# FACULTY OF COMPUTING

## SEMESTER 1/20222023

# SECR1213– NETWORK COMMUNICATION
# SECTION 04

# Network Design for Faculty of Computing Block N28B

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# ABSTRACT

Universiti Teknologi Malaysia is well-known for graduating students with the necessary skills and knowledge to work for world-renowned corporations. Thus, student enrollment at this university has steadily increased over the years, particularly at the Faculty of Computing, where they anticipate a 10% increase in both students and academic staff over the next three years. To meet the demand, the faculty council decided to construct a two-story building that will be used for learning purposes by both lecturers and students, and will include 5 labs and other facilities.

To ensure that the project progressed smoothly, it was divided into several tasks with different deadlines. Task 1 requires the team to create a project setup and floor plan for the building. In the meantime, for Task 2, they conducted a preliminary analysis and initial design, focusing on the devices to be used and other requirements prior to the goals. In Task 3, they list all of the LAN devices and the quantities that must be used in the building to stay within the budget. Task 4 requires the team to connect all of the devices in the building, while Task 5 requires them to assign IP addresses to every device in every lab in the building. Finally, in Task 6, a report will be created by combining all of the Tasks into a single report to summarise the work completed. The report should provide readers with a better understanding of this project.

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**INTRODUCTION**

The Faculty of Computing is determined in producing students with enough skills and knowledge in objectives to give back to society, especially to Universiti Teknologi Malaysia itself. Thus, in this Network Communication course, students are required to do the group project with individual review to bring forth what we have learnt in class into how it appears in the real world. The goal of this group project is to construct a small network with all of its necessary components. We need to understand first the user and customer needs and plan for them within the allocated budget. Then, we must plan and design a network infrastructure for present and future needs. Finally, we need to conduct research on the availability, the cost and services of network devices. This project is divided into 6 tasks that must be finished within the given time.

The first task required the students to design a two-storey building layout with 5 labs and other additional facilities using their own creativity and then draw a floor plan in accordance with the specification given. Next, Task 2 was coming up with the students conducting a preliminary analysis, with a focus on the devices to be used and the requirements for both present and future. In real life, this portion is usually done through meetings and interviews. Once students find this information, they can determine whether the project is feasible or not. Moving forward to Task 3 where students are required to determine good LAN devices for the labs. They must take into account all factors including the hardware's performance on each floor and each lab. In task 4, we begin to link the PC, servers, network, and other gadgets. We must ensure that the connections work well. When planning, the devices must take into account four physical areas: the work space, the telecommunications room, the backbone or vertical cabling, and the distribution or horizontal cabling. Setting the IP addressing scheme is task number five. During this task. We must investigate the most effective way to segment the subnetwork using the Network Address given to our team. Lastly, Task 6 requires us to finish our group report for customer assessment. The report's goal is to summarize the work done and offer suggestions for improvement. The report should be expanded to provide a better understanding of your work, your ideas, and your reflections since it is based on the guideline.

**PROJECT BACKGROUND**

The background of this project is starting with the situation faced by the Faculty of Computing when they expected 10% growth in both students and academic staff in the next 3 years. This includes all the students whether they are undergraduate or postgraduate students that further their studies in the computer science field. Hence, in order to support this escalation, the Faculty of Computing has decided to build a 2-storey building that can support the increase in the number of students. Other than that, the Faculty of Computing also decides that the building will be fully-equipped with all the needs for the students' use. These include, 4 new labs, 1 video conferencing room and also student lounge. All of these buildings are necessary in the building because it will be used by the lecturers and also all the students for learning purposes. Apart from that, the Faculty of Computing also has set certain criteria that need to be met in a long implementation of the building. It is to ensure that the new building will be beneficial to the target users. In order to make sure that the building will be ready for anything and have a reliable, efficient and secure network that can be easily managed, this project will take all aspects into consideration. All aspects will be looked into very carefully and make sure that the cost of implementing this building will be cost effective.
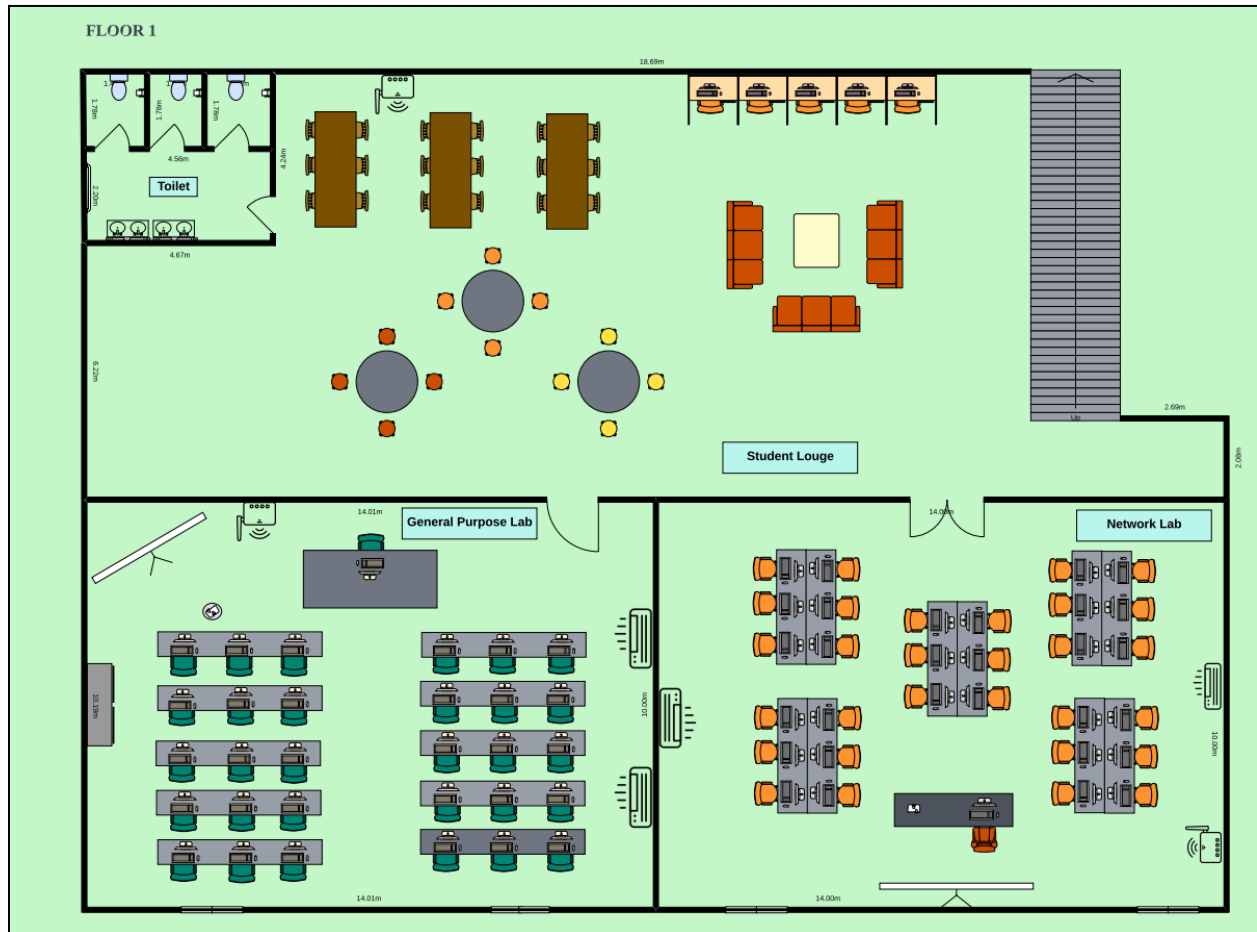
# TASK 1

## GROUND FLOOR



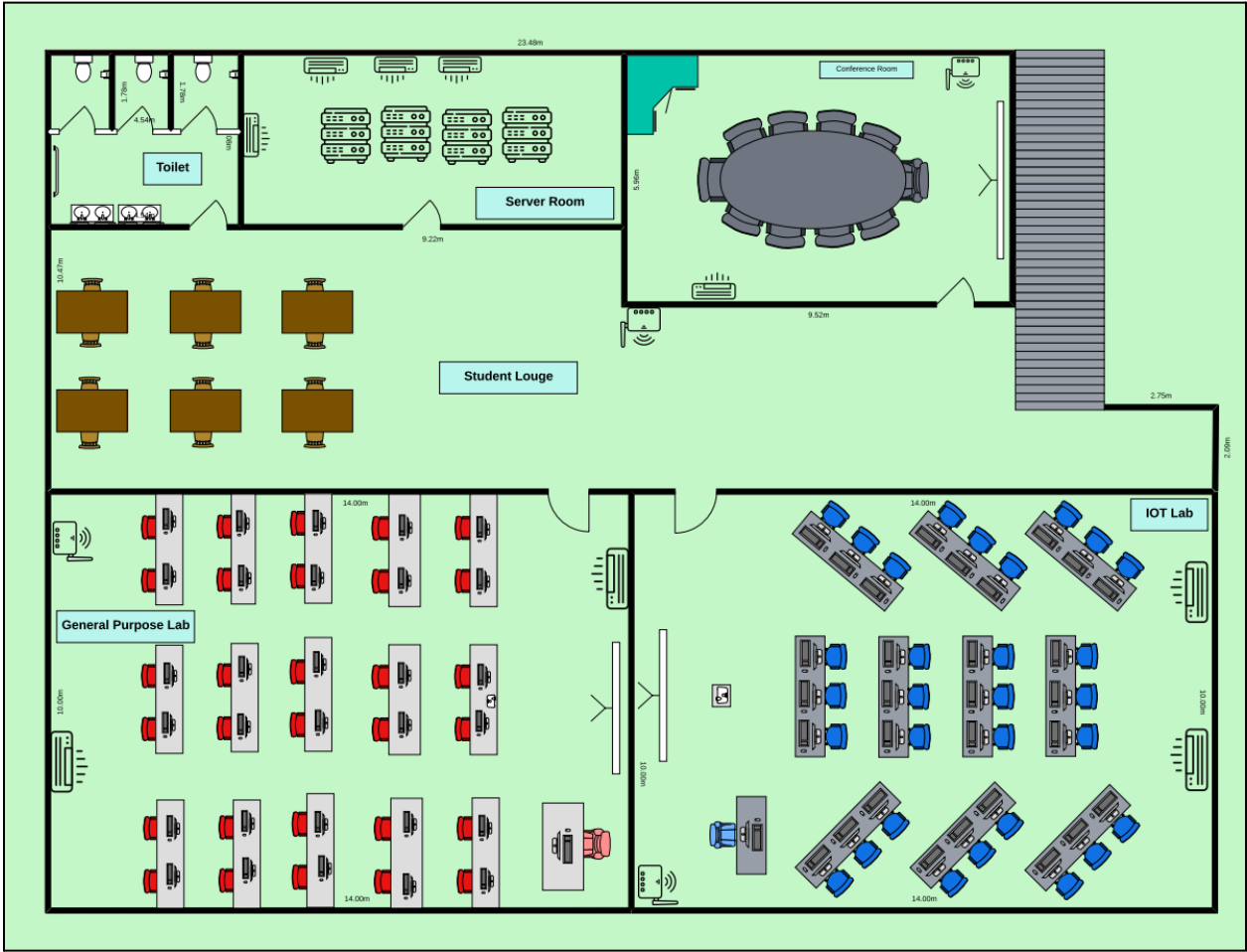**FIGURE 1 : GROUND FLOOR**

# FIRST FLOOR



**FIGURE 2 : FIRST FLOOR**

**REFLECTION TASK 1**

During the completion of Task 1, the team discovered a new software in designing the floor plan using a tool called Lucidchart. Aside from that, we gained new knowledge, particularly in designing a building based on the client's specifications, which includes two general purpose labs, one network lab, one IOT lab, one video conferencing room, and one student lounge. We encountered some difficulties in designing the building during Task 1 because our team lacked experience and knowledge in floor planning which slowed our progress. But by working together in researching and reading other reports by our seniors, we were able to overcome this problem. Not to mention, our lecturer's feedback and assistance with our work also helps us complete Task 1.

# TASK 2

**FEASIBILITY STUDY**

This project proposed an overall network design and floor plan to be served in the new building that will be established in the Faculty of Computing, which contains many spaces to be operated by this network, as our country, Malaysia, is heading toward the fourth industrial revolution where the uses of the technology can be very common in our daily lives. Our key goal in creating this floorplan is to support this initial planning, including secured devices, high performance to the core backbone, support for features, the ability to offer secure VPN connections from remote places, and the ability to be a manageable and scalable system. Hence, our project is mainly to achieve those specific requirements mentioned before.

First and foremost, we want to offer a secure device that all users in the network building may access. This device will be configured with policies to monitor and guard against illegal or unwanted access to the network devices. This includes providing the Faculty of Computing building with a secure computing environment by deploying reliable security software. It is intended to be completely practical and nearly inaccessible to those without the necessary credentials for the system. This strategy will lessen the risk of unauthorized consumption by any outsiders and can offer students, staff, and other building users a secure building system.

Aside from that, we would like to offer a system with high performance to the network system's core backbone and support for new features as they are developed. We will offer the highest performance level for any gear used in this facility and by all users. This uses fast technology and is appropriate for running the Faculty of Computing's administrative and educational operations. Any device in this building that will have software installed on it can be used without any problems. Hence, the network that will be utilized in this facility must therefore enable clients to retrieve, process, and store text and graphics .

Other than that, the facility should also undergo routine maintenance to guarantee that the components, cables, routers, and other networking devices can function as intended given the yearly increase in users and to ensure that all users receive the greatest performance. We don't want any confusion to arise while participating in video conferences, giving presentations, giving lectures, or accessing online resources because it could irritate other network users. Update and integration are therefore essential in this situation. The technology must be dependable, current, and compatible with all potential connected devices because the building used a Local Area Network (LAN) connection to ensure productive communication across the organizations.

In addition, we want to make sure that the network system we plan to use can support safe VPN connections from faraway locations. The VPN will therefore help to reduce the risk of internal data breaches, support remote workers, and provide security against hostile assaults. Many remote users will want to connect through unreliable network connections, such as insecure Wi-Fi. A VPN may eliminate that danger, and we'll see to it that the VPN endpoint software is kept current to prevent vulnerabilities that may arise from using an outdated client software version.

Last but not least, we will increase the network's bandwidth capacity and assist its physical expansion to new development areas to ensure that the network that will be installed is capable of managing increasing workloads in affordable and sustainable ways. Additionally, it has all the qualities of a scalable network, such as responsiveness, efficiency, adaptability, and accessibility, but also security, dependability, and availability.

## LIST OF QUESTIONS

**1. How will you protect your servers from any attack such as DDoS attack?**

We will use VPNs and private networks to ensure the security of the servers. This needs to be included since the organization may need to protect its server and data from any malicious attack. Moreover, it can also track and trace the users who are connected to the servers and even the location of your PC or laptop. This might help them if anything happens in the future. Besides, we will also set up and maintain a firewall. A firewall's main objective is to limit or get rid of unauthorized network connections so that authorized traffic can flow more freely. They can guide in disconnecting connections to the Internet from PCs and servers, protecting data privacy and security.

**2. What are the desktop computer configurations that you require for every lab ?**

| | |
|---|---|
| **Processor (CPU):** | Intel Core i5 sixth generation or newer |
| **Sustainability:** | EPEAT Silver rating (preferably EPEAT Gold) |
| **Operating System:** | Microsoft Windows 10 Professional x64 |
| **Memory:** | 16GB RAM |
| **Storage:** | 512 GB internal Solid State Drive (SSD) or 1 TB internal HDD |
| **Monitor/Display:** | 24" LCD monitor |
| **Network Adaptor:** | 802.11ac 2.4/5 GHz wireless adapter |
| **Graphics:** | Intel HD Graphics 2500 |

3. **What Internet Service Provider (ISP) suits best for your network?**

We would like to choose Unifi as the main ISP in the building. Since Unifi offers a few plans that are affordable considering that the wifi will be fully utilized by everyone in the faculty. We plan to subscribe to the Unifi plan which consists of 800 Mbps download speed and 200 Mbps upload speed and it costs RM349 per month.

4. **What type of network topology do you want to implement in the building?**

As each device is connected to a central switch, a star topology will be employed for the network. Because the entire network can be handled from one place using this star architecture, it is simple to add or delete nodes without having to take the network offline. Additionally, it offers a fast data transfer rate, which is essential for students and employees to finish their work.

5. **What is the important software that will be installed on each PC?**

For every workstation, a few internet browsers will be installed such as Google Chrome, Mozilla Firefox, and Internet Explorer. Next, for word, presentation, and spreadsheet software, we will install Microsoft Word 2021, Microsoft Powerpoint, and Microsoft Excel respectively. For a better learning experience, software such as WireShark, Visual Studio Code, and MATLAB will be installed beforehand.

**6. What network architecture will be used?**

A Local Area Network will be used for this project and it will implement the client-server architecture. LAN is among the most versatile and flexible networking technology for providing customized communications systems. LAN can basically meet the needs of any place or venue. Any user size, any application kind, and any cost/performance ratio can be handled. LANs are simple to use due to their excellent flexibility, which is caused by a number of variables including distributed architecture design, software standards, and hardware independent technologies.

**7. What are the devices needed to construct the network infrastructure?**

Routers - To connect to the switches or hubs that will be used.
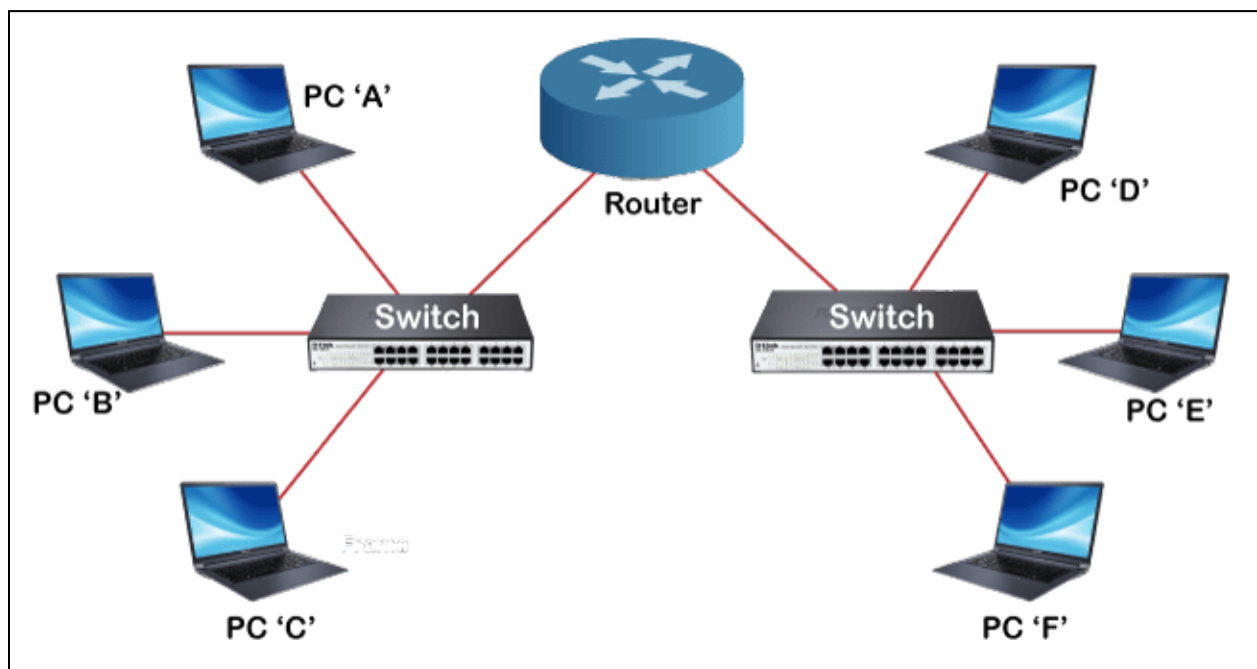Switches/Hubs - To connect with all the computers in each lab.



**FIGURE 3 : NETWORK COMPONENTS**

**8. What type of physical media do you want to use for your network plan?**

We will use both wired and wireless connections. In terms of wired connections, we will use Ethernet because the speed provided by an Ethernet connection is much faster than that of a wireless connection and also has higher levels of security because it will be able to control who uses the network and prevent security breaches. As for the wireless connection, it will allow multiple devices to be remotely connected to the same internet connectivity. They will also be able to access the Internet using their mobile phones, tablets, laptops, and other devices as long as their devices are within its range.

**9. Are the labs using the same equipment as other labs?**

No, because each lab will have its own specific equipment and tools to help students in their studies.

**10. What WiFi technology is going to be used in the building?**

We will use WiFi 6 instead of WiFi 5. This is due to the fact that WiFi 6 expands the number of devices that can be supported by a single router while also providing faster speed than WiFi 5 for both single and multiple devices when connected to a router. Furthermore, it has improved security protocols for secure internet browsing.

**11. What are the types of servers going to be used in the labs altogether?**

There will be two types of servers used, which are file servers and web servers. For file servers, it will allow the user to easily access all of the user's files from one central location while also allowing the user to control access so that the user's information is not leaked to others. Meanwhile, web servers deliver site content to users. It is critical that the web user functions properly so that the site content can be delivered to users as quickly as possible.

**12. What application architecture is going to be used in the labs?**

The client-server architecture will be used in all labs and conference rooms. This is because it is easy to manage and maintain, and data can be delivered to clients quickly. Because the data is centralized, it also adds security to the data, making it less likely to be leaked.

**REFLECTION TASK 2**

Based on the preliminary research that we have conducted in this phase, we learnt that this phase is important for us to be clear about what we should plan and implement in this project. A lot of research needs to be done in a way for us to understand what devices should be used, the requirements needed for each of the devices, the most suitable architecture for this project and other important information to develop a network for a new building of the Faculty of Computing. For example, we learnt that setting up a firewall is not enough to protect the network from malicious attacks so we decided to make up with VPNs and private networks set up to ensure strict security. Other than that, we search and brainstormed on what ISP that can provide maximum deals with an affordable budget and the software that is important to be installed in the PCs beforehand which will be used by Computer Science students. We also consider what type of servers needed to be installed in the labs and its functionality. To sum up the reflection for task 2, our group cooperates well in brainstorming the possible questions that are important for our project and we also assigned each member to get the accurate answer for each question that has been raised in order to work efficiently.

# TASK 3

## LIST OF DEVICES NEEDED AND DESCRIPTIONS

| Type | Function | Description | Qtty | Price/Unit (RM) | Total (RM) |
|---|---|---|---|---|---|
| **D-Link 48 Port Managed Switches**  | Keep traffic between devices from getting in the way of other devices on the same network, increase LAN bandwidth and connect multiple PCs to the network. | **Switching Capacity**<br>● 104 Gbps<br><br>**Transmission Method**<br>● Store-and-forward<br><br>**Maximum 64 bytes packet forwarding rate**<br>● 77.4 Mbps<br><br>**Packet Buffer Memory**<br>● 12 MB<br><br>**AC Input**<br>● 100 to 240 VAC 50/60Hz internal universal power supply<br><br>**Maximum Power Consumption**<br>● 34.85 watts<br><br>**Heat Dissipation**<br>● 118.92 TU/hr<br><br>**Storage Temperature**<br>● -4 ° to 158°F (-40° to 70°C)<br><br>**Diagnostic LEDs**<br>● Link/Activity/Speed (Per 10/100/1000 Mbps port) | 8 | 2,300 | 18,400 |

| | | | | | |
|---|---|---|---|---|---|
| **Asus RT-AX82U Router**  | Allows internet access to reach the whole building and prevent dead spots where the internet can not be accessed. | **WiFi Range**<br>● up to 2000 sq ft & 30+ devices<br><br>**Data Rate**<br>● WiFi 5 (802.11ac) (1024QAM) : up to 4333 Mbps<br>● WiFi 6 (802.11ax) (5GHz) : up to 4804 Mbps<br><br>**Antenna**<br>● External antenna x 4<br><br>**Firewall & Access Control**<br>● Firewall: SPI intrusion detection, DoS protection<br>● Access control：Parental control, Network service filter, URL filter, Port filter<br><br>**Processor**<br>● 1.5 GHz tri-core processor<br><br>**Ports**<br>● RJ45 for 10/100/1000 BaseT for WAN x 1, RJ45 for 10/100/1000 BaseT for LAN x 4<br>● USB 3.2 Gen 1 x 1<br><br>**Wi-Fi Technology**<br>● OFDMA<br>● Beamforming: standard-based and universal<br>● 1024-QAM high data rate<br>● 20/40/80/160 MHz bandwidth | **3** | **1,100** | **3,300** |

| D-Link DWL-8620AP Wireless Access Point | Enable devices to connect to the internet without the existence of wired media. | **Data Transfer**<br>● 2.4GHz Up to 800 Mbps<br>● 5GHz Up to 1733 Mbps<br><br>**Wireless Frequency**<br>● 5 GHz: Up to 5850 MHz<br>● 2.4 GHz: Up to 2483 MHz<br><br>**Wireless Functions**<br>● Multiple SSIDs (Up to 16 SSIDs, 8 for each band)<br>● Enable/Disable Wireless Radio<br>● Automatic Channel Assignment<br>● Transmit Power Control (Adjust Transmit Power on dBm)<br><br>**Wireless Security**<br>● WPA Personal/ Enterprise<br>● AES and TKIP<br><br>**Power Method**<br>● Power Supply External power adapter: 12 V DC 2.5 A<br>● Supports 802.3at PoE PD on LAN 1 Port Power over Ethernet24.24 W<br><br>**LAN Interface**<br>● 2 x 10/100/1000BASE-T LAN port<br><br>**SSID Security**<br>● Up to 32 SSIDs, 16 per radio, 802.1Q VLAN, Station Isolation<br><br>**Features**<br>● Beamforming technology<br>● Band Steering for efficient traffic management<br>● Dual Gigabit Ethernet LAN port | 6 | 2,900 | 17,400 |

| | | | | | |
|---|---|---|---|---|---|
| | | ● UL2043 certified chassis (Plenum-rated SKU) | | | |
| **Lenovo ThinkSystem SR530 Rack Server (Xeon Silver 4110, 8GB, 600GB, 2x Integrated 1 GbE RJ-45 ports)**<br><br>**Height: 43mm x Width: 434mm x Depth: 498mm**<br><br> | Hold and organize IT equipment, It will store the data provide access to data in each of the lab | **Server Model**<br>● Lenovo ThinkSystem SR530 Rack Server<br><br>**Server Processor**<br>● Force feedback Intel Xeon Silver 4110 Processor<br>● 2.1GHz, 11M Cache<br>● Max Turbo Frequency 3.0GHz<br><br>**Server Memory**<br>● 8GB DDR4 RAM<br><br>**Optical Drive**<br>● External USB DVD RW Optical Disk Drive<br><br>**Server Network Controller**<br>● 2x Integrated 1 GbE RJ-45 ports (no 10/100 Mb support)<br>● Onboard LOM slot for up to 4x 1/10 Gb Ethernet ports:<br>● 2x 1 GbE RJ-45 ports (no 10/100 Mb support)<br>● 2x 10 GbE RJ-45 ports (no 10/100 Mb support)<br>● 2x 10 GbE SFP+ ports (no 10/100 Mb support)<br>● Optional Mezzanine LOM (ML2) slot for dual-port 10 GbE cards with SFP+ or RJ-45 connectors.<br>● 1x RJ-45 10/100/1000 Mb Ethernet systems management por | 4 | 10080 | 40320 |

| | | | | | |
|---|---|---|---|---|---|
| | | **Storage**<br>● 600GB 10K SAS 12Gb Hot Swap 512n HDD<br><br>**Server Power Supply**<br>● Up to two redundant hot-swap 450 W Platinum AC power supplies | | | |
| **35ft (10.7m) Cat6 Snagless Unshielded (UTP) PVC CM Ethernet Network Patch Cable, Blue** | To provide an ideal solution to connect LAN network components and provide bigger bandwidth for internet connections for better internet and reliability in data transferring. | **Cable Type**<br>● Cat6 Snagless<br><br>**Cable Jacket**<br>● PVC CM (Round)<br><br>**Data Rate Support**<br>● 1000 Base-T and Maximum to 10GBase - T<br><br>**Conductor Type**<br>● Stranded Pure Bare Copper<br><br>**Gauge(AWG)**<br>● 24 (7/0.20mm)<br><br>**PoE Compatibility**<br>● PoE/PoE+/PoE++<br><br>**Shielding Type**<br>● Unshielded (U/UTP)<br><br>**Length**<br>● 35ft (10.7m) including plugs<br><br>**Maximum Frequency**<br>● 550 MHz<br><br>**Connectors**<br>● RJ45 (Male)<br><br>**Wire Scheme**<br>● T568B, Straight | **100** | **50** | **5000** |

| | | | | | |
|---|---|---|---|---|---|
| **LC-LC OM3 Multi Mode Duplex Fiber Optic Patch Cord Cable Multimode MM**<br> | To be used for communication over short distances such as within the building or on a campus also to provide bigger bandwidth for data transferring | <u>**Color**</u><br>● Aqua<br><br><u>**Internal layer Diameter**</u><br>● 50/125µm<br><br><u>**Fiber type**</u><br>● Duplex<br><br><u>**Diameter**</u><br>● 3mm/2mm<br><br><u>**Length**</u><br>● 1/2/3/5/10/20/50 meter(s)<br><br><u>**Working Temperature**</u><br>● -40°C ~ +75°C<br><br><u>**Storage Temperature**</u><br>● -50°C ~ +85°C<br><br><u>**Return Loss**</u><br>● ≥50dB<br><br><u>**Repeat Insert Times**</u><br>● 1000 Times | **10** | **32** | **320** |
| **Jadaol High Speed Cat 6 Ethernet Cable**<br> | To provide an ideal solution to connect LAN network components and provide bigger bandwidth for internet connections for better internet and reliability in data transferring. | <u>**Cable Type**</u><br>● Cat6 4-pair UTP<br><br><u>**Outside diameter**</u><br>● 5.8 ± 0.3 mm<br><br><u>**Conductor type**</u><br>● 100% Bare Copper<br><br><u>**Conductor gauge**</u><br>● 32 AWG<br><br><u>**Shielding Type**</u><br>● Unshielded (U/UTP)<br><br><u>**Connector type**</u><br>● RJ45 (Male) | **100** | **57.50** | **5750** |

| | | | | | |
|---|---|---|---|---|---|
| **D-LINK NFP-0WHI21 Double Face Plate** | Giving protection for permanent LAN cable links for network extensions and improving the device's design and appearance | **Module type**<br>● Keystone Jack<br>● Tel type<br><br>**Lan category**<br>● Cat6a<br><br>**Size(mm)**<br>● 86 x 86<br><br>**Material**<br>● Polycarbonate<br><br>**Manufacturer**<br>● D-Link | 60 | 8 | 480 |
| **TRENDnet 48-Port Blank Keystone Shielded 2U HD Patch Panel** | Provides a way to keep large numbers of cables organized, enabling flexible connectivity into network hardware by interconnecting multiple devices together | **Category**<br>● Cat6A shielded keystone jacks<br><br>**Material**<br>● SPCC steel construction<br>● ABS plastics<br><br>**Dimension**<br>● 483 x 86 x 110mm<br><br>**Weight**<br>● 1.04kg<br><br>**Number labels**<br><br>**Easily identifiable** | 8 | 150 | 1200 |
| **Dell OptiPlex 7000SF-I7708G-1TB-W11 SFF Desktop PC** | Desktop PCs contain the physical hardware that makes a computer run and connects to input | **Operating System**<br>● Windows 11 Pro<br><br>**Processor**<br>● 12th Gen Intel® Core™ i5-12500 (18 MB cache, 6 | 120 | 4,500 | 540,000 |

| | | | | | |
|---|---|---|---|---|---|
|  | devices such as the monitor, keyboard and mouse users interact with. | cores, 12 threads, 3.00 GHz to 4.60 GHz Turbo, 65 W)<br><br>**Memory**<br>● 8GB DDR4 3200MHz RAM<br><br>**Storage**<br>● 1TB 3.5 inch 7200rpm HDD<br><br>**Hard Drive**<br>● 512 GB, M.2 2230, PCIe NVMe, SSD, Class 35<br><br>**Keyboard**<br>● Dell Wired Keyboard KB216 Black<br><br>**Mouse**<br>● Dell USB Optical Mouse-MS116 (EPEAT) | | | |
| **Dell 27 4K UHD USB-C Monitor - S2722QC**<br><br> | For learning purpose, students can surf the internet and use any software during the lessons in class | **PC Model**<br>● DELL 27 4K UHD USB-C Monitor<br><br>**Display Type**<br>● LED-backlit LCD monitor / TFT active matrix<br><br>**Native Resolution**<br>● 4K 3840 x 2160 at 60 Hz<br><br>**Input Voltage**<br>● AC 100-240 V (50/60 Hz)<br><br>**Diagonal Size**<br>● 27"<br><br>**Pixel per Inch**<br>● 163 | 120 | 1829 | 219480 |

| | | | | | |
|---|---|---|---|---|---|
|  | A plug for mounting low-voltage electrical components. Very useful in data communication.For instance, Local Area Networks (LANs). | **LAN Category**<br>● Cat6a<br><br>**Modular Connector Type**<br>● RJ45 Jack<br><br>**Manufacturer**<br>● roline<br><br>**Shielding Types**<br>● Unshielded | 8 | 34.50 | 276 |
| **Fortinet Fortigate FG-100F Firewall Hardware**<br> | Perform inspection of both inbound and outbound network traffic and enforce access controls and other security policies. | ● Firewall Throughput : 20 Gbps<br>● NGFW Throughput : 1.6 Gbps<br>● Threat Protection Throughput : 1Gbps<br>● IPS Throughput : 2.6 Gbps<br>● SSL/VPN Throughput : 1 Gbps<br>● 2x WAN ports<br>● 1x DMZ port<br>● 1x MGMT port<br>● 2x HA port<br>● 16x switch ports with 4 SFP port shared media | 1 | 12900 | 12900 |
| | | | | **TOTAL** | **864,829** |

**TABLE 1 : LIST OF DEVICES**

| | | |
|---|---|---|
| **Budget Provided** | = | **RM 2,500,000.00** |
| **Total cost** | = | **RM 864,829.00** |
| **Remaining Budget** | = | **RM 1,635,171.00** |

**REFLECTION TASK 3**

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

    As this is the first time for us to implement a project that actually building the network architecture, we didn't have any specific expectations on the price, Hence, we always make sure that we did not over spent the budget that already provided and choose the affordable and reasonable equipments on the market in order to build our own network building. Other than that, we do think that some of the equipment is expensive because of its functions. The equipment's price is actually based on the brands and their functionality, some of them are more reliable than the cheaper one because of the memory size, the speed to get the work done and so on.

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

    Yes, we considered cost as a factor of choosing everything that is needed on this network building. Our group was provided with a budget of RM2.5 million and we don't want to waste the money on purchasing high price equipment. It is because we also care about the cost that is needed to install the equipment on the building and that process needs a lot of money as we have to pay for the workers and others. Other than that, there are many things that need to be included in the process of building the network, such as we need to install Wifi connection with a high-speed internet connection to make sure all the users in the building can access the network without having any problems. We also care about the maintenance cost that is needed to be paid in the future.

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

The major differences between devices can not be distinguished directly as the devices are doing the same work eventually. With the rapid development of technology nowadays, a lot of brands are trying to catch up with the latest technology by manipulating them to build new devices. Thus, a lot of brands are having the same devices with minor differences. To find one difference, it may be the different preferences of the targeted customer. For example, a lot of home users prefer Huawei router rather than Cisco router because they are familiar with the brand Huawei on a daily basis such as their mobile phones, laptops and wearables. Meanwhile, the big companies prefer Cisco to Huawei because Cisco is famous amongst corporate users and it is also majoring in networking products such as switches and wireless routers.

# TASK 4

## IDENTIFYING WORK AREAS

### GROUND FLOOR



### FIRST FLOOR

# DETERMINE CONNECTIONS, PATCH CORD AND SWITCH PORT

## GROUND FLOOR
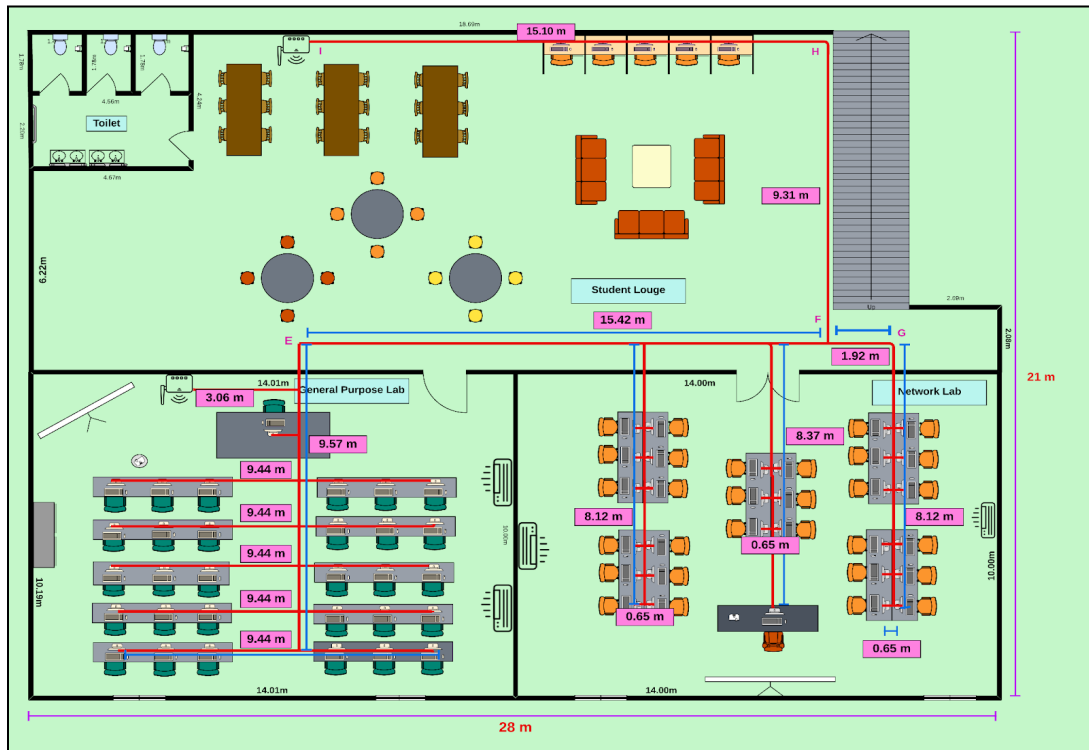


## FIRST FLOOR
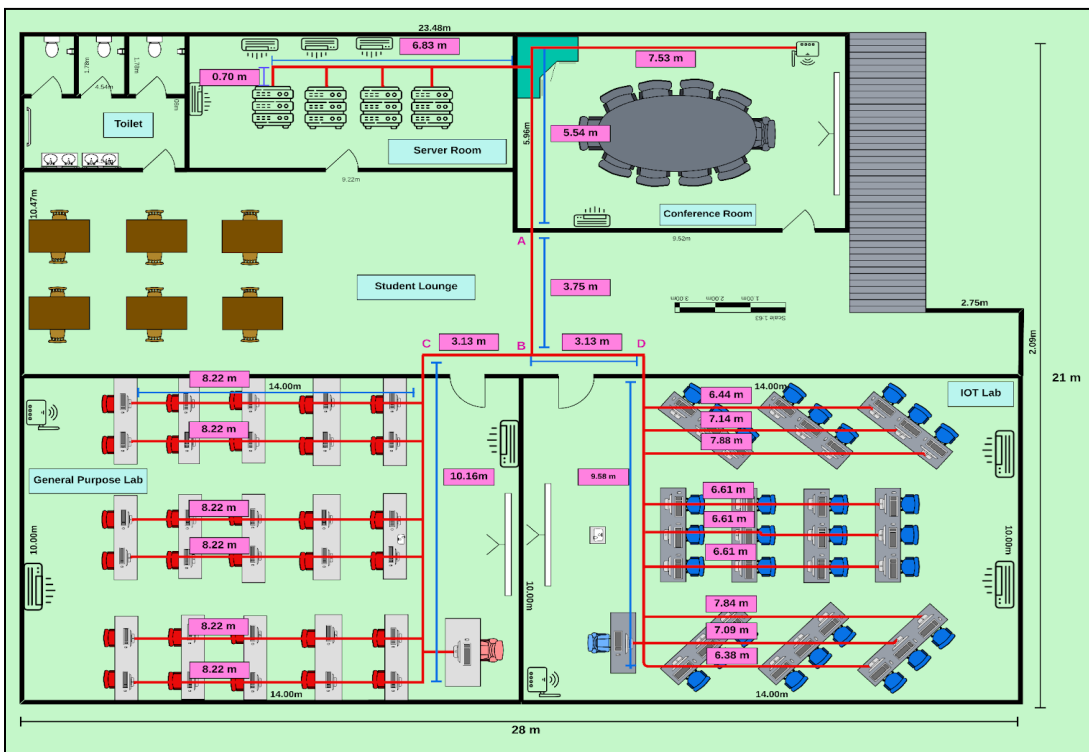
# OVERALL NETWORK DIAGRAM
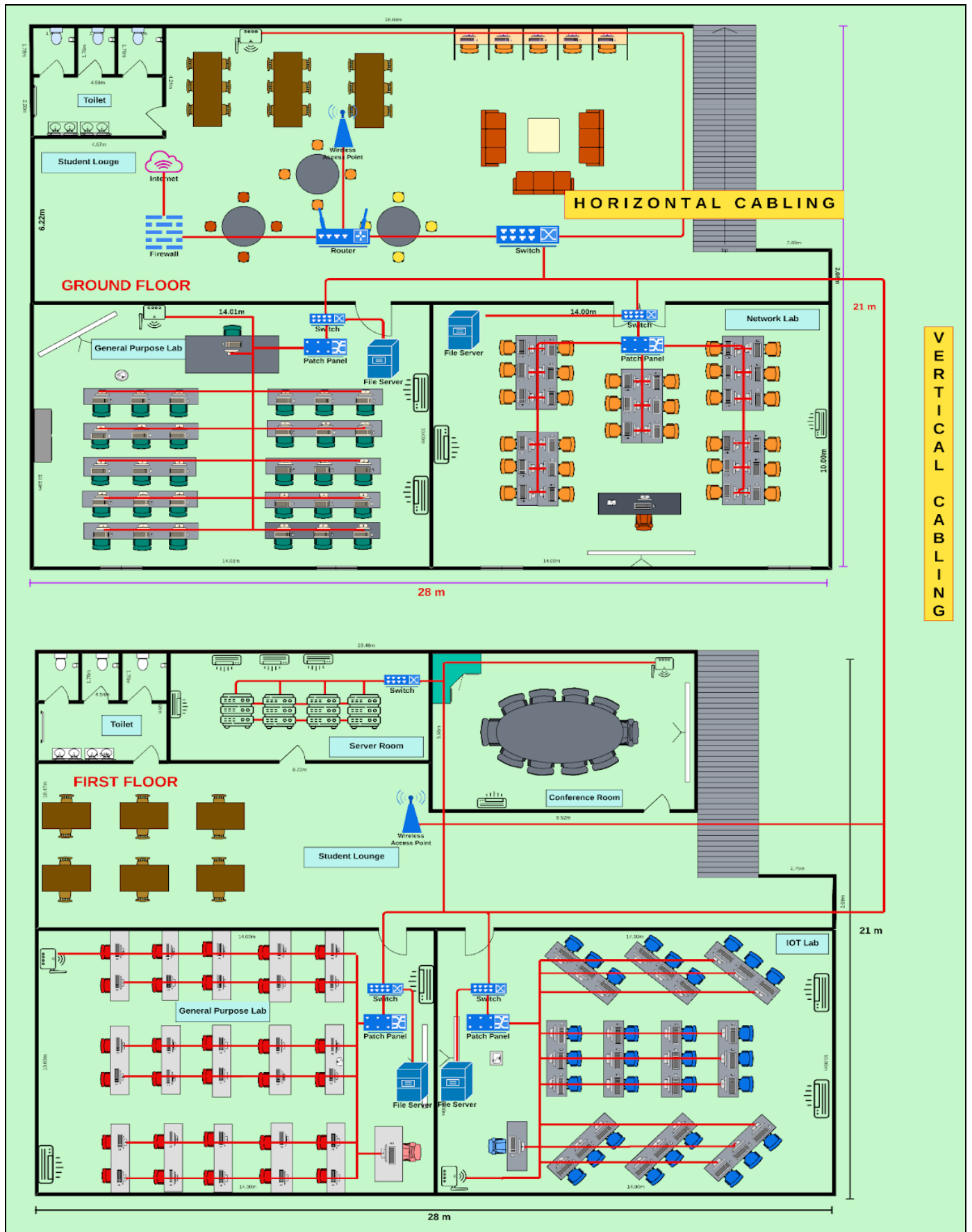
## IDENTIFY CABLE AND TYPE

### CABLE LENGTH

| Description | Cable Type | Length (m) |
|---|---|---|
| Ground Floor | | |
| General Purpose Lab | CAT6A | 59.83 |
| Network Lab | CAT6A | 34.36 |
| E to F | CAT6A | 15.42 |
| F to G | CAT6A | 1.92 |
| F to H | CAT6A | 9.31 |
| H to I | CAT6A | 15.10 |
| Peripheral Connection | CAT6A | 80.0 |
| Total Length | | 215.94 |
| First Floor | | |
| General Purpose Lab | CAT6A | 59.48 |
| IoT Lab | CAT6A | 72.18 |
| Conference Room | CAT6A | 13.07 |
| Server Room | CAT6A | 9.63 |
| A to B | CAT6A | 3.75 |
| B to D | CAT6A | 3.13 |
| B to C | CAT6A | 3.13 |
| Peripheral Connection | CAT6A | 80.0 |
| Total Length | | 244.37 |
| Horizontal Cabling | | 240.46 |
| Vertical Cabling | Fibre Optic Cable | 72.97 |
| Total Length | | 313.43 |
| TOTAL LENGTH OF CABLE USED | | 773.74 |

**REFLECTION TASK 4**

In this task, we need to identify all the work areas in the building and determine all the network connections in the building. Based on the floor plan, we divided all the working areas on each floor. For the ground floor, there are two work areas, which are the General Purpose Lab 1 and Network Lab, while on the first floor, there are four work areas, which are General Purpose Lab 2, IOT Lab, Conference Room and Server Room.

Next, we also have determined the networking structure that will be installed in the building. We did ensure that the cabling plan is in the best state as it is important for the networking to run smoothly in the building. From the networking structure, we also have determined the connections, switch port and patch cord that need to be used in the building. The types and lengths of the cables that we will use were also considered throughout completing this task. To conclude, we manage to gain new knowledge especially on networking structure.

# TASK 5

## CALCULATION

There are 5 work areas in our network building which are 2 general purpose labs, server room, IOT lab, and network lab. Hence, the IP address given to our group is 192.17.0.0 /8. Since, the IP address using /8, hence is 11111111.00000000.00000000.00000000 where 11111111 is the network portion while .00000000.00000000.00000000 is the host portion.

| Network Address | 192.17.0.0/8 |
|---|---|
| Network Portion | 1111111 |
| Host Portion | .00000000.00000000.00000000 |
| Total Host | $2^{24} = 16777216$ |
| Total Valid IP Address | $2^{24} - 2 = 16777214$ |

TABLE 2 : SUBNETTING CALCULATION

Hence, our network building has 5 different work areas and each work area needs to have different IP addresses to avoid any problems in the future. Each of the labs in the network building have their own devices namely personal computer, switch, patch panel and file server.

| **5 subnets** 8 subnet by default (2^3) where 3 subnets will not be used | - General Purpose Lab<br>- General Purpose Lab<br>- IOT Lab<br>- Network Lab<br>- Server Room<br>- Not be used<br>- Not be used<br>- Not be used |
|---|---|

**ISP's Block**

   192.17.0.0  /8  - **11000000**.**00010001.00000000.00000000**

**Subnet Address #0**

   192.17.0.0  /8  - **11000000**.**000**10001.00000000.00000000

**Subnet Address #1**

   192.49.0.0  /8  - **11000000**.**001**10001.00000000.00000000

**Subnet Address #2**

   192.81.0.0  /8  - **11000000**.**010**10001.00000000.00000000

**Subnet Address #3**

   192.113.0.0  /8  - **11000000**.**011**10001.00000000.00000000

**Subnet Address #4**

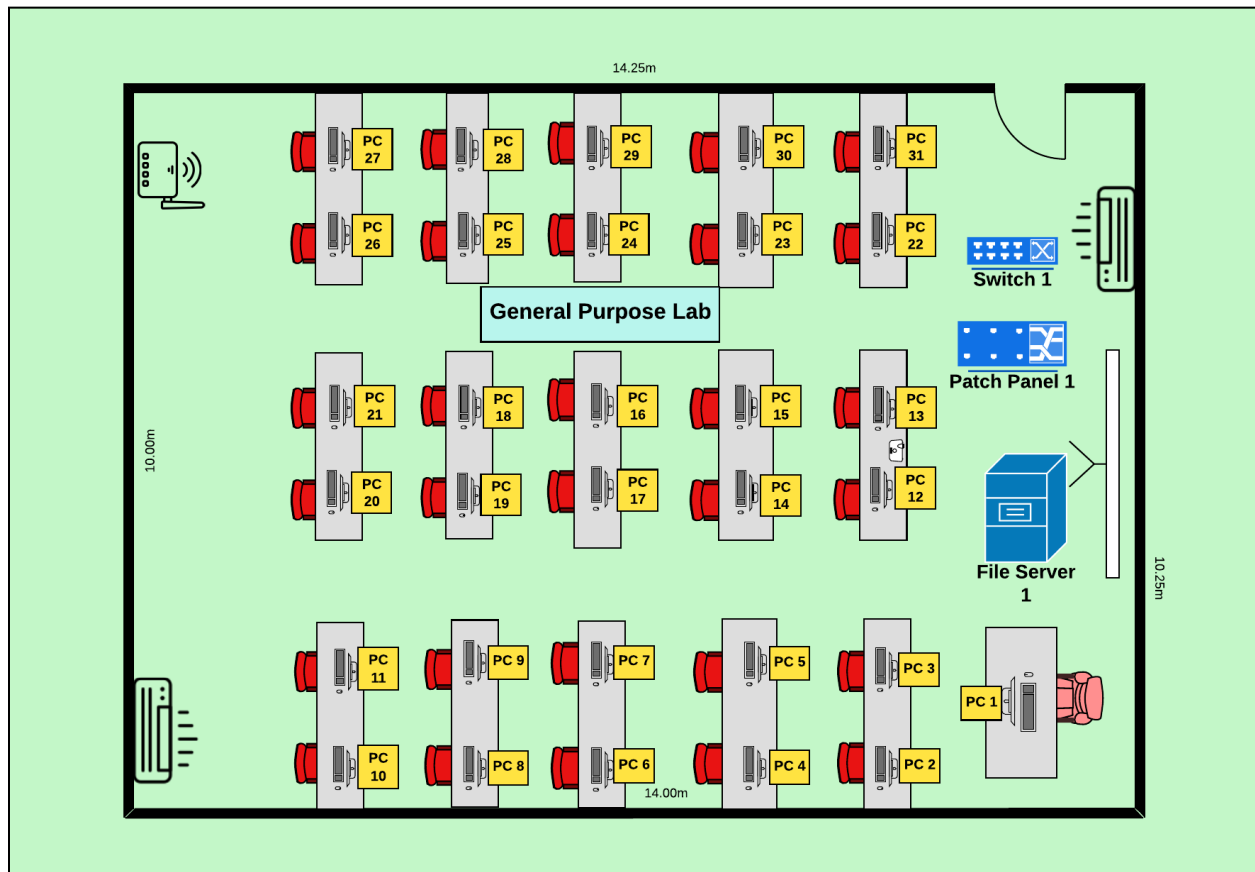   192.145.0.0  /8  - **11000000**.**100**10001.00000000.00000000

## GENERAL PURPOSE LAB



**Figure 4 : General Purpose Lab 1**

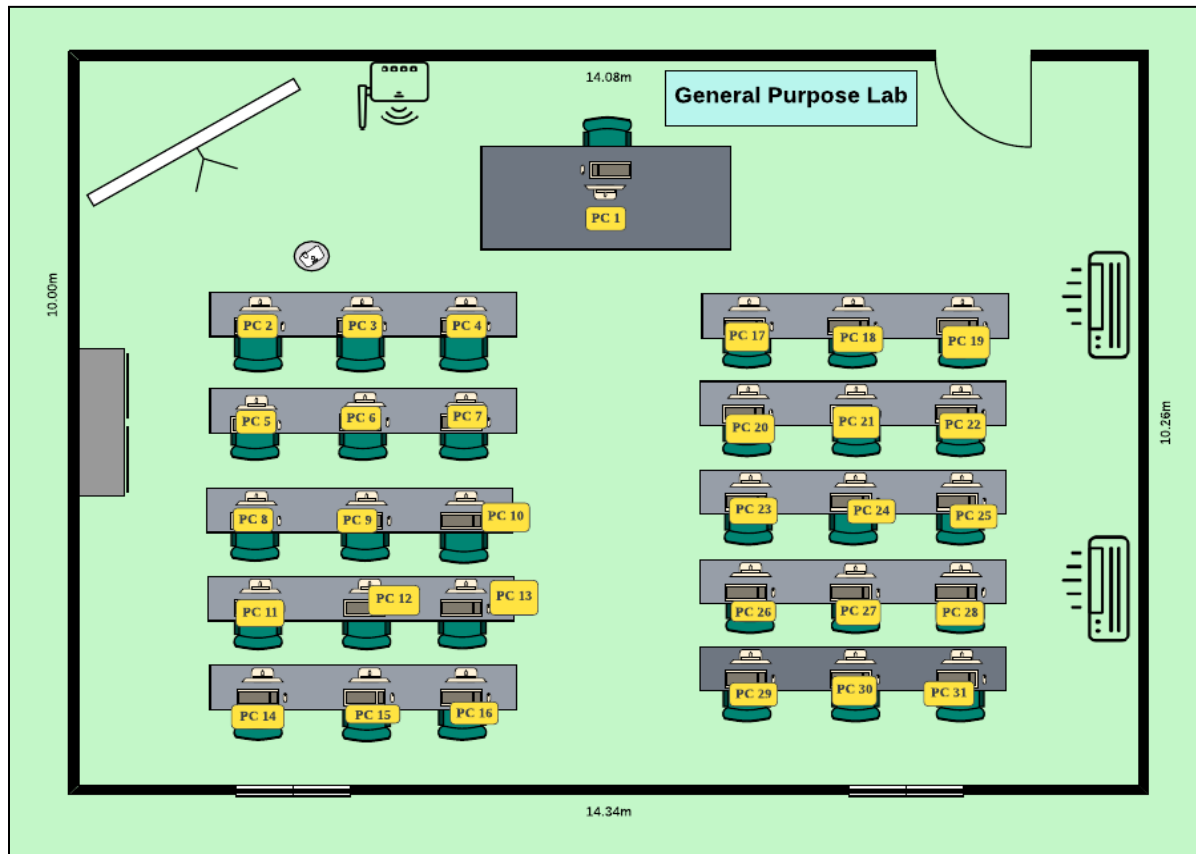| DEVICES | IP ADDRESS |
|---|---|
| SWITCH 1 | IP ADDRESS : 192.17.0.1   /8<br>**11000000**.**000**10001.00000000.00000001 |
| PATCH PANEL | IP ADDRESS : 192.17.2   /8<br>**11000000**.**000**10001.00000000.00000010 |
| FILE SERVER | IP ADDRESS : 192.17.0.3   /8<br>**11000000**.**000**10001.00000000.00000011 |
| PERSONAL COMPUTER 1 - PERSONAL COMPUTER 31 | IP ADDRESS : 192.17.0.4   /8<br>**11000000**.**000**10001.00000000.00000100<br>until IP ADDRESS : 192.17.0.1   /8<br>**11000000**.**000**10001.00000000.00000001 |

## GENERAL PURPOSE LAB



**Figure 5 : General Purpose Lab 2**

| DEVICES | IP ADDRESS |
|---|---|
| SWITCH 1 | IP ADDRESS : 192.49.0.1   /8<br>**11000000**.**001**10001.00000000.00000001 |
| PATCH PANEL | IP ADDRESS : 192.49.0.2   /8<br>**11000000**.**001**10001.00000000.00000010 |
| FILE SERVER | IP ADDRESS : 192.49.0.3   /8<br>**11000000**.**001**10001.00000000.00000011 |
| PERSONAL COMPUTER 1 - PERSONAL COMPUTER 31 | IP ADDRESS : 192.49.0.4   /8<br>**11000000**.**001**10001.00000000.00000100<br>until IP ADDRESS : 192.49.0.34   /8<br>**11000000**.**000**10001.00000000.00100010 |

## IOT LAB



**Figure 6 : IOT Lab**

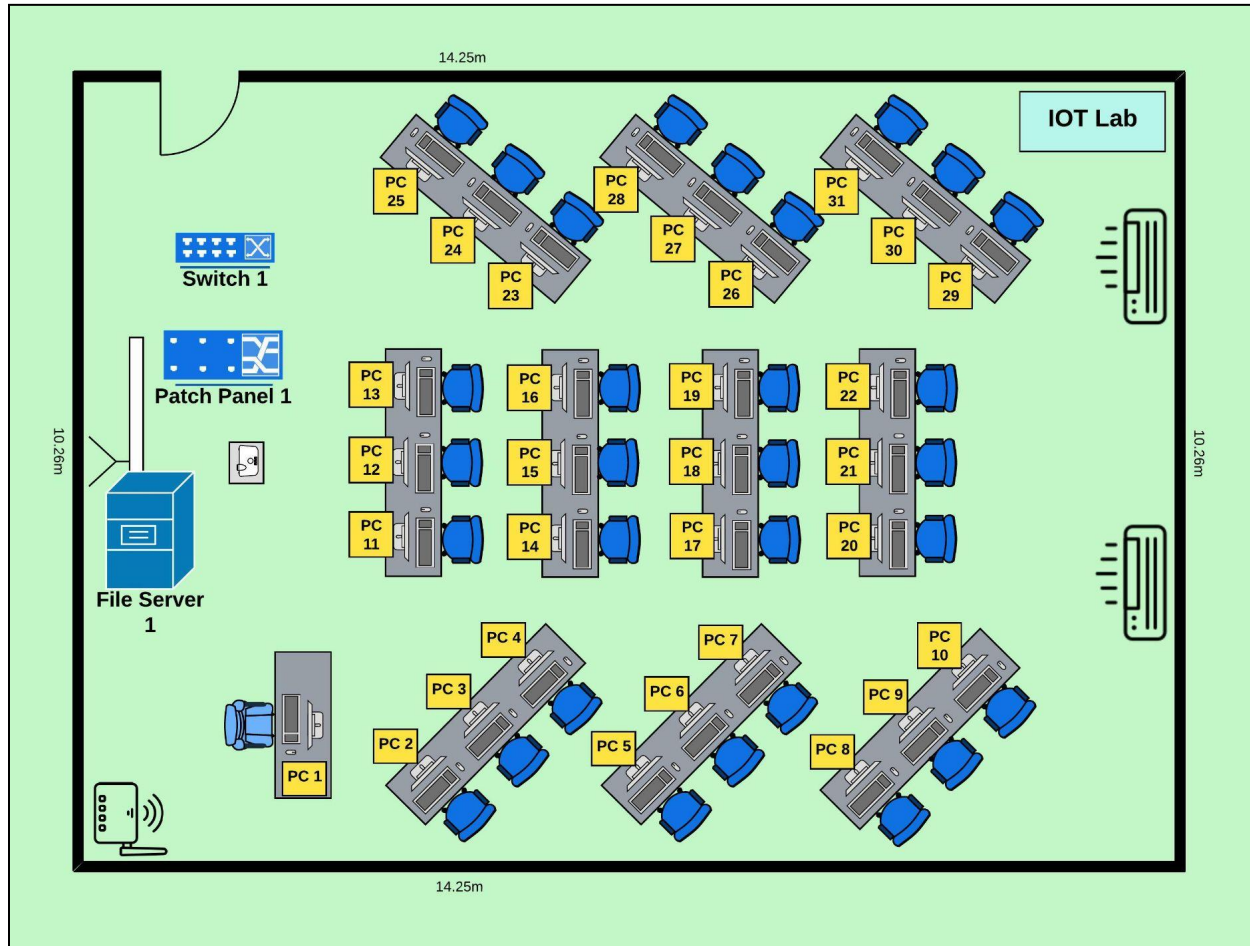| DEVICES | IP ADDRESS |
|---|---|
| SWITCH 1 | IP ADDRESS : 192.81.0.1   /8<br>**11000000**.**010**10001.00000000.00000001 |
| PATCH PANEL | IP ADDRESS : 192.81.0.2   /8<br>**11000000**.**010**10001.00000000.00000010 |
| FILE SERVER | IP ADDRESS : 192.81.0.3   /8<br>**11000000**.**010**10001.00000000.00000011 |
| PERSONAL COMPUTER 1 - PERSONAL COMPUTER 31 | IP ADDRESS : 192.81.0.4   /8<br>**11000000**.**010**10001.00000000.00000100<br>until IP ADDRESS : 192.81.0.34   /8<br>**11000000**.**010**10001.00000000.00100010 |

# NETWORK LAB



**Figure 7: Network Lab**

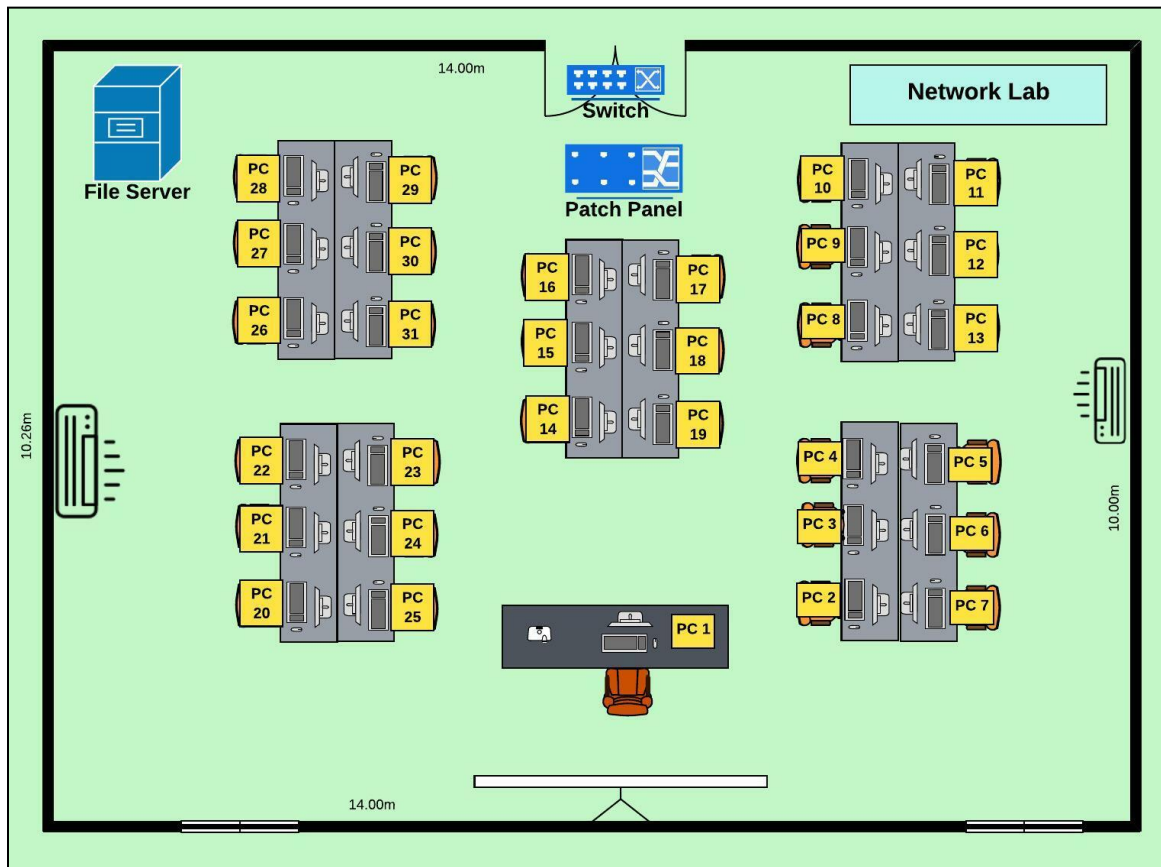| DEVICES | IP ADDRESS |
|---|---|
| SWITCH 1 | IP ADDRESS : 192.113.0.1  /8<br>**11000000**.**011**10001.00000000.00000001 |
| PATCH PANEL | IP ADDRESS : 192.113.0.2  /8<br>**11000000**.**011**10001.00000000.00000010 |
| FILE SERVER | IP ADDRESS : 192.113.0.3  /8<br>**11000000**.**011**10001.00000000.00000011 |
| PERSONAL COMPUTER 1 -<br>PERSONAL COMPUTER 31 | IP ADDRESS : 192.113.0.4  /8<br>**11000000**.**011**10001.00000000.00000100<br>until IP ADDRESS : 192.113.0.34  /8<br>**11000000**.**011**10001.00000000.00100010 |

# REFLECTION TASK 5

After completing this task, we have gained more knowledge on IP addressing schemes as we need to ensure every host can connect to the network without conflict of addresses. Next, we also managed to gain new knowledge on how to divide the subnetwork from the Network Address that has been assigned to us. Throughout completing this task, we also learnt on how to implement what we have learnt about IP addressing into a real-life situation.

**CONCLUSION**

Throughout completing this project, we have learned many new things and implemented all the skills that we have learned in the class by creating our own network communication in the new building. Apart from that, we also learned how to work together as one group in order to handle this one case study and realized that communication is the most important thing in order to make such a building that is fully-equipped with all the key points and criteria that had been set from Faculty of Computing, Not only that, from each task that had been given to us, it gave us the knowledges that we didn't gain during lecture. For example, for Task 1, we learned on how to create a floor plan for our own building and make sure the design of the floor plan considering all aspects that had been set by Faculty of Computing such as the number of personal computers in one lab must considered the increase of number of students in the future, Hence, it need a proper plan before design it. Other than that, from Task 2, we learned that it is important to consider all aspects before building the network, hence we implemented the feasibility study and some of the questions that will give insight to our group and also the clients. These questions include all the equipment that will be used, type of network that will be used and many else. Furthermore, from Task 3, our group realized that there are many tools or equipment that we didn't know about and we made a research about all the equipment that will be needed. From Task 4, we gathered our manpower and tried to do cabling on all the devices that we researched from the previous task and connected all the equipment using the cables that we agreed at the first place. Lastly, from Task 5, we learned how to divide the IP address into a few subnets since in the building, there will be quite a number of work areas. Other than that, we also gave each of the components its own IP address.

# TEAM MEMBERS AND RESPONSIBILITIES

| NAME | MATRIC NUMBER | RESPONSIBILITIES |
|---|---|---|
| MUHAMMAD NUR SOLIHIN BIN MALIK RADZUAN | A21EC0089 | **TASK 1**<br>● Provide the design for the floor plan of general purpose lab 1<br>● Provide the meeting minutes<br><br>**TASK 2**<br>● Provide the details of feasibility study<br>● Provide the meeting minutes<br><br>**TASK 3**<br>● Provide the details of some of the equipment listed.<br>● Provide the meeting minutes<br><br>**TASK 4**<br>● Provide the connection of the cables for general purpose lab 1 and helping other members with connection.<br>● Provide the meeting minutes<br><br>**TASK 5**<br>● Provide the calculation of dividing the IP Address into 5 subnets<br>● Provide the IP Address for general purpose lab 1.<br><br>**TASK 6**<br>● Provide the conclusion<br>● Provide the project background<br>● Report formatting<br>● Appendices<br>● References |

| MUHAMAD AMSYAR BIN IBRAHIM | A21EC0058 | **TASK 1**<br>● Provide the design for the floor plan of IOT lab and student lounge<br><br>**TASK 2**<br>● Identify important questions for the project together with other members and find an accurate answer<br><br>**TASK 3**<br>● Provide the details of some of the equipment listed.<br>● Calculate the total cost and budget<br><br>**TASK 4**<br>● Provide the connection of the cables for the IOT lab and help other members with connection.<br><br>**TASK 5**<br>● Provide the IP Address for the IOT lab.<br><br>**TASK 6**<br>● Prepare the abstract<br>● Provide reflection for Task 1 |
|---|---|---|

| NORAIN BINTI MOHD SULAIMAN | A21EC0106 | **TASK 1**<br>   ● Provide the design for the floor plan of general purpose lab 2, student lounge and conference room<br><br>**TASK 2**<br>   ● Identify important questions for the project together with other members and find an accurate answer<br><br>**TASK 3**<br>   ● Provide the details of some of the equipment listed.<br>   ● Calculate the total cost and budget<br>   ● Contribute in task 3 reflection<br><br>**TASK 4**<br>   ● Provide the connection of the cables for general purpose lab 2 and helping other members with connection.<br><br>**TASK 5**<br>   ● Provide the IP Address for general purpose lab 2.<br><br>**TASK 6**<br>   ● Prepare the introduction<br>   ● Provide reflection for task 2 |
| --- | --- | --- |

| SARAH FARHANA BINTI SALLEH | A21EC0226 | **TASK 1**<br>    ● Provide the design for floor plan of network lab and server room<br>**TASK 2**<br>    ● Identify important questions for the project together with other members and find an accurate answer<br>**TASK 3**<br>    ● Provide the details of some of the equipment listed.<br>    ● Calculate the quantity and total cost for the suggested equipment<br>**TASK 4**<br>    ● Provide the connection of the cables for the network lab and help other members with connection.<br>    ● Calculate the total length of the cable used in the building.<br>**TASK 5**<br>    ● Provide the IP Address for network lab.<br>**TASK 6**<br>    ● Provide reflection for Task 4<br>    ● Provide reflection for Task 5 |
|---|---|---|

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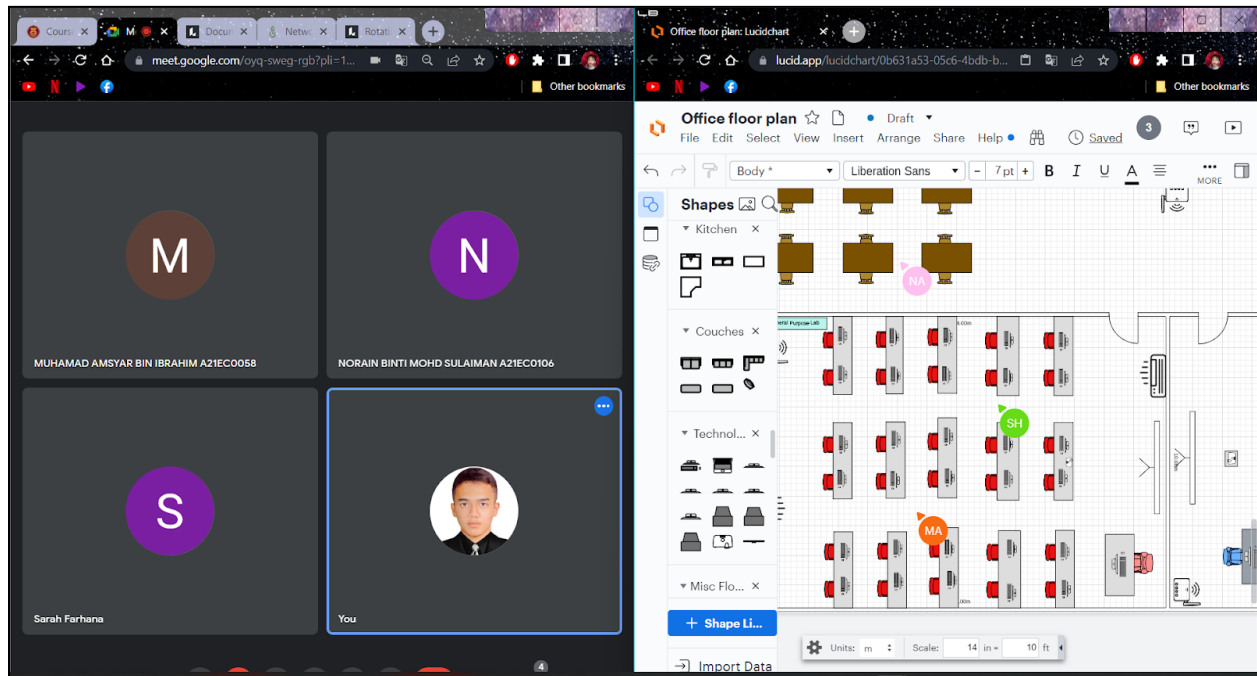
# APPENDICES

MEETING      : 1
DATE         : 22/11/2022 ( Sunday )
PLATFORM  : Google Meet

**ATTENDEES:**
1. MUHAMMAD NUR SOLIHIN BIN MALIK RADZUAN          A21EC0089
2. MUHAMAD AMSYAR BIN IBRAHIM                              A21EC0058
3. SARAH FARHANA BINTI SALLEH                               A21EC0226
4. NORAIN BINTI MOHD SULAIMAN                               A21EC0106

**OBJECTIVES:**
1. Read the task 2 questions
2. Divide the tasks for each of the members in group
3. Provide ideas for the type of questions that need to be included in the project based on the case study provided.
4. Discuss and improvise the floor plan that each of us have made.
5. Exchange ideas on creating the question for task 2.

**MEETING** : 2
**DATE** : 4TH DECEMBER 2022
**TIME** : 9.00 PM - 10.30 PM
**LOCATION** : GOOGLE MEET

**ATTENDANCES**
1. MUHAMMAD NUR SOLIHIN BIN MALIK RADZUAN        A21EC0089
2. MUHAMAD AMSYAR BIN IBRAHIM        A21EC0058
3. SARAH FARHANA BINTI SALLEH        A21EC0226
4. NORAIN BINTI MOHD SULAIMAN        A21EC0106

**OBJECTIVES**
- Divide each of the group members with a specific devices to be research
- Make sure all of the group members understand the need of the case study and look for a specific devices that are need to be included in the network building
- Research some of the network devices that are used in many places
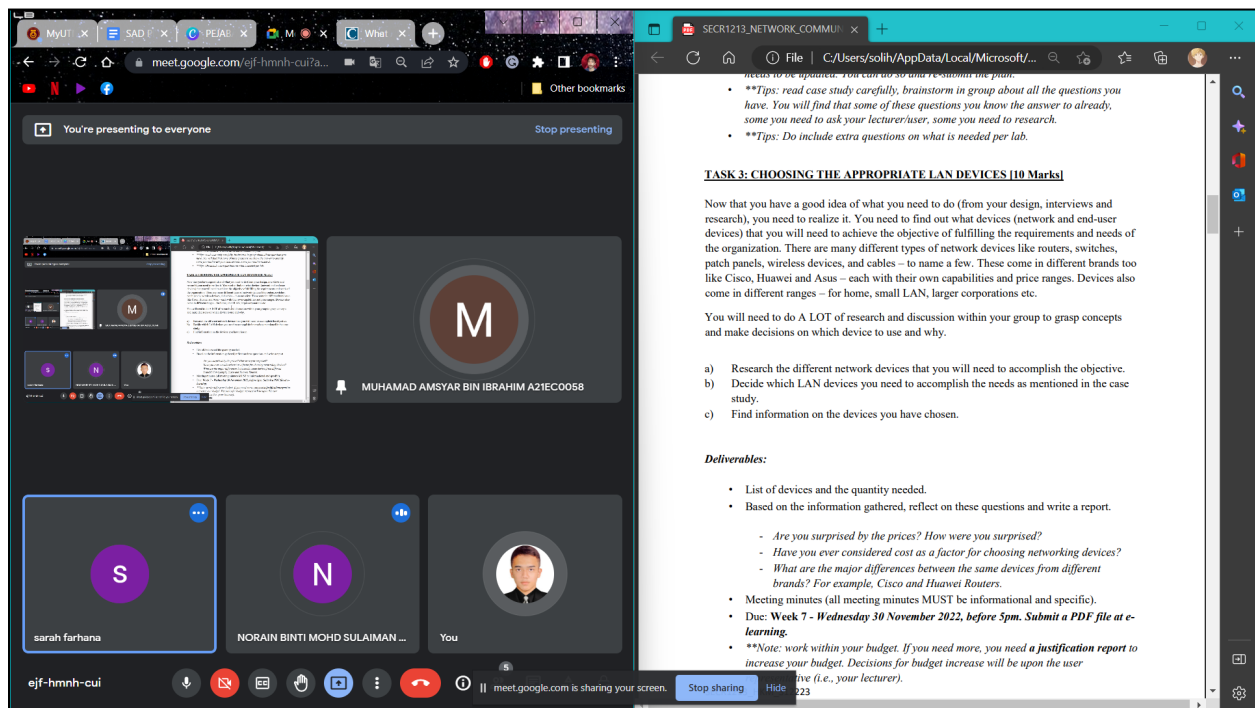
**MEETING    : 3**
**DATE         : 19TH JANUARY 2023**
**TIME         : 9.00 PM - 10.30 PM**
**LOCATION  : GOOGLE MEET**

**ATTENDANCES**
5. MUHAMMAD NUR SOLIHIN BIN MALIK RADZUAN      A21EC0089
6. MUHAMAD AMSYAR BIN IBRAHIM                            A21EC0058
7. SARAH FARHANA BINTI SALLEH                               A21EC0226
8. NORAIN BINTI MOHD SULAIMAN                             A21EC0106

**OBJECTIVES**
- Make the calculation for the subnets
- Identify how many subnets will be used based on the needs of the cas study
- Discussing all the key points that will be listed in the final report
- Divide the tasks into a smaller tasks for each of the team members