UTM UNIVERSITI TEKNOLOGI MALAYSIA

SCHOOL OF COMPUTING
Faculty of Engineering

SECR/SCSR1213 - 03

NETWORK COMMUNICATION

NETWORK DESIGN FOR SCHOOL OF COMPUTING BLOCK N28B by GROUP G

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0.0 Abstract

This is the report for a project given in subject SECR1213 Network Communication, where it is about the network design from floor planning to IP assignment for a new 2-storey building for School of Computing, UTM, namely N28B. This will be a compilation of all the tasks done by us which include from Task 1 where we are required to draw a floor plan for the building until Task 5 where we need to do subnetting and IP assignment to each lab and room. In brief, our team manages to get the project done together and learn new skills and knowledge throughout the journey. We want to take this opportunity to thank our lecturer and advisor in this project, Dr Raja Zahilah Binti Raja Mohd Radzi who gives advice and valuable suggestions to us to improve and enhance our project. We also feel grateful to be given this chance to do such a project where we get to have the opportunity to simulate and apply the knowledge we learn during the lecture in a real life situation.

Table of Contents

Table of Figures

1.0 Introduction

In this project we were given the instruction to design the network for a proposed building, namely N28B for School of Computing, Faculty of Engineering UTM. In other words, we need to gather information from the client (which is the School of Computing Chairman), analyse the client requirement, propose the floor plan, and do the feasibility testing. Next up, we will go on a shopping trip where we need to identify the devices we are going to buy and install in the new building while keeping the budget in check. After we identify the devices to be bought, we have to plan our network cabling structure and finally, the subnetting and IP address assignment for each end device.

The aim for this project is :

1. To propose a scalable network that is future proof.
2. Reliable and secure network which should also be easy to manage at the same time.
3. Improve overall performance and experience for the students and academic staff.

1.1 Project background

The growing number of students and academic staff urge the need for new buildings. The building is said to need to be ready for anything, which is future proof, a network which is secure, reliable and easy to manage and last but not least, the whole project needs to be cost efficient. There are some units or facilities that must exist inside the building which includes 4 new labs (a general purpose lab, a Computer Security lab, a Network lab and a IOT lab) which consists of at least 30 workstation and 1 multi-terabyte server in each of the labs. Besides, there should also be 2 video conferencing rooms for virtual meeting purposes. The budget given to us in this project is RM1.3M and the IP address assigned to our team is 172.18.5.0

2.0 Task 1: Project Setup

2.1 Floor Plan

Note : Scaling on the parameter of the building for every floor plan is measured in cm

a) Ground Floor :

Figure 1 : Floor Plan for Ground Floor

b) 1st Floor

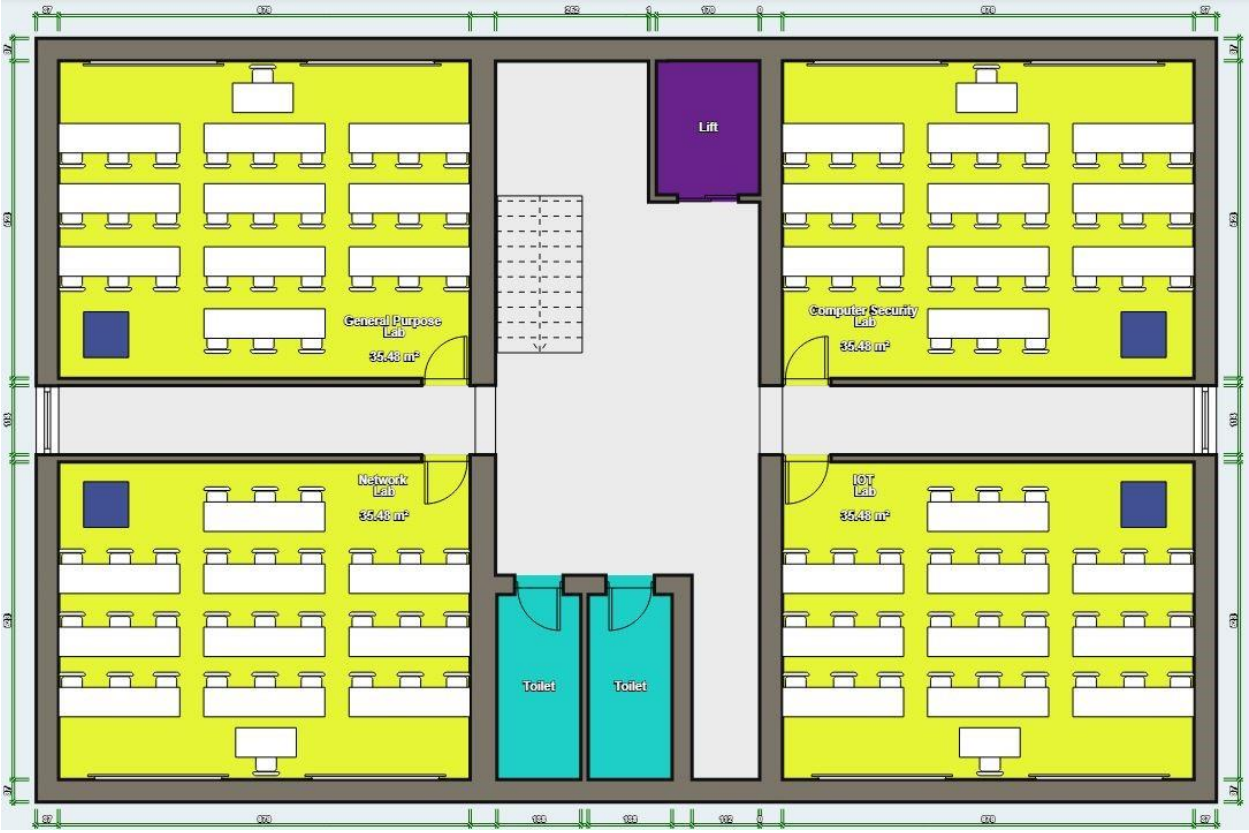
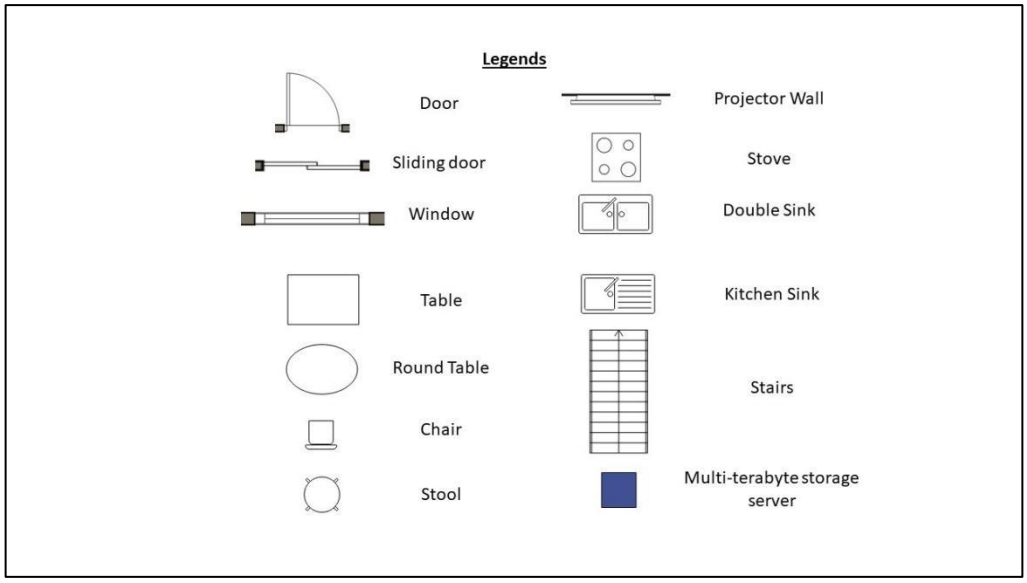


Figure 2 : Floor Plan for First Floor



Legend 1 : Floor Plan

2.2 Reflection Task 1

This is the first time we are getting a task that requires us to draw a floor plan, but fortunately our team members are very helpful and cooperative by giving opinions and suggestions for tools that we can use to complete this task. We start off by deciding where the main focus (the 4 labs and 2 video conferencing room) should be located and proceed with other facilities and the structure of the building. This Task 1 as the first task of the project is not heavy and gives us an opportunity to break the ice by having discussion together. We also learn to plan things properly and study about a particular field of knowledge that might be beneficial to the task first along the task, as this floor plan will be the foundation of the whole project.

3.0 Task 2 : Initial Design - Preliminary Analysis

3.1 Q&A

1. What are the devices needed for setting up a network?

Those devices are router, modem, switch, and access point.

- A router is a systems administration gadget that advances information bundles between computer networks. Router plays out the traffic coordinating capacities on the Internet. Information sent through the web, for example, a page or email, is as information bundles.
- Modem is short for "Modulator-Demodulator." It is a hardware part that allows a computer or another device, such as a router or switch, to connect to the Internet. It converts an analogue signal from a telephone or cable wire to binary (1s and 0s) that a computer can understand.
- A network switch is a networking tool that connects devices on a computer network by using packet switching to obtain and transmit data to the target device. A network switch is a multi-port network connection that uses MAC addresses to deliver data at the data link layer of the OSI model.
- An access point is a device that generates a wireless local area network(WLAN) usually in an office or large building. An access point connects to a wired router, switch, or hub via an Ethernet cable, and projects a Wi-Fi signal to a designated area. For example, if you want to enable Wi-Fi access in your company's reception area but don't have a router within range, you can install an access point near the front desk and run an Ethernet cable through the ceiling back to the server room.

2. How to set up a Local Area Network (LAN)?

Create Network:

a) Identify the local services that you want available on the network. Identify network-attached printers, network disk drives, any server that will share printers or disks.

b) Identify how many devices will have to connect to the network. Each device, server or workstation will require a unique address.

c) Run cables to workstations where possible. A wired LAN will always get better performance and be more secure than a wireless LAN. Wherever possible, run a cable to servers, printers, IP phones or work locations. Run a cable to any area where you are likely to work. Use standard Ethernet cables or building wiring as installed according to the TIA-568 standard. Select and purchase a switch or cable router. The simple secure way to connect to the Internet is to use a cable router. Many makes and models are available. If the model you choose does not have enough ports to connect all of your computers, then you will need to purchase a switch as well.

d) Configure the WAN port of the cable router. Configuration details will vary from vendor to vendor. Your internet service provider will supply essential information you will need to configure the WAN port.

e) Configure the LAN ports of your cable router. Most cable routers will act as a Dynamic Host Configuration Server or DHCP server. This means that the router will give addresses to workstations automatically. Be sure that the address pool has enough addresses for all of the workstations. Make certain that there are enough addresses outside of the range for any hosts that need static addresses. For example, a network address with a mask of 255.255.255.0 has a total of 254 hosts. If the dynamic pool has 200 addresses available, that means the remaining 54 addresses are available to give printers or servers static addresses.

f) Connect the wires for the network. Workstations and servers can be connected with standard Ethernet cables. Connect the switch to the cable router LAN ports by using the up-link or straight port on the switch. If the switch does not have an uplink port, connect any standard port of the switch to a LAN port on the cable router with an Ethernet crossover cable. Ethernet crossover cables can be purchased at any electronics store.

g) Test the services and Internet connectivity. Test each of the workstations to ensure they can connect to the Internet and test any local servers and printers. Print test pages on the shared printers. Tests read and write permissions on shared file servers by copying files to the servers and copying files from the server to a workstation.

3. **What kind of network topology is suggested?**

There are 5 topologies that are bus, ring, mesh, star and hybrid topology. In bus topology there is a main cable and all the devices are connected to this main cable through drop lines. In ring topology each device is connected with the two devices on either side of it. In mesh topology each device is connected to every other device on the network through a dedicated point-to-point link. In star topology each device in the network is connected to a central device called hub. A combination of two or more topology is known as hybrid topology. So the suggested topology is hybrid topology that combines mesh and star topology. Star topology is used in every lab and room to connect all devices to a central device(hub) and mesh is used to connect all hubs to each other.

4. **How to make sure that the wireless coverage is enough for a particular area?**

Put wireless access points in every lab and room.

5. **What is the communication medium that we will use in this project?**

Communication mediums are one of the important things we need to consider in planning this project. The speed of transferring data in the labs will depend on the communication medium that we will use. If the communication medium is not working properly, the rate of data transfer will be slow, delayed or even lost during transmission. The type of communication medium that we will set-up in our lab is wired network, coaxial cable and Ethernet cable for indoor connection. Coaxial cable can achieve high data transmission rates and is suitable for our project. The Ethernet cable that we want to use is CAT5.

6. **Which storage server will we be using?**

Storage server is also known as file server. Generally there are 3 types of storage server: Direct Attached Storage, Cloud Data Storage and Storage Area Network. Direct Attached Storage is basically an on-site storage in which it will directly connected to servers, computers etc.; Cloud Data Storage on the other hand is as its name implies it is a remote server which will store the data in a cloud storage; Storage Area Network is another on-site storage but what it does it that it is able to deliver a

high-performance and expandable storage. On paper Storage Area Network would sound like the best out of all 3 but in reality this kind of storage server is very expensive for both setup and maintenance. Cloud storage servers need a fairly low cost to maintain and setup but it mostly requires monthly rental servers. Hence, we decided to stick with Direct Attached Storage as it is very affordable.

7. **What are the security concerns for the workstations and servers?**

- Data breach : The possibility of permanent data loss is quite high as the cloud storage
- Data loss : It can happen when there are problems on the cloud provider's side, the system has no backup to restore, the information of the data has changed and it cannot be reverted back or when it is unavailable due to lack of personal account data and other credentials such as encryption keys.
- Insecure API: Application Programming Interface (API) allows operating systems within the cloud infrastructure. Most common problems that lead the availability of API to cloud security risk are unauthorized access, lack of access monitoring, clear text authentication and many more.
- Cybersecurity Attack : Not having good protection could lead to damage such as malware and Denial of Service (DoS)

8. **What kind of protection measures need to be taken for ICT devices?**

- Data breach: a cloud security system must have a perimeter firewall and multi-layer approach that covers every step of the users activity. For example, multi-factor authentication where the user provides two or more evidence or factors for authentication (if the user is a UTM student they can provide their student ID).
- Data loss: create a backup using a data loss prevention software such as Google Cloud Data Loss Prevention and McAfee DLP Endpoint.
- Insecure API : Apply multi-factor authentication, Secure Socket Layer (SSL) or Transport Layer Security (TSL) for data transmission and
- Host/Platform configuration: Use a secure by default configuration. For example, build a custom Virtual Machine Manager (VMM) that only provides necessary services to support application stack (set of application programs that help in

performing tasks such as Microsoft Word, Spreadsheet, Database, etc). Limiting capabilities reduce the number of patches needed to keep the application stack secure.

- Cybersecurity Attack : Block of IP address that is considered as a threat, limit source rate, use up to date intrusion detection system and place a firewall such as firewall traffic type of inspection features to check the source and destination of incoming traffic.

9. What is the maintenance‘s frequency for those equipment?

- Regularly scheduled check the computer hardware and software to ensure it operates properly. Once a year should be enough for each hardware but updating the software needs to be done at least once per month. Every hardware is encouraged to be replaced every 5 to 8 years. Meanwhile for a server, regular maintenance will help the server runs efficiently
- Preventive maintenance should be applied where it requires :
  - Cleaning the computer hardware
  - Download the latest drivers for the hardware
  - Download the latest updates for the software
  - Ensure to have the latest antivirus protection updates
  - Run disk software utilities (Defrag and ScanDisk)
- Server maintenance requires :
  - Ensure backups are working
  - Check disk usage
  - Monitor RAID alarms
  - Update operating system (OS)
  - Update control panel
  - Check system security
  - Check application updates
  - Check remote management control

10. What is the long-term goal for this project?

To build a system that is easy to manage and scalable, great improvement for overall performance even after changing from old to new equipment, provide protection from network breaches, Denial of Services (DOS) and e-business application attacks, capability to support high performance to the core backbone, ability to support features and security in hardware via access control list (ACLs) and securable VPN connections from remote locations.

11. What kind of lab upgradability is expected?

In terms of upgradability, the four new labs need to be flexible to changes. It will be used daily by the staff and students of computer science, so the lab needs to keep up with the current technology as it should not be obsolete. Then, if the computers or any electronic devices in the lab become outdated in future, it should be easy and accessible to change to new ones. For the performance, it is important that the lab must be equipped with high-speed internet connection in preparation for education in line with 4IR (4th Industrial Revolution). The security also needed to be top-notch and maintenance work in the lab should be done regularly to get the best performance.

3.2 Feasibility

After our group has gathered enough information needed to fulfil the requirements of the project, it's time for us to determine the feasibility of our project. We will be focusing on 3 main elements in determining feasibility, that is: Technical, Operational and Economical.

First and foremost, the technical part. In order to handle the increasing number of students, the floor plan that we design is definitely enough to provide space and facilities for them. Our floor plan included what was requested such as 4 new labs (General purpose lab, Computer security lab, Network lab and IOT lab) and 2 video conferencing rooms. On top of that, we also provide cafes and lounges for students. To make sure the high-speed Internet connectivity, we decided to use coaxial cable on the outside and Ethernet cable to directly connect to workstation and other devices that required fastest and reliable Internet connectivity. Meanwhile wireless connectivity is also prepared for mobile devices. Combination of mesh and star topology will be used to reduce networking error consequences. The workstations will also be equipped with the latest hardware that can meet the users' needs in terms of performance.

Besides, we have also studied and identified the equipment needed to set up a working LAN and Wireless-LAN which are router, switches etc.

About the operational part, those facilities like labs and video conferencing room will definitely be made use of. Especially in this Covid pandemic period, people are relying on online meetings. A new workstations and learning environment will definitely motivate students who learn inside those rooms. In case of security of the building, we will also be installing an air-conditioner in the room and taking care of the air condition in the room, especially the area where the server sits. The building structure is also simple where the emergency escape route is clear and straightforward. And of course, things like fire extinguishers will be mounted.

Last but not least, the economical part. The budget assigned to us is RM 1.3M which is pretty sufficient and viable. Our building structure is simple and the size is moderate, which is fairly manageable. Besides, in order to save the cost of equipment and cabling, we put

video conferencing rooms and labs in respective clusters where 2 video conferencing rooms are on the ground floor whereas the labs are all on the first floor. The cables we choose are coaxial and Ethernet cable (Cat5) which are both good value for money. For the multi-terabyte storage server, Direct Attached Storage was chosen for it affordable price and easy maintenance Precautions will also be made to reduce the cost of maintenance such as installing air-conditioners to keep the optimum temperature for servers and workstations which will properly be used for full office hours or even 24 hours. Anti-virus software will also be installed to avoid malware attack to the workstation as well as the server.

3.3 Reflection Task 2

This task is basically the initial planning of the project, where we have to go through a lot of study and reading to really know and understand what we are going to do next. We need to come up with questions and find the answer for ourselves either through the Internet or ask the right person. Since the task requires knowledge from the later syllabus at that moment, hence it means that we need to study ahead to understand what we are doing. This gives us an early exposure to the things that we are going to learn later in the lecture and have a better understanding of it.

4.0 Task 3 : Choosing The Appropriate LAN Devices

4.1 List of Devices

Devices	Quantity	Price (RM) x Quantity = Total (RM)
Cisco ASR 1002-HX Router 	1	169,137.47 x 1 = 169,137.47
Cisco Catalyst 2960L 48 Port Switch 	4	4888.00 x 4 = 19,552.00
SOARNEX EP100-08-62 8 Port Switch 	2	290.00 x 2 = 580.00
TP-Link Deco M5 AC1300 Wireless Access Point 	2	259.00 x 2 = 518.00

SmartStor DS4600 Storage Server 	12	999.00 x 12 = 11,988.00
Toshiba Hard Disk P300 3TB Internal Hard Disk 	28	309.80 x 28 = 8,674.40
Dell Precision 3630 Tower Workstation 	124	4315.00 x 124 = 535,060.00

Samsung Monitor 24" / IPS LED 75Hz 5ms F24T350FHE 	124	409.00 x 124 = 50,716.00
FANTECH Wired Keyboard and Mouse Combo KM100 	124	24.00 x 124 = 2,976.00
CK-LINK UTP CAT5 NETWORK LAN CABLE 305M (1000FT) 	2	150.00 x 2 = 300.00
CK-LINK UTP CAT6 NETWORK LAN CABLE 305M (1000FT) 	1	239.00 x 1 = 239.00

100 PCS/LOT Cat5 Cat5e Network Internet Connector RJ45 8P8C Cable Modular Plug Heads Connector 	2 (100 pcs each)	7.50 x 2 = 15.00
Cat5/Cat5e RJ45 Connector Plug Socket 	9 (20 pcs each)	79.92 x 9 = 719.28
Baoblaze Cable Rackmount or Wallmount 24 Port Patch Panel Unshielded Cat6/Cat5 UTP 	1	17.00 x 1 = 17.00
Double RJ45 CAT5e Wall Socket/Plate 	70	15.00 x 70 = 1,050.00

Epson EB-X41 XGA 3.600 Lumens Projector  	6	2000.00 x 6 = 12,000.00
Total Price		**RM 813,542.15**

4.2 Summary List of Devices

Based on the devices and quantities that we have listed out above, the total price is RM813,542.15. After finalized the list we were quite surprised by the cost since the budget given to our group is RM1.3M which we assumed to be moderately acceptable for this project. Since this is our first time doing research on such issue we can say that it is an eye opener for us because we get to learn how and which type of network and end-user devices such as routers, switches and cables to choose. In general, we are surprised and satisfied with the overall cost which is high yet does not exceeds our budget.

There are few factors that need to considered in choosing network devices and cost is one of it. This is because we have been given a specific budget so we cannot randomly choose each networking devices according to our interest. Besides, doing a thorough research is very important as we aim to maintain a cost effective environment in our building.

Network devices come in many brands such as Cisco and Huawei. There are few differences in both brand for each devices. For routers, the differences can be seen in the user experience, agility, advanced security and virtualization.

In user experience, Huawei has limited application high availability compared to Cisco. It only offers basic policy-based routing while Cisco not only monitor path performance but also provides an effective load-balance across path while delivers ideal application-level SLAs. Moreover, Huawei requires extra hardware in enhances application experience and does not support intelligent caching or WAN acceleration which are the opposite for Cisco.

Secondly, in terms of agility, Cisco is more beneficial than Huawei. As we know, both has various model routers. Thus, Cisco's offers NETCONF and YANG support across branch, WAN and cloud platforms meanwhile certain router model from Huawei do not support NETCONF/YANG. When choosing software license packages, Huawei offers perpetual license for basic and advance feature sets per-device whilst Cisco offers one software product for predictable OpEx which makes purchase easier.

Next, the difference in security is overwhelming between these two. Huawei only supports basic access control lists for filtering and encryption capability meanwhile Cisco integrates real-time contextual awareness, security automation, threat prevention, malware protection, EAL-4 certified perimeter defense and web security. For instance, Huawei AR router lacks advanced security protection such as web security, threat prevention or malware protection. When it comes to security for end-to-end architecture, Huawei is limited as it does not publish its secure development life cycle and trustworthy system. Apart from that, Cisco provides cloud-delivered, integrated security service for branch rooters, protection against real time threat such as malware, phishing and botnets. Cisco also provides network as sensor and enforcer where comprehensive network visibility enables faster anomalies detection and deeper forensics of internal and external threats compared to Huawei router which is insufficient as a network security sensor as it only offers sample-based network application visibility. Moreover, Cisco is a trustworthy system because it products have trust anchors, secure boot and run time prevention. The software is also digitally signed.

Last but not least, differences in terms of virtualization. While the enterprise network function for Huawei offers up to 8 VMs or VNFs yet uses basic supervisor hardware and capability limited to the chassis, Cisco simplify operations and deployment of virtual routing, security and application services. In native application hosting, Huawei has limited service. The router OS (VRP) does not offer native integration with a third party tool unless it uses another VM. Cisco’s compute and storage includes local resources for applications. Network functions or services, data backup and analytic meanwhile Huawei local compute and storage resources neither replaceable nor upgradable and only offers in main supervisor module.

4.3 Reflection Task 3

In task 3, we discover a lot about the price of the products needed to complete our project. We found out that some of the networking devices is expansive. It is new to us all since this is the first project needed us to find the price ourselves. There are many things to consider in choosing the best equipment to be use as different variety and brands does matter to make sure we did not overspend our remaining budget. Based on what we have learned in class, we could identify the best networking devices that is suitable for our project. The quantity needed for each networking devices also needed to be consider and to make sure we always have enough throughout the project.

5.0 Task 4 : Making The Connections LAN and WAN

5.1 Work Area

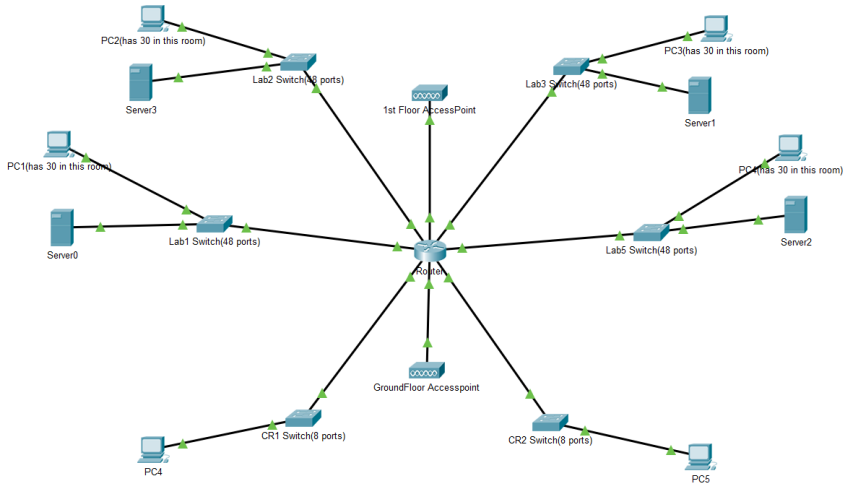


Figure 3 : Network Topology

Figure 3 shows the topology of our network inside the proposed building. Based on Figure 4, the area at the bottom will be the devices placed at the ground floor whereas the area at the top will be the devices placed at the first floor.

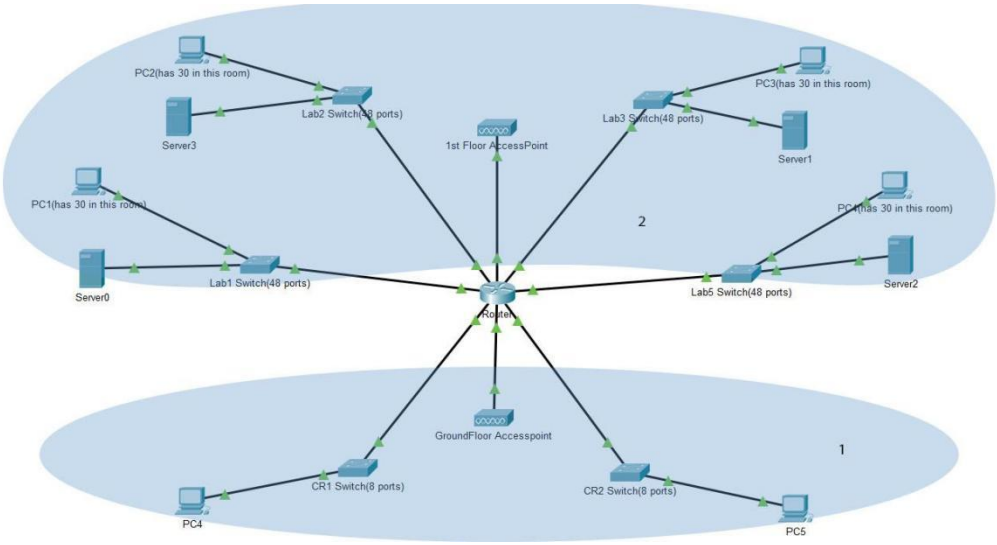


Figure 4 : Area of Devices

There will be 30 workstations at respective labs. All 30 workstations are represented by just 1 PC each together with 1 multi-terabyte server. Hence, a 48-ports switch was used in

those labs. On the ground floor, 8 ports switch was used as we expect there will not be much workstation needed to connect to the Internet in the video conferencing room. We also placed 1 access point on each level of the building which can cover up to 5500 feet squares in order to provide wireless connectivity for the entire building.

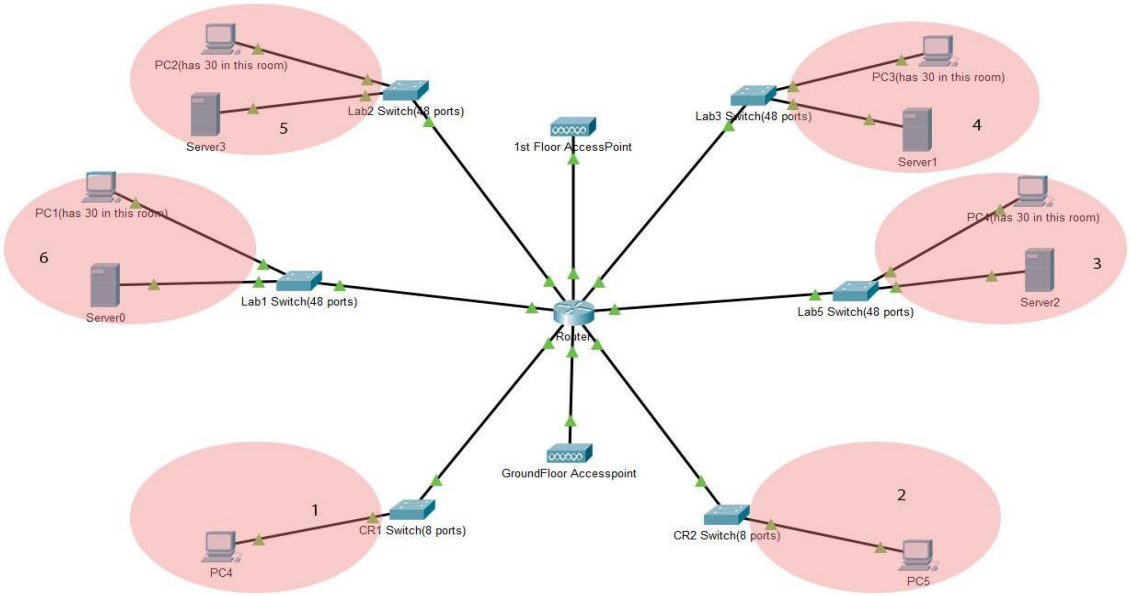


Figure 5 : Work Area in Topology

The areas that shaded pink in Figure 5 are the work area in our topology. There are 2 on the ground floor and 4 on the first floor, which make it a total of 6 work areas.

5.2 Connections, Patch Cords and Switch Ports

Having known our amount of work area, now we can do some calculation to determine the number of connections, patch cords as well as switch ports needed.

First of all, let's start from the ground floor, consider both the video conferencing room is connecting the maximum number of end devices we expected which are 8, this will result in 8*2 (times 2 because 2 video conferencing room) = **16 connections**, 16*2 (times 2 because there are 2 sections of patch cord needed in order to form a horizontal cabling) = **32 patch cords** and finally **16 switch ports**. Note that these are the total for ground floor alone. The switch bought which has 8-ports which is just enough for this situation.

Next, we move on to the first floor. There are 4 labs located on the first floor, with 30 workstations + 1 lecturer's workstation and 1 server, which result in 32*4 (times 4 because there are 4 labs and 32 because 30+1+1 server) **128 connections**, 128*2 = **256 patch cords** and finally **128 switch ports**. 48-ports switch was bought for each of the labs which will be having 192 switch ports available in total for first floor uses.

All in all, a **total** of 16+128 = **144 connections**, 32+256 = **288 patch cords**, and 16+128 = **144 switch ports** are needed for the entire building. Access points are also installed inside the building in order to provide Internet connectivity for devices that connect wirelessly.

5.3 Floor Plan

- Backbone/Vertical Cabling

Cat5 and Cat6 cables are used in this case study where the total length of Cat5 and Cat6 cables are 77m and 9m respectively.

a) Ground Floor

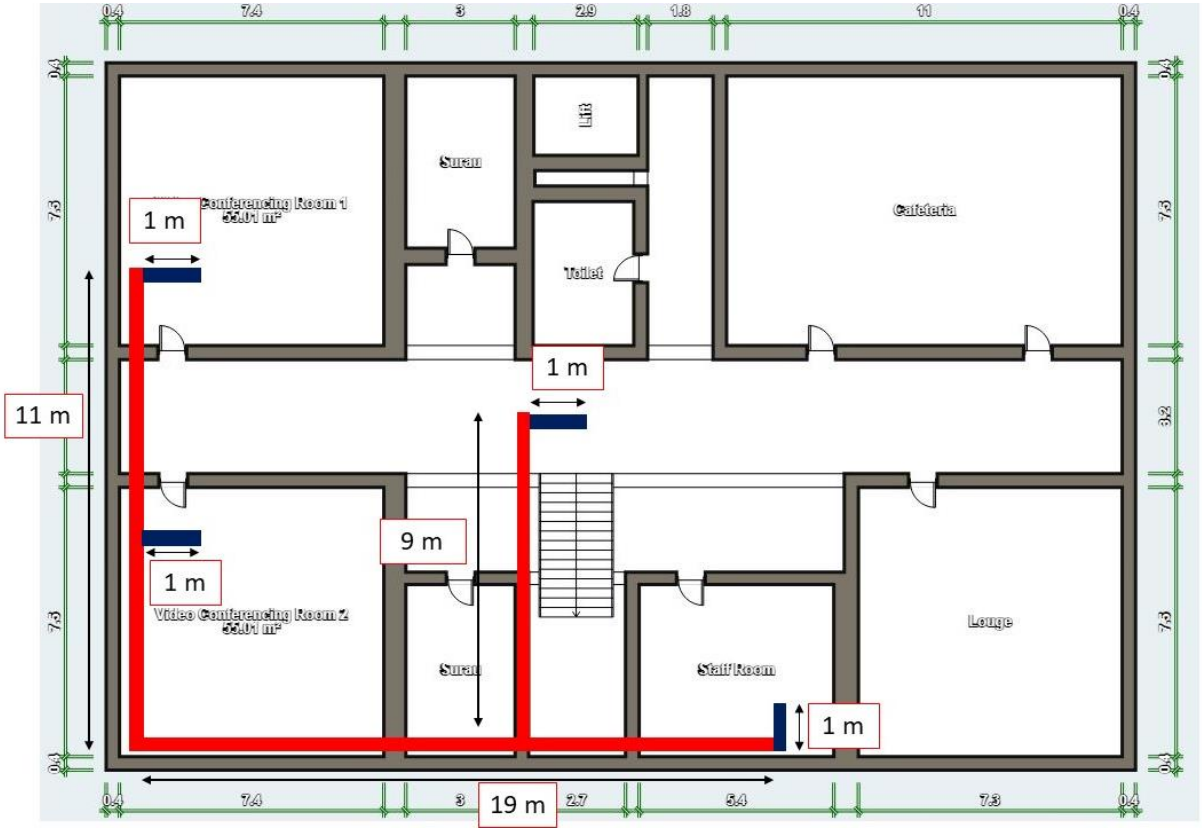


Figure 6 : Cabling Ground Floor

b) First Floor

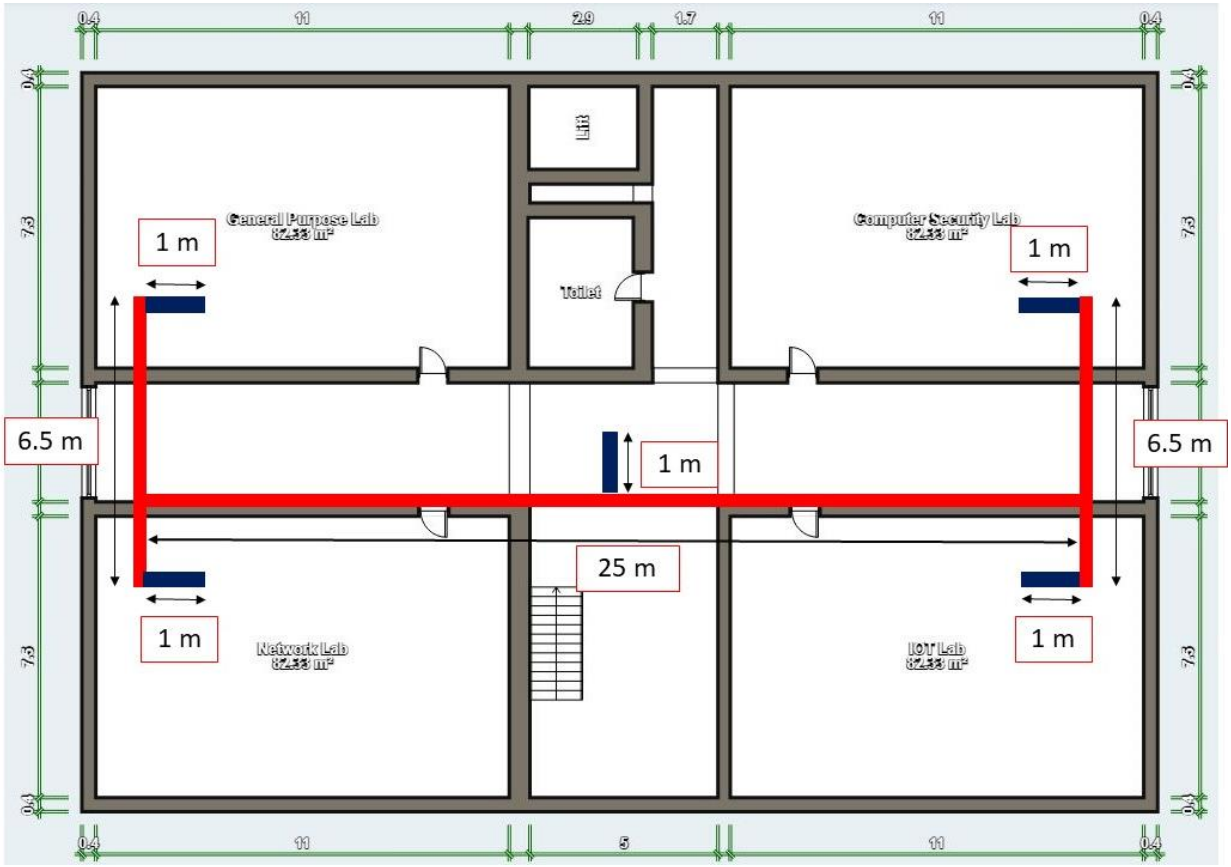
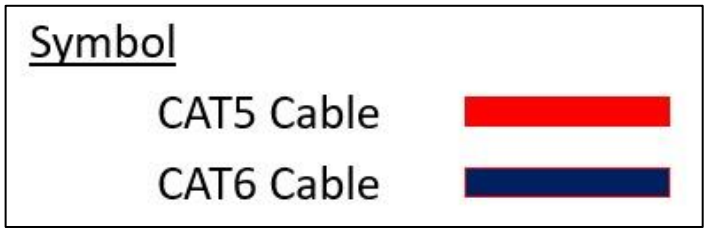


Figure 7 : Cabling First Floor



Legend 2 : Vertical Cabling

- Access Point, Router and Switches

As shown in Figure 8 and Figure 9 below, each floor is provided with 1 access point and router is placed only on the ground floor in the staff room. Switches are placed in each lab and video conference room. There are total of 6 switches,4 48-port switch and 2 8-port switch, 2 access points and 1 router.

a) Ground Floor

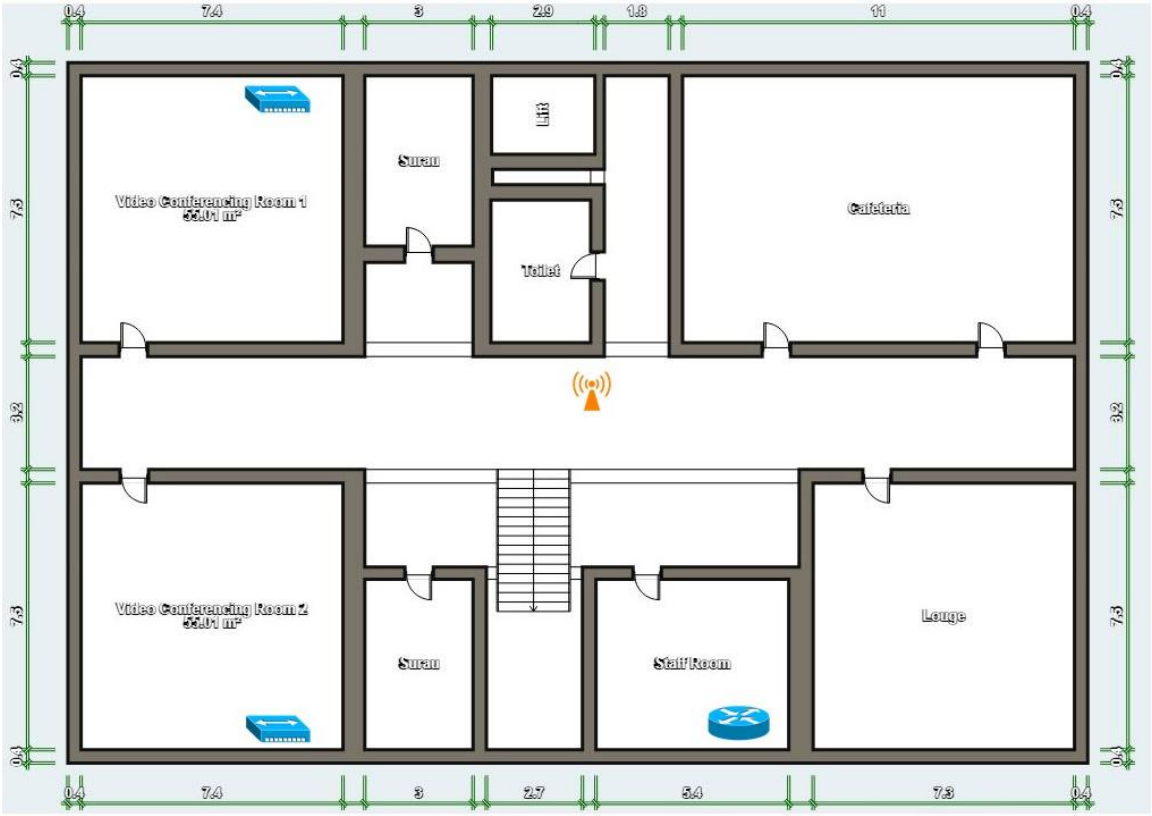


Figure 8 : Access Point, Router and Switches Floor Plan

b) First Floor

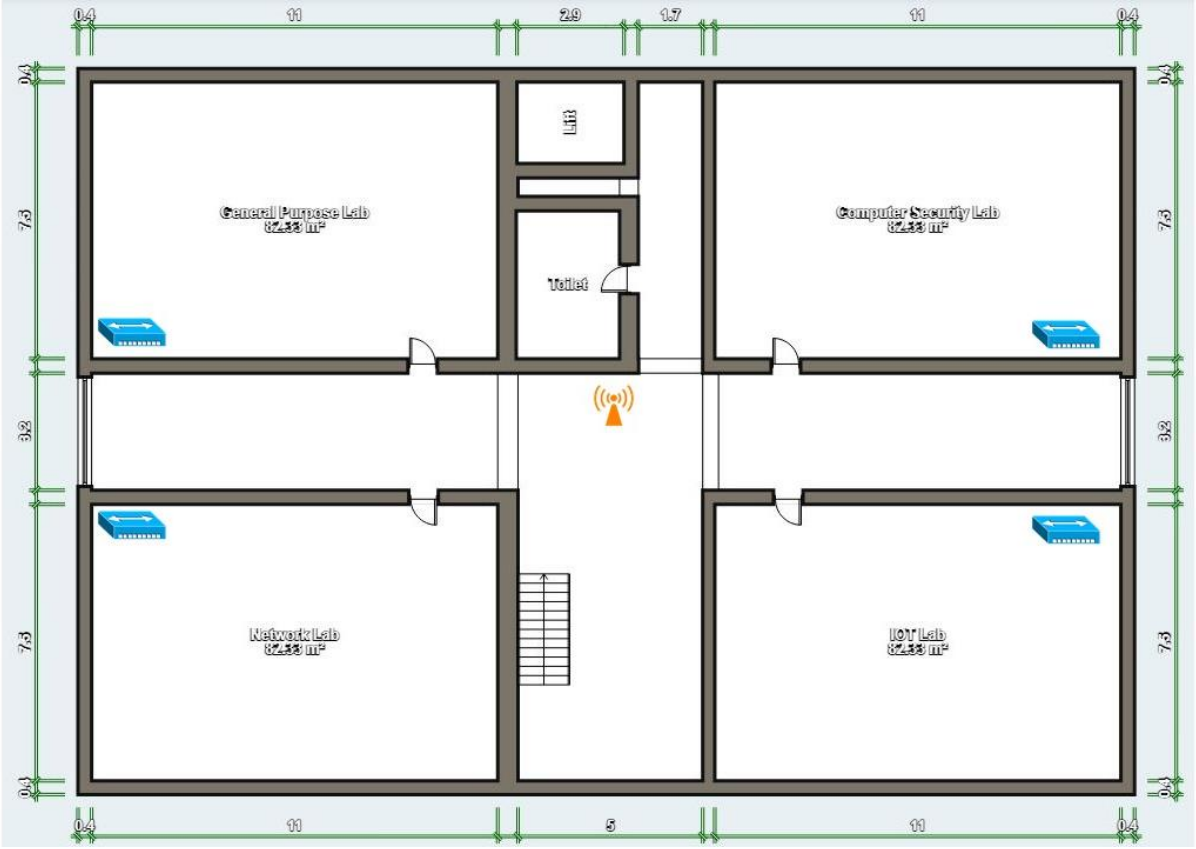
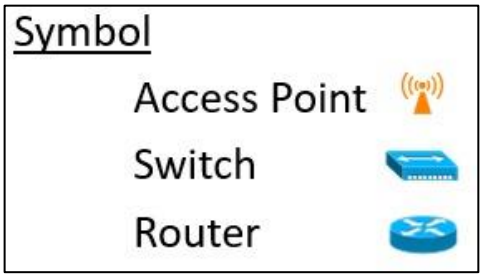


Figure 9 : Access Point and Switches Floor Plan



Legend 3 : Access Point, Router and Switches

- Distribution/Horizontal Cabling

The cabling will be implemented on the floor either using on-floor or in-floor raceway. Image 1, 2 and 3 below shows height and length for based on estimation that has been done. In Image 1, the calculation are in foot. Assuming the wall height for each floor is approximately 3m, the door should be about 2m. Image 2 shows the suitable length and height for PC desk to apply ergonomic effectively. The calculation are in cm and angle are in degree. This is important for calculating the cable length needed to connect between the PCs and multi-terabyte storage server. Meanwhile, Image 3 shows the length needed for conference table to be put inside the video conference room. All the calculations for the cable length is shown in Figure 16.

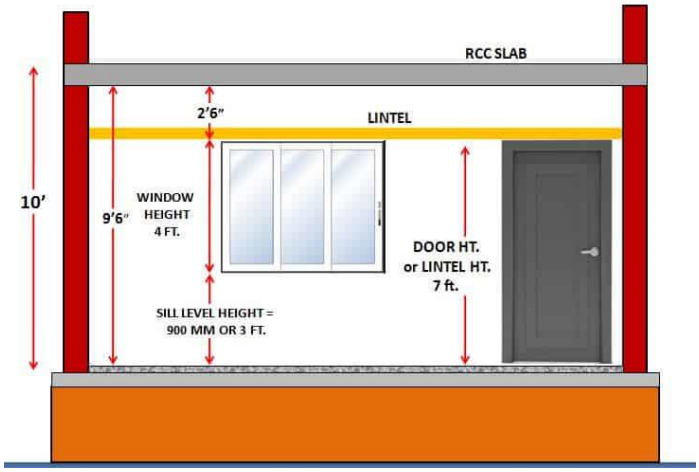


Image 1 : Wall and Door

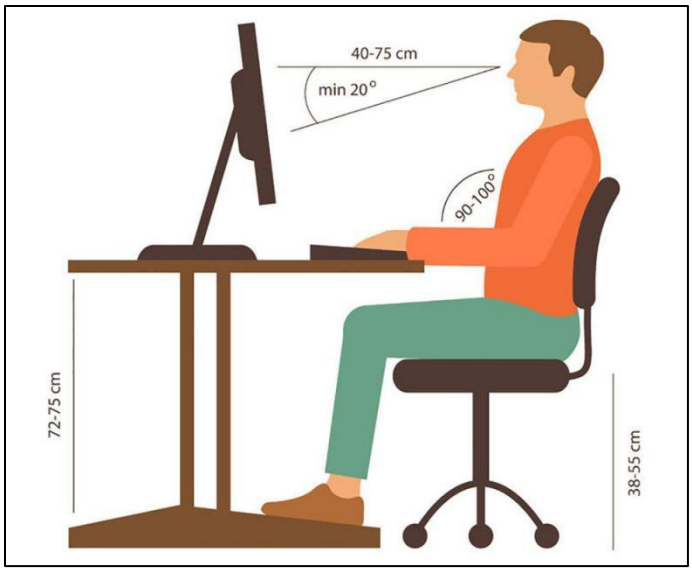


Image 2 : PC Desk

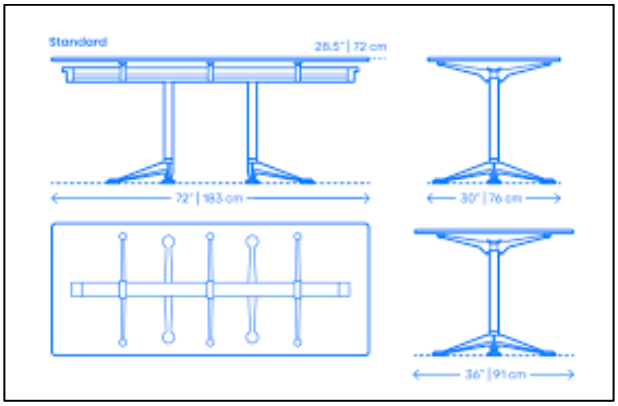
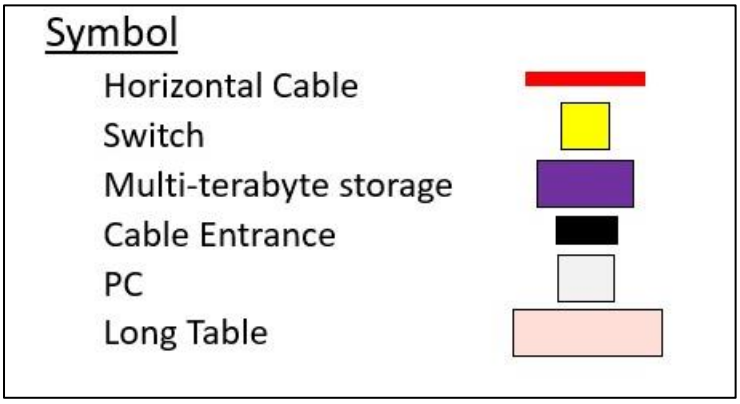


Image 3 : Conference Table



Legend 4 : Horizontal Cabling

a) Ground Floor

For this floor, the cable is only used in video conferencing room 1 and 2. The type of cable that we use is cat6 cable. As mentioned above, all cable will be implemented on the floor. There are 1 PC, 4 long table and a 8-port switch.

- Video Conferencing Room 1

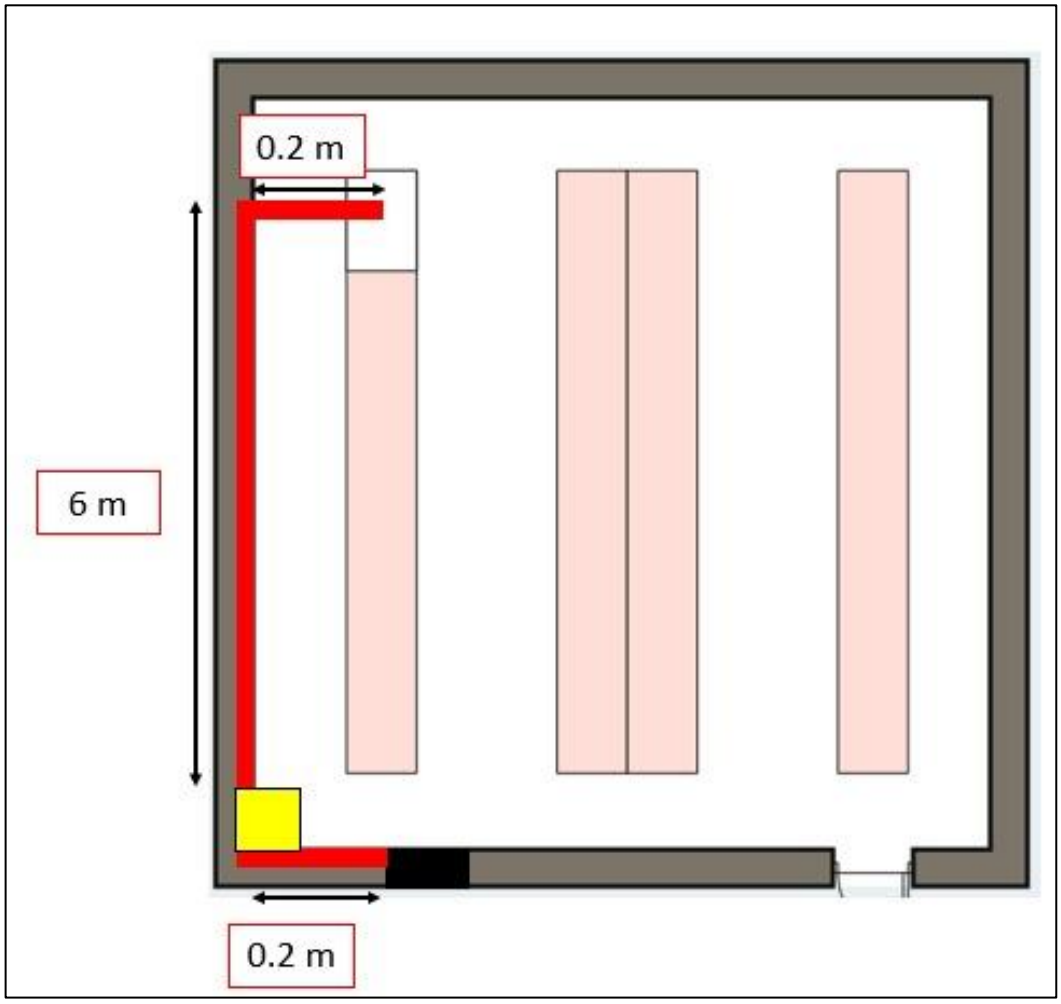


Figure 10 : Cabling Video Conference Room 1

- Video Conferencing Room 2

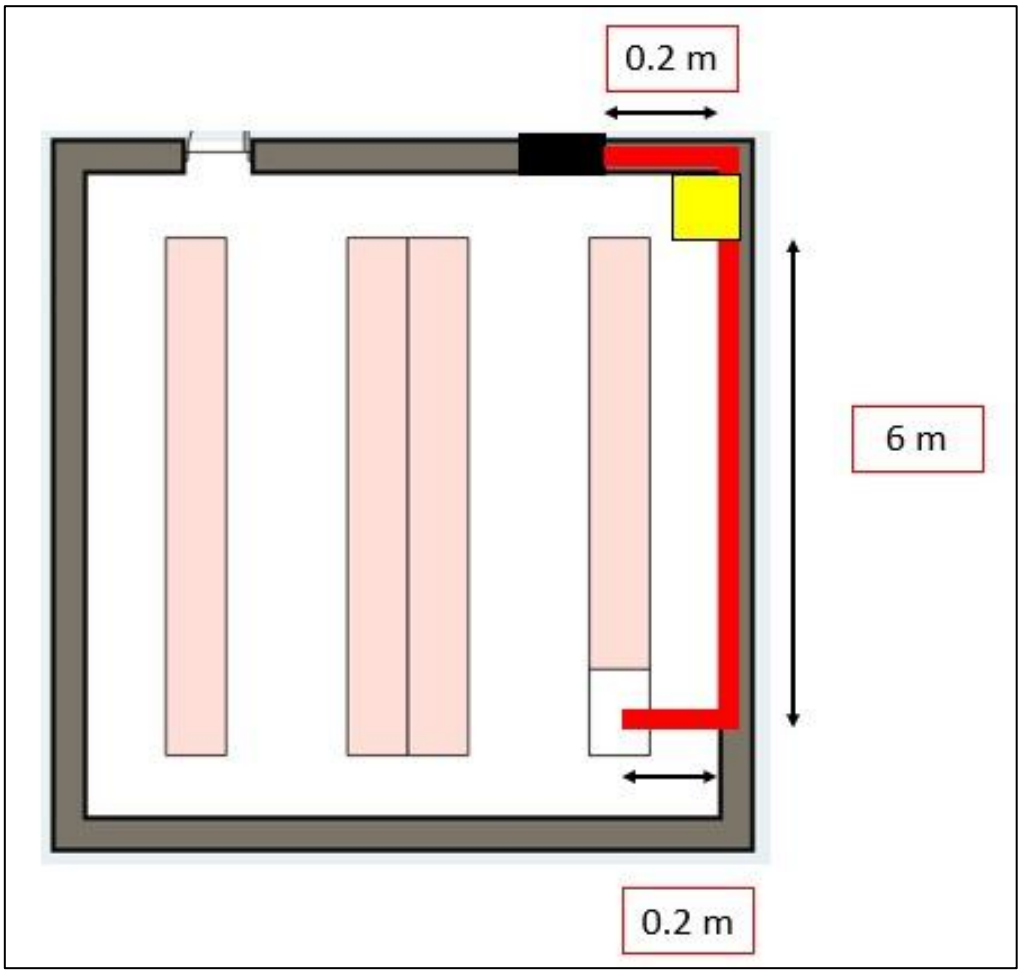


Figure 11 : Cabling Video Conference Room 2

b) First Floor

All 4 labs are equipped with same devices but in different arrangement. There are 30 PCs and 1 multi-terabyte storage server in this lab. The desk are placed using 3:3 coordination since it is neater and more convenience for cabling and friendly environment. Besides, 48-port switch and Cat6 cable is used for each lab.

- Computer Security Lab

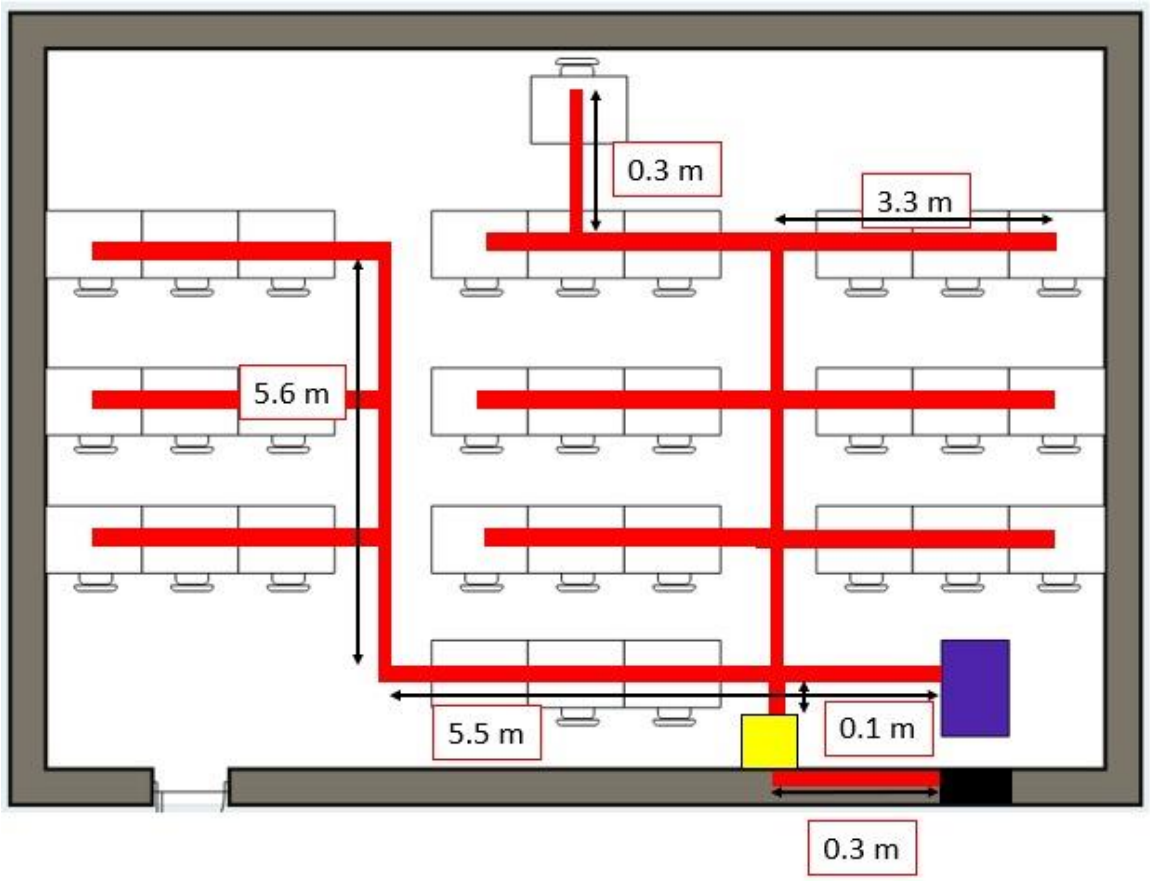


Figure 12 : Cabling Computer Security Lab

- General Purpose Lab

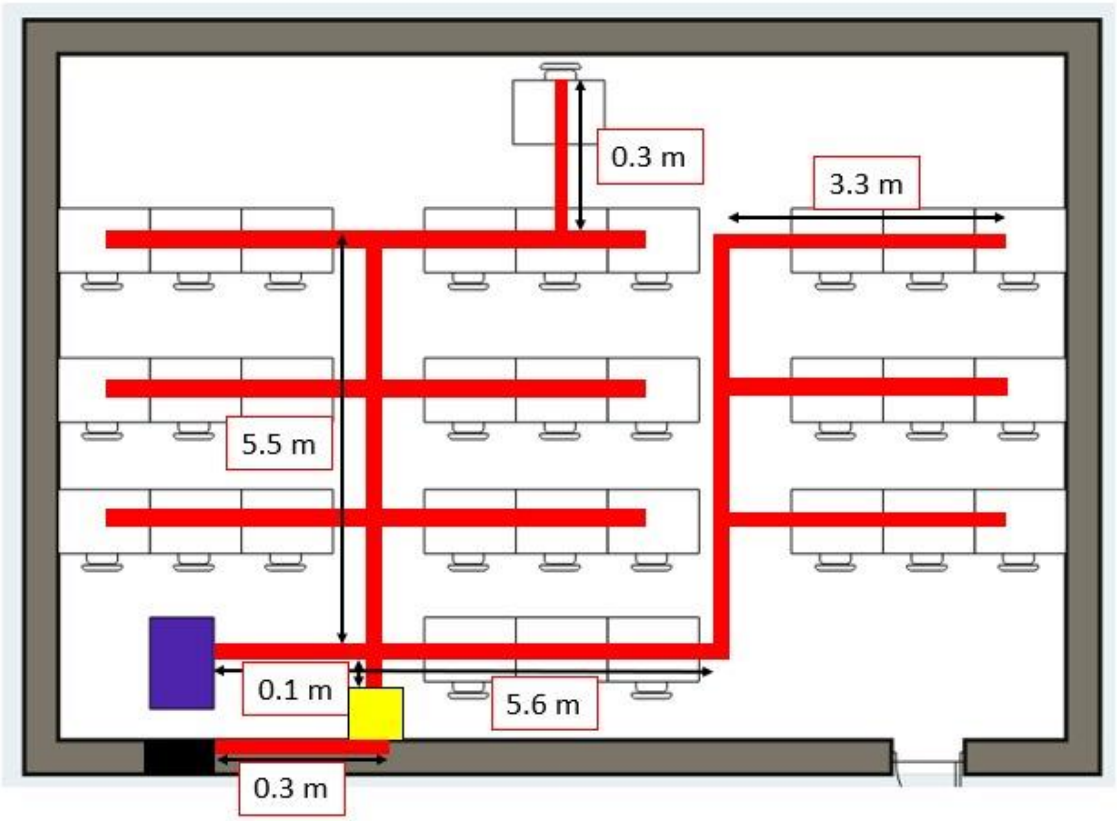


Figure 13 : Cabling General Purpose Lab

- IOT Lab

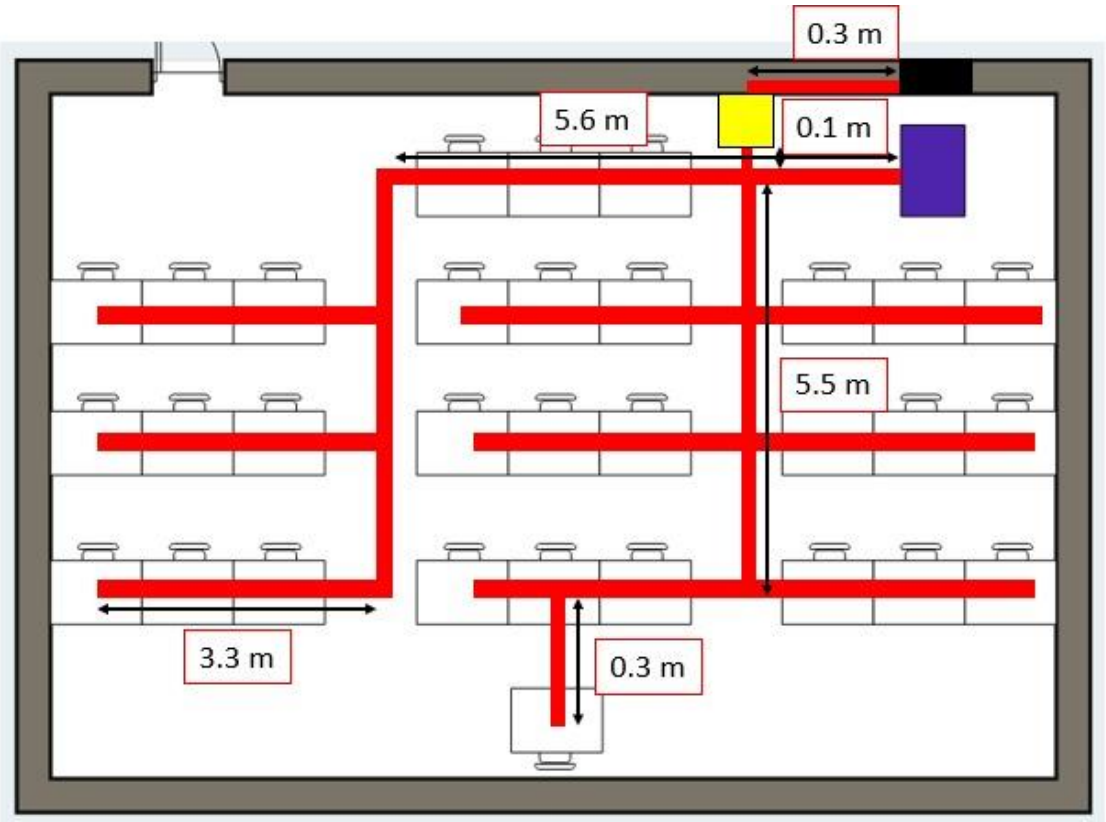


Figure 14 : Cabling IOT Lab

- Network Lab

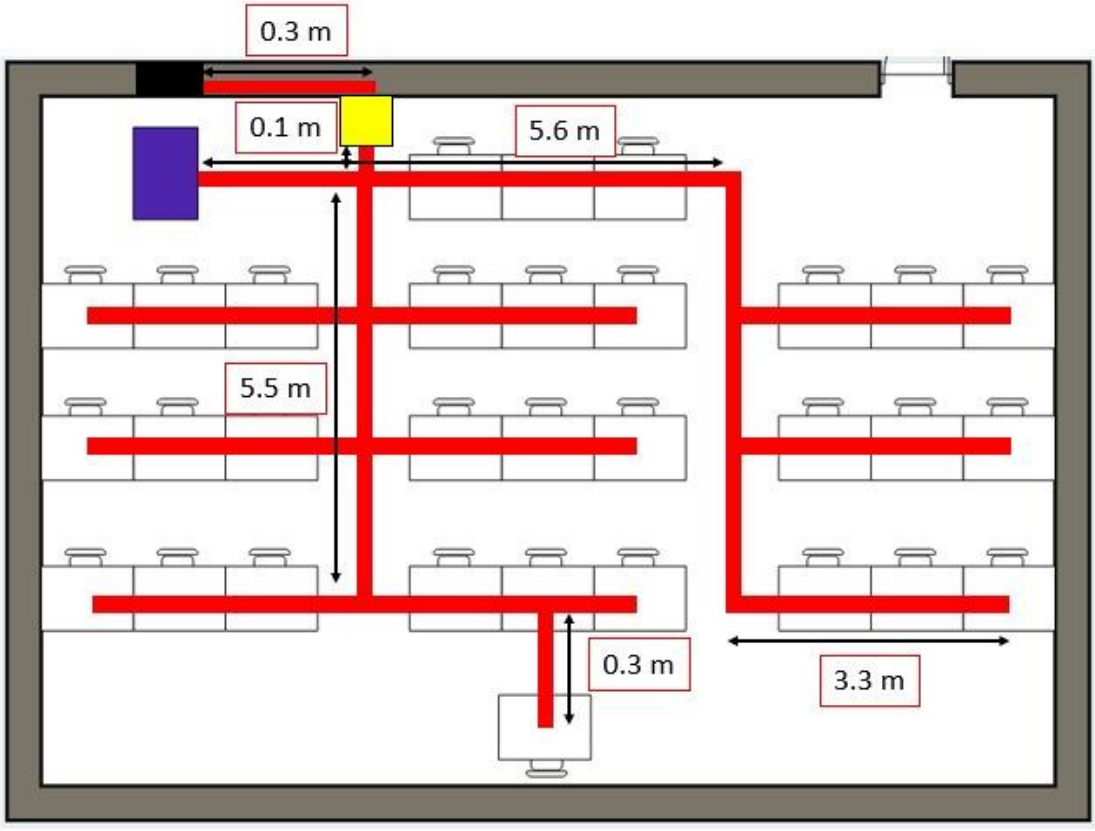


Figure 15 : Cabling Network Lab

Cat5 Cable

Total = Main (GF) + Main (1F)

= 43 m + 42 m

= 85 m

Cat6 Cable

Total = Main (GF) + Main(1F) + (4 Lab) + (2 Video Conferencing Room)

= 4 m + 5 m + 188 m + 13 m

= 210 m

Figure 16 : Cable Length Calculation

5.4 Reflection Task 4

Task 4 needs us to analyse back our plan thoroughly. Based on our plan for this project, the cable does need to span across the room and different cables is used for better planning. The length of cable that we have purchase in task 3 should be enough to use in task 4. We need to consider the size of each pc desk and wall height to make sure the calculation of the cable length is accurate. The cost still does not exceed the total budget that have been given to our group, so we are still good to move on to the next task. We also need to consider that the bandwidth is adequate to all the user in the lab and there is room for upgrade in the future.

6.0 IP Addressing Scheme

6.1 Introduction and Calculation

The **IP address assigned** to our group is 172.18.5.0/18. The information we can obtain here is that the notation is /18, which means the **subnet mask** is 255.255.192.0. By doing the AND operation on the given IP address, 172.18.5.0 and the subnet mask, we can get our network address which is 172.18.0.0 and we change the binary bit starting from the 19th bit onwards to 1 (count from left to right) we will get our broadcast address, which is 172.18.63.255. Hence, a small conclusion we can get from here is that the usable or available IP address for us to assign to the end host ranges from 172.18.0.1 to 172.18.63.254. But since the IP address assigned to us is 172.18.5.0, the **available IP address** for us to assign to the end host ranges from 172.18.5.1 to 172.18.63.254, with **network address** of 172.18.5.0 and **broadcast address** of 172.18.63.255.

Subnet Mask	Network Address	Broadcast Address	Available Address
255.255.192.0	172.18.5.0	172.18.63.255	172.18.5.1 - 172.18.63.254

But the real question is that, how do we distribute the IP addresses by following the needs of each work area. At the ground floor, there is a maximum of 16 end devices (each video conferencing room AKA vc room contributes 8) plus one wireless access point; whereas at the first floor we have 32 end devices in each lab, in which we have a total of 4 labs, plus a wireless access point. Meanwhile on the first floor we have 4 labs with 31 workstations (including students' and lecturers') and 1 multi-terabyte storage server located in each room. That resulted to 128 connection.

6.2 IP Address Ground Floor

After a discussion among our group members, we decided to use the notation of /28 on the ground floor in each vc room. The **subnet mask** will be 255.255.255.240. The reason why we do this is that /28 will provide us 16 addresses, in which it can accept 16 on each subnet. So the end device of the **first vc room** will have an **IP address ranging** from 172.18.5.1 to 172.18.5.14 with a **network address** of 172.18.5.0 and **broadcast address** of 172.18.5.15. Next up, the **second vc room** will have an **IP address ranging** from 172.18.5.17 to 172.18.5.30 with a **network address** of 172.18.5.16 and **broadcast address** of 172.18.5.31. The **wireless access point** will be using the default IP address assigned to it. The detail of network topology is shown in **Figure 1**.

Room	**End Devices**	**Subnet Mask**	**IP Address Range**	**Broadcast Address**	**Network Address**
First VC	8	255.255.255.240	172.18.5.1 - 172.18.5.14	172.18.5.15	172.18.5.0
Second VC	8		172.18.5.17 - 172.18.5.30	172.18.5.31	172.18.5.16

6.3 IP Address First Floor

The subnet mask for each lab will be 255.255.255.192. The reason why we choose the subnet mask because /26 will provide 64 address. The end device of the **general purpose lab** will have the **IP address ranging** from 172.18.6.1 to 172.18.6.63 with the **network address** of 172.18.6.0 and **broadcast address** of 172.18.6.64. The **computer security lab** room will have the **IP address ranging** from 172.18.6.66 to 172.18.6.127 with the **network address** of 172.18.6.65 and **broadcast address** of 172.18.6.128. Next is the **IOT lab** that will have the **IP address ranging** from 172.18.6.130 to 172.18.6.191 with the **network address** of 172.18.6.129 and **broadcast address** 172.18.6.192. Finally, the **network lab** will have the **IP range** of 172.18.6.194 to 172.18.6.255 with the **network address** of 172.18.6.193 and **broadcast address** of 172.18.7.0. The detail of network topology is shown in **Figure 1.**

Room	End Devices	Subnet Mask	IP Address Range	Broadcast Address	Network Address
General Purpose Lab	32	255.255.255.192	172.18.6.1 - 172.18.6.63	172.18.6.64	172.18.6.0
Computer Security Lab	32	255.255.255.192	172.18.6.66 - 172.18.6.127	172.18.6.128	172.18.6.65
IOT Lab	32	255.255.255.192	172.18.6.130 - 172.18.6.191	172.18.6.192	172.18.6.129
Network Lab	32	255.255.255.192	172.18.6.194 - 172.18.6.255	172.18.7.0	172.18.6.193

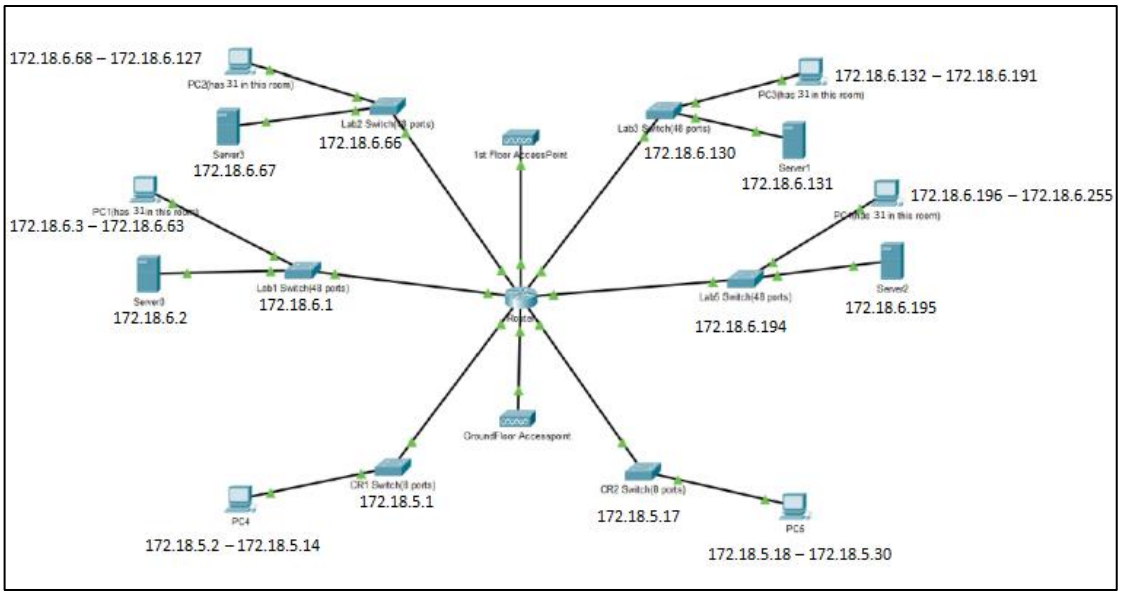


Figure 17 : Topology of IP Address

6.4 Reflection Task 5

In task 5, IP addresses were given to every group then we assigned the given IP addresses to all the devices and arrange them in a simple way. For the ground floor, we decided to use the notation of /28 so the subnet mask will be 255.255.255.240. We use /28 because it will provide 16 addresses. Then for the first floor, we use /26 for the notation so the subnet mask will be 255.255.255.192 for each lab on this floor. The reason we decided to use /26 is that it will provide us 64 addresses. So we have enough range of IP addresses for each floor. Task 5 acquired us to identify the total hosts provided by each different subnet mask so that we can decide which subnet mask is suitable to use. This is the opportunity for us to use the acknowledgment that we obtain from lecture classes in a real-life situation.

7.0 Conclusion

In a nutshell, we all are happy with the output of this project that we put our effort together to complete. In this project, we have come out with our own design of the floor plan for the new building, made some research about networking devices and decided which one to use, prearranged the network structure, planned the cabling, and finally assigned IP addresses for each room and labs. We complete our project without exceeding the proposed budget because we made much research to decided on what networking devices to use.

During the making of the project, we acknowledge some strengths that we have. We all are agreeable to work together with each other and we always provide the opportunity to anyone who wants to give ideas in the group. We all also always on time because all task are distributes fairly among us and team leader always remind us about the due date so that the task can be complied on time.

Nevertheless, we also encounter some problems during the making of the project. We faced some miscommunication because, during this pandemic, we can not have face-to-face sessions so it is hard to explain to each other if we have problems. Even we kept asking each other if there is any problem, some problems still hard to solved effectively because it is easier to solve together face-to-face. Then, team members always depend on the group leader to come out with some decisions that can cause some delay in the progress.

8.0 Team Members and Responsibilities

For this project, we have been assigned into random group represent by letter. Each group consists of 4 members. Our group is group G and the members are Liew Wei Xian, Mohamad Syahmi, Saiful Habib Danial and Nur Azizah. Before starting the project, we assigned each member with roles. Wei Xian as the leader, Azizah as the compiler and Syahmi and Habib are the reviewer to recheck each task before submission to avoid careless mistake. We also came up with a group name, Good Game Co. This project is introduced during early October 2020, and the progress for the project are divided into tasks. Each task is done thoroughly after discussion with group members. The minute meeting shown in appendices are record for each discussion made in our group. In each task, we divided the work properly to ensure every members partake it.

9.0 References

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19) [Image and prices of switch 8 ports]. (n.d) https://bit.ly/39nsRto

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10.0 Appendices

10.1 Minute Meeting Task 1

Meeting Title		
Date : 26/10/2020	**Time :** 08:00 pm - 11:30 pm	**Location :** Whatsapp Group
Attendees :	Nur Azizah Liew Wei Xian (Host) Mohamad Syahmi Saiful Habib Danial	

Agenda Topic	
Discussion :	Brainstorming the group name, design of the building and floorplan.
Conclusion :	The group name is Good Game. The ground floor will consists of 2 video conferencing room, 1 study room, 1 cafe and 1 surau. Meanwhile the first floor will consists of 4 laboratory. Both floor will have a stairs and 1 toilet for each gender.

Actions	**Person In Charge**	**Deadline**
Draw floorplan	Syahmi	27/10/2020
Guide and help Syahmi in drawing floorplan	Liew	
	Habib	
	Azizah	

10.2 Minute Meeting Task 2

Meeting Title		
Date : 07/11/2020	**Time :** 10:00 pm - 11:30 pm	**Location :** Whatsapp Group
Attendees :	Nur Azizah Liew Wei Xian (Host) Mohamad Syahmi Saiful Habib Danial	

Agenda Topic			
Discussion :	Improvement of task 1, generate ideas for Q&A and feasibility.		
Conclusion :	Legend and lift will be added on the floorplan, 10 questions and points of feasibility have been listed.		
Actions		**Person In Charge**	**Deadline**
Do the correction of Task 1 as advised by the lecturer		Syahmi	09/11/2020
Full explanation of feasibility		Liew	
Full answer with elaboration for each question		Habib	
		Azizah	

10.3 Minute Meeting Task 3

Meeting Title		
Date : 24/12/2020	**Time :** 01:30 pm - 03:00 pm	**Location :** Whatsapp Group
Attendees :	Nur Azizah Liew Wei Xian (Host) Mohamad Syahmi Saiful Habib Danial	

Agenda Topic	
Discussion :	Choosing network devices, generate points for reflections.
Conclusion :	Affordable and appropriate network devices are chosen based on the price range and the points for reflection is listed.

Actions	**Person In Charge**	**Deadline**
List out the devices and quantity needed	Syahmi	29/12/2020
	Liew	
	Habib	
Elaboration of reflection	Azizah	

10.4 Minute Meeting Task 4

Meeting Title		
Date : 01/01/2021	**Time :** 09:30 pm - 10:30 pm	**Location :** Whatsapp Group
Attendees :	Nur Azizah Liew Wei Xian (Host) Mohamad Syahmi Saiful Habib Danial	

Agenda Topic	
Discussion :	Choosing the locations for switches, cable type and other devices in the floorplan and in the work area, telecommunication room,vertical and horizontal cabling.
Conclusion :	All the network devices' position, cabling area and cable type have been chosen

Actions	**Person In Charge**	**Deadline**
List the work area, connections, patch cords and switch ports	Habib	06/01/2021
	Liew	
Elaborate and draw floorplan for horizontal and vertical cabling	Syahmi	
	Azizah	

10.5 Minute Meeting Task 5

Meeting Title		
Date : 13/01/2021	**Time :** 09:00 pm - 11:00 pm	**Location :** Whatsapp Group
Attendees :	Nur Azizah Liew Wei Xian (Host) Mohamad Syahmi Saiful Habib Danial	

Agenda Topic	
Discussion :	Calculation of IP address and decide the distribution of the subnetwork.
Conclusion :	All the subnet mask, network and broadcast address and usable IP address has been calculated and distributed fairly

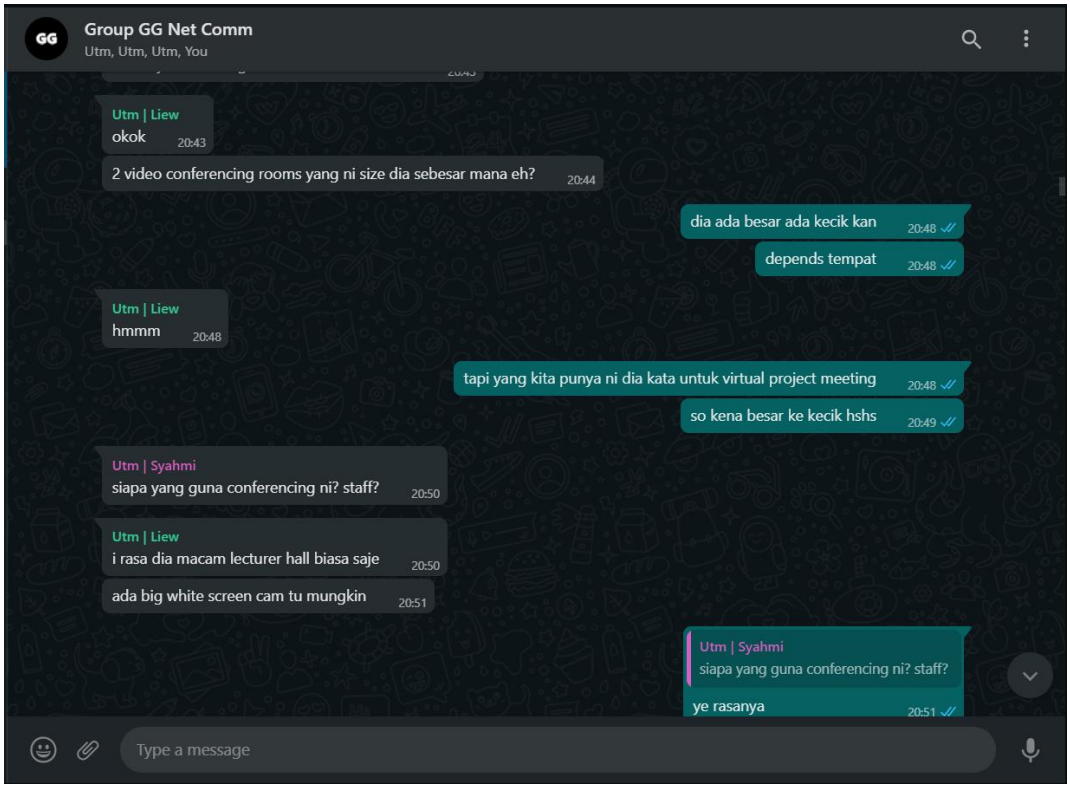
Actions	**Person In Charge**	**Deadline**
Elaboration of IP address for first floor	Syahmi	16/01/2021
Elaboration of introduction and calculation	Liew	
Elaboration of IP address for ground floor	Azizah	
Topology of IP address.	Habib	

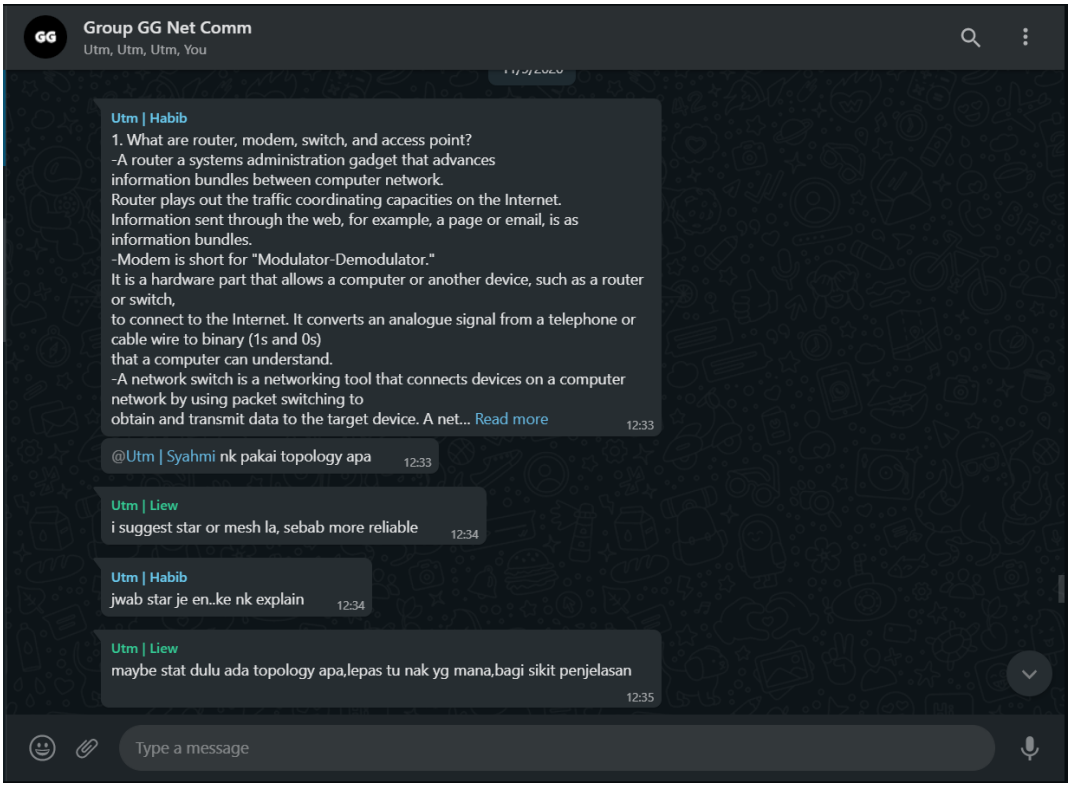
10.6 Minute Meeting Task 6a

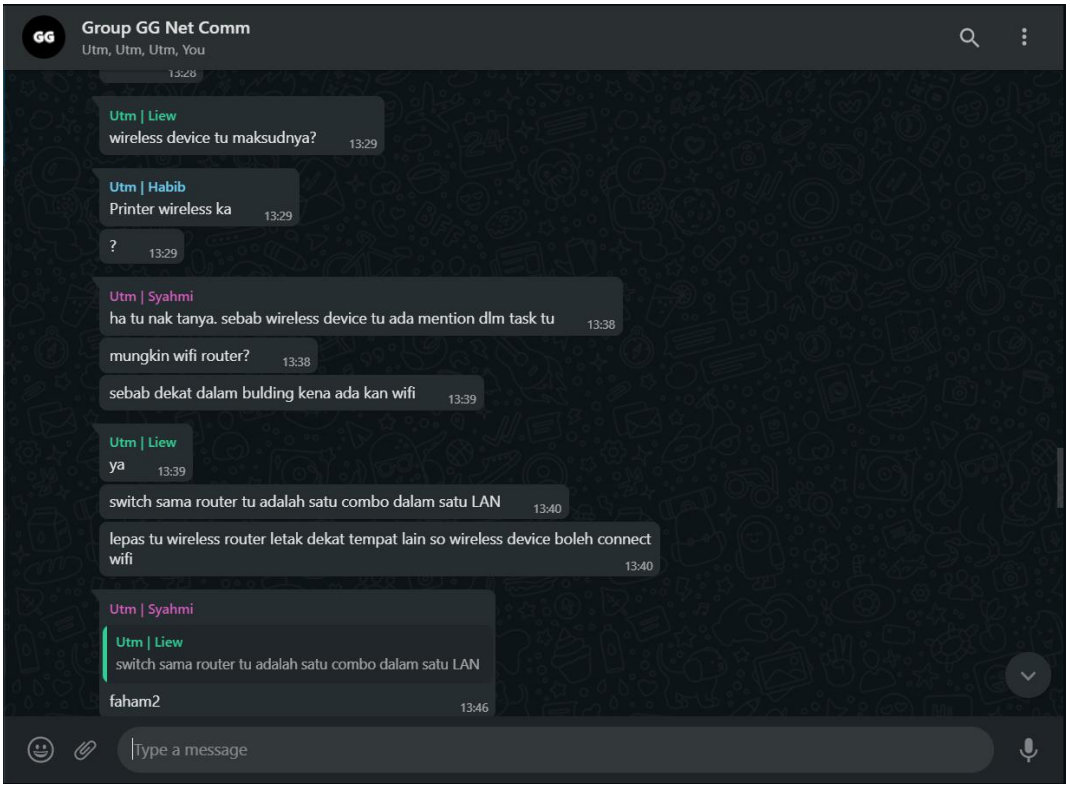
Meeting Title		
Date : 19/01/2021	**Time :** 09:00 pm - 10:00 pm	**Location :** Whatsapp Group
Attendees :	Nur Azizah Liew Wei Xian (Host) Mohamad Syahmi Saiful Habib Danial	

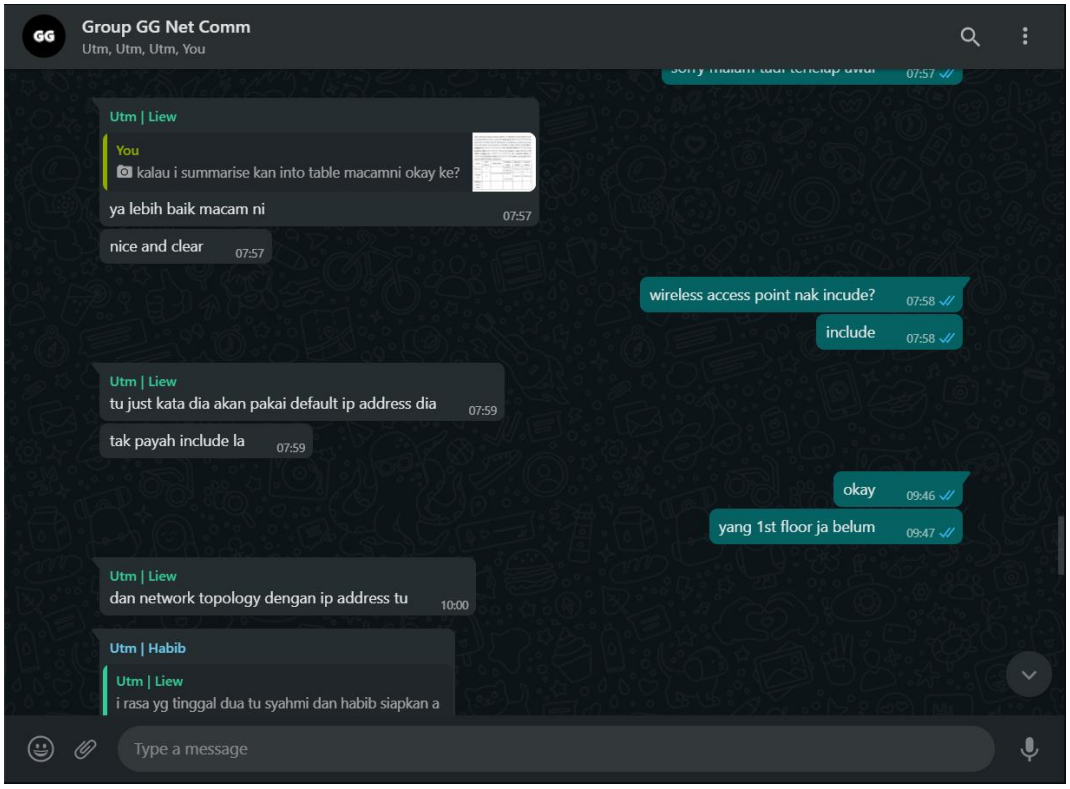
Agenda Topic			
Discussion :	Distribute task		
Conclusion :	Each member will do the reflection and conclusion		
Actions		**Person In Charge**	**Deadline**
Reflection and conclusion		Syahmi	22/01/2021
		Liew	
		Habib	
Compiling task 1-5, minute meeting and appendices		Azizah	

10.7 Proof of Discussion






Group GG Net Comm
Utm, Utm, Utm, You
Utm | Liew
wireless device tu maksudnya? 13:29
Utm | Habib
Printer wireless ka 13:29
? 13:29
Utm | Syahmi
ha tu nak tanya. sebab wireless device tu ada mention dlm task tu 13:38
mungkin wifi router? 13:38
sebab dekat dalam bulding kena ada kan wifi 13:39
Utm | Liew
ya 13:39
switch sama router tu adalah satu combo dalam satu LAN 13:40
lepas tu wireless router letak dekat tempat lain so wireless device boleh connect wifi 13:40
Utm | Syahmi
Utm | Liew
switch sama router tu adalah satu combo dalam satu LAN
faham2 13:46
Type a message


Group GG Net Comm
Utm, Utm, Utm, You
Utm | Liew
You
kalau i summarise kan into table macamni okay ke?
ya lebih baik macam ni 07:57
nice and clear 07:57
wireless access point nak incude? 07:58
include 07:58
Utm | Liew
tu just kata dia akan pakai default ip address dia 07:59
tak payah include la 07:59
okay 09:46
yang 1st floor ja belum 09:47
Utm | Liew
dan network topology dengan ip address tu 10:00
Utm | Habib
Utm | Liew
i rasa yg tinggal dua tu syahmi dan habib siapkan a
Type a message