NEW ERA UNIVERSITY COLLEGE

Faculty of Computer Science & Information Computing
Technology Department of Information Computing Technology

DIPLOMA IN COMPUTER SCIENCE

TNWK213 NETWORKING

GROUP ASSIGNMENT

GROUP MEMBERS
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DATE OF SUBMISSION: 19 / 8 / 2024

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1.0 INTRODUCTION

The New Era University College (NEUC) has entrusted our group to o create a network that functions over numerous buildings, with a minimum of two buildings, with each building having a minimum of two floors. These structures may include an office building, commercial building, medical facility, or educational institution. The network must guarantee that every device can connect to the internet and interact efficiently.

1.1 BACKGROUND

This goal of this project is to plan, design and skilfully implement a Local Area Network (LAN) topology will serve as the fundamental backbone connecting the diverse rooms within the NEUC Educational Facility.

Besides, our objective is to establish and configure a suite of vital network devices that will play pivotal roles in enhancing the overall network performance and user experience throughout the facility. This includes configuring switches, routers, access points, and more, to ensure reliable and secure connectivity across all spaces.

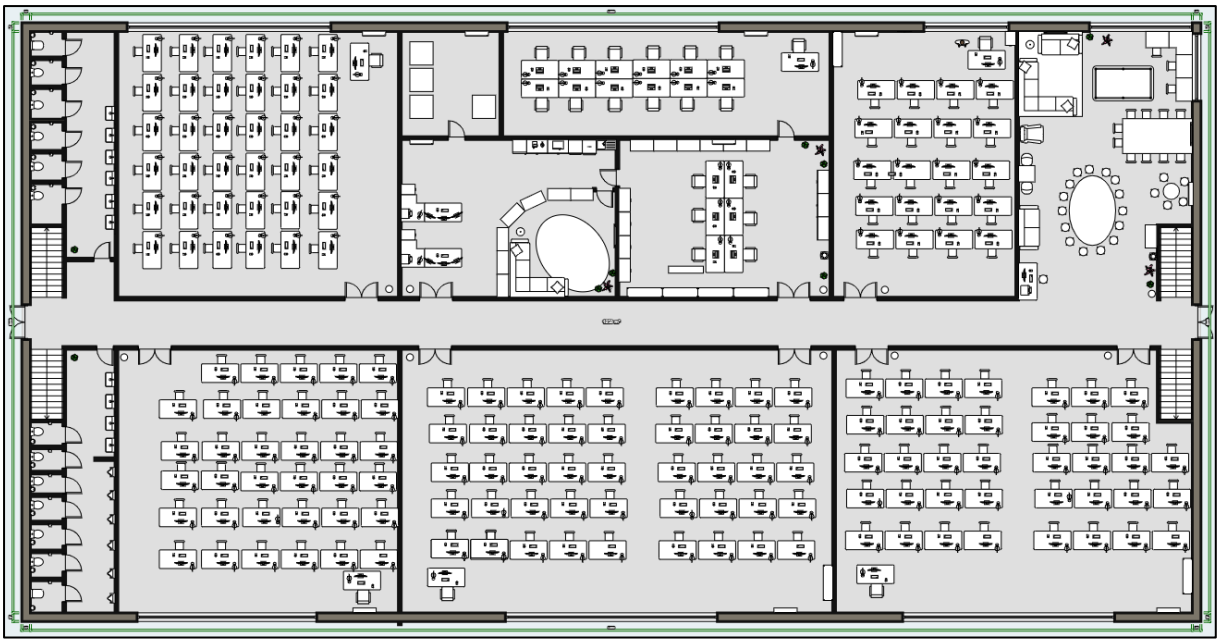
Additionally, we will undertake the creation of a detailed and well-structured full floor plan of the buildings to provide an in-depth and comprehensive understanding of the network layout. This plan will meticulously outline the network connections between key areas, such as the office, computer room, classrooms, and library.

Furthermore, an intelligent and efficient IP addressing scheme will be carefully designed to ensure seamless data communication and streamlined management of all devices within the network. This will ensure that each room and device is optimally connected, allowing for efficient network administration and user access across the facility.

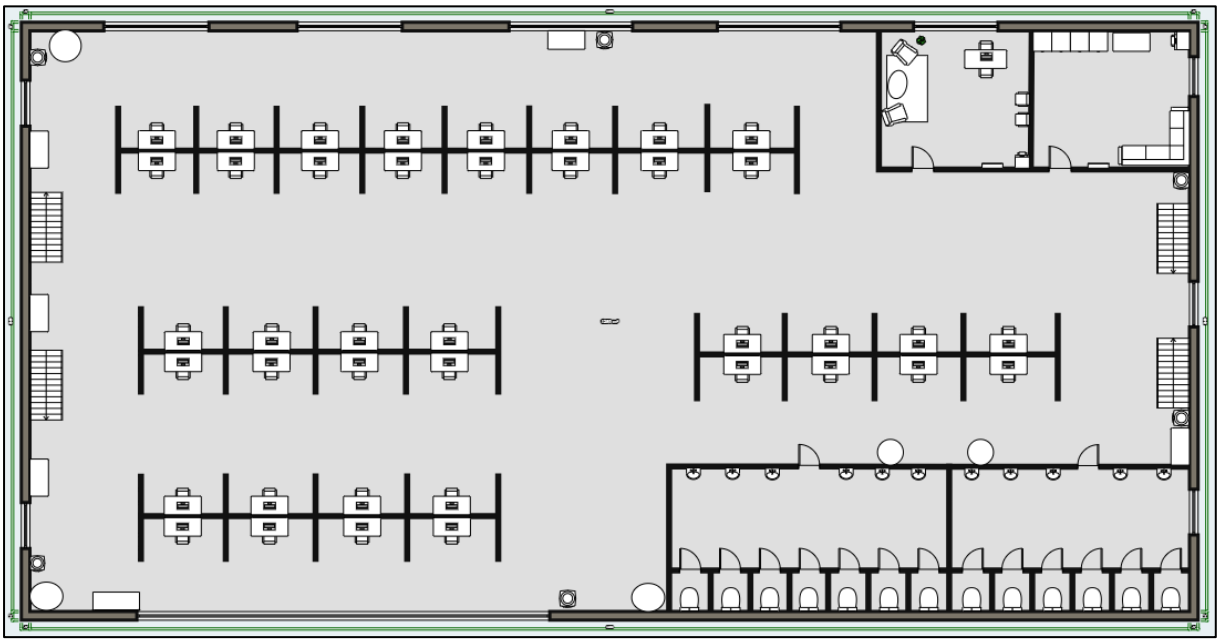
2.0 FLOOR PLAN LAYOUT

2.1 THE PLAN DESIGN AND LEGEND

Classroom



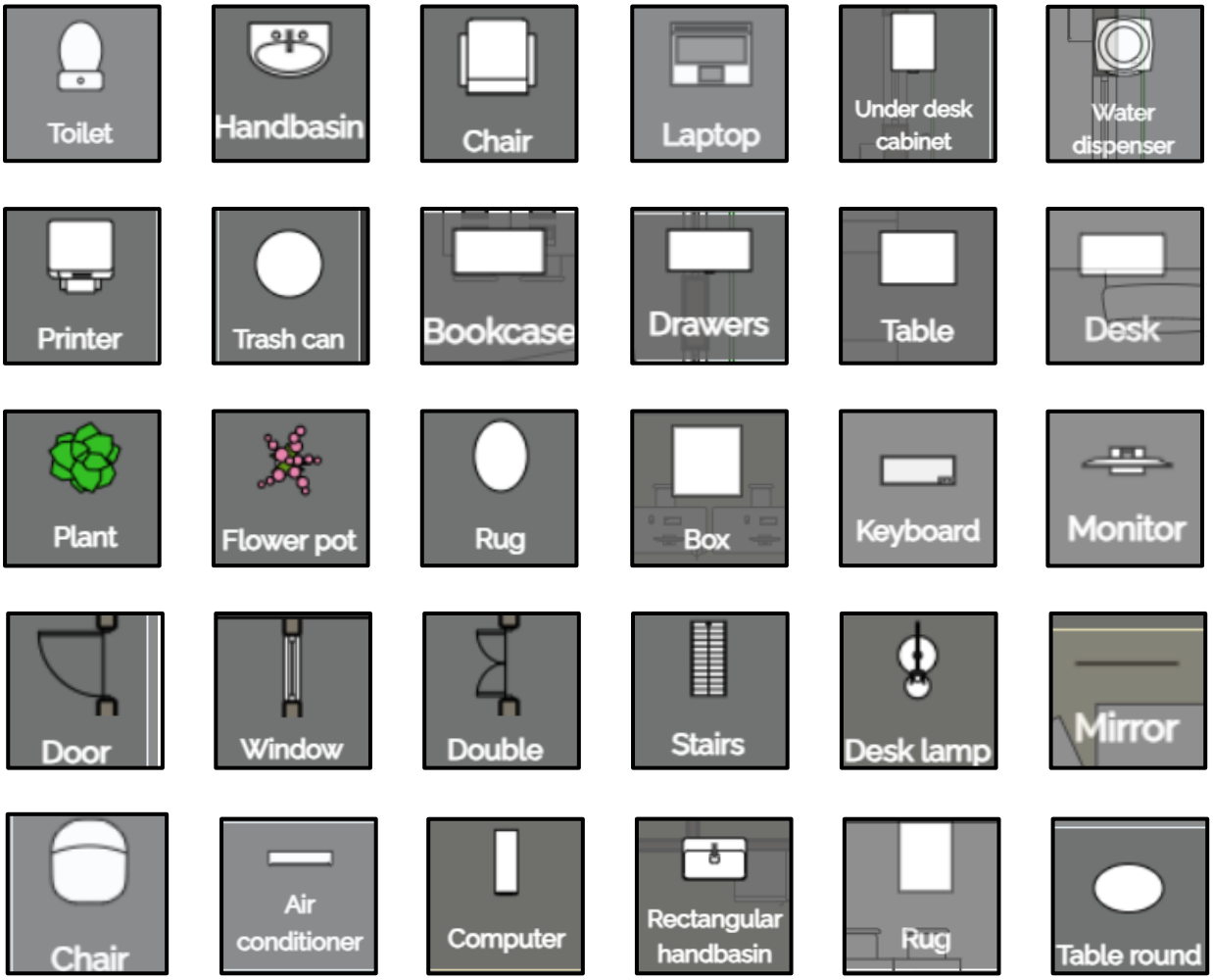
OFFICE



Computer Room

LIBRARY

LEGEND


Toilet
Handbasin
Chair
Laptop
Under desk cabinet
Water dispenser
Printer
Trash can
Bookcase
Drawers
Table
Desk
Plant
Flower pot
Rug
Box
Keyboard
Monitor
Door
Window
Double
Stairs
Desk lamp
Mirror
Chair
Air conditioner
Computer
Rectangular handbasin
Rug
Table round

2.2 EXPLANATION OF FLOOR PLAN DESIGN

The floor plan consists of two distinct buildings: an office building and a study building, each has two floors. It allocates all the required facilities, such as an office, a computer room, a classroom, and a library. The first building has a computer room and an office. The second building has a classroom and a library. Both buildings are the same size, 5000cm x 2500cm.

First Building (First Floor)

The allocation of the first floor of the first building to a computer room is a logical choice. This is because it can let the students easily get into the computer room without using stairs. Then, if the students have some questions that want to be solved by teachers, they can go to the second floor to ask the teachers.

First Building (Second Floor)

The allocation of the second floor of the first building to an office is a logical choice. Then, when the teachers need technology support, they can solve the problem in the computer room more efficiently. After that, teachers can supervise the computer easily. Computer room can share the resource to the office easily.

Second Building (First Floor)

Designating the first floor of Building 1 as a classroom area is a strategic choice. Classrooms are essential to any educational institution and situating it on the ground floor ensures easy access for both students and staff because this arrangement can minimize the need for navigating stairs, which is especially beneficial for those with mobility issues. Additionally, placing classrooms on the first floor creates a central hub for educational activities, making it convenient for students to reach their classes and library without traversing the entire building. This layout also encourages interaction and fosters a sense of community among students across different grades and subjects.

Second Building (Second Floor)

Justification for the second building Floor Plan second floor. Library selecting the second floor of the second building as the library is a strategic decision. The library is a hub of knowledge and resources for students, teachers, and researchers. Placing it on the second door reduces the noise from the entrance, hallways, and communal areas, making it easier to maintain a peaceful atmosphere for study and reading. Placing it on the second floor also ensures easy access for everyone, including visitors from outside the institution, and protects both the resources and the patrons. Furthermore, many windows, more natural light, and plenty of comfortable seating areas can be integrated, fostering an environment conducive to learning and research. Additionally, it allows for the efficient integration of digital technologies and collaborative spaces, encouraging group study and research discussions. Also, the first floor is often reserved for high-traffic areas such as cafeterias, classrooms, and lobbies. Placing the library on the second floor can free up prime space for those essential services and ensure a better traffic flow.

3.0 NETWORK DEVICES

3.1 ROUTER

Product Name	UDM-Pro	UDM-SE
Rack Width	1RU	1RU
Interface	LAN (8) GbE RJ45 ports (1) 10G SFP+ port WAN (1) GBE RJ45 (1) 10G SFP+ port	LAN (8) GbE RJ45 ports (1) 10G SFP+ port WAN (1) 2.5 GbE RJ45 ports (1) 10G SFP+ port
Wireless/Wired	Wired	Wired
Interface Slots	4	4
Modular LAN switch Ports	(8) GbE RJ45	(8) 2.5 GbE RJ45 including (2) PoE+ and (6) PoE
Price	US$379	US$499

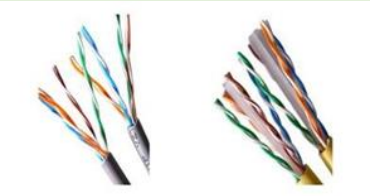
After evaluating the specifications, the decision has been made to choose the UDM-SE router over the UDM-Pro This choice is based on the UDM-SE offers 4 integrated 10/100/1000/2500 Ethernet ports (rj45), 4 interface slots, For WAN (1) 10G SFP+ port and (1) 2.5 GbE Rj45. For LAN (1) 10G SFP+ and (8) GbE RJ45 including (2) PoE+ and (6) Poe. A price of US$499, which better suits our requirements compared to the Dream Machine Pro priced at US$379.

3.2 SWITCH

Product Name	USW-Pro-48	USW-48
Forwarding Performance	130.944Mpps	77.376 Mpps
Switching Capacity	176 Gbps	104 Gbps
Port Quantity	52	49
Gigabit Ports	48	48
FSP ports	(4)1/10G	(1)1G
Wireless/Wired	Wired	wired
Price	US$599	US$399

We have compared the Pro 48 and the Standard 48 switches based on their specifications, and we decided to go with the Pro 48 model for my needs. The USW-Pro-48 offers enhanced performance with a forwarding performance of 176.944Mpps and a switching capacity of 176Gbps. Which is higher than the USW-48's 77.376 Mpps and 104 Gbps respectively. Additionally, the USW-Pro-48 features (4) 1/10G SFP+ ports, providing even greater connectivity options. Although it comes at a slightly higher price of US$599 compared to the USW-48's US$399, we believe the improved the improved performance and additional FSP ports of the USW-Pro-48 make it a better choice for my wired network needs.

3.3 CABLING

Product Name	CAT5e	CAT6
Maximum Bandwidth	Up to 100Mhz	0-250 MHz (minimum); 500 MHz maximum
Maximum Data Rate	1000Mbps	10 Gbps over 33.55 meters (110-165 feet) of cable
Maximum Cable Distance  CAT5e CAT6	100 meters	100 meters for slower network speeds (up to 1,000 Mbps) and higher network speeds over short distances. For Gigabit ethernet, 55 meters max, with 33 meters in high crosstalk conditions.
Connector	RJ45	RJ45
Shielding	UTP/STP	UTP/STP
Cost	Varies by length and manufacturer generally $0.20-$30 per foot.	Varies by length and manufacturer, with $0.40 - $0.60 per foot as an average. Generally. About 20% higher than Cat5e.

The cabling type that we have chosen is Cat6, and this decision is based on a thorough evaluation of the provided specifications, Cat6 offers significant advantages over Cat5e in terms of both bandwidth and data rate capabilities. With a bandwidth ranging from 0 –250 MHz, and a maximum of 500MHz, cat 5e's achieved a remarkable data rate of 10 Gbps over distances of 33-55 meters, compared to Cat5e's maximum bandwidth of 100MHz, Additionally, Cat6 achieves a remarkable data rate of 10 Gbps over distances of 33-55 meters, compared to Cat5e's 100Mbps. Moreover, Cat6 can support higher network speeds over short distances, making it an ideal choice for our project's needs. The use of RJ45 connectors and the availability of both UTP and STP shielding options align with our network requirements.

3.4 WIRELESS ACCESS POINT

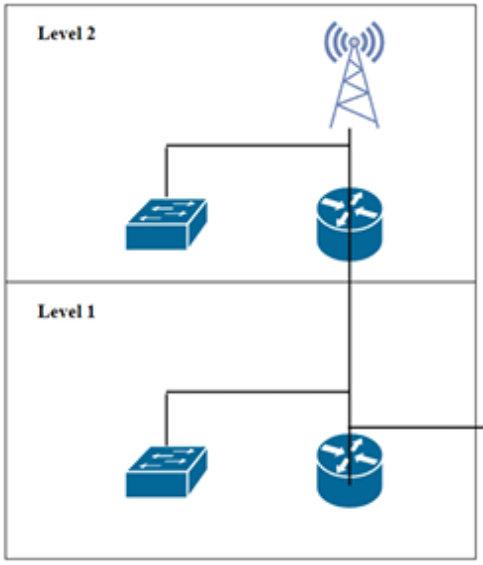
Product Name	U6-Enterprise	U7-Pro
Wi-Fi Standards	802.11a/b/g/n/ac/ax (Wi-Fi 6/6E)	802.11a/b/g/n/ac/ax/be (Wi-Fi 6/6E, Wi-Fi 7)
Wireless security	WPA-PSK, WPA-Enterprise (WPA/WPA2/WPA3)	WPA-PSK, WPA-Enterprise (WPA/WPA2/WPA3/PPSK)
Spatial streams	8 per radio	6 per radio
Max. data rate	2.4 GHz 573.5 Mbps (BW40) 5 GHz 4.8 Gbps (BW160) 6 GHz 4.8 Gbps (BW160)	2.4 GHz 688 Mbps (BW40) 5 GHz 8.6 Gbps (BW240) 6 GHz 5.7 Gbps (BW320)
Uplink	1/2.5 GbE RJ45 port	1/2.5 GbE RJ45 port
PoE+	Yes	Yes
VLAN	802.1Q	802.1Q
Concurrent clients	600+	300+
Price	US$279	US$189

The WIRELESS ACCESS POINT we have chosen is U7-Pro, and this decision is based on a thorough evaluation of the provided specifications and our calculations. U7-Pro offers some over U6-Enterprise in terms of both data rate capabilities and price. With a data rate from 2.4 GHz 688 Mbps (BW40) 5 GHz 8.6 Gbps (BW240) 6 GHz 5.7 Gbps (BW320), U7-Pro surpasses U6-Enterprise's maximum data rate of 2.4 GHz 573.5 Mbps (BW40)5 GHz 4.8 Gbps (BW160) 6 GHz 4.8 Gbps (BW160). Moreover, U7-Pro has a lower price making it ideal choice for our project’s needs.

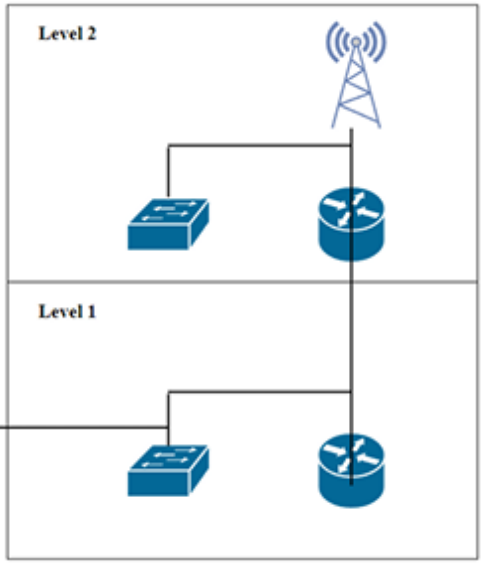
4.0 NETWORK DESIGN

4.1 SIDE VIEW OF NETWORK DIAGRAM

Computer Room & Office (Building 1)

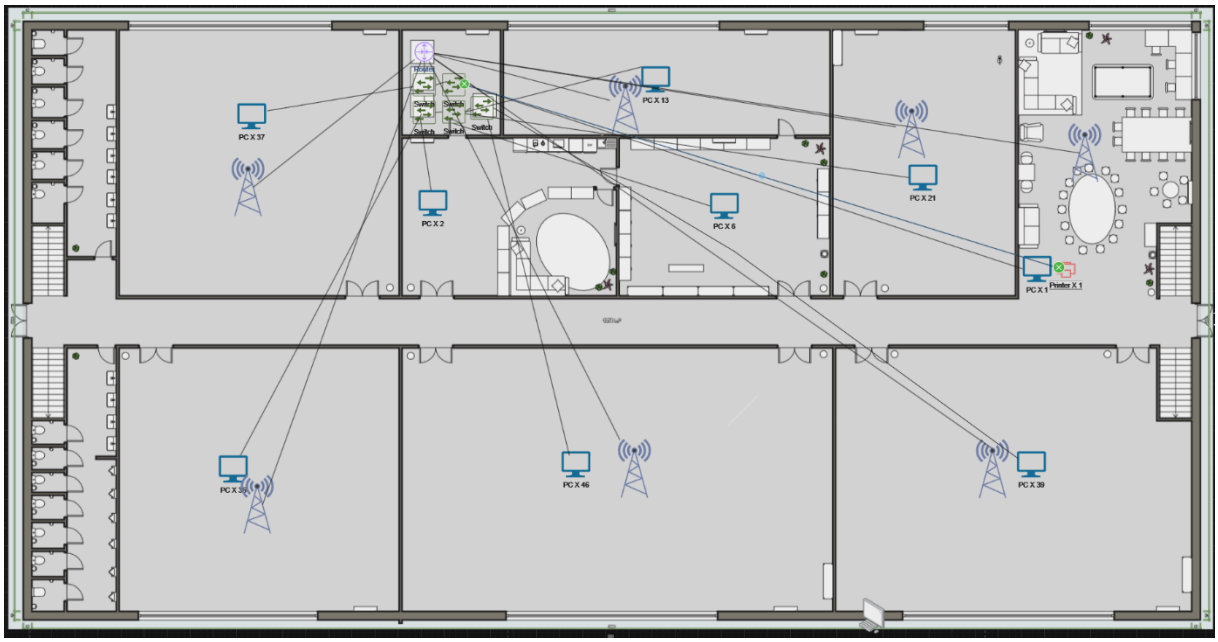


Classroom & Library (Building 2)

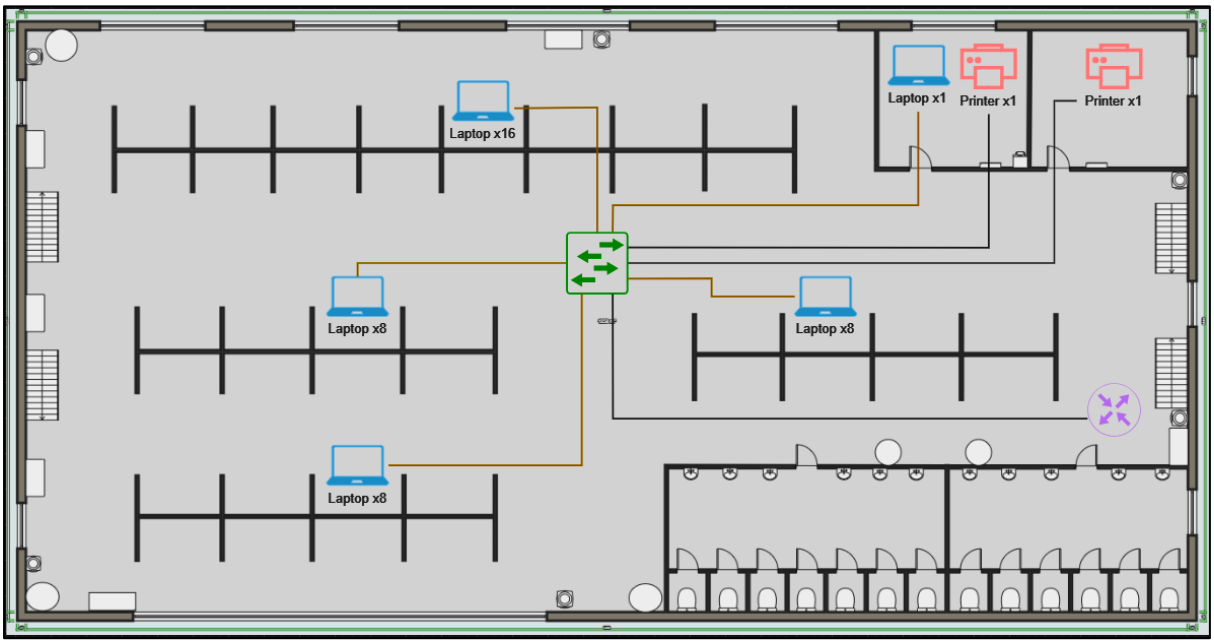


4.2 AERIAL VIEW OF NETWORK DIAGRAM

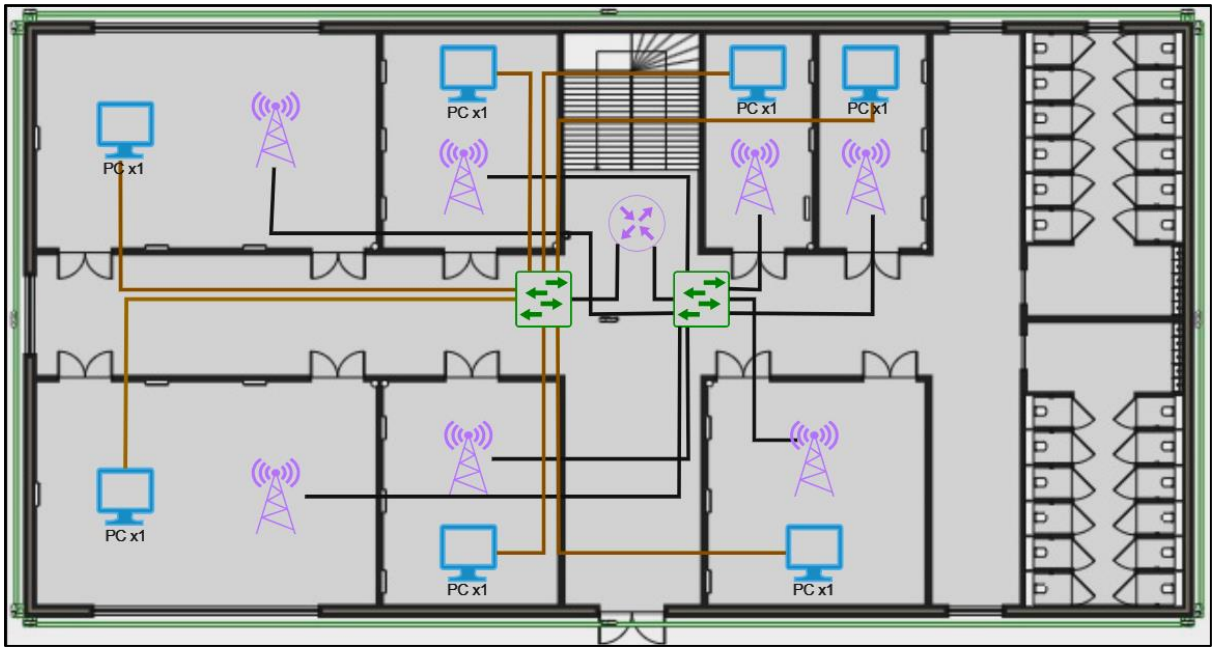
CLASSROOM



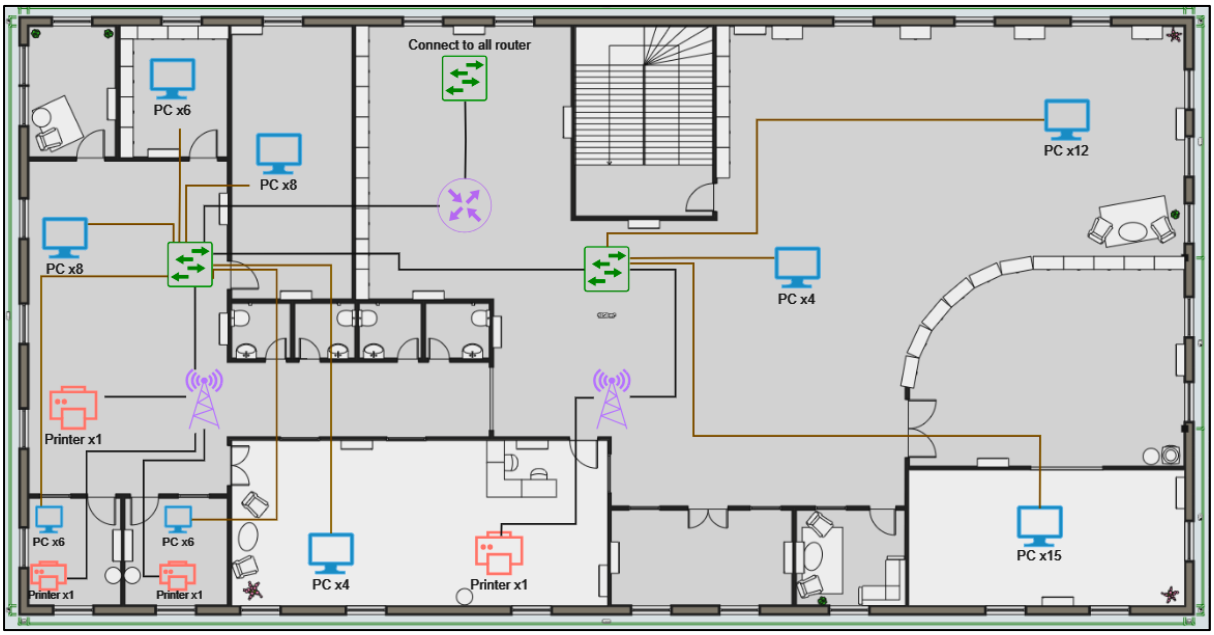
OFFICE



COMPUTER ROOM



LIBRARY



LEGEND

PC

Laptop

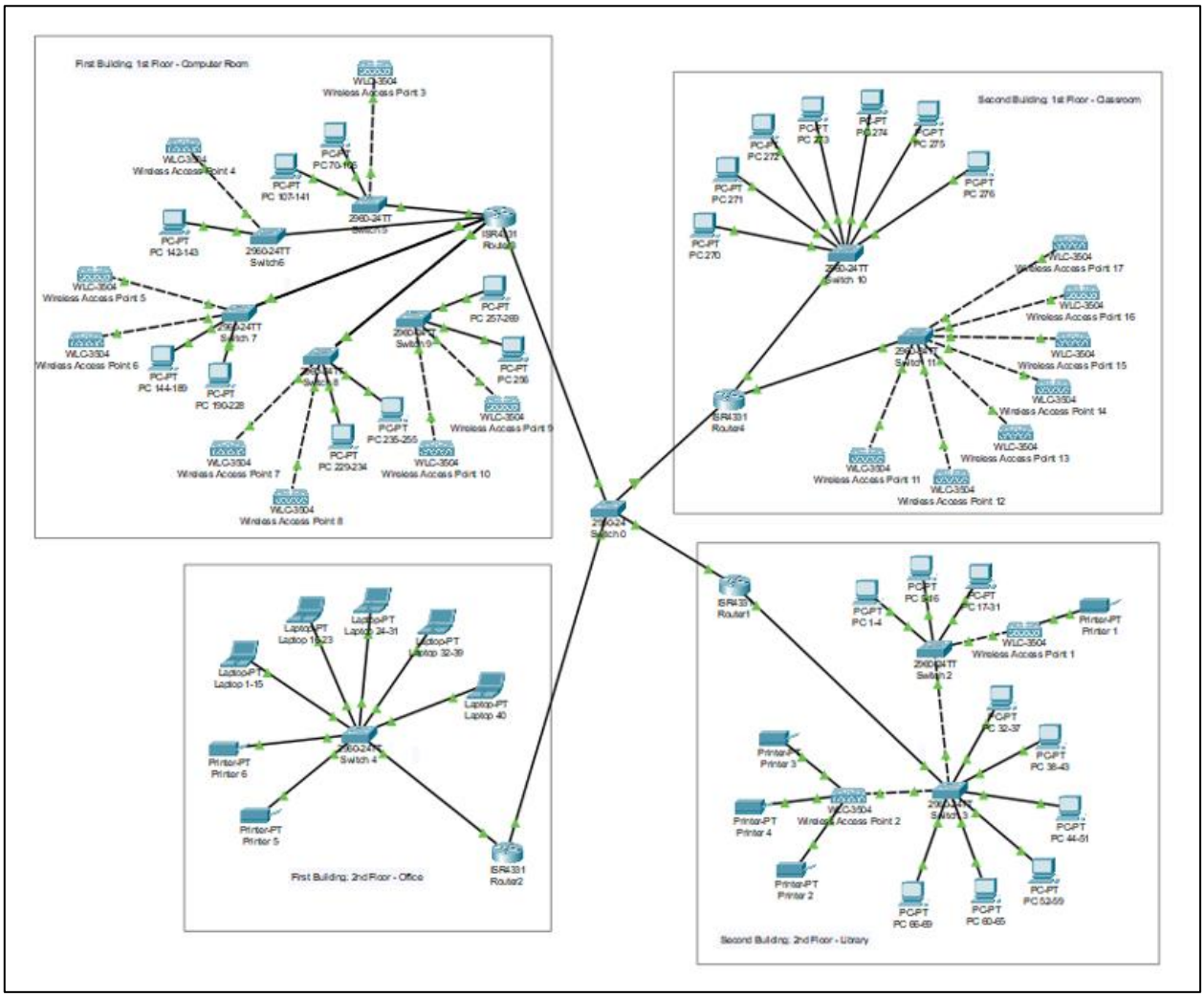
Printer

Router

Switch

Wireless Access Point

4.3 NETWORK DESIGN (TOPOLOGY)



Due to the high number of computers on our floor plan, we have opted to use a single computer icon to represent an entire room or section of computers. This approach is necessary to maintain clarity and prevent screen clutter, as the plan includes nearly 200 computers, which would be overwhelming if displayed individually.

5.0 INDIVIDUAL COMPONENTS

5.1 QUEE YOU XIN (2370383-DCS)

- Designed the floor plan of the computer room.
- Explanation of floor plan design of computer room.
- 3.1 Routers
- 3.2 Switches
- 3.3 Cabling
- 4.2 Aerial View of a Network Diagram – Computer Room
- 4.3 Network Design – Computer Room

5.2 SOO MUN HONG (2390027-DCS)

- Designed the floor plan of the office.
- Explanation of floor plan design of the office.
- 4.1 Side view of network diagram
- 4.2 Aerial view of a network diagram – Office
- 4.3 Network Design – Office

5.3 LIM JINJIE (2370036-DCS)

- Designed the floor plan of the classroom.
- Explanation of floor plan design of the classroom.
- 4.2 Aerial view of network diagram – Classroom
- 4.3 Network Design – Classroom

5.4 NICHOLAS CHAY KHAI WENN (2390101-DCS)

- Designed the floor plan of the library.
- Explanation of floor plan design of the library.
- 4.2 Aerial view of network diagram – Library
- 4.3 Network Design – Library
- Designed the PowerPoint for presentation.

6.0 CONCLUSION

In summary, we worked closely together to devise an optimal network setup, with a strong focus on boosting performance, ensuring reliability, enhancing security, and simplifying management. We accomplished this by carefully choosing the right network devices and cabling. Although we did not necessarily go for the most cutting-edge technology, our solution comes remarkably close to being top-notch. Moreover, it achieves this level of quality while remaining budget friendly.

7.0 REFERENCES

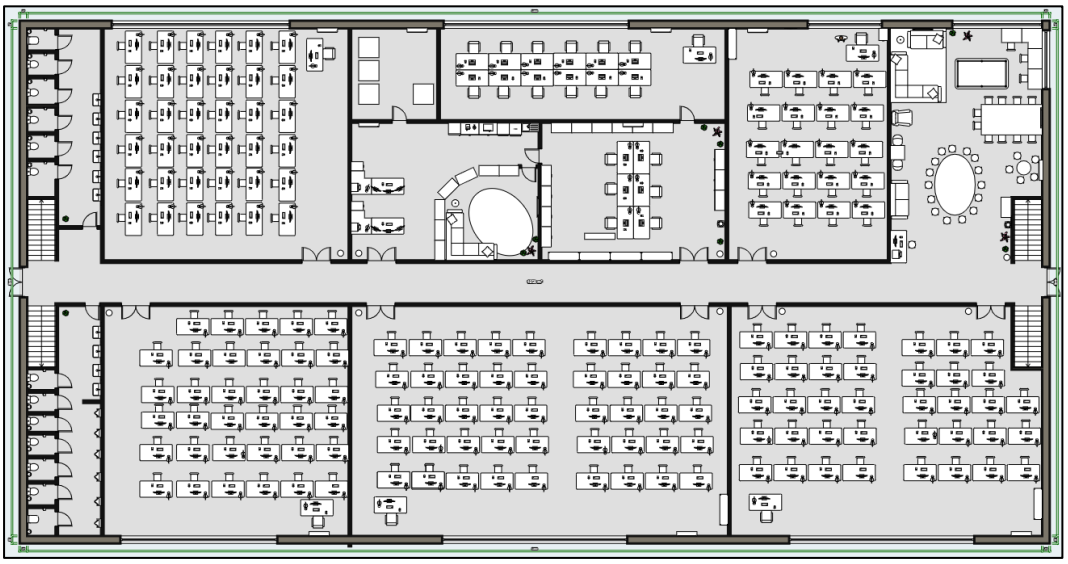
1. https://www.newera.edu.my/
2. https://store.ui.com.com/us/en?s=us&l=en
3. https://design.ui.com/projects/150147d8-d7ef-4313-b149-de944b42c64a/plans/default
4. https://app.diagrams.net/
5. https://elp.newera.edu.my/mod/resource/view.php?id=190136
6. https://floorplancreator.net/
7. https://app.diagrams.net/
8. https://www.packettracernetwork.com/download/download-packet-tracer.html
9. https://www.blackbox.co.uk/gb-gb/page/43869/Resources/Technical-Resources/Black-Box-Explains/Copper-Cable/Category-5e-And-6
10. https://app.diagrams.net/?src=about

8.0 APPENDIXES

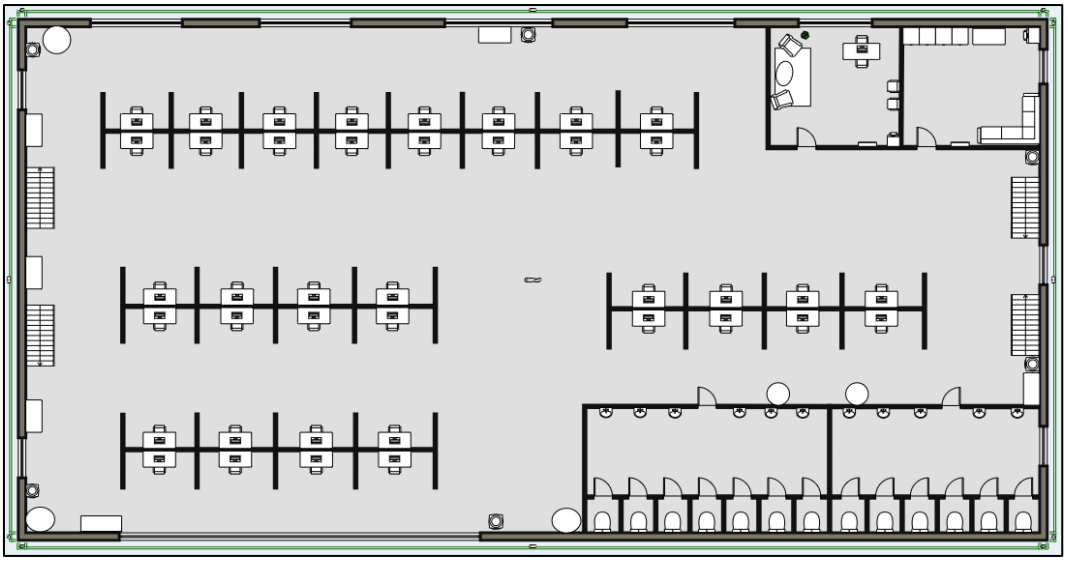
APPENDIX A: FLOOR PLANS AND NETWORK DIAGRAMS

Floor Plans

- Computer – First Building, Second Floor



- Office – First Building, Second Floor

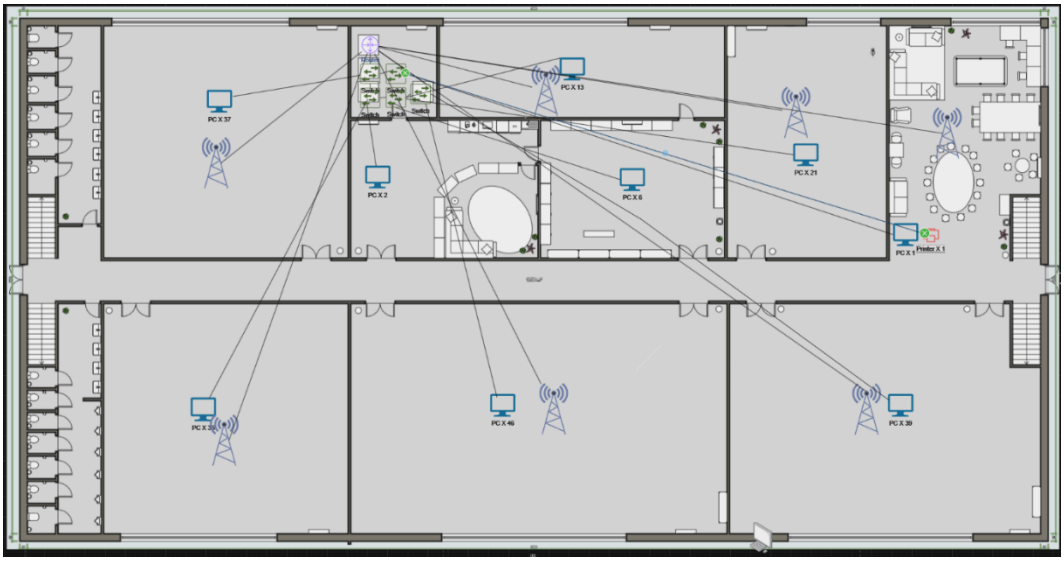


- Classroom – Second Building, First Floor

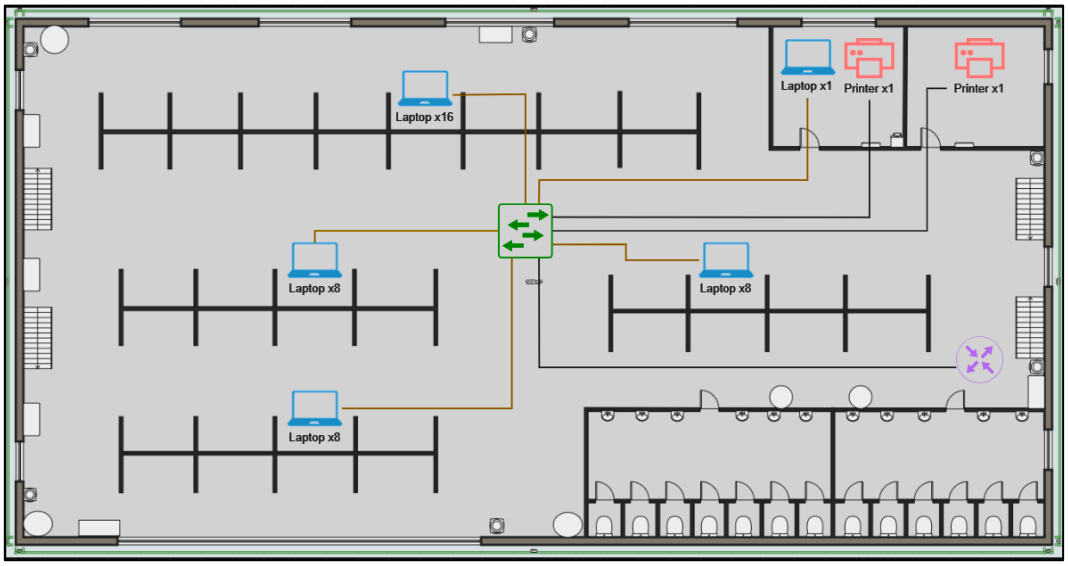
- Library – Second Building, Second Floor

Network Diagrams

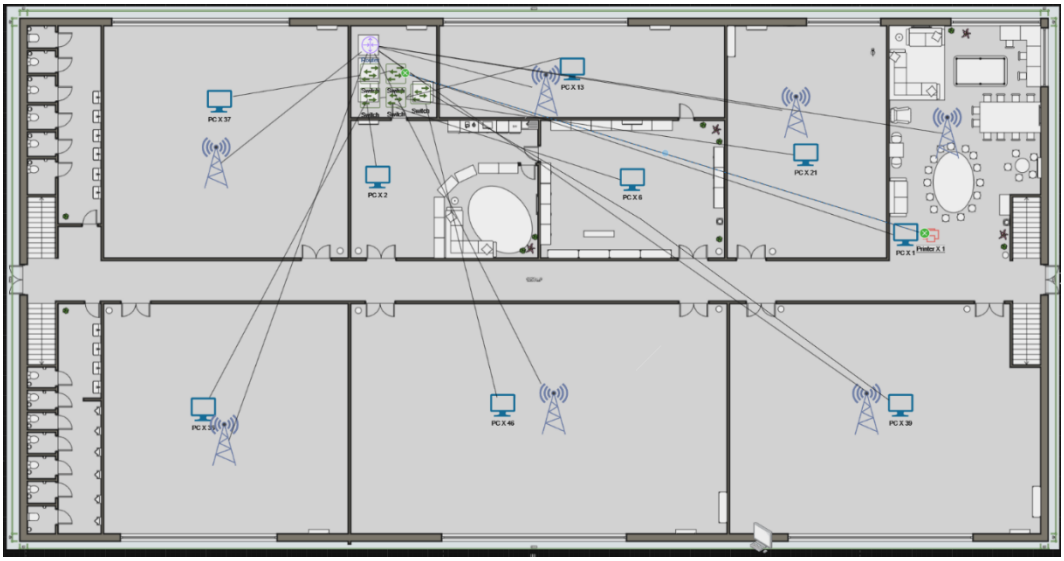
- Aerial View of Network Diagram
  - Top-down view of network connections across the entire facility.
  - Computer Room – First Building, First Floor



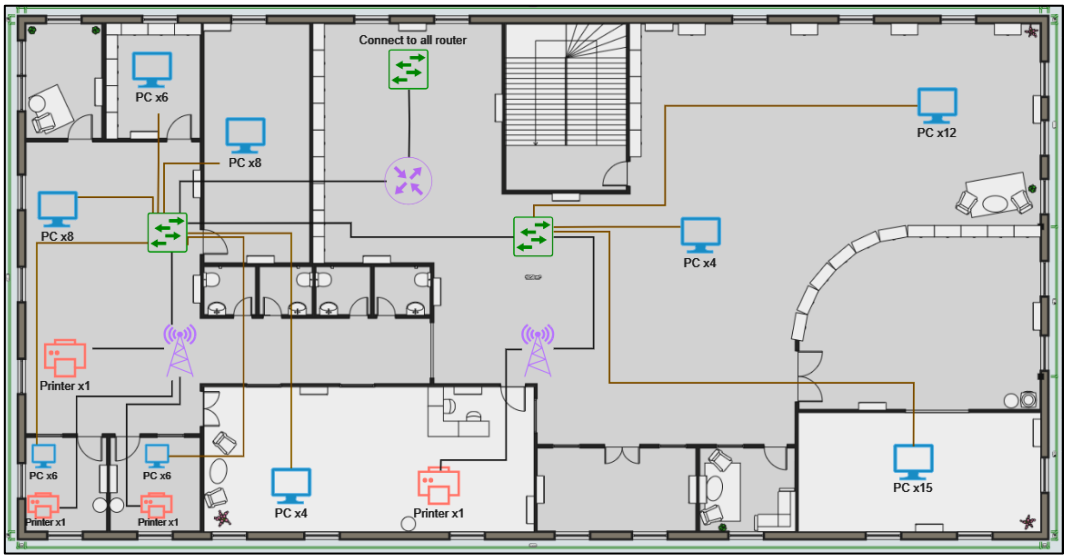
  - Office – First Building, First Floor



- Classroom – Second Building, First Floor

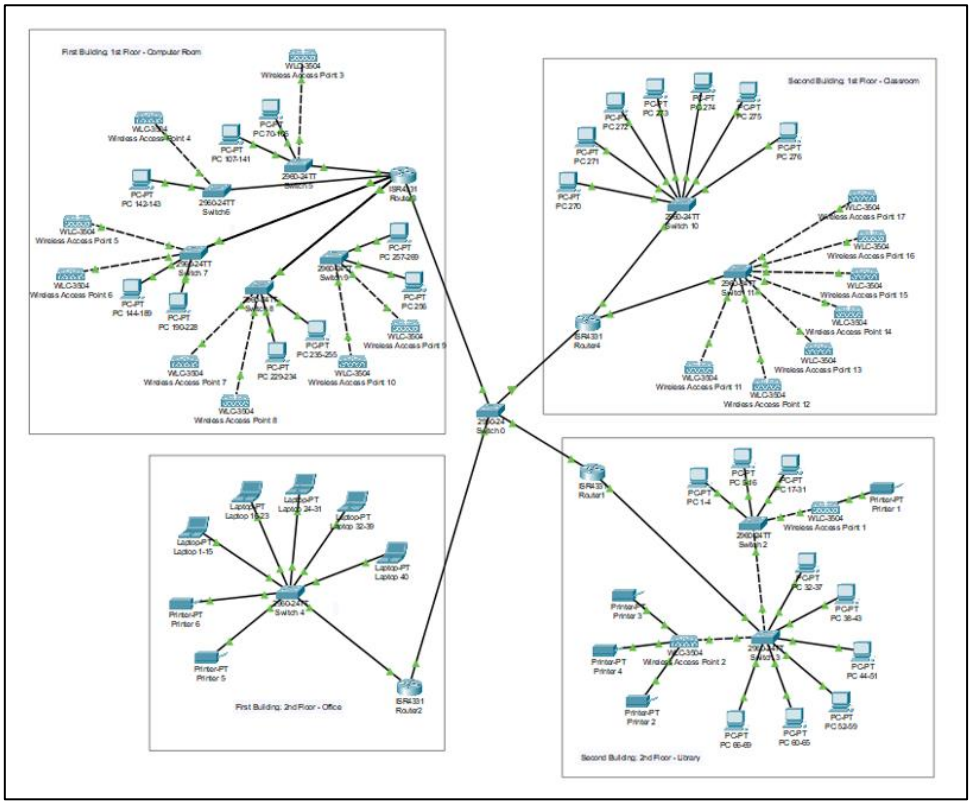


- Library – Second Building, Second Floor



Network Topology Diagram

- Logical network topology showing device connections and IP addressing scheme.



APPENDIX B: DEVICE SPECIFICATIONS

Router Specifications

Product: UDM-SE

- Interface:
  - LAN: (8) GbE RJ45 ports, (1) 10G SFP+ port
  - WAN: (1) 2.5 GbE RJ45 port, (1) 10G SFP+ port
  - Wireless/Wired: Wired
  - Price: US$49

Product Name	UDM-Pro	UDM-SE
Rack Width	1RU	1RU
Interface	LAN (8) GbE RJ45 ports (1) 10G SFP+ port WAN (1) GBE RJ45 (1) 10G SFP+ port	LAN (8) GbE RJ45 ports (1) 10G SFP+ port WAN (1) 2.5 GbE RJ45 ports (1) 10G SFP+ port
Wireless/Wired	Wired	Wired
Interface Slots	4	4
Modular LAN switch Ports	(8) GbE RJ45	(8) 2.5 GbE RJ45 including (2) PoE+ and (6) PoE
Price	US$379	US$499

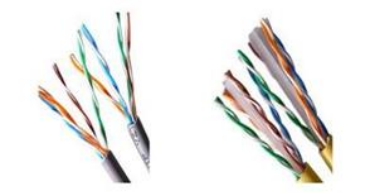
Switch Specifications

- Product: USW-Pro-48
  - Forwarding Performance: 130.944Mpps
  - Switching Capacity: 176 Gbps
  - Port Quantity: 52 (48 Gigabit Ports, 4 SFP ports)
  - Price: US$599

Product Name	USW-Pro-48	USW-48
Forwarding Performance	130.944Mpps	77.376 Mpps
Switching Capacity	176 Gbps	104 Gbps
Port Quantity	52	49
Gigabit Ports	48	48
FSP ports	(4)1/10G	(1)1G
Wireless/Wired	Wired	wired
Price	US$599	US$399

Cabling Specifications

- Cable Type: Cat6
  - Maximum Bandwidth: 0-250 MHz (500 MHz maximum)
  - Maximum Data Rate: 10 Gbps over 33-55 meters
  - Connector: RJ45
  - Shielding: UTP/STP
  - Cost: Approximately $0.40 - $0.60 per foot

Product Name	CAT5e	CAT6
Maximum Bandwidth	Up to 100Mhz	0-250 MHz (minimum); 500 MHz maximum
Maximum Data Rate	1000Mbps	10 Gbps over 33.55 meters (110-165 feet) of cable
Maximum Cable Distance  CAT5e CAT6	100 meters	100 meters for slower network speeds (up to 1,000 Mbps) and higher network speeds over short distances. For Gigabit ethernet, 55 meters max, with 33 meters in high crosstalk conditions.
Connector	RJ45	RJ45
Shielding	UTP/STP	UTP/STP
Cost	Varies by length and manufacturer generally $0.20-$30 per foot.	Varies by length and manufacturer, with $0.40 - $0.60 per foot as an average. Generally. About 20% higher than Cat5e.

Wireless Access Point Specifications

- Product: U7-Pro
  - Wi-Fi Standards: 802.11a/b/g/n/ac/ax/be (Wi-Fi 6/6E, Wi-Fi 7)
  - Max. Data Rate:
    - 2.4 GHz: 688 Mbps (BW40)
    - 5 GHz: 8.6 Gbps (BW240)
    - 6 GHz: 5.7 Gbps (BW320)
  - Price: US$189

Product Name	U6-Enterprise	U7-Pro
Wi-Fi Standards	802.11a/b/g/n/ac/ax (Wi-Fi 6/6E)	802.11a/b/g/n/ac/ax/be (Wi-Fi 6/6E, Wi-Fi 7)
Wireless security	WPA-PSK, WPA-Enterprise (WPA/WPA2/WPA3)	WPA-PSK, WPA-Enterprise (WPA/WPA2/WPA3/PPSK)
Spatial streams	8 per radio	6 per radio
Max. data rate	2.4 GHz 573.5 Mbps (BW40) 5 GHz 4.8 Gbps (BW160) 6 GHz 4.8 Gbps (BW160)	2.4 GHz 688 Mbps (BW40) 5 GHz 8.6 Gbps (BW240) 6 GHz 5.7 Gbps (BW320)
Uplink	1/2.5 GbE RJ45 port	1/2.5 GbE RJ45 port
PoE+	Yes	Yes
VLAN	802.1Q	802.1Q
Concurrent clients	600+	300+
Price	US$279	US$189

APPENDIX C: IP ADDRESSING SCHEME

IP Address Allocation

- First Building:
  - Office Area: 192.168.1.0/24
  - Computer Room: 192.168.2.0/24
- Second Building:
  - Classroom: 192.168.3.0/24
  - Library: 192.168.4.0/24

DHCP Configuration

- DHCP Server:
  - Pool Range for the First Building: 192.168.1.100 - 192.168.1.200
  - Pool Range for the Second Building: 192.168.3.100 - 192.168.3.200

APPENDIX D: SOFTWARE AND TOOLS USED

Software List

- Packet Tracer: Used for network design and simulation.
- Diagrams.net: Tool for creating network diagrams and floor plans.
- Floor Plan Creator: Application for designing detailed floor layouts.

APPENDIX E: GLOSSARY

Technical Terms

- LAN (Local Area Network): A network that connects devices within a limited area, such as a building or campus.
- IP Address: A unique address assigned to each device on a network.
- DHCP (Dynamic Host Configuration Protocol): A protocol that automatically assigns IP addresses to devices on a network.

APPENDIX F: ADDITIONAL REFERENCES

1. Floor Plan Creator Tool: https: https://floorplancreator.net/

2. Packet Tracer Network Tool: https://www.packettracernetwork.com/download/download-packet-tracer.html

3. Diagrams.net Tool: https://app.diagrams.net/?src=about

APPENDIX G: PICTURES OF THE MEMBERS

1. Lim Jinjie (2370036 – DCS)

2. Quee You Xin (2370283 – DCS)

3. Soo Mun Hong (2390027 – DCS)

4. Nicholas Chay Khai Wenn (2390101 – DCS)