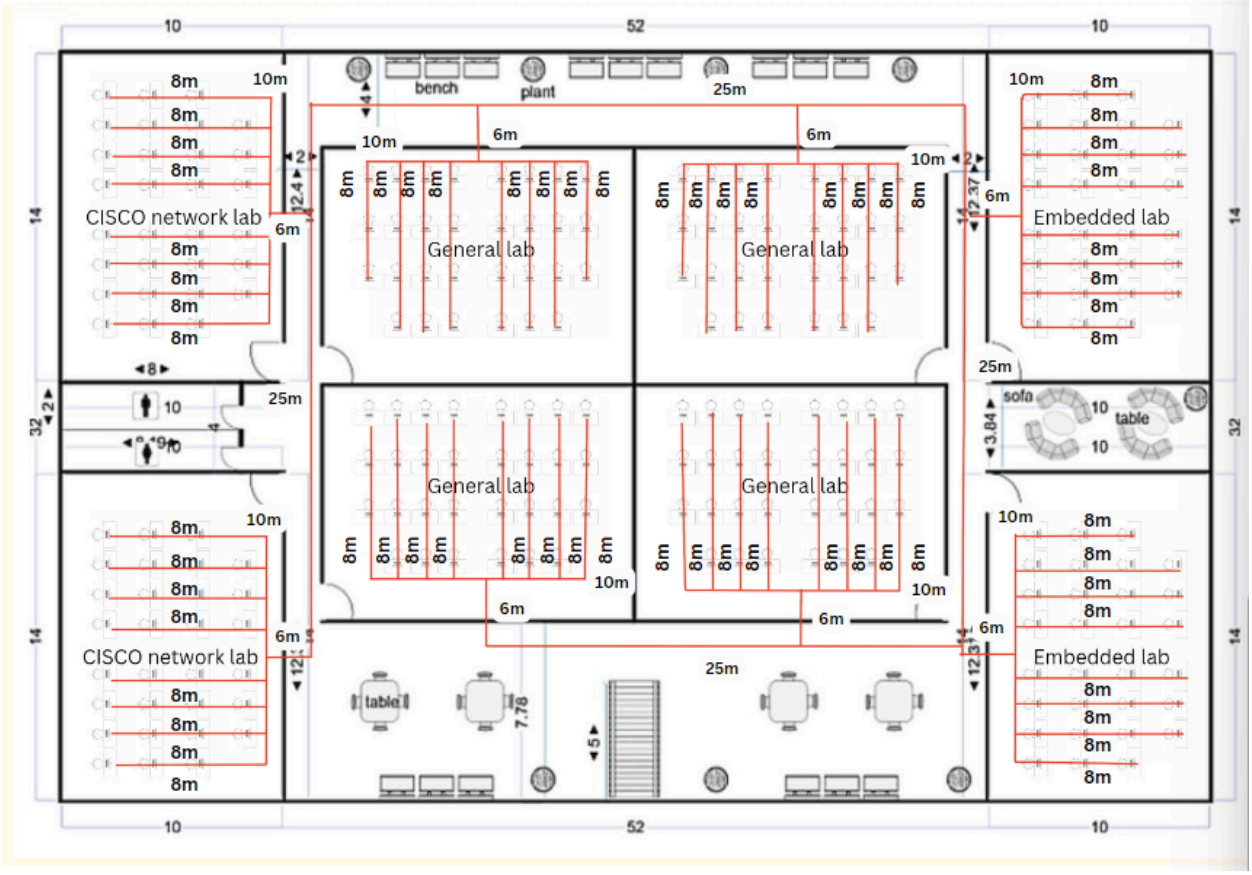
3.4.3.1 Ground floor



1 unit = 1 meter

CAT7 ethernet cable has been used in the ground floor to connect each workstations, switches and other electronic devices to the router for every workspaces and then finally to the server room which works as the network provider.

3.4.3.2 First Floor



We have determined to use CAT7 Ethernet cable for our network plan. First floor will be using the CAT7 Ethernet cable to connect each workstation and switches to the router for every lab.

Number of connections, patch cords and switch ports

Area	**Number of Shielded RJ45 Connector**
Hybrid Classroom 1	5
Hybrid Classroom 2	5
Video Conference Room 1	10
Video Conference Room 2	10
Meeting Room 1	10
Meeting Room 2	10
Server Room	10
CISCO Network Lab 1	30
CISCO Network Lab 2	30
General Lab 1	30
General Lab 2	30
General Lab 3	30
General Lab 4	30
Embedded Lab 1	30
Embedded Lab 1	30
Total	**300**

Area	**Number of Patch Cords**
Hybrid Classroom 1	5
Hybrid Classroom 2	5
Video Conference Room 1	10
Video Conference Room 2	10
Meeting Room 1	10
Meeting Room 2	10
Server Room	10
CISCO Network Lab 1	30
CISCO Network Lab 2	30
General Lab 1	30
General Lab 2	30
General Lab 3	30
General Lab 4	30
Embedded Lab 1	30
Embedded Lab 1	30
Total	**300**

Area	**Number of Switches**	**Number of Ports**
Hybrid Classroom 1	1	24
Hybrid Classroom 2	1	24
Video Conference Room 1	1	24
Video Conference Room 2	1	24
Meeting Room 1	1	24
Meeting Room 2	1	24
Server Room	1	24
CISCO Network Lab 1	2	48
CISCO Network Lab 2	2	48
General Lab 1	2	48
General Lab 2	2	48
General Lab 3	2	48
General Lab 4	2	48
Embedded Lab 1	2	48
Embedded Lab 1	2	48
Total	**23**	**552**

Cable type and length

Description	Cable Type	Length(m)
Ground Floor		
Hybrid Classroom 1	CAT7 Ethernet cable	42
Hybrid Classroom 2	CAT7 Ethernet cable	42
Video Conference Room 1	CAT7 Ethernet cable	31
Video Conference Room 2	CAT7 Ethernet cable	31
Meeting Room 1	CAT7 Ethernet cable	29
Meeting Room 2	CAT7 Ethernet cable	29
Student Lounge	CAT7 Ethernet cable	33
Server Room	CAT7 Ethernet cable	42
Peripheral connections	CAT7 Ethernet cable	65
Total length of the Ground Floor (m)		**344**
First Floor		
CISCO Network Lab 1	CAT7 Ethernet cable	80
CISCO Network Lab 2	CAT7 Ethernet cable	80
General Lab 1	CAT7 Ethernet cable	80
General Lab 2	CAT7 Ethernet cable	80
General Lab 3	CAT7 Ethernet cable	80
General Lab 4	CAT7 Ethernet cable	80
Embedded Lab 1	CAT7 Ethernet cable	80
Embedded Lab 1	CAT7 Ethernet cable	80
Peripheral connections	CAT7 Ethernet cable	100
Total length of the First Floor (m)		**740**
Fibre optic cable		**50**
Total length of all use cable (m)		**1134**

A shielded RJ45 connector is a specialized connector used to terminate Ethernet cables, particularly in shielded categories like CAT7. These connectors link devices such as computers, switches, and routers to the network. Implementing 300 shielded RJ45 connectors with CAT7 cabling ensures an effective and efficient network, minimizing communication breakdowns even in challenging environments like server rooms and laboratories with high electrical interference. The shielding improves strength and signal quality, making them ideal for high-speed data transfer, perfectly aligning with the demands of this project.

Each connector requires an RJ45 patch cord to establish a physical connection between a device and a switch. High-quality patch cords ensure stable connections with minimal signal loss, which is essential for maintaining the reliability and performance of the network. The total number of patch cords needed is 300, matching the number of shielded RJ45 connectors. This guarantees that every device has a dedicated cable, supporting efficient point-to-point connections throughout the network.

In this project, switch ports are provided using the Cisco Catalyst 2960-24TT-L Switch. This switch offers 24 Fast Ethernet ports for connecting devices like workstations and printers, along with 2 Gigabit uplink ports for high-speed communication between switches and the network backbone. Its port capacity is ideal for labs and classrooms with high device counts, and make it a perfect fit for server rooms and CISCO Network Labs. Using multiple switches where needed keeps the network organized and efficient ensuring seamless connectivity across the building.

A total of 1700m of CAT7 Ethernet cables is implemented in the building due to their advanced shielding and physical structure, which includes individually shielded twisted pairs and an additional outer shield. This design minimizes crosstalk and electromagnetic interference (EMI), providing superior signal quality and supporting speeds of up to 10 Gbps. These cables are ideal for high-performance networks, making them perfect for server rooms, labs, and hybrid classrooms requiring low latency and high bandwidth.

Fibre optic cables are used as backbone connections between floors and key network nodes. In this project, they connect switches between the ground floor and the first floor, ensuring high-speed, long-distance data transmission without interference. With their higher bandwidth and immunity to EMI, fibre optic cables are also suitable for installation in network labs. Additionally, wireless connectivity is applied in common areas such as lounges, meeting rooms, and open workspaces, offering flexibility and convenience for mobile devices like laptops, tablets, and smartphones.

3.5 Task 5

3.5.1. Subnet Mask

Given: 192.18.0.0/8

Ground Floor Subnets

Work Area	No of Workstation	Subnet Required	Reasons for Subnets
Hybrid Classroom 1&2, Library & Student Lounge	1 + 1 +2 + 4 = 8	1	High-quality video and audio streaming and multiple device connections
Video Conferencing Room 1&2, Server Room	1 + 1 + 3 = 5	1	Stable video and audio streaming, high-speed, secure network for core building infrastructure
Meeting Room 1&2	1 + 1 = 2	1	Meeting monitoring and recording
Total	**12**	**3**	

First Floor Subnets

Work Area	No of Workstation	Subnet Required	Reasons for Subnets
Cisco Network Lab 1	31	1	High-speed dedicated network for simulations
Cisco Network Lab 2	31	1	High-speed dedicated network for simulations
Embedded Lab 1&2	31 + 31= 62	1	Low-latency network for real-time IoT and machine learning
General Lab 1&2	31 + 31 = 62	1	Moderate bandwidth for general-purpose activities
General Lab 3&4	31 + 31 = 62	1	Moderate bandwidth for general-purpose activities
Total	**248**	**5**	

Total no of Subnets = 3 + 5 = 8

$2^n \geq$ Number of Subnets
$\Rightarrow 2^n \geq 8$
$\Rightarrow 2^n \geq 2^3$
$\Rightarrow n = 3$

We need to borrow 3 bits from the host portion of the IP address. Our given IP address is 192.18.0.0/8. The original subnet mask has 8 bits reserved for the network.

Borrowing 3 bits means the network portion now uses: 8+3=11 bits.
The remaining host bits are: 32−11=21 bits.

The first 11 bits are 1s(Network portion), and the remaining 21 bits are 0s(Host portion).
Binary: 11111111.11100000.00000000.00000000
Dotted Decimal: 255.224.0.0

So, the new subnet mask is /11 or 255.224.0.0

By borrowing 3 bits, we create $2^3 = 8$ subnets where each subnet has $2^{21} - 2 = 2{,}097{,}150$ usable IP addresses, excluding the network and broadcast addresses. So, the given IP address space has been divided efficiently among different departments or networks while accommodating the anticipated 15% growth of users.

3.5.2 Range of IP address, Network and Broadcast address for the subnet

Subnet no	Area	Network Address	Broadcast Address	Range of IP address
0	Hybrid classroom 1&2, Library, Student Lounge	192.0.0.0	192.31.255.255	192.0.0.1-192.31.255.254 1100 0000.0000 0000.0000 0000.0000 0001 - 1100 0000.0001 1111.1111 1111.1111 1110
1	Meeting Room 1&2	192.32.0.0	192.63.255.255	192.32.0.1-192.63.255.254 1100 0000.0010 0000.0000 0000.0000 0001 - 1100 0000.0011 1111.1111 1111.1111 1110
2	Video Conferencing Room 1&2, Server Room	192.64.0.0	192.95.255.255	192.64.0.1-192.95.255.254 1100 0000.0100 0000.0000 0000.0000 0001 - 1100 0000.0101 1111.1111 1111.1111 1110
3	CISCO Network Lab 1	192.96.0.0	192.127.255.255	192.96.0.1-192.127.255.254 1100 0000.0110 0000.0000 0000.0000 0001 - 1100 0000.0111 1111.1111 1111.1111 1110
4	CISCO Network Lab 2	192.128.0.0	192.159.255.255	192.128.0.1-192.159.255.254 1100 0000.1000 0000.0000 0000.0000 0001 - 1100 0000.1001 1111.1111 1111.1111 1110
5	Embedded Lab 1&2	192.160.0.0	192.191.255.255	192.160.0.1-192.191.255.254 1100 0000.1010 0000.0000 0000.0000 0001 - 1100 0000.1011 1111.1111 1111.1111 1110
6	General Lab 1&2	192.192.0.0	192.223.255.255	192.192.0.1-192.223.255.254 1100 0000.1100 0000.0000 0000.0000 0001 - 1100 0000.1101 1111.1111 1111.1111 1110
7	General Lab 3&4	192.224.0.0	192.255.255.255	192.224.0.1-192.255.255.254 1100 0000.1110 0000.0000 0000.0000 0001 - 1100 0000.1111 1111.1111 1111.1111 1110

3.5.3 Range of IP address for user types based on the area

3.5.3.1 Hybrid classroom 1&2, Library, Student Lounge

User	**IP range**
Hybrid classroom 1	192.0.0.1
Hybrid classroom 2	192.0.0.2
Library	192.0.0.3-192.0.0.4
Student Lounge	192.0.0.5-192.0.0.8

3.5.3.2 Meeting Room 1&2

User	**IP range**
Meeting Room 1	192.32.0.1
Meeting Room 2	192.32.0.2

3.5.3.3 Video Conferencing Room 1&2, Server Room

User	**IP range**
Video Conferencing Room 1	192.64.0.1
Video Conferencing Room 2	192.64.0.2
Server Room	192.64.0.3-192.64.0.5

3.5.3.4 CISCO Network Lab 1

User	**IP range**
Student (PCs)	192.96.0.1-192.96.0.30
Lecturer (PCs)	192.96.0.31

3.5.3.5 CISCO Network Lab 2

User	**IP range**
Student (PCs)	192.128.0.1-192.128.0.30
Lecturer (PCs)	192.128.0.31

3.5.3.6 Embedded Lab 1&2

User		**IP range**
Embedded Lab 1	Student (PCs)	192.160.0.1-192.160.0.30
	Lecturer (PCs)	192.160.0.31
Embedded Lab 2	Student (PCs)	192.160.0.32-192.160.0.61
	Lecturer (PCs)	192.160.0.62

3.5.3.7 General Lab 1&2

User		**IP range**
General Lab 1	Student (PCs)	192.192.0.1-192.192.0.30
	Lecturer (PCs)	192.192.0.31
General Lab 2	Student (PCs)	192.192.0.32-192.192.0.61
	Lecturer (PCs)	192.192.0.62

3.5.3.8 General Lab 3&4

User		**IP range**
General Lab 3	Student (PCs)	192.224.0.1-192.224.0.30
	Lecturer (PCs)	192.224.0.31
General Lab 4	Student (PCs)	192.224.0.32-192.224.0.61
	Lecturer (PCs)	192.224.0.62

4.0 Reflection

This project was a knowledgeable journey that combined theoretical knowledge with practical application in designing a network system for the Faculty of Computing. The process involved creating a detailed floor plan, selecting appropriate devices, performing feasibility studies, and implementing a scalable and efficient network structure.

One key learning was the importance of balancing performance and budget constraints. The project demonstrated that achieving high-speed and secure networks within a fixed budget requires detailed research and comparison of device specifications, performance, and cost-effectiveness. This was particularly evident when choosing modems, routers, and switches, where understanding the trade-offs between brands and models is important.

Collaborative teamwork was a key of this project. Regular meetings and open communication enabled us to overcome challenges, respect differing opinions, and leverage each member's strengths. This builds an environment of mutual learning and adaptability.

The experience of identifying subnets, IP allocation, and understanding bandwidth requirements for various labs and rooms enhanced our technical skills. Additionally, designing a scalable IP addressing scheme emphasized the importance of future-proofing in network management.

Challenges, such as limited initial knowledge, motivates us to deepen our understanding of network infrastructure. This project has been invaluable in developing our problem-solving skills, technical expertise, and teamwork, preparing us for future academic and professional endeavors.

5.0 Conclusion

Providing a scheme for the duration of several months and then coming together as a team to work through and overcome precarious hurdles, the finishing touches of the project were made possible.

The project showed us how to develop a network system using a real case study. It taught us to select suitable network devices that had to meet not only performance specifications but also budget constraints. It was the first time in history that we designed a LAN network system from scratch, involving floor plans and device placing to achieve maximum performance. Development of an efficient and scalable IP addressing scheme made us understand much more about network management.

More than the technical knowledge, the project taught us how to cooperate and communicate. Regular meetings were scheduled before starting each task, and at those meetings, everybody was on board to understand the given task. We sometimes had disagreements, but we have always respected each other's opinions. Any mistake was never considered a finality instead, we treated them as intervention opportunities to help each other learn and grow together. It was that respect and support toward one another that enabled us to deliver satisfactorily.

One of the most challenging things was not knowing practically anything about acting on a network system design. With no prior experience in handling such tasks, we had to rely on extensive research and guidance from knowledgeable individuals. The project actually identified segments that we must work on, improvement in basic knowledge plus alternative research on improved tools or methods for network designing. Nevertheless, we will pursue acquiring knowledge through study and practice to advance in our skill sets.

In conclusion, this project has been an enriching journey. It helped us apply the theoretical knowledge we had learned onto a real-life scenario, sharpen our problem-solving skills and work together as a team. We are sure that the lessons learned will help us in our future academic and professional careers. We are very grateful for the opportunity that has been given to us to do this project and look forward to building upon this experience.

6.0 Team Members and Responsibilities

<table>
<tr><td colspan="2">Team Member List:
1. CHANG WEN XUEN
2. LIM CHEN XI
3. FARAH NABILA BINTI WAN ISMAIL
4. ANISA CHOWDHURY</td></tr>
<tr><td>CHANG WEN XUEN

• Task 1: Floor plan (ground floor, first floor, server room)
• Task 2: 3 Questions & legal feasibility
• Task 3: Explanation and List for Wireless Access Point, expected cost, one reflection
• Task 4: Cable lengths, Identifying the cable length & type
• Task 5:Range of IP address for user types based on the area
• Task 6: Compile tasks, Task distribution, financial budget report</td><td>LIM CHEN XI

• Task 1:Floor Plan (general purpose lab, cisco network lab)
• Task 2: 3 Questions
• Task 3: Explanation and List for Modem & Switch, one reflection
• Task 4: Network Diagram
• Task 5: Range of IP address for user types based on the area
• Task 6: Conclusion, compile meeting minutes
• Completed all meeting minutes</td></tr>
<tr><td>FARAH NABILA BINTI WAN ISMAIL

• Task 1: Floor plan (video conferencing, student lounge, cafeteria, meeting room)
• Task 2: 3 Questions & technical feasibility
• Task 3: Explanation and List for Router, 2 reflections
• Task 4:Floor plan and workspace for the first floor
• Task 5:Range of IP address, Network and Broadcast address for the subnet
• Task 6: Abstract, Introduction, References</td><td>ANISA CHOWDHURY

• Task 1: Floor plan (embedded lab, hybrid classroom)
• Task 2: 3 Questions & economic feasibility
• Task 3: Explanation and List for Network Cables & Network Cable Connector
• Task 4:Floor plan and workspace for ground floor
• Task 5: Subnet Mask
• Task 6: Project Background and overview of client’s current status and issue</td></tr>
</table>

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Appendix

1. **Minute Meeting**

TASK 1:

Date/Time	11/10/2024 10:00 AM
Agenda	Network Communications 4G Meeting
Minutes prepared by:	Chang Wen Xuen
Location	Google Meet
1. Meeting Objectives	
Task 1 Discussion Meeting	
2. Attendance	
1. Chang Wen Xuen	A23CS5012
2. Lim Chen Xi	A23CS0103
3. Farah Nabila Binti Wan Ismail	A23CS0077
4. Anisa Chowdhury	A23CS0288
3. Minutes	
Introduction to the Task 1	Chang Wen Xuen introduce the case study and highlight the important point in the case study, especially the criteria needed for the floor plan.
Assignation of task	1. Chang Wen Xuen Floor plan for ground floor, first floor and server room 2. Lim Chen Xi Meeting minute, floor plan for general purpose lab and Cisco Network lab 3. Farah Nabila Binti Wan Ismail Floor plan for video conferencing, student lounge, cafeteria and meeting room 4. Anisa Chowdhury Floor plan for Embedded lab and hybrid classroom
Software to use	Use Smartdraw to draw the floor plan
Due date to finish the task	16/10/2024

TASK 2:

Date/Time	31/10/2024 8:00 p.m.
Agenda	Network Communications 4G Meeting
Minutes prepared by:	Lim Chen Xi
Location	Google Meet
1. Meeting Objectives	
Task 2 Discussion Meeting	
2. Attendance	
1. Chang Wen Xuen	A23CS5012
2. Lim Chen Xi	A23CS0103
3. Farah Nabila Binti Wan Ismail	A23CS0077
4. Anisa Chowdhury	A23CS0288
3. Minutes	
Introduction to the Task 2	Chang Wen Xuen explains the task that needs to be done for Task 2 and discusses assigning the task.
Discussion of Questions Collected	Chang proposes 6 questions, Farah proposes 4 questions, Lim proposes 4 questions, Anisa proposes 2 questions and Chang ask for opinions on analysing and filtering questions.
Interview	We discuss where, when, who and how to interview
Assignation of task	1. Chang Wen Xuen Filter the question, Question 7-9, Legal feasibility 2. Lim Chen Xi Question 10-12, Meeting minute 3. Farah Nabila Binti Wan Ismail Question 1-3, Technical feasibility 4. Anisa Chowdhury Question 4-6, Economic feasibility
Due date to finish	7/11/2024

TASK 3:

Date/Time	21/10/2024 8:00 p.m.
Agenda	Network Communications 4G Meeting
Minutes prepared by:	Lim Chen Xi
Location	Google Meet
1. Meeting Objectives	
Task 3 Discussion Meeting	
2. Attendance	
1. Chang Wen Xuen	A23CS5012
2. Lim Chen Xi	A23CS0103
3. Farah Nabila Binti Wan Ismail	A23CS0077
4. Anisa Chowdhury	A23CS0288
3. Minutes	
Introduction to the Task	Chang Wen Xuen explains the task that needs to be done for Task 3 and discusses assigning the task.
Assignation of task	1. Chang Wen Xuen Explanation and List for Wireless Access Point, expected cost, and one from reflection 2. Lim Chen Xi Explanation and List for Modem & Switch, and Meeting minute 3. Farah Nabila Binti Wan Ismail Explanation and List for Router and 2 from reflection 4. Anisa Chowdhury Explanation and List for Network Cables & Network Cable Connector
Due date to finish	5/12/2024

TASK 4:

Date/Time	13/10/2024 7:00 p.m.
Agenda	Network Communications 4G Meeting
Minutes prepared by:	Lim Chen Xi
Location	Google Meet
1. Meeting Objectives	
Task 4 Discussion Meeting	
2. Attendance	
1. Chang Wen Xuen	A23CS5012
2. Lim Chen Xi	A23CS0103
3. Farah Nabila Binti Wan Ismail	A23CS0077
4. Anisa Chowdhury	A23CS0288
3. Minutes	
Introduction to the Task	Chang Wen Xuen explains the task that needs to be done for Task 4 and discusses assigning the task.
Assignation of task	1. Chang Wen Xuen Cable lengths, Identifying the cable length & type 2. Lim Chen Xi Network diagram and Meeting minute 3. Farah Nabila Binti Wan Ismail Floor plan and workspace for first floor 4. Anisa Chowdhury Floor plan and workspace for ground floor
Due date to finish	27/12/2024

TASK 5:

Date/Time	4/1/2025 7:00 p.m.
Agenda	Network Communications 4G Meeting
Minutes prepared by:	Lim Chen Xi
Location	Google Meet
1. Meeting Objectives	
Task 5 Discussion Meeting	
2. Attendance	
1. Chang Wen Xuen	A23CS5012
2. Lim Chen Xi	A23CS0103
3. Farah Nabila Binti Wan Ismail	A23CS0077
4. Anisa Chowdhury	A23CS0288
3. Minutes	
Introduction to the Task	Chang Wen Xuen explains the task that needs to be done for Task 5 and discusses assigning the task.
Assignation of task	1. Chang Wen Xuen Range of IP address for user types based on the area 2. Lim Chen Xi Range of IP address for user types based on the area and Meeting minute 3. Farah Nabila Binti Wan Ismail Range of IP address, Network and Broadcast address for the subnet 4. Anisa Chowdhury Subnet mask
Due date to finish	18/1/2025

TASK 6:

Date/Time	4/1/2025 7:30 p.m.
Agenda	Network Communications 4G Meeting
Minutes prepared by:	Lim Chen Xi
Location	Google Meet
1. Meeting Objectives	
Task 6 Discussion Meeting	
2. Attendance	
1. Chang Wen Xuen	A23CS5012
2. Lim Chen Xi	A23CS0103
3. Farah Nabila Binti Wan Ismail	A23CS0077
4. Anisa Chowdhury	A23CS0288
3. Minutes	
Introduction to the Task	Chang Wen Xuen explains the task that needs to be done for Task 6 and discusses assigning the task.
Assignation of task	1. Chang Wen Xuen Task distribution, Financial budget report and compile task 1-task 5 2. Lim Chen Xi Conclusion, compile all meeting minutes 3. Farah Nabila Binti Wan Ismail Abstract, Introduction, References 4. Anisa Chowdhury Project Background and an overview of the client's current status and issue
Due date to finish	25/1/2025

2. Meeting Photo at Google Meet

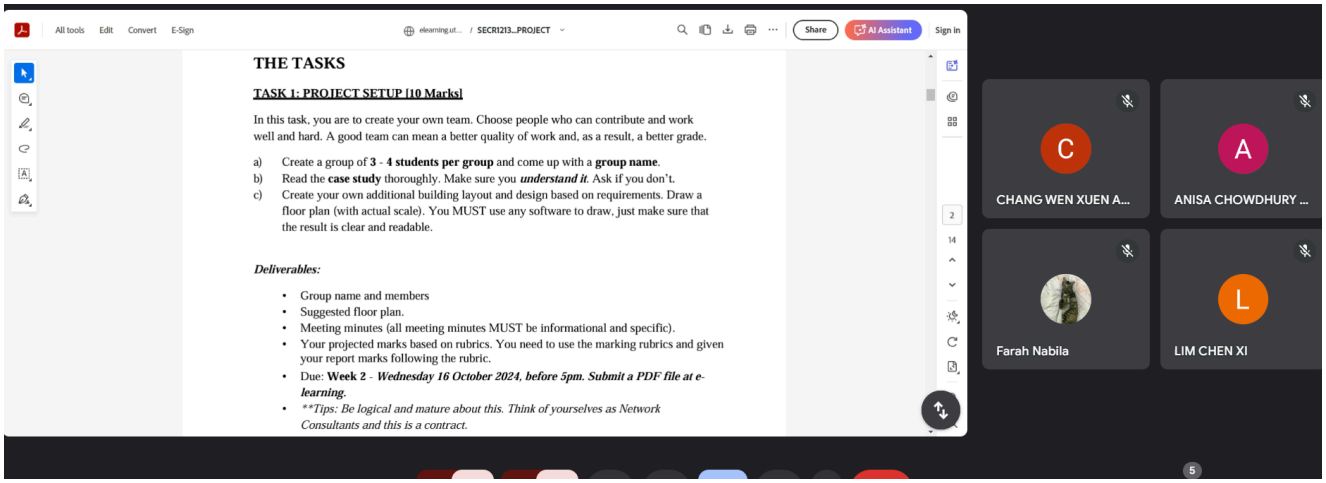

Figure A1: Meeting of Task 1

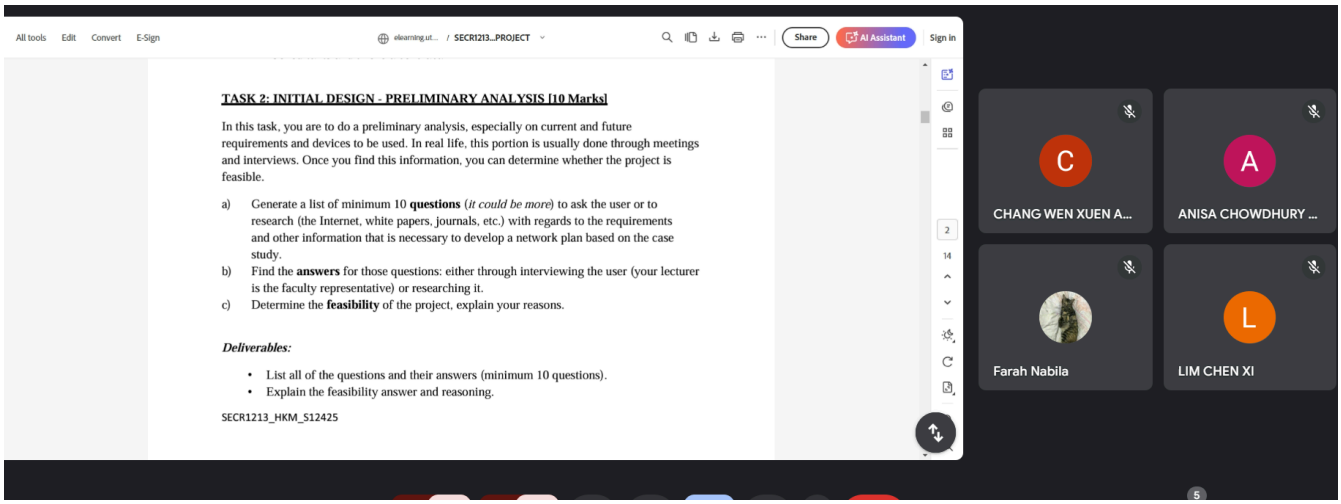

Figure A2: Meeting of Task 2

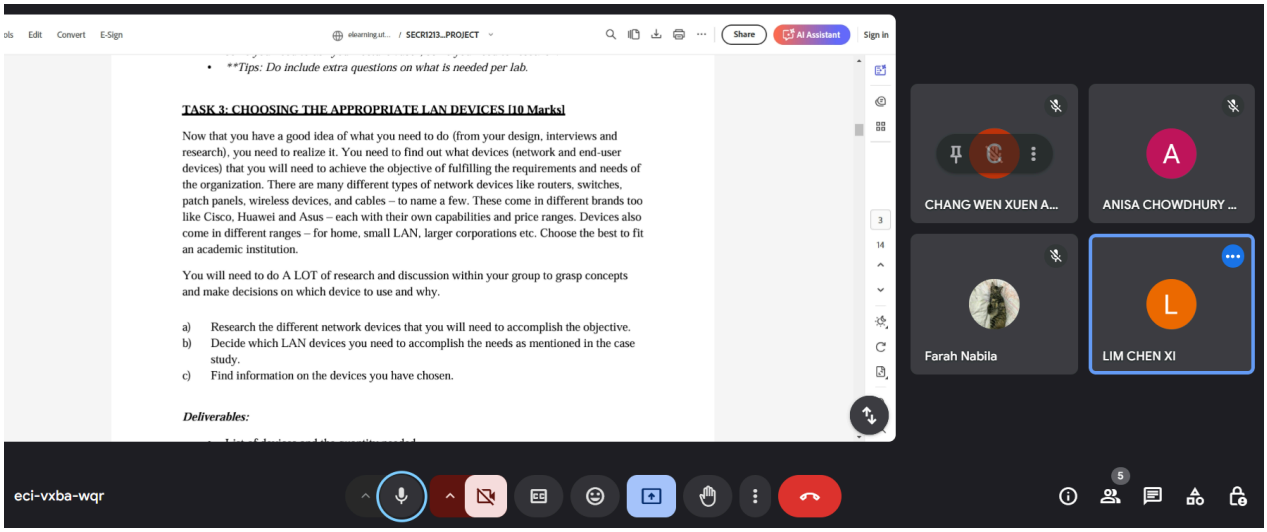

Figure A3: Meeting of Task 3

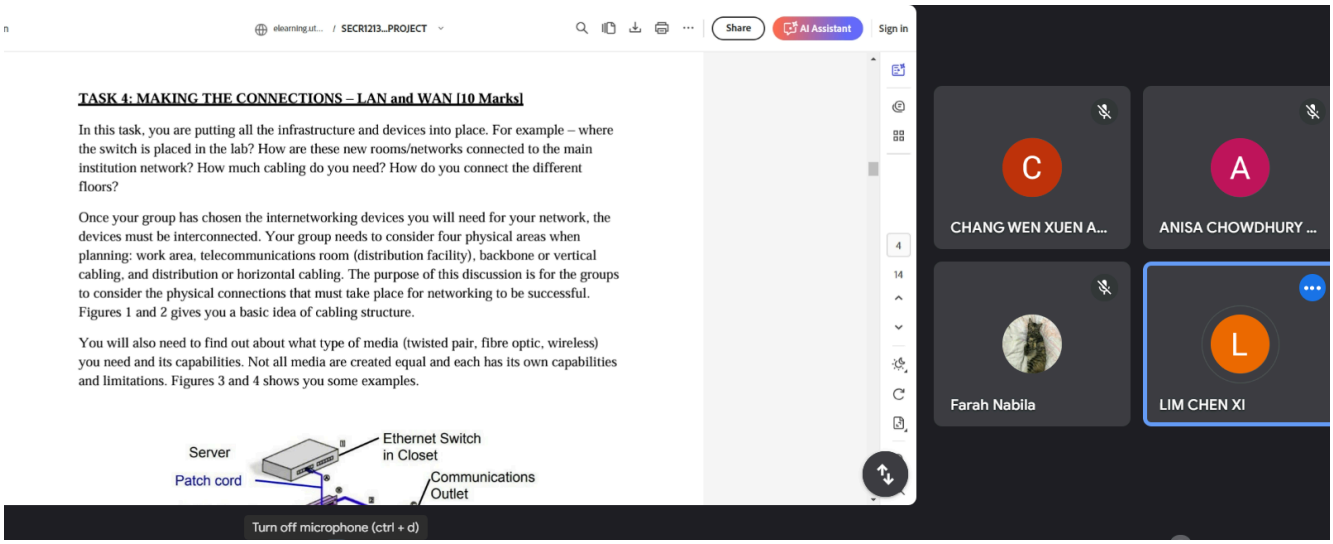

Figure A4: Meeting of Task 4

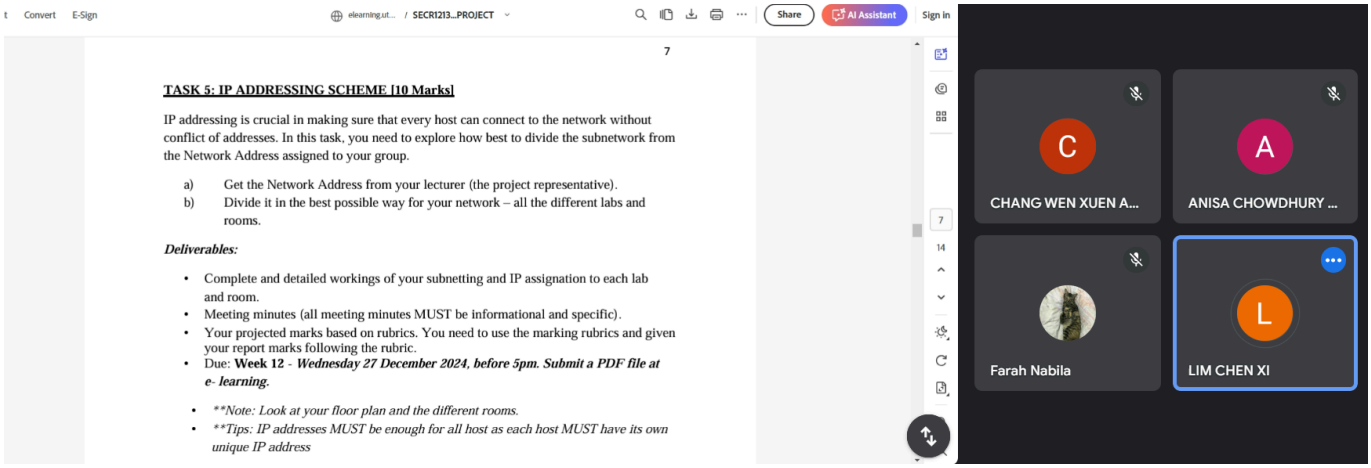

Figure A5: Meeting of Task 5

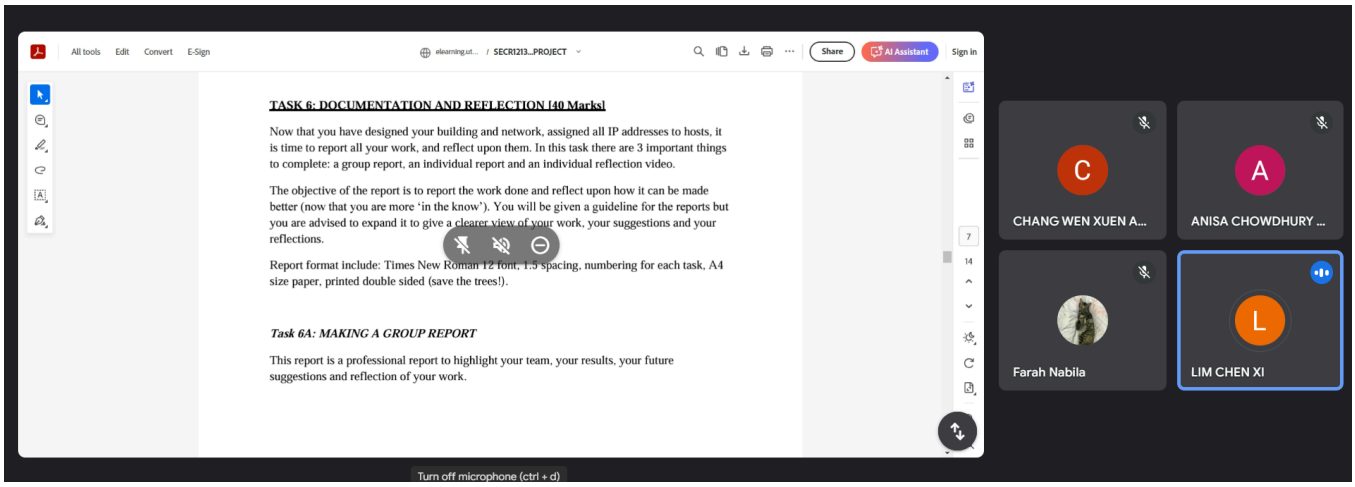

Figure A6: Meeting of Task 6

3. Financial Budget

Details	**Quantity**	**Amount(RM)**
Income		
Assigned budget		**2,200,000.00**
Expenses		
Motorola MB8611 Ultra-Fast DOCSIS 3.1 Cable Modem	2	1680.54
Cisco Catalyst 2960-24TT-L Switch	4	1884.00
ASUS RT-BE88U	2	3598.00
Cat7 Ethernet Cable	40	2000.00
Shielded RJ45 Connector	50	750.00
TP-Link EAP650 (AX3000)	6	3894.00
Cat 7 24 ports Network Patch Panel	8	1736.00
Fibre optic cable	10	1000.00
Labour Fee	1	8000.00
Total for expenses		**24542.54**
BALANCE (Income-Expenses)		**2175457.46**