NETWORK COMMUNICATION PROJECT

SCHOOL OF COMPUTING
FACULTY OF ENGINEERING
UNIVERSITI TEKNOLOGI MALAYSIA
81310, UTM,

JOHOR BAHRU, JOHOR

+607-5538828
(ACADEMIC OFFICE)

+60 – 5538822 (FAX)

PREPARED BY:

Group: ProNet

1.	**GUI YU XUAN**	**A20EC0039**
2.	**ADRIANA MAISARAH BINTI AZNAN**	**B21EC0004**
3.	**UMMU AQILLAH BINTI MAT RESAT**	**B21EC0062**
4.	**NAVINTHRA RAO A/L VENKATAKUMAR**	**A20EC0104**

SECTION/COURSE CODE : [SECR1213] [01] – [NETWORK COMMUNICATION]

LECTURER : [DR. SYED HAMID HUSSAIN MADNI]

SESSION/SEMESTER : [2021/2022] - [01]

Case Study Report submitted to School of Computing, University Technology Malaysia in partial fulfillment to complete the SECR1213 Project for Semester 1 session 2020/2021

ABSTRACT

The project of Network Communication (SECR1213) requires us to design our building and network. Our group needs to build a 2-storey building which is filled with the infrastructure of the network devices such as computers, switches, and etc. We also need to determine the cable connection to connect the devices and the type of media to use. We also had been given a task to assign the IP address for every host device. There are five tasks that need to be completed in order to make sure the network system has met the School of Computing's requirements.

Task 1 is a project setup where we need to draw a floor plan that includes equipment and a complete building layout and design. Task 2 is the preliminary analysis. An interview session and research are conducted to obtain the information that is necessary to develop the network plan. Task 3 is choosing the appropriate LAN devices. We have to select the network devices that we need to fulfill the requirements and needs of the school. We have been given only 2 millions to get the devices. Task 4 is making the connection by choosing the appropriate type of media and planning the suitable cabling. Task 5 is to assign the IP address.

TABLE OF CONTENT

TABLE OF FIGURES

<u>INTRODUCTION</u>

This project requires our team to carry out the preliminary design of the floor plan and establish a reliable, efficient and secure network. The network systems we tend to build must meet the requirements of future needs and must be able to support the high performance of the network. Besides the rooms and labs that our stakeholders need, our team plans to accommodate some rooms to support higher internet speeds.

The aim of this project is to build a building which meets the requirements of the stakeholders and is able to provide a higher internet speed to support the high performance. The scope of this project is the budget assigned by the stakeholder, the users who use the infrastructure, project limitations and the resources that are available to use. The target users are students, academic and supporting staff. The budget that has been assigned is 2 million.

The objectives of this project:

- ❖ To build a scalable network system
- ❖ To improve the performance of the current network system
- ❖ To provide a secure network environment
- ❖ To properly build a new network system which meets the user's needs.

The assumptions we have made in the project:

- ➔ Increase of 10 growths in students and academic staff

PROJECT BACKGROUND AND AN OVERVIEW OF THE CLIENT'S CURRENT STATUS AND ISSUE

In this project, The School Of Computing has already approximated that 10 percent of growth in the number of students and staff for the next 3 years. At present, there are 1200 students for both undergraduate and postgraduate, 97 academic and 35 supporting staff. In the future, the School of Computing would like to see further improvements. The reason our team wants to develop a good technology is because the device that we're using now was not updated. At the moment, the technology used does not reach a satisfactory level. Technology is evolving and must keep up with the passage of time in order for students to understand more about the subject they are learning and for the student to be successful. They also aim to build a new two-storey building that will include four new labs, a general-purpose lab, a network lab, a computer security lab, and an internet of Things lab. Two video conferencing rooms are also essential to include. Each lab will be required to have 30 workstations from The School of Computing for this new future functionality.

To see a new improvement and budget more, they will need to focus on cutting-edge technology, such as having a good internet connection, to prepare for the Fourth Industrial Revolution and ensure that they will not need to upgrade the equipment that they already have for the next decade. Our team decided on a budget of RM 2 million. However, the devices we chose to supply were less than a certain price. The School of Computing intended for the facility to be dependable, efficient, and to have a stable internet connection in each lab. To achieve a greater enhancement, they must create a system that is simple to maintain and expand, improve performance, and secure the network to prevent Internet worms, e- business application attacks and denial-of-service attacks. The School of Computing also needs to provide features such as high-performance support for the core backbone, quality of service, and hardware security based on access control lists (ACLs), as well as to ensure that the system secures VPN connections from remote locations.

TAKS 1: PROJECT SETUP

Figure 1: Floor Plan

2 storey building floor plans with estimated measurements and labels.

First floor:

1. Telecommunication Room
2. 2 Video Conferencing Room
3. Relaxation Room
4. Lobby
5. 2 Washrooms
6. Staircase

Second Floor

1. Telecommunication Room
2. General Purpose Lab
3. IOT Lab
4. Computer Security Lab
5. Network Lab
6. 2 Washrooms
7. Staircase

TASK 2: INITIAL DESIGN-PRELIMINARY ANALYSIS

Interview with Dr. Syed Hamid Hussain Madni

1. How much bandwidth does the school need?

    -   25Gbps (minimum)

2. Do we need a telecommunication room and a server in each lab?

    -   Yes. Telecommunication rooms are important for natural disaster recovery. Each room needs one server and overall needs one server to control all of the building such as labs, conference rooms, WIFI and main address.

3. Do you think each floor should contain one modem and one router?

    -   Yes. WIFI modem and router must be provided for every floor.

4. Is our network time-limited or permanent?

    -   Permanent network to ensure the students and staff can connect to the network for completing their works.

5. The system requirement for building.

    -   High speed network, 5G network, Minimum 25 Gbps
    -   Each lab has minimum iCALL 11
    -   High speed server, Backup server
    -   Firewall
    -   Data Storage (take the service from the Cloud)
    -   Fiber optics

- Internet service provider in Malaysia
- IP service from network

6. What is the budget for this project?
   - RM 2 million

Research

7. Which of the application architectures is better to provide interaction between user and application?

- Client - server architecture
  - always-on host called server which has a fixed and permanent IP address and serves the request from many others hosts.
  - Clients won't communicate directly with each other but it may connect intermittently.
  - Clients have dynamic IP address

- Peer-to peer architecture
  - No always-on server
  - Communicate directly with peers but the communication is not passing through server
  - Peers controlled by desktops and PC
  - Are intermittently connected and IP address will change

8. Is the firewall a crucial element for the network setup? What is the purpose of a network firewall?

  ● It is crucial to help build a security system for the building. A building without a security system will open the doors to security threats. A firewall maintains distance to keep destructive threats out of the reach of the system. Firewall controls the incoming and outgoing network signals based on the monitored security parameters set by the software administrators. Fully functional firewalls can prevent unauthorized access to computers and networks. It protects data of a company or organization falling into the hands of wrong individuals and provides extra protection against viruses and malware. Firewall can sense and detect if there are any kind of malicious threats that are trying to enter the network and block the movement of the malicious threat.

9. How do you sustain the engagement of a network?

  ● Engagement of the network can be sustained through several steps. One of it is by organizing the organizations into several small groups. It could lead to a more productive engagement between the group members to make it a successful discussion and getting the job done.

10. What types of cables do the building use and why does the building decide to use the stated cables?

  ● Fiber-Optic Cable. Because they're fast and designed for long-distance, high-performance data networking, and telecommunications.

11. There are many kinds of network devices such as routers, switches, and modems. These devices need to be able to support different configurations. So, what devices do you prefer we can have to support high performance?

- According to the findings, the client needs network devices such as routers, switches, and WIFI for both wired and wireless networks, particularly for the Video Conferencing room and IOT Lab , which require both wired and wireless networks. As a result, we aimed to have a few components to create the client a simple and reliable network. Modem, router, switches, and wires, for example. The modem connects networks, whereas the router establishes a network connecting computers. In a wired network, switches are used to link devices via Ethernet connections.
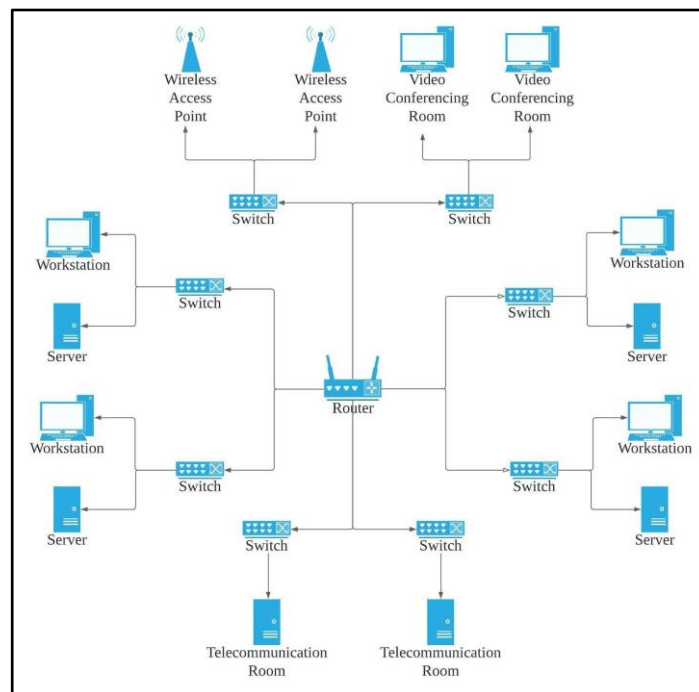
Feasibility

In our project, client-server architecture is used to connect the users together by using a shared database. This is because all the important information is stored in the same place, which can help administrators have complete control over the management and administration. Besides that, client-server architecture is also well protected because it can be enforced with access controls and can recover all the lost data. Moreover, this architecture makes it easy to expand resources without interruptions. Then, a firewall is installed to prevent the school's network from being open to threats and protect the computers and data from all kinds of malware and malicious threats such as Trojan. Fiber optic cables are used to provide high performance to the network. Telecommunication room is built for placing servers. Cloud storages are also provided for storing data with plenty of storage capacity that will not overload and increase the access time of the network.

TASK 3: CHOOSING THE APPROPRIATE LAN DEVICES

After conducting an interview and doing the research on the devices and system requirements, we are required to determine the suitable LAN devices for the network. Each device has its own price and the specification that we must consider. The price ranges and capabilities are different according to the brands of the system requirements such as Cisco, Huawei and Asus.

We researched the price range of online stores to compare prices so that we were able to choose the cheapest device. We also did research on the official product websites and determined the capabilities and specifications of the devices.

From the overall floor plan, there are two telecommunication rooms, two video conferencing rooms and four computer labs. Therefore, in order to connect the network to each other, there are a total of eight switches connected to a router. Two switches connect the router to the telecommunication rooms, one switch connects the router to two video conferencing rooms, four switches connect the router to the server and the end system and one switch connects two wireless access points. The table below is the list of the network devices.

Figure 2: Network Topology

DEVICES	DESCRIPTION	QUANTITY	PRICE PER UNIT (RM)	TOTAL PRICE (RM)
Router Model: **TP-Link AX5400 Dual-Band Gigabit Wi-Fi 6 Router Archer AX73** Dimensions (W×D×H): 272.5 × 147.2 × 49.2 mm	Standards Wireless: Wi-Fi 6 IEEE 802.11ax/ac/n/a 5 GHz IEEE 802.11ax/n/b/g 2.4 GHz WIFI Speed: AX5400 5 GHz: 4804 Mbps (802.11ax) 2.4 GHz: 574 Mbps (802.11ax) WIFI Features: OFDMA, MU-MIMO, Beamforming, WPA3, OneMesh Processor: 1.5GHz Triple-core CPU Ethernet Ports: 1 Gigabits WAN Port 4 Gigabits LAN Ports LAG available with 2 LAN Ports USB Port: 1 USB 3.0 Port	1	449	449
Switch Model: S3900-48T6S-R, 48-Port Gigabit Ethernet L2+ Fully Managed	Ports: 48x 10/100/1000BASE-T RJ45	6x 10G SFP+ Switching Capacity: 216 Gbps	6	1,854	11, 124

Switch, 48 x Gigabit RJ45, with 6 x 10Gb SFP+ Uplinks, Stackable Switch (Connect to computer labs and telecommunication rooms) 	Forwarding Rate: 162 Mbps RAM: 256 MB Flash Memory: 32 MB Packet Buffer: 1.5 MB MAC Address: 16,000 Airflow: Left to Right Jumbo Frame: 9,000 Number of VLANs: 4,000			
Switch Model: **S3900-24T4S-R, 24-Port Gigabit Ethernet L2+ Fully Managed Switch, 24 x Gigabit RJ45, with 4 x 10Gb SFP+ Uplinks, Stackable Switch, Fanless** (connect to wireless access point and video conferencing room)	Ports: 24x 10/100/1000BASE-T RJ45 | 4x 10G SFP+ Switching Capacity: 128 Gbps Forwarding Rate: 96 Mbps RAM: 256 MB Flash Memory: 32 MB Packet Buffer: 1.5 MB MAC Address: 16,000	2	1,329	2, 658

	Airflow: Left to Right Jumbo Frame: 9,000 Number of VLANs: 4,000			
Wireless Access Point Model: **TP-Link EAP225 V3	Omada AC1350 Gigabit Wireless Access Point	Business WiFi Solution w/ Mesh Support, Seamless Roaming & MU-MIMO	PoE Powered	SDN Integrated	Cloud Access & Omada App	White** 	Standards: IEEE 802.11ac, IEEE 802.11a/b/g/n Wireless Data Rates: AC1350 / Up to 1.35Gbps Frequency Band: 2.4 GHz / 5 GHz Antenna: 3 x Internal Omni 2.4 GHz: 4 dBi 5 GHz: 5 dBi Security: Captive Portal Authentication Access Control Wireless Mac Address Filtering Wireless Isolation Between Clients SSID to VLAN Mapping Rogue AP Detection 802.1X Support	2	699	1, 398

				Total	15, 629

Based on the floor plan, two video conferencing rooms are located on the first floor. The table below is the list of devices for the video conferencing room.

DEVICES	DESCRIPTION	QUANTITY	PRICE PER UNIT (RM)	TOTAL PRICE (RM)
Projector YABER Y31 Projector 	This projector is one of the best budget projectors. Not just that the projector is affordable but it is still a quality projector. It is still suitable for the video conferencing room due to its high resolution **Specifications**: ● Model: Y31 ● High Brightness: 7200 lumens ● Lamp type: LCD LED ● Native Resolution: 1920*1080P (Supported 4k UHD) ● Contrast Ratio: 10000: 1 ● Keystone Correction: ± 50° 4D (horizontal and vertical correction) ● Digital Zoom Range: -	2	1,186.88	2, 373.76

	25% ● Lamp Life:100000 hours. ● Aspect Ratio: 4: 3/16: 9 ● Sound: Built-in 5W dual stereo speakers. ● Screen Size: 50"-300" ● Dimension: 12(Width)*9((Depth) * 4.1(Height) inches ● Weight: 5.7 lb			
Screen Mdbebbron 120 inches 16:9 HD Foldable screen	A backdrop screen used to project images using a projector for better and clearer view. **Specifications**: ● Format: 16:9 HD ● Size: 120 inches ● Viewing Size: 104" * 58" ● Support: 160 viewing angle ● 1080 P Full HD	2	148.32	296.64

	● Front projector ● Rear projector ● Material: Polyester ● Weight: 11.2 Ounces			
Microphone VocoPro 12-Channel UHF Digital Wireless Conference System (900 MHz)	The 12-Channel UHF Digital Wireless Conference System from VocoPro is equipped: ● 12 Conference Microphones ● Has 12 Balanced XLR Outputs and 3 ¼ Mixed Outputs ● 3 4-channel receivers making it ideal for medium-sized audiences. ● The system operates in the 900 MHz frequency band, free from TV broadcast interference. ● It has 24-bit digital audio quality and a transmission range of up to 200' to deliver a clean, professional quality signal.	2	3,673.52	7, 347.04
Interactive Whiteboard	Vibe Smartboard 55' is an interactive whiteboard that can	2	12,704.28	25, 408.56

Vibe Smartboard 55″	transform any kind of room such as a conference room, classroom into a dynamic collaborative space. **Specifications:** i) <u>Panel</u> ● Diagonal Screen Size: 55" ● Optimum resolution: 3840(H) ● Brightness: 300-350 cd/m^2 ● Contrast Ratio (Typical): 1200 : 1 ii) <u>System</u> ● Chip System: Rockchip 3399 ● CPU: Dual-core Cortex-A72 up to 1.8GHz, Quad-core Cortex-A53 up to 1.4GHz. ● GPU: Mali-T864 GPU ● RAM: 4GB DDR3 ● Storage: 32GB EMMC ● Operating System: VibeOS Based on Android 7.1			

	iii) <u>Board</u> • Product Size: 50.6(Width)*29.1(Height)*2.9(Depth) in inches • Package size: 56.7(Width)*37(Height)* 9.1(Depth) in inches • Weight: 54.1 lb iv) <u>Touch</u> • Multi-Touch Technology: Infrared Touch • Refresh rate: 60Hz • Response Time: <7 ms v) <u>Connections</u> • HDMI: IN & OUT • USB: 2.0, 3.0 and Debug • Network: 2.4G/5G WIFI, Ethernet • Audio: 3.5 mm Audio out			

Video camera	Logitech C930e is an advanced HD 1080p webcam that delivers high-resolution video in virtually any kind of environment including low-light and harshly backlit settings.	2	575.49	1,150.98
Logitech C930e 	**Specifications**: ● Supported resolution: 1080p at 30 fps / 720p at 30 fps ● Diagonal field of view: 90 degrees ● OS Support: Windows 7 or later, Mac OS 10.7 or later, Chrome OS v. 29.0.1547.70 and higher ● CPU Minimum: 2.4-GHz Core 2 Duo ● RAM minimum (for 1080p streaming): 2GB ● Focus type: Autofocus ● Lens type: Glass ● Digital zoom: 4X ● Built-in mic: Stereo, dual omnidirectional ● Size: 3.7 x 2.8 x 1.7 inches ● Weight: 5.7 ounces			

	● Cable length: 5 feet USB-A			
			Total	36,576.98

For the second floor, there are four computer labs in this building such as general-purpose lab, computer security lab, IOT lab and network lab. The table below is the list of devices for computer labs.

DEVICES	DESCRIPTION	QUANTITY	PRICE PER UNIT (RM)	TOTAL PRICE (RM)
Server DELL OptiPlex 3080 Tower Desktop	Processor ● Acceleration Use Only Intel® Core™ i5-10505 Operating system ● Windows 10 Pro (Includes Windows 11 Pro License) English Video card ● Intel® Integrated	4	2908.18	11,632.72

	Graphics Memory ● 8GB ,1x8GB, DDR4 non ECC memory ● OptiPlex 3080 Tower with 260W up to 85% efficient Power Supply (80Plus Bronze) Hard drive ● M.2 256GB PCIe NVMe Class 35 Solid State Drive Dimension ● Width: 155 mm (6.1") ● Depth: 292 mm (11.5") ● Height: 324 mm (12.76")			
Workstation ThinkCentre M75t Gen 2	Processor ● Up to AMD Ryzen™ 7 PRO 4750G Operating System ● Up to Windows 10 Pro 64 Graphics ● AMD Radeon™	120	2093.20	251,184

	Vega Memory ● Up to 128GB DDR4 Connectivity ● WiFi 6 2 x 2 AX ● WiFi 5 2 x 2 AC ● Bluetooth® 5.0 Storage ● Dual storage: SSD + HDD ● Up to 1TB M.2 PCIe SSD ● Up to 2TB 7200rpm SATA HDD External Bay ● Slim optical disc drive				
Patch Panel PowerMAX 2U 48P Cat6 UTP Patch Panel 	● Support both T568A and T568B wiring scheme ● Meets and exceeds all current Cat6 standards ● Accepts 22~26AWG ● 1000Mbps Gigabit Ethernet ● Optional rear cable management	5	479	2395	

TRENDnet 8-Port Cat. 6 Unshielded Patch Panel	● 8 x Gigabit RJ-45 ports ● Designed for Category 6 cabling ● Supports a 250 MHz connection ● Cat. 6 color coded labeling for T568A ● and T568B wiring schemes	1	150.89	150.89
Monitor Dell 24 Monitor - SE2422H	Device Type ● LED-backlit LCD monitor - 24" Native Resolution ● Full HD (1080p) 1920 x 1080 at 75 Hz Color Support ● 16.7 million colors Screen Coating ● Anti-glare, 3H Hard Coating Dimensions (WxDxH) - with stand ● 55.264 cm x 17.881 cm x 42.025 cm Input Connectors ● HDMI, VGA	120	579	69,480

Screen BlitzWolf BW-VS5 100 inch Projection Screen 16:9 with Stable Stand 	Model ● BW-VS5 Viewing angle ● 160 ° Aspect ratio ● 100 Bracket material ● aluminum tube Material ● PVC Projection size ● 2214*1245mm Weight: net weight ● 2.9kg 4K Resolution ● Immerse yourself in extreme visual enjoyment with clear, vivid, and full HD image	2	201.30	402.60
Projector Weyon mini projector Portable LED 1080P 	Projector Features ● Portable Input Connectivity ● HDMI, USB, VGA Projector Type ● Home Use Resolution ● HD	2	319	638
Total				335,883.21

There are two telecommunication rooms in the building. The table below is the list of devices for telecommunication rooms.

DEVICES	DESCRIPTION	QUANTITY	PRICE PER UNIT (RM)	TOTAL PRICE (RM)
Storage server Model: **Cisco UCS S3260 Storage Server** 	Server Node: Dual 2-socket server nodes based on 2nd Gen Intel Xeon Scalable Intel Xeon Scalable processors with up to 48 cores per server node Storage: 1.5 TB of DDR4 memory per M5 server node 1 TB of Intel Optane™ DC Persistent Memory high-performance Nonvolatile Memory Express (NVMe) and flash memory Data Storage: Massive 840-TB Policy-based storage management framework for zero-touch capacity on demand I/O Controller: Dual-port 40-Gbps system I/O	2	14, 923	29, 846

	controllers with a Cisco UCS Virtual Interface Card 1300 platform embedded chip PCIe-based system I/O controller for Quad Port 10/25G Cisco VIC 1455 Dual Port 100G Cisco VIC 1495 Unified I/O for Ethernet or Fibre Channel to existing NAS or SAN storage environments Support for Cisco bidirectional transceivers, with 40-Gbps connectivity over existing 10-Gbps cabling infrastructure			
Firewall Model: **ASA5508-K9 ASA 5500-X Series Next-Generation Firewalls with firepower services**	Interface: 8x1 Gigabit Ethernet Interface 1 Management Port Stateful Inspection Throughput: 500 Mbps Maximum 3DES/AES VPN Throughput: 175 Mbps IPsec site-to-site VPN peers: 100 VLANs: 50 Memory: 8 GB Flash: 8GB	2	5, 562	11, 124

| Backup Software

Brand: **Acronis**

Acronis | Provide disaster recovery by storing backups in data centers

Support back up of disks, partitions, servers, data and mobile devices.

Provide recovery of files, folders, applications, or entire system

Provide full image and mirror image backup, capturing a replica of the system disk or selected partition

Able to optimize disk usage and protect data

Provide ransomware protection, detecting suspicious changes to data, backup files and backup application | 1 | 396 per year | 396 |
| | | | **Total** | 41, 366 |

Besides the devices, when interconnecting various devices on the network, cabling and connectivity is important. The table below is the list of cables used in the building.

CABLE TYPE	DESCRIPTION	QUANTITY / LENGTH	PRICE PER UNIT (RM)	SUBTOTAL (RM)
Fiber Optic Patch Cable Laser-Optimized Multimode	● Connector Type: LC UPC to SC UPC ● Fiber Mode: OM4 50µ - Multimode 10Giga/550m optimized Cables ● Cable Jacket: PVC (OFNR) 2.0mm ● Color: Aqua ● Data Rate: 10GB @ 850nm ● Distance: Up to 550 meters ● Able to run 100GB up to 150 meters utilizing a MPO connector ● Applications: High-Speed Networks – Data Centers, Financial Centers & Corporate Campuses	207m x 10	RM61/ 10m	12 627
Keystone SC Simplex Multimode OM3 / OM4 Fiber Optic Keystone	● Simplex SC to Simplex SC ● Multimode (OM2, OM3, OM4) compatible ● High precision ceramic sleeve ● For UPC polish type cables	168	11	1 848

	• Low insertion loss • White keystone color • Snap-in design			
Faceplate SC Simplex Fiber Optic Faceplate	• Connector type: SC Fiber OpticSurface: Flat • Material: Plastic • Dimensions: 86mmx86mm • Ports: SC Simplex	168	8.90	1 495.20
			TOTAL	RM 15 970.20

The total price of the devices are RM445 425.39.

After research, we found that the price of network equipment was higher than our expectations. We think that with the advancement of technology and the widespread use of the network, the price of networking devices will be cheaper, but this is not the case. However, we also found that the price is based on the specifications of the device. High price of the devices will provide users with a greater performance. Therefore, it can handle the system better due to its better processing power.

After research, we have considered cost as a factor for choosing networking devices. This is because we must determine the devices based on the budget provided. Hence, it is important for us to look for cost-effective devices.

As we mentioned before, the price ranges and capabilities are different according to the brands of the system requirements such as Cisco, Huawei and Asus. Hence, the tables below are the comparison of the differences between the same devices from different brands.

Routers

BRAND	CISCO	NIGHTHAWK	TP-Link
Model	Cisco RV160W VPN Router	NIGHTHAWK RAX20 DUAL-BAND AX4 WIFI 6 ROUTER - AX1800	TP-Link AX5400 Dual-Band Gigabit Wi-Fi 6 Router Archer AX73
Ports	4 Wireless Port	1 Gigabit WAN Port 4 Gigabit LAN Ports	1 USB 3.0 Port 4 Gigabit LAN Ports 1 Gigabit WAN Port
Forwarding Rate	825 Mbps	1200 Mbps	5400 Mbps
Firewall Protection	SPI (Stateful Packet Inspection) Firewall Port-Forwarding and Triggering DoS (Denial of Service prevention)	AES (Advanced Encryption Standard) encryption with PSK (Pre-Shared Key)	TP-Link HomeShield
RAM	Not Applicable		512 MB
Price	655	701	449

Switches

BRAND	CISCO	TP-LINK	DELL
Model	SG250-50HP 50-Port Gigabit PoE Smart Switch	SMB JETSTREAM 28-PORT GIGABIT SFP L2 MANAGED SWITCH	EMC POWER SWITCH N1148T-ON 48G C/W 2 SFP SWITCH
Ethernet Ports	48 x 10/100/1000, 2 x Gigabit SFP/RJ-45	24 x 10/100/1000 Mbps RJ45 Ports	48 x 10/ 100/ 1000Mbps half/ full duplex RJ45 ports
Forwarding Capacity	100 Gbps	95.2 Mpps	132 Mpps
Price	RM 4,262.00	RM 3,300.00	RM 3,550.00

Server

BRAND	DELL	LENOVO	FUJITSU
Model	Dell Poweredge T30 Mini tower Server, Xeon E3-1225 v5 3.3 GHz, 1TB HDD, 8GB RAM, N0 OS	Lenovo ThinkServer TS150 Tower Server, Xeon E3-1225 v6 3.3GHz, 8GB RAM, 2x 1TB HDD, No OS	Fujitsu Primergy TX1310 M1 - Tower - Xeon E3-1226V3 3.3 GHz - 8 GB - HDD 2 x 1 TB

Power	290W	Fixed 250W Bronze	250 W
Processor	1 processor from the following product families: ● Intel Xeon processor E3-1225 v5 ● Intel Pentium G4400	Processors such as below: ● One Intel Xeon Processor E3-1200 v6 Series ● Core i3 Pentium ● Celeron up to 8MB	Processors such as below: ● CPU: Intel Xeon E3-1226V3 / 3.3 GHz
Memory	Architecture: 4 DIMM slots Maximum RAM: up to 64GB DDR4 2133MT/s	1x8GB UDIMM DDR4-2400ECC	Installed number: 8GB/ 32GB (Max) Technology: DDR3 SDRAM - ECC
Slots	4 slots: ● 1 PCIe x16 3.0 ● 1 PCIe x16 3.0 (x4 speed) ● 1 PCIe x4 3.0 ● 1PCI	● 4 PCIe 3.0 slots: x16/x16, x16/x4, x1/x1, x1/x1 (open end) ● 1 x PCIe 3.0: HL/FH: x16/x4	● 1 (total) / 0 (free) x CPU ● 4 (total) / 3 (free) x memory ● 2 (total) / 2(free) x PCIe 3.0 x8 ● 1 (total) / 1

		● 1 x PCIe 3.0: HL/FH: x1	(free) x PCIe 2.0 x4 (1x mode) ● 1 (total) / 1 (free) x PCIe 2.0 x8 (x4 mode)
Operating System	● Microsoft Windows Server 2012 ● Microsoft Windows Server 2012 R2 ● Red Hat Enterprise Linux ● Ubuntu 14.04 / 16.04	● Microsoft Windows Server 2016 ● Microsoft Windows Server 2012 R2 ● VMware Vsphere (ESXi) ● Red Hat Enterprise Linux Server ● Client (Microsoft Windows 10)	● Software: ServerView
Price (RM)	2,780.00	4,099.00	8,391.64

Wireless Access Point

BRAND	TP-LINK	HUAWEI	CISCO
Model	TP-Link Archer C80 AC1900 Wireless MU-MIMO Wi-Fi Router	Huawei Ax2 Pro WiFi 6 Router 5G Dual Band	Cisco Business 240AC Dual-Band Wireless Access Point

Wi-Fi Speed	1300Mbps at 5GHz + 600Mbps at 2.4GHz	2.4 GHz	2.4 GHz / 5 GHz (Dual-Band)
Ports	1× Gigabit WAN Port 4× Gigabit LAN Ports	4	2 x 10/100/1000 Mb/s Gigabit Ethernet (RJ45) (Uplink) PoE 1 x Ethernet (RJ45) (Console)
Price (RM)	199.00	275.27	673.77

TASK 4: MAKING THE CONNECTIONS - LAN AND WAN

WORK AREA
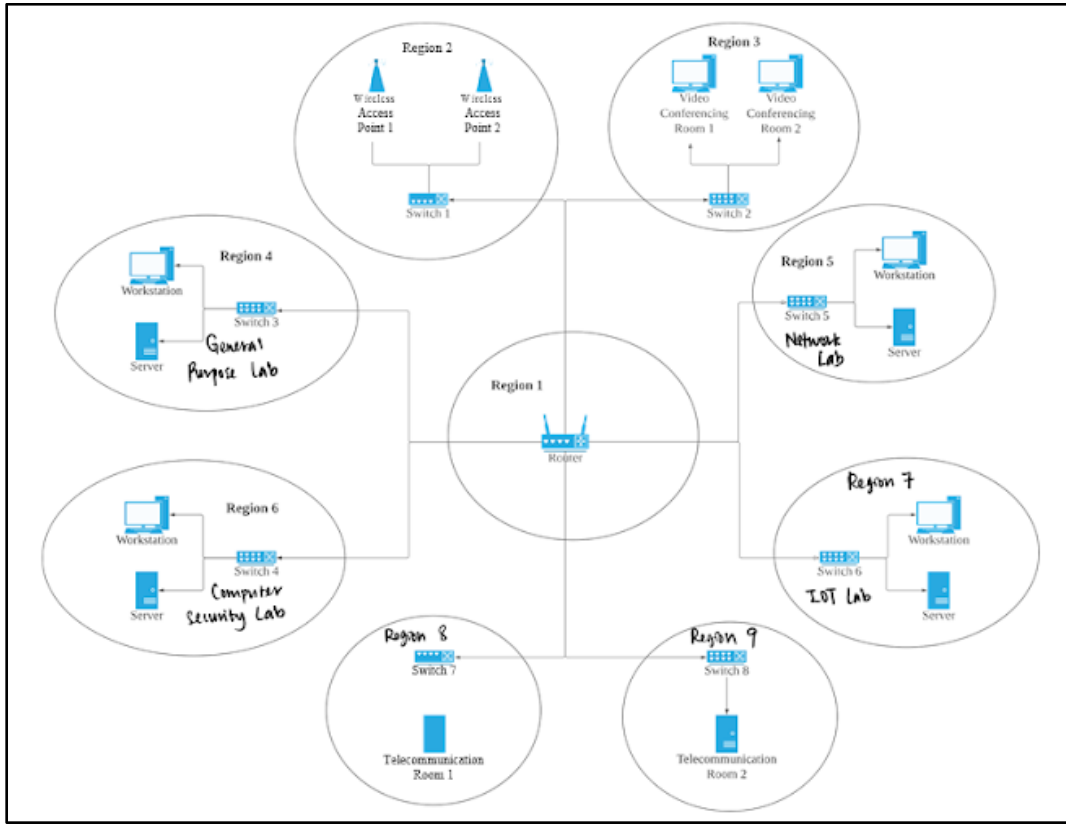
Figure 3: Work Area

Work area had been divided into 9 regions.

Region 1: A router connects to 8 switches.

Region 2: Switch 1 is connected to wireless access point 1 and wireless access point 2.

Region 3: Switch 2 is connected to video conferencing room 1 and video conferencing 2.

Region 4: Switch 3 is connected to the 31 end devices in the General-Purpose Lab.

Region 5: Switch 5 is connected to the 31 end devices in the Network Lab.

Region 6: Switch 4 is connected to the 31 end devices in the Computer Security Lab.

Region 7: Switch 6 is connected to the 31 end devices in the IOT Lab.

Region 8: Switch 7 is connected to the telecommunication room 1.

Region 9: Switch 8 is connected to the telecommunication room 2.

CONNECTION

Region	Number of connections	Description
1	8	Connection 1 – Link Router to Switch 1
		Connection 2 – Link Router to Switch 2
		Connection 3 – Link Router to Switch 3
		Connection 4 – Link Router to Switch 4
		Connection 5 – Link Router to Switch 5
		Connection 6 – Link Router to Switch 6
		Connection 7 – Link Router to Switch 7
		Connection 8 – Link Router to Switch 8
2	2	Connection 9 – Link Switch 1 to ISP 1
		Connection 10 – Link Switch 1 to ISP 1
3	2	Connection 11 – Link Switch 2 to personal computer in Video Conferencing Room 1
		Connection 12 – Link Switch 2 to to personal computer in Video Conferencing Room 2
4	31	Connection 13 to 43 – Link Switch 3 to 30 workstations in General Purpose Lab.
		Connection 44 – Link Switch 3 to the server in General Purpose Lab.
5	31	Connection 45 to75 – Link Switch 5 to 30 workstations in Network Lab.
		Connection 62 – Link Switch 5 to the server in Network Lab.

6	31	Connection 63 to 93 – Link Switch 4 to 30 workstations in Computer Security Lab.
		Connection 94 – Link Switch 4 to the storage server in Computer Security Lab
7	31	Connection 95 to 125 – Link Switch 6 to 30 workstations in IoT Lab.
		Connection 126 to 156 – Link Switch 6 to the server in IoT Lab.
8	1	Connection 127 – Link Switch 7 to Telecommunication Room 1.
9	1	Connection 128 – Link Switch 8 to Telecommunication Room 2.

SWITCH PORT

Switches	Quantity	Description
48 Port switch	6	- 30 workstations and 1 server in General Purpose Lab. 31 switches in use and 17 switches in access. - 30 workstations and 1 server in Network Lab. 31 switches in use and 17 switches in access. - 30 workstations and 1 server in Computer Security Lab. 31 switches in use and 17 switches in access. - 30 workstations and 1 server in IoT Lab. 31 switches in use and 17 switches in access. - Switch located in Telecommunication Room 1 on the first floor. - Switch located in Telecommunication Room 2 on the first floor.
24 Ports switch	2	- Switch located in the Server room on the first floor. It is the center that connects the Wireless Access Point 1 & 2. - Switch located in the Server room on the first

		floor. It is the centre that connects the Video Conferencing Room 1 & 2.

CABLING

i. Overall Building

First Floor
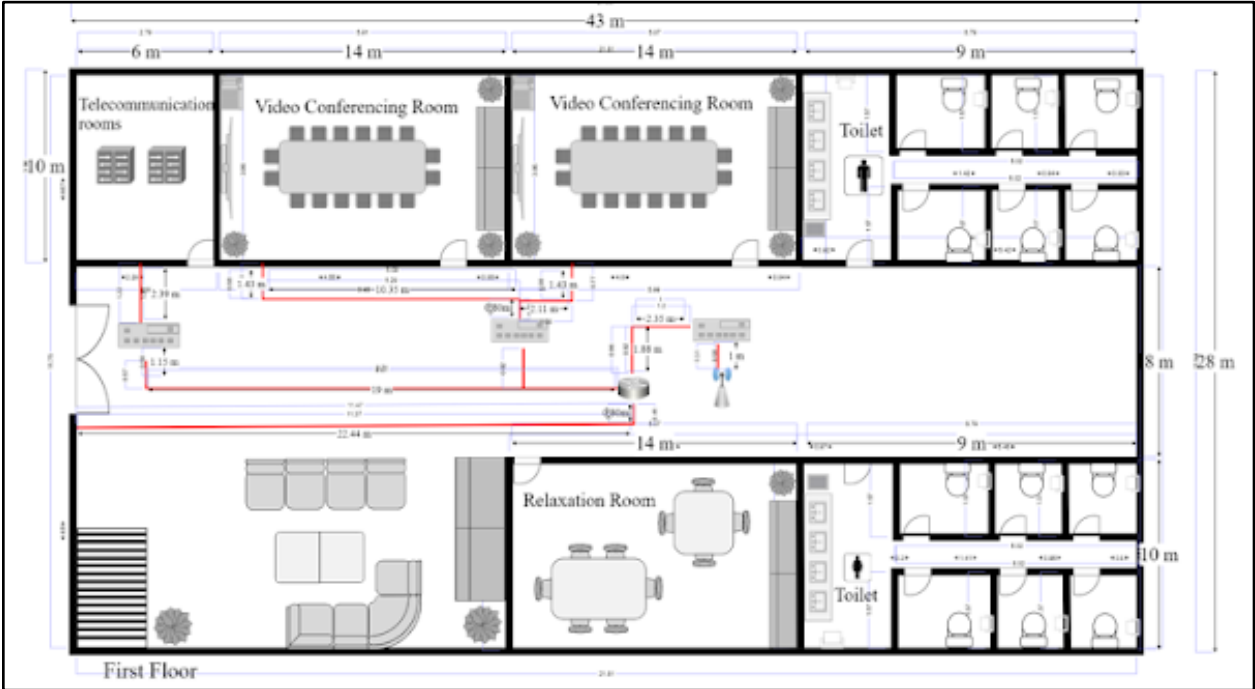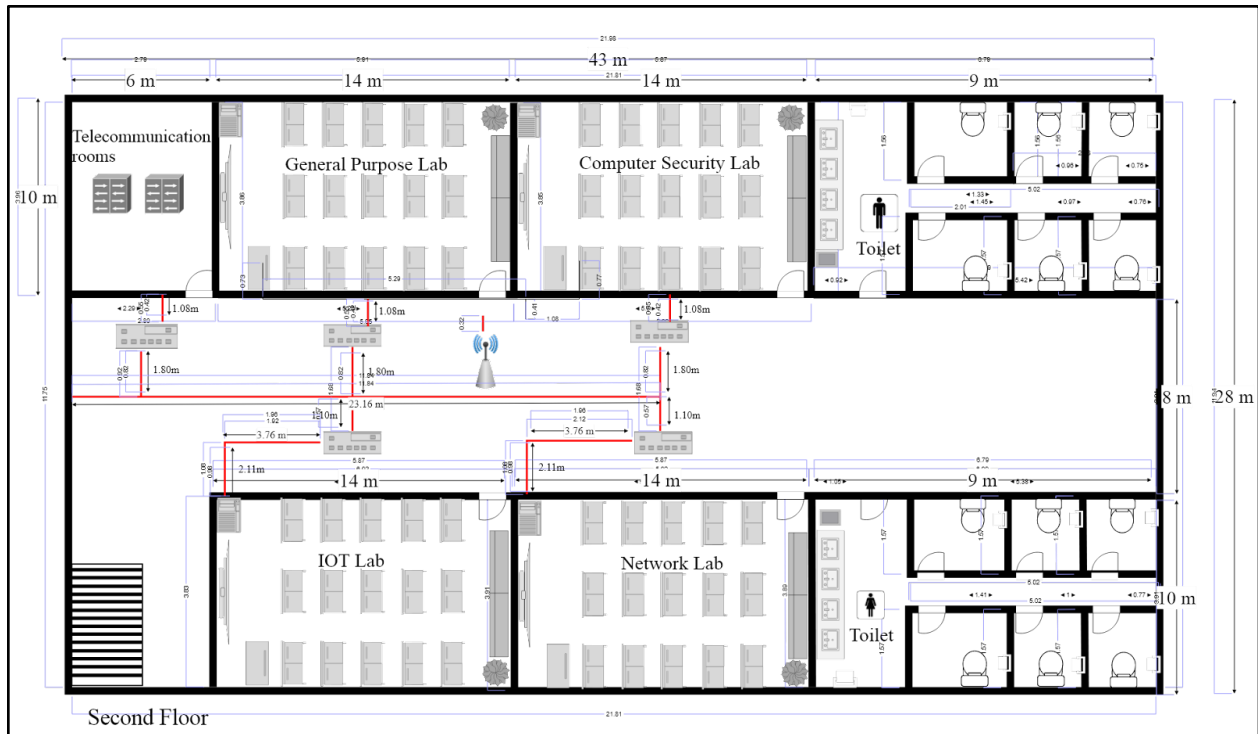
Figure 4&5: Horizontal and vertical cabling with the measurement
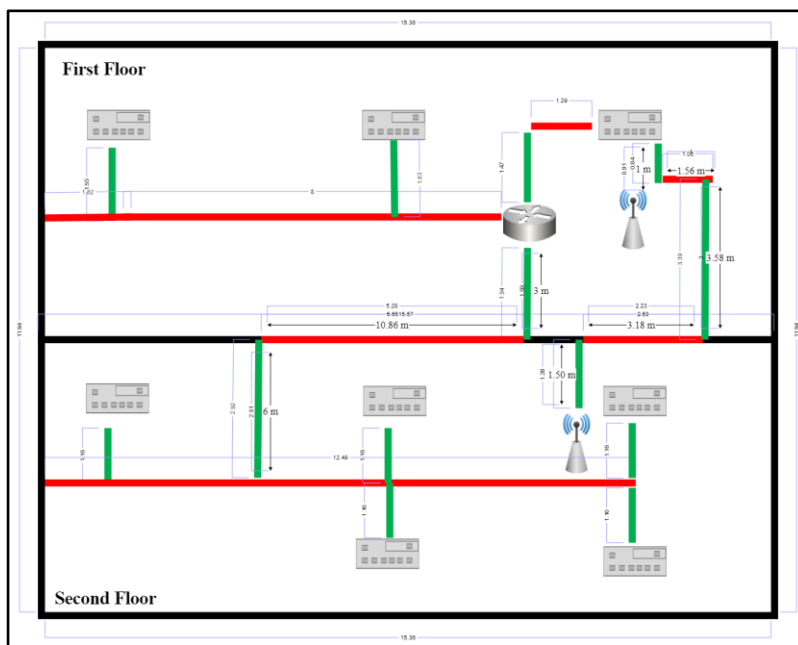
Figure 6: Horizontal and vertical cabling

We are using fiber optic cable for the cabling for the overall building. Red line represents horizontal cabling while the green light cable represents vertical cabling.

Assumptions   made   for   the   building:

`1. The height of each floor is 6m.

2. The fiber optic cable will be extended to the ground of the first floor and the ground of the second floor.

Total length of the fiber optic cable in first floor =
$$(2.39+2(1.43)+10.35+2.11+0.80+2(1.15)+1.88+1+19+22.44)m = 65.13 \text{ m}$$

Total length of the fiber optic cable in second floor =
$$(3(1.08)+3(1.80)+23.16+2(1.10)+2(3.76)+2(2.11))m = 45.74 \text{ m}$$

Total Length of fiber optic cable for the connection between switch and wireless access point in second floor = $(1+1.56+3.58+3.18+1.5+3+10.86+6)m = 30.68m$

Total length of the fiber optic cable used = 65.13m + 45.74 m + 30.68m = 141.55 m

ii.   Video Conferencing Room
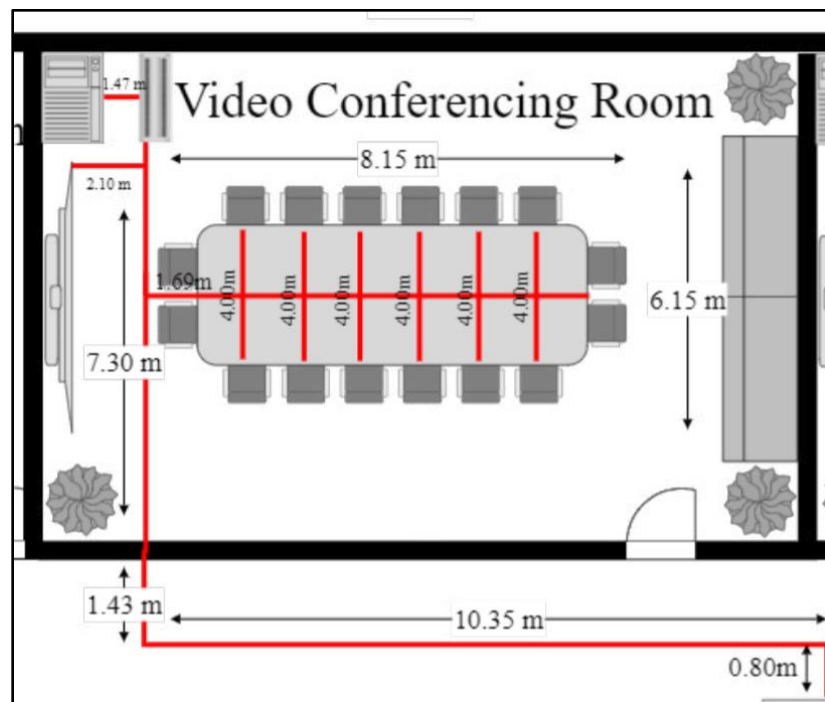
Figure 7: Cabling of Video Conferencing Room

Explanation: One 48-Port Gigabit Ethernet L2+ Fully Managed Switch will be used in the video conferencing room. Each room has one projector, which is the YABER Y31 Projector. Each video conference room will be equipped with a single 120-inch 16:9 HD Foldable screen from Mdbebbron. Server DELL OptiPlex 3080 Tower Desktop is one of the servers available. VocoPro 12-Channel UHF Digital Wireless Conference System will also be equipped with a microphone (900 MHz). Each conferencing room will also include a Vibe Smartboard 55″ Interactive whiteboard. Finally, each conferencing room will be equipped with a video camera, which will be a Logitech C930e model.

Total length of the fiber optic cables used in Video Conferencing Room:

1.47 + 2.10 + 7.30 + 1.43 + 10.35 + 8.15 + 0.80 + 1.69 + 14(4.00) = 89.29 m

---

iii.   General Purpose Lab
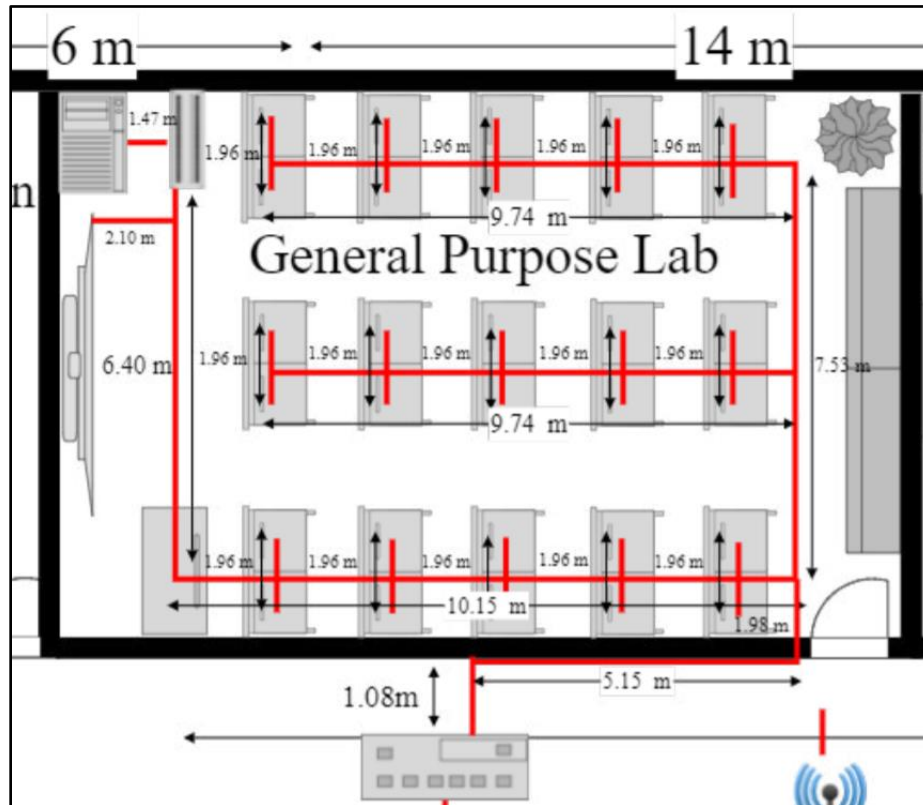
Figure 8: Cabling of General-Purpose Lab

Explanation: One 48-Port Gigabit Ethernet L2+ Fully Managed Switch will be provided for the general use lab. The General-Purpose Lab is equipped with 30 ThinkCentre M75t Gen 2 workstations and 30 DELL 24 Monitor displays. Server DELL OptiPlex 3080 Tower Desktop is the only server in the General-Purpose Lab. In the General-Purpose Lab, one 48-port Cat6 UTP Patch Panel is used. In the General-Purpose Lab, there are 17 faceplates. On the floor, all of the faceplates will be installed. 1 BlitzWolf BW-VS5 100-inch Projection Screen 16:9 with Stable Stand Screen and 1 Weyon tiny projector Portable LED 1080P are available in the General-Purpose Lab.

Total length of the fiber optic cables used in General Purpose Lab:

$(1.47 + 2.10 + 6.40 + 10.15 + 8.43 + 13.45 + 2.11 + 3.76 + 2(9.74) + 15(1.96))$ m $= 96.75$ m

---

iv.   **Network Lab**
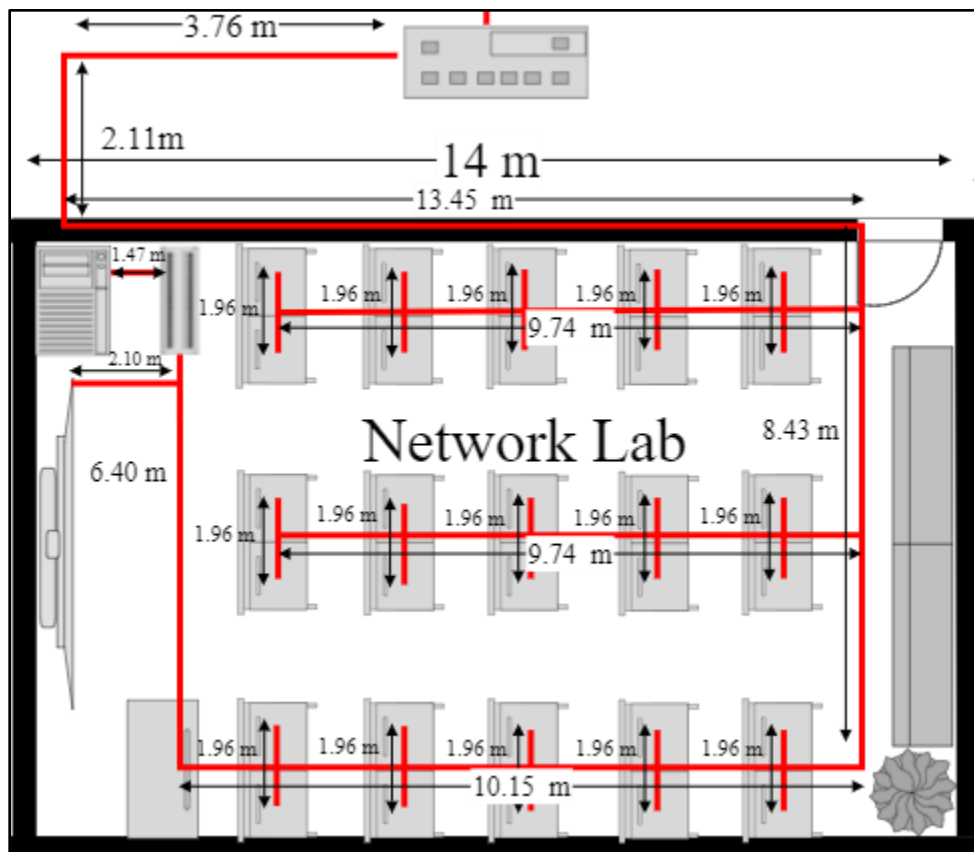
Figure 9: Cabling of Network Lab

Explanation: For Network Lab, there will be one 48-Port Gigabit Ethernet L2+ Fully Managed Switch. There are 30 workstations of model ThinkCentre M75t Gen 2 and 30 monitors of the model DELL 24 Monitor in the Network Lab. In the Network Lab, there is 1 server which is Server DELL OptiPlex 3080 Tower Desktop. 1 48-port Cat6 UTP Patch Panel is used in the Network Lab. There are 17 faceplates in the Network Lab. All the faceplates will be equipped on the floor. In Network Lab, there are 1 BlitzWolf BW-VS5 100-inch Projection Screen 16:9 with Stable Stand Screen and 1 Weyon mini projector Portable LED 1080P.

Total length of the fiber optic cables used in Network Lab:

$(1.47 + 2.10 + 6.40 + 10.15 + 8.43 + 13.45 + 2.11 + 3.76 + 2(9.74) + 15(1.96))$ m = 96.75 m

v.   Computer Security Lab
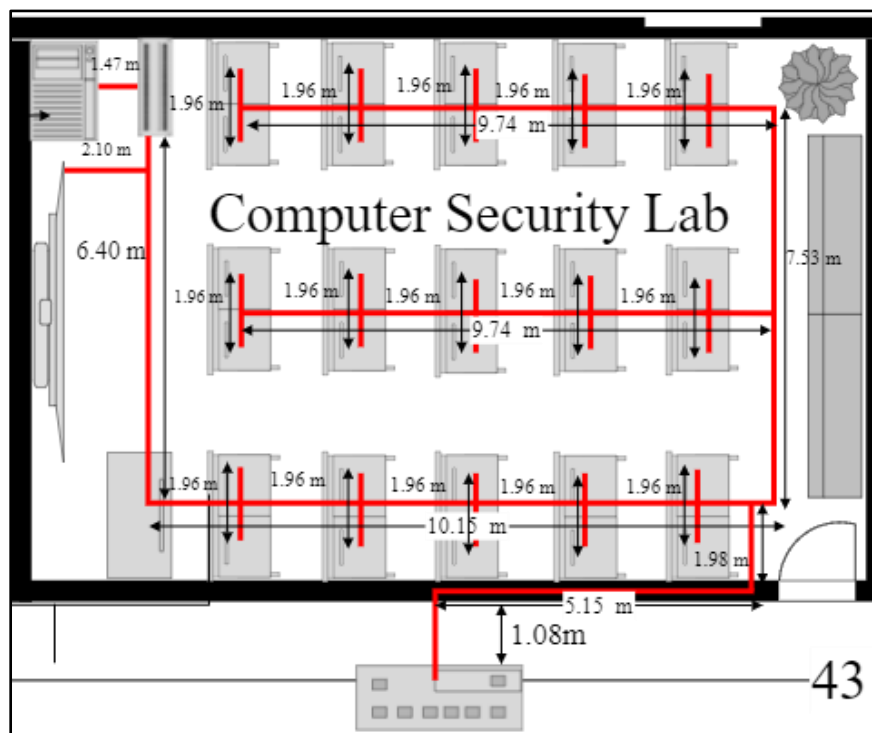
Figure 10: Cabling of Computer Security Lab

Explanation: For Computer Security Lab, there will be one 48-Port Gigabit Ethernet L2+ Fully Managed Switch. There are 30 workstations of model ThinkCentre M75t Gen 2 and 30 monitors of the model DELL 24 Monitor in the Computer Security Lab. In the Computer Security Lab, there

is 1 server which is Server DELL OptiPlex 3080 Tower Desktop. 1 48-port Cat6 UTP Patch Panel is used in the Computer Security Lab. There are 17 faceplates in the Computer Security Lab. All the faceplates will be equipped on the floor. In Computer Security Lab, there are 1 BlitzWolf BW-VS5 100-inch Projection Screen 16:9 with Stable Stand Screen and 1 Weyon mini projector Portable LED 1080P.

Total length of the fiber optic cables used in Computer Security Lab:

(1.47 + 2.10 + 6.40 + 10.15 + 1.08 + 5.15 + 1.98 + 7.53 + 2(9.74) + 15(1.96)) m = 84.74 m

---

vi.   IOT Lab
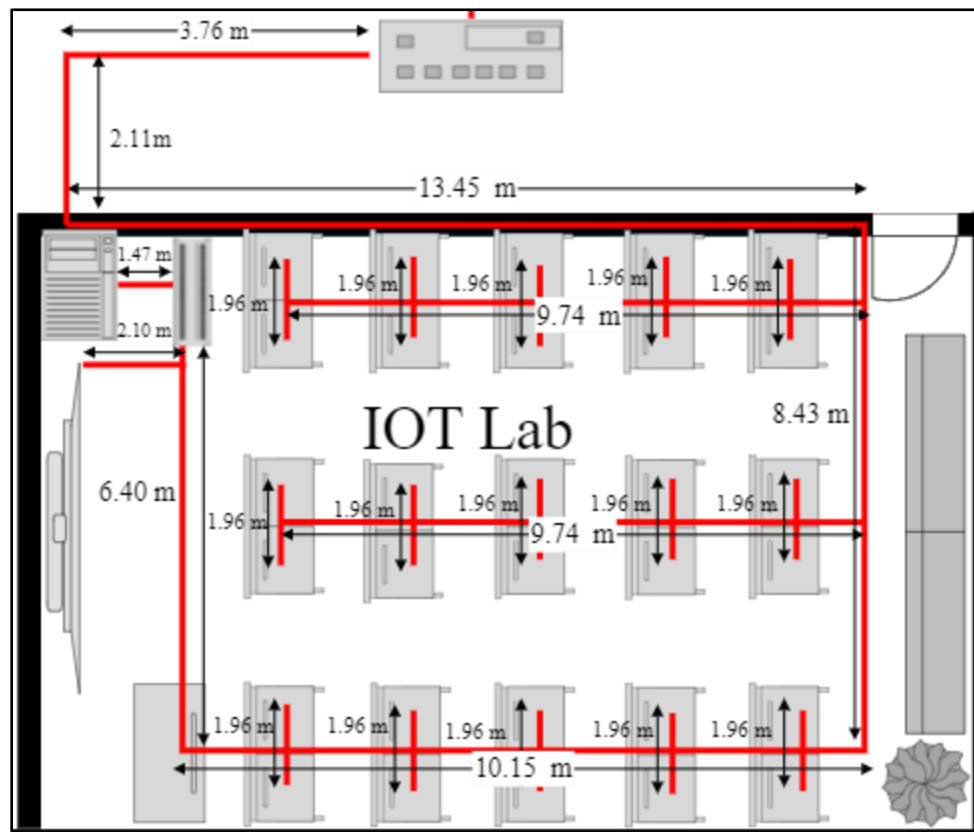
Figure 11: Cabling of IOT Lab

Explanation: For IOT Lab, there will be one 48-Port Gigabit Ethernet L2+ Fully Managed Switch. There are 30 workstations of model ThinkCentre M75t Gen 2 and 30 monitors of the model DELL

24 Monitor in the IOT Lab. In the IOT Lab, there is 1 server which is Server DELL OptiPlex 3080 Tower Desktop. 1 48-port Cat6 UTP Patch Panel is used in the IOT Lab. There are 17 faceplates in IOT Lab. All the faceplates will be equipped on the floor. In IOT Lab, there are 1 BlitzWolf BW-VS5 100-inch Projection Screen 16:9 with Stable Stand Screen and 1 Weyon mini projector Portable LED 1080P.

Total length of the fiber optic cables used in IOT Lab:

(1.47 + 2.10 + 6.40 + 10.15 + 8.43 + 13.45 + 2.11 + 3.76 + 2(9.74) + 15(1.96)) m = 96.75 m

---

vii. Telecommunication Room
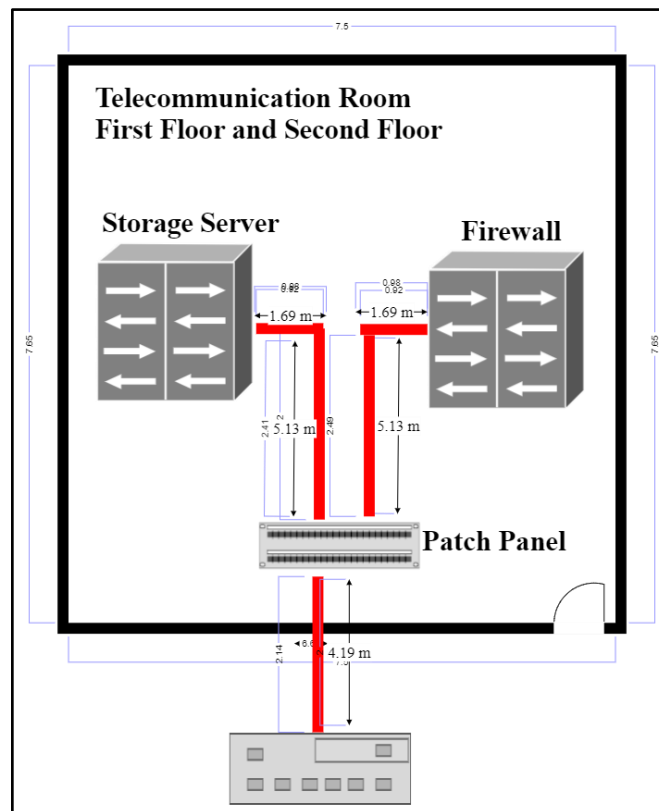
Figure 12: Cabling of Telecommunication Rooms

> **Total length of the fiber optic cables used in Telecommunication Room :**
>
> 2(4. 19+2(5.13)+2(1.69))m = 17.83 m

TOTAL CABLING

Total Fiber Optic Cable used to make patch cord

= 3 meter * 156

= **468 Meters**

Total Fiber Optic Cable Cable needed for the horizontal cabling

= Length of Fiber Optic in First Floor + Length of Fiber Optic in Second Floor

=(354 + 1314) m

= 1668m

Total Fiber Optic needed the entire building

= Total Fiber Optic used to make patch cord + Total fiber Optic needed for the vertical cabling +

Total Fiber optic needed for the horizontal cable

= (468 + 72 + 1668) m

= 2208 m

= 7254 Feet

Here is the summarized table for its total length and cost:

Types of Cabling	Length of Cat6 Ethernet Cable	Cost of Cat6 Ethernet Cable (305m/Box)
(For Patch Cord)	468	2 * RM380.00 =RM760.00
Vertical Cabling	(Ground floor + First Floor + Height of Ground Floor) =(30+34+4+4)m =72m	1 * RM380.00 = RM380.00
Horizontal Cabling	(Ground floor + first floor) = (354 + 1314)m = 1668m	6 * RM380.00 = RM2280.00
Total	2208m (7245 feet)	RM3420.00

TASK 5: IP ADDRESSING

1.   CALCULATING IP ADDRESS

Each lab consists of 30 workstations for students, 1 workstation for the lecturer, 1 server and 1 screen. Hence, in every lab, there will be an IP address for 33 end devices. Besides that, each video conferencing room consists of 13 end devices, 1 server and 1 screen. Hence, in every video conferencing room, there will be an IP address for 15 end devices. Furthermore, there are 2 telecommunication rooms. Each telecommunication room consists of 2 servers. Hence, in every telecommunication room, there will be an IP address for 2 end devices. WAN networks also need to be included because WAN is important for users to communicate.

Calculations:

1. Students

    There are around 400 students.

    $2^n > 400$

    $n \log 2 > \log 400$

    $n > \log 400 \, / \log 2$

    $n > 8.64$ (2 decimal place)

    $n \approx 9$

    $32 - 9 = 23$ bits

Hence, we can conclude that there are 23 bits in the network portion and 9 bits in the host portion. Subnet address is 192.19.0.0/23.

	192. 19. 0000 0000. 0000 0000
AND	255.255. 1111 1110. 0000 0000
	192. 19. 0000 0000. 0000 0000

Network address = 192.19.0.0

Broadcast address = 192.19.1.255

Usable IP address from 192.19.0.1 to 192.19.1.254

2. Lecturer

There are around 30 lecturers.

$2^n > 30$

n log 2 > log 30

n > log 30 / log 2

n > 4.91 (2 decimal places)

n ≈ 5

32 - 5 = 27 bits

Hence, we can conclude that there are 27 bits in the network portion and 5 bits in the host portion. Subnet address is 192.19.2.0/27.

192. 19. 0000 0010. 0000 0000

AND   255.255. 1111 1111. 1110 0000

192. 19. 0000 0010. 0000 0000

Network address = 192.19.2.0

Broadcast address = 192.19.2.31

Usable IP address from 192.19.2.1 to 192.19.2.30

3. Server

There are around 10 servers.

$2^n > 10$

n log 2 > log 10

n > log 10 / log 2

n > 3.32 (2 decimal places)

n ≈ 4

32 - 4 = 28 bits

Hence, we can conclude that there are 28 bits in the network portion and 4 bits in the host portion. Subnet address is 192.19.2.32/28.

192. 19. 0000 0010. 0010 0000

AND 255.255. 1111 1111. 1111 0000

192. 19. 0000 0010. 0010 0000

Network address = 192.19.2.32

Broadcast address = 192.19.2.47

Usable IP address from 192.19.2.33 to 192.19.2.46

4. Screen

There are around 6 screens.

$2^n > 6$

n log 2 > log 6

n > log 6 / log 2

n > 2.58 (2 decimal places)

n ≈ 3

32 - 3 = 29 bits

Hence, we can conclude that there are 29 bits in the network portion and 3 bits in the host portion. Subnet address is 192.19.2.48/29.

$$192.\ 19.\ 0000\ 0010.\ 0011\ 0000$$

AND $\underline{255.255.\ 1111\ 1111.\ 1111\ 1000}$

$\underline{192.\ 19.\ 0000\ 0010.\ 0011\ 0000}$

Network address = 192.19.2.48

Broadcast address = 192.19.2.55

Usable IP address from 192.19.2.49 to 192.19.2.54

5. WAN

There are around 10 WANs.

$2^n > 10$

n log 2 > log 10

n > log 10 / log 2

n > 3.32 (2 decimal places)

n ≈ 4

32 - 4 = 28 bits

Hence, we can conclude that there are 28 bits in the network portion and 4 bits in the host portion. Subnet address is 192.19.3.0/28.

$$192.\ 19.\ 0000\ 0011.\ 0000\ 0000$$

AND $\underline{255.255.\ 1111\ 1111.\ 1111\ 0000}$

$\underline{192.\ 19.\ 0000\ 0011.\ 0000\ 0000}$

Network address = 192.19.3.0

Broadcast address = 192.19.3.15

Usable IP address from 192.19.3.1 to 192.19.3.14

6. Router

There are 4 routers used in the setup.

$2^n > 4$

n log 2 > log 4

n > log 4 / log 2

n > 2

n ≈ 2

32 - 2 = 30 bits

Hence, we can conclude that there are 30 bits in the network portion and 2 bits in the host portion. Subnet address is 192.19.3.16/30.

```
        192. 19.  0000 0011.  0001 0000
AND     255.255. 1111  1111.  1111 1100
        192. 19.  0000 0011.  0001 0000
```

Network address = 192.19.3.16

Broadcast address = 192.19.3.19

Usable IP address from 192.19.3.17 to 192.19.3.18

7. Wireless Access Point

There are 4 wireless access points.

$2^n > 4$

n log 2 > log 4

n > log 4 / log 2

n > 2

n ≈ 2

32 - 2 = 30 bits

Hence, we can conclude that there are 30 bits in the network portion and 2 bits in the host portion. Subnet address is 192.19.4.0/30.

$$192.\ 19.\ 0000\ 0011.\ 0000\ 0100$$
$$\textbf{AND}\quad \underline{255.255.\ 1111\ 1111.\ 1111\ 1100}$$
$$\underline{192.\ 19.\ 0000\ 0011.\ 0000\ 0100}$$

Network address = 192.19.4.0

Broadcast address = 192.19.4.7

Usable IP address from 192.19.4.1 to 192.19.4.6

Network	Subnet Address	Host Address Range	Broadcast Address
Student	192.19.0.0/23	192.19.0.1 to 192.19.1.254	192.19.1.255
Lecturer	192.19.2.0/27	192.19.2.1 to 192.19.2.30	192.19.2.31
Server	192.19.2.32/28	192.19.2.33 to 192.19.2.46	192.19.2.47
Screen	192.19.2.48/29	192.19.2.49 to 192.19.2.54	192.19.2.55
WAN	192.19.3.0/28	192.19.3.1 to 192.19.3.14	192.19.3.15
Router	192.19.3.16/30	192.19.3.17 to 192.19.3.18	192.19.3.19
Wireless Access Point	192.19.4.0/30	192.19.4.1 to 192.19.4.6	192.19.4.7

2. ASSIGNING IP ADDRESS

2.1. First Floor

Device Name	Server IP address
Router	192.19.3.17

Telecommunication Room 1

Device Name	Server IP address
Server 1	192.19.2.33
Server 2	192.19.2.34

Video Conferencing Room 1

Device Name	Server IP address
Server 3	192.19.2.35

Device Name	Server IP address
Screen 1	192.19.2.49

Device Name	Lecturer IP address
PC1	192.19.2.1

Device Name	Student IP address
PC2	192.19.0.1
PC3	192.19.0.2
PC4	192.19.0.3
PC5	192.19.0.4

PC6	192.19.0.5
PC7	192.19.0.6
PC8	192.19.0.7
PC9	192.19.0.8
PC10	192.19.0.9
PC11	192.19.0.10
PC12	192.19.0.11
PC13	192.19.0.12

Video Conferencing Room 2

Device Name	Server IP address
Server 4	192.19.2.36

Device Name	Server IP address
Screen 2	192.19.2.50

Device Name	Lecturer IP address
PC14	192.19.2.2

Device Name	Student IP address
PC15	192.19.0.13
PC16	192.19.0.14
PC17	192.19.0.15
PC18	192.19.0.16
PC19	192.19.0.17
PC20	192.19.0.18

PC21	192.19.0.19
PC22	192.19.0.20
PC23	192.19.0.21
PC24	192.19.0.22
PC25	192.19.0.23
PC26	192.19.0.24

2.2.   Second Floor

Telecommunication Room 2

Device Name	Server IP address
Server 5	192.19.2.37
Server 6	192.19.2.38

General Purpose Lab

Device Name	Server IP address
Server 7	192.19.2.39

Device Name	Server IP address
Screen 3	192.19.2.51

Device Name	Lecturer IP address
PC27	192.19.2.3

Device Name	Student IP address
PC28	192.19.0.25
PC29	192.19.0.26

PC30	192.19.0.27
PC31	192.19.0.28
PC32	192.19.0.29
PC33	192.19.0.30
PC34	192.19.0.31
PC35	192.19.0.32
PC36	192.19.0.33
PC37	192.19.0.34
PC38	192.19.0.35
PC39	192.19.0.36
PC40	192.19.0.37
PC41	192.19.0.38
PC42	192.19.0.39
PC43	192.19.0.40
PC44	192.19.0.41
PC45	192.19.0.42
PC46	192.19.0.43
PC47	192.19.0.44
PC48	192.19.0.45
PC49	192.19.0.46
PC50	192.19.0.47
PC51	192.19.0.48
PC52	192.19.0.49
PC53	192.19.0.50
PC54	192.19.0.51
PC55	192.19.0.52

| PC56 | 192.19.0.53 |
| PC57 | 192.19.0.54 |

Computer Security Lab

Device Name	Server IP address
Server 8	192.19.2.40

Device Name	Server IP address
Screen 4	192.19.2.52

Device Name	Lecturer IP address
PC58	192.19.2.4

Device Name	Student IP address
PC59	192.19.0.55
PC60	192.19.0.56
PC61	192.19.0.57
PC62	192.19.0.58
PC63	192.19.0.59
PC64	192.19.0.60
PC65	192.19.0.61
PC66	192.19.0.62
PC67	192.19.0.63
PC68	192.19.0.64
PC69	192.19.0.65
PC70	192.19.0.66

PC71	192.19.0.67
PC72	192.19.0.68
PC73	192.19.0.69
PC74	192.19.0.70
PC75	192.19.0.71
PC76	192.19.0.72
PC77	192.19.0.73
PC78	192.19.0.74
PC79	192.19.0.75
PC80	192.19.0.76
PC81	192.19.0.77
PC82	192.19.0.78
PC83	192.19.0.79
PC84	192.19.0.80
PC85	192.19.0.81
PC86	192.19.0.82
PC87	192.19.0.83
PC88	192.19.0.84

IOT Lab

Device Name	Server IP address
Server 9	192.19.2.41

Device Name	Server IP address
Screen 5	192.19.2.53

Device Name	Lecturer IP address
PC89	192.19.2.5

Device Name	Student IP address
PC90	192.19.0.85
PC91	192.19.0.86
PC92	192.19.0.87
PC93	192.19.0.88
PC94	192.19.0.89
PC95	192.19.0.90
PC96	192.19.0.91
PC97	192.19.0.92
PC98	192.19.0.93
PC99	192.19.0.94
PC100	192.19.0.95
PC101	192.19.0.96
PC102	192.19.0.97
PC103	192.19.0.98
PC104	192.19.0.99
PC105	192.19.0.100
PC106	192.19.0.101
PC107	192.19.0.102
PC108	192.19.0.103
PC109	192.19.0.104
PC110	192.19.0.105
PC111	192.19.0.106

PC112	192.19.0.107
PC113	192.19.0.108
PC114	192.19.0.109
PC115	192.19.0.110
PC116	192.19.0.111
PC117	192.19.0.112
PC118	192.19.0.113
PC119	192.19.0.114

Network Lab

Device Name	Server IP address
Server 10	192.19.2.42

Device Name	Server IP address
Screen 6	192.19.2.54

Device Name	Lecturer IP address
PC120	192.19.2.6

Device Name	Student IP address
PC121	192.19.0.115
PC122	192.19.0.116
PC123	192.19.0.117
PC124	192.19.0.118
PC125	192.19.0.119
PC126	192.19.0.120

PC127	192.19.0.121
PC128	192.19.0.122
PC129	192.19.0.123
PC130	192.19.0.124
PC131	192.19.0.125
PC132	192.19.0.126
PC133	192.19.0.127
PC134	192.19.0.128
PC135	192.19.0.129
PC136	192.19.0.130
PC137	192.19.0.131
PC138	192.19.0.132
PC139	192.19.0.133
PC140	192.19.0.134
PC141	192.19.0.135
PC142	192.19.0.136
PC143	192.19.0.137
PC144	192.19.0.138
PC145	192.19.0.139
PC146	192.19.0.140
PC147	192.19.0.141
PC148	192.19.0.142
PC149	192.19.0.143
PC150	192.19.0.144

2.3.   Wireless Access Point

Device Name	Server IP address
Wireless Access Point 1	192.19.4.1
Wireless Access Point 1	192.19.4.6

REFLECTION

Each activity that our team completes will be reflected on. It is beneficial to reflect on what we learned while working on this project. The soft skills that can be developed during doing this project are teamwork. We all learned how to divide the tasks in order to complete this assignment before the deadline through collaboration. We also learn how to be prepared to accept responsibility for both mistakes and achievements as a result of these soft skills. Critical thinking is another soft skill that we may learn. Before selecting how to handle the problem, we must first observe and comprehend the task's requirements. Analytical skills become important if the task is already known how to be done. The task analysis will include facts, data, or information regarding each activity. This form of soft ability is really useful because it prepares us to enter the job scope in future.

Another skill that can be developed by working on this project is technical skill. The definition of technical skill is a set of abilities or knowledge that allows us to do practical activities in this project. Project management is a skill that we can use on this project. For example, in task 2, our group must determine how much it will cost to use this project. When we have previously established the cost, it is possible to manage the budget effectively so that it does not exceed the recommended cost. Furthermore, we must conduct additional study in various sources in order to identify more economical but high-quality equipment that will be used for a long time. Following that, during this project, software proficiency is also applied. For example, when we were working on assignment 1, we had to decide which software would be best suited to the task. This task also teaches us to explore something with which we are unfamiliar.

CONCLUSION

For the completion of this project, we have taken full responsibility in completing each task with perfection to ensure we have achieved our target. We are glad we are able to implement the knowledge we acquired through all the lectures taught by our lecturer and the personal research. We have applied the skills we learnt from all the six chapters in the Network Communication course during 5 phases of this project completion. A scalable network and wireless connectivity for future growth in preparation for education in line with a 2-storey building for School Of Computing which is filled with the infrastructure of the network devices has been successfully planned.

During the process of execution, we have all learnt our strengths and weaknesses as a team. Firstly, we have all played with our strength very well and efficiently. One of our main strengths is the kind of great teamwork spirit we have in discussing all the new requirements for the 2-storey building for School Of Computing. Our teamwork spirit has helped us in learning and accepting new ideas and knowledge. We have worked our strength in all of the tasks. For example, for task 1, when we were assigned to design the floor plan, we all as a team decided to collect all the ideas for the floor plan and discuss it at the next meeting session. We planned on how we want to equip the building with all the essential equipment and rooms enough for the building to run efficiently as well as conductively for all the staff and students using the building for learning purposes. It is not just that, we have showcased it in task 4 during the cabling for the whole building. We have made sure we have all the cabling for the building approved by all the team members before submitting task 4. Regarding task 3, we have all discussed deeply on all the LAN devices required for network purposes for each room in the building.

Instead, we too had some issues during the completion of the project as well. For instance, we had some issues during task 4 for cabling for the building. For instance, we were not so sure about the length of the cabling at the early stages as well as the cabling flow for the whole building. As time passed by and through many discussions, we managed to finalize the design for the cabling. At one point, during task 3, we were not sure how to finalize the devices required for each room such as Telecommunication rooms, Computer Security Lab, General Lab, IOT lab and Network Lab. It may be due to lack of exposure to such a wide range of technology out in the

market. Moreover, there are more devices out there in the market where we did not learn in the class. However, through further learning and research through the WEB, we learned about the capacity of the devices through the comparison between the other devices and choosing the best for our building. Fortunately, we were grateful to understand all the requirements and specifications and decide on which devices we would use to complete the scalable network and wireless connectivity.

Last but not least, there is room for improvements in this project for the designation and construction of the building. For instance, for servers, we have created additional IP addresses for servers just in case there are more servers added in the building in the future. That was almost created for many devices such as the router and so on. There can be a possibility where there may be a wireless "Dead Zone" where the interference on Wi-Fi connection occurs causing a certain area under Wi-Fi coverage in a building unable to detect the Wi-Fi signal. Wireless "Dead Zone" may be caused by distance from the source, placement of the furniture or equipment or many more. Thus, it is important to build a good scalable network and wireless connectivity in a building. A student should not only acquire all the skills of network communication but also unlock some architecture skills in constructing and designing the buildings. We have gained more understanding of all the syllabus we have learned through the lectures by the completion of the project. Hence, this project has helped us build good communication, support and rapport among us as team members and uplifted our team spirit for the completion of the project at a rapid pace with effective results.

HELP OF CLIENT'S DECISION MAKING PROCESS

As far as we are aware, present technology, particularly the Internet, has reached its pinnacle of progress. It has become a crucial aspect of our lives where technology has assisted us in connecting with the communities together. Today, Internet connectivity has progressed beyond just giving access to the Internet to powering sophisticated infrastructure. It is critical in network planning to constantly assess the present state of network security and the vulnerability of network devices to potential harmful assaults. This is due to the fact that technological innovation virtually everyday introduces new risks to the system. System vulnerability scanning will aid in the discovery of the organization's internet-facing technologies as well as the identification of weaknesses in the school's computer network. The data acquired from the test, which may be performed on an annual basis, can be utilized to improve the security of the system.

Following that, technological improvements have shown that many people prefer to relocate their computer network to the cloud for a variety of reasons. In comparison to the others, the rate of adoption of technical innovations in cloud-based architecture is significantly higher. In addition to boosting overall system security, utilizing cloud services, infrastructure, software, and the whole platform, in general, is managed in a more simpler approach. This removes the capital expenditure of adopting in-house gear and software, allowing the school to function on a modest budget.

TEAM MEMBERS AND RESPONSIBILITIES

No.	Member	Responsibilities
1	NAVINTHRA RAO A/L VENKATAKUMAR	1. Project Manager 2. Coordinates group member 3. Task reminder 4. Gather group meeting
2	GUI YU XUAN	1. Network Architecture 2. Reminds due date for every assignments 3. Helping group members in choosing the suitable hardware and cabling 4. Suggestion on the connection of the devices
3	ADRIANA MAISARAH BINTI AZNAN	1. Financial Manager 2. Helping group members in floor planning 3. Monitor the money spend
4	UMMU AQILLAH BINTI MAT RESAT	1. Technician of Network Security 2. Research the technologies that suitable for the building 3. Suggestion on the network security requirements

REFERENCES

1. Kurose, J. F., & Ross, K. W. (1986). Computer Networking. *A Top-Down Approach*. (6th ed.). Pearson Education.

2. SenHeng. (n.d.). TP-Link AX5400 Dual-Band Gigabit Wi-Fi 6 Router Archer AX37. https://www.senheng.com.my/tp-link-ax5400-dual-band-gigabit-wi-fi-6-router-archer-ax73.html?dxid=Cj0KCQiAoNWOBhCwARIsAAiHnEg6BNXvLoy34CxDQgv_fhvLZ9feLxQqd_JPb1xRaAYz-AdCm6YDPbgaArF3EALw_wcB&utm_id=Cj0KCQiAoNWOBhCwARIsAAiHnEg6BNXvLoy34CxDQgv_fhvLZ9feLxQqd_JPb1xRaAYz-AdCm6YDPbgaArF3EALw_wcB&gclid=Cj0KCQiAoNWOBhCwARIsAAiHnEg6BNXvLoy34CxDQgv_fhvLZ9feLxQqd_JPb1xRaAYz-AdCm6YDPbgaArF3EALw_wcB

3. FS. (n.d.). S3900-48T6S-R, 48-Port Gigabit Ethernet L2+ Fully Managed Switch, 48xGigabit RJ45, with 6x10Gb SFP+ Uplinks, Stackable Switch. https://www.fs.com/sg/products/134657.html?country=my&currency=MYR&paid=google_shopping&gclid=Cj0KCQiAoNWOBhCwARIsAAiHnEiarHDG2JcniZSTPS69suRWR_qjwPG5rElK6HNDJ_2aa4gnxP5XajEaAmUVEALw_wcB

4. FS. (n.d.). S3900-24T4S-R, 24-Port Gigabit Ethernet L2+ Fully Managed Switch, 24 x Gigabit RJ45, with 4 x 10Gb SFP+ Uplinks, Stackable Switch, Fanless. https://www.fs.com/sg/products/134655.html?country=my&currency=MYR&paid=google_shopping&gclid=Cj0KCQiAoNWOBhCwARIsAAiHnEgygyrQxcKSTtN1GiUllUEPzYavto4JZ4IfrlMvSJVE-2CnsWnhwWAaAvBZEALw_wcB

5. Newegg. (n.d.). TP-Link EAP225 V3 | Omada AC1350 Gigabit Wireless Access Point | Business WiFi Solution w/ Mesh Support, Seamless Roaming & MU-MIMO | PoE Powered | SDN Integrated | Cloud Access & Omada App | White. https://www.newegg.com/tp-link-eap225-v3/p/0ED-000J-00093

6. Cisco. (n.d.). Cisco UCS S3260 Storage Server. https://www.cisco.com/c/en/us/products/servers-unified-computing/ucs-s3260-storage-server/index.html

7. Lazada. (n.d.). ASA5508-K9 ASA 5500-X Series Next-Generation Firewalls with firepower services.

https://www.lazada.com.my/products/asa5508-k9-asa-5500-x-series-next-generation-firewalls-with-firepower-services-i1139058683.html

8. Acronis. (n.d.). Cyber Protect. https://www.acronis.com/en-us/products/cyber-protect/

9. Amazon. (n.d.). Cisco RV160W VPN. https://www.amazon.com/Cisco-Systems-RV160W-Wireless-AC-Router/dp/B07KCR1MQK

10. Netgear. (n.d.). NIGHTHAWK RAX20 DUAL-BAND AX4 WIFI 6 ROUTER - AX1800. https://netgearstore.my/products/nighthawk-rax20-dual-band-ax4-wifi-6-router-ax1800#

APPENDICES

<u>Meeting Minutes</u>

TASK	DATE	TIME	DESCRIPTION
TASK 1	18 October 2021	5.00 pm - 6.00 pm	● Create Whatsapp Group ● Decide member role
	19 October 2021	10.30 am -12.30 pm	● Discuss the floor plan. ● Facilities, dimension, scale ● Software used to draw the floor plan
	27 October 2021	3.00 pm - 4.00 pm	● Finalize the floor plan
TASK 2	31 October 2021	5.00 pm - 7.00 pm	● Provide interview questions and problems
	4 November 2021	5.00 pm - 7.00 pm	● Decide which question to be used
	7 November 2021	12.00 pm -12.30 pm	● Interview session with Dr. Syed Hamid Hussain Madni ● Complete report with the interview questions and research questions
	8 November 2021	5.00 pm - 7.00 pm	● Discussing the feasibility study
	12 November 2021	2.00 pm - 3.00 pm	● Finalize task 2
TASK 3	25 November 2021	5.00 pm - 7.00 pm	● Discuss the hardware devices

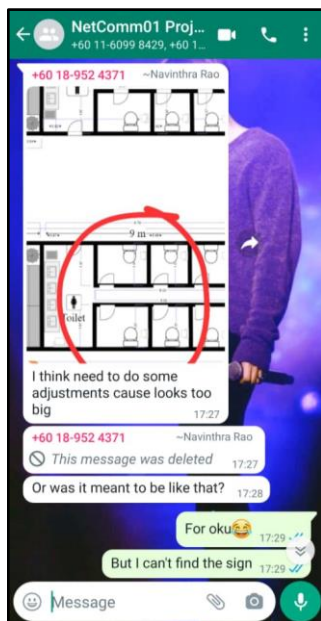|			and assign tasks
	30 November 2021	5.00 pm - 7.00 pm	● Discuss on the hardware to be used for comparing ● Discuss the finding of the price
	2 December 2021	5.00 pm - 7.00 pm	● Finalize task 3
TASK 4	12 December 2021	5.00 pm - 7.00 pm	● Discuss the work area and the arrangement of the devices ● Decide the cable connection ● Assign tasks
	24 December 2021	8.00 pm - 9.00 pm	● Finalize task 4
TASK 5	2 January 2021	5.00 pm - 7.00 pm	● Discuss on the number of hosts ● Determine the network ● Discuss the subnetwork
	6 January 2021	5.00 pm - 7.00 pm	● Check for the errors
	7 January 2021	5.00 pm - 7.00 pm	● Finalize task 5

Pictures of our team working on the project
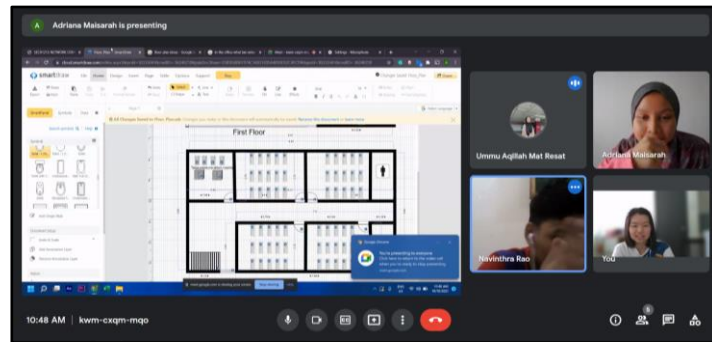
Group meeting
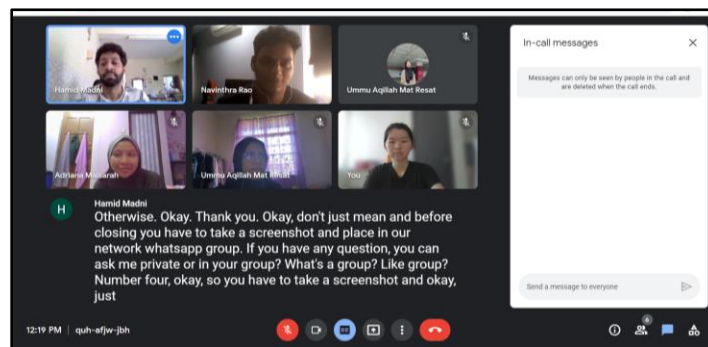
Interview session with Dr. Syed Hamid Hussain Madni

Discussion in WhatsApp Group