Network Design for School of Computing Block N28B

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

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Case Study Report submitted to School of Computing, Universiti Teknologi Malaysia in partial fulfilment to complete the SECR 1213 final project for Semester I session 2020/2021

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Thanks to the God because given us the opportunity to complete this report and project just in time. Even though, we have faced with a lot of difficulties along this task, He guided us to the right path, and we could not be any more grateful by where we are now.

This report and task will be not complete without a great teamwork from the Group 6 or also known as SANI Digital Resources. Each of team members always committed and contributed more than enough to finish the project without doing any in person meet-up and meeting during this hard time. Honorable mention, our lecturer of SECR1213 Dr. Muhalim bin Mohamed Amin himself always give us a proper guide while working on this project.

Next, my appreciation and gratitude extended to the staff from School of Computing who willingly participate and interviewed to have better understanding to create a proper networking plan for this project.

Finally, the appreciation is dedicated to our fellow friends and family which always motivate us on completing this project along with the report.

Abstract

The history of Faculty of Computing (FC) began in 1981 when it was known as Department of Computer Science, under the wings of Faculty of Science. This department began its operation at UTM Gurney Road Kuala Lumpur where it received its first intake of Computer Science Integration Programme students. This programme integrated the programme of Diploma with Bachelor of Science (BSc) of Computer Science. In 1984, the department was established as Institute of Computer Science that consisted of Academic Unit and Administrative Computing Unit.In 1991, the Institute was separated from the Administrative Computing Unit and be elevated to a faculty status knows as Faculty of Computer Science and Information Systems. The year also marked the first intake of Master of Science (MSc) and Doctor of Philosophy (PhD) of Computer Science students.

The establishment of new faculty, increasing student and staff populations, and demands for facilities have resulted in a move to the UTM main campus in Skudai, Johor in 1995.As the years go by, the faculty has seen a significant increasing number of students due to the popularity of its high quality postgraduate academic programmes. The number of postgraduate students and staff, and demands for more sophisticated facilities has resulted in additional 5-storey building in 2012 to provide a conducive environment for teaching, learning and research.In January 2013, once again the faculty made a significant stride by rebranding the faculty's name from Faculty of Computer and Information System to Faculty of Computing. Branding the organizational restructuring and strengthening the academic programmes as well the faculty research will hopefully make it in line with the university vision to be recognized as a world class centre of academia and technological excellence.

The School of Computing (SC) currently has 1200 students (both undergraduate and postgraduate), 97 academic and 35 supporting staffs. They anticipate a 10% growth in both students and academic staffs in the next 3 years. To facilitate this growth, SC plans to build a new 2 –storey building. This new building will house 4 new labs, 2 video conferencing rooms, for virtual project meetings. A total 30 workstations and one multi-terabyte storage sever is planned for each lab. The labs are divided into 1 general purpose lab, 1 Computer Security lab, 1 Network lab and 1 IOT lab. Each lab is equivalent to the current Digital Logic Lab in size and are must be equipped with high-speed internet connection in preparation for education in line with 4IR (4th Industrial Revolution). SC Chair wants the building to be 'ready for anything' and have reliable, efficient, and secure network that can be easily managed. He also noted that it should be cost effective.

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Chapter 1

1. Project Setup

On this chapter, we will summarize our group information in detail. As state the on the case study, we are required to form a group of 4 to execute the phase 1 to 6. The group formed with dedicated and motivated students, while the group consists of 2 SECPH students along with 2 new intake students from SECBH programme.

1.1. Group Information

The team has decided to go with SANI Digital Resources as the group name. SANI are the acronyms of each initial name from each member. S stand for Syakila, A as for Alis, N for Nabiel and I stand for Iwanina. This shown the members are committed to do this project by achieving the goals and objective planned.

The team also have come out with the logo for this group project. This is to show our professionalism side of each team members. Behind the ideas of connected dots, is to represent our different ideas and opinion are all used to achieve the goals aimed for each phase.

Figure 1.1 SANI Digital Resources logo

1.2. Team Members and Roles

The team leading this project are consist of 4 people, and the team are assigned to a role and responsibilities each:

Roles	Name	Matric ID	Programme
Project Manager :	**MUHAMMAD NABIEL IZZUDDIN BIN RADZUAN**	**A20EC0241**	**1SECB**
Technician :	**NURUL ALIS ALIA BINTI MOHAMAD ZAMRI**	**A19EC0141**	**2SECP**
Technician :	**NURFATIN IWANINA BINTI MOHD ABDUL RASHID**	**A20EC0242**	**1SECB**
Audit :	**NUR ALEEYA SYAKILA BINTI MUHAMAD SUBIAN**	**A19EC0127**	**2SECP**

Table 1.2 Shown the table of members and roles assign

1.3. Introduction to Project

From the case study given, School of Computing anticipate a 10% growth in number of students and academic staffs for the next 3 years. Therefore, the **aim** of the project that has been given to us is solely about building a network for a new 2-storey building of School of Computer. The new 2-storey building including 4 new labs and 2 video conferencing rooms that needed to be placed. The **objective** of building a good network is to interconnect various devices to share resources between users. When building a network, we need to accomplish a given target. For instance, we might need to minimize the expense as much as we can and by the meantime, the network can also last long. In our scope, we will be doing from planning the design network, determining the good network devices that will cost up below our budget and placing the devices to their correct places.

1.4. Budget Given

Based on case study question, the budget given by group arrangement, since our team placed on the sixth place the budget given is **RM 1,500,000**. The budget is numerously big, and a lot can be done to provide the best networking plan for the building proposed.

GROUP	6
BUDGET GIVEN	RM 1,500, 000

Table 1.3 Summarize of budget given

1.5. Meeting

The team always committed to do a meeting every two weeks from the day of submissions. Most of the meeting are conducted on virtual text communicating application WhatsApp group text. The minute meeting will be attached on **Appendix A** for further referencing.

1.6. Reflections

First of all, for task 1, we need to setup the project. So firstly, we need to create our own team. For this task, we need to sum up our team information in detail. As express the looking into case study, we are needed to form a group of 4 to execute all the task 1 to 6.

Also for this task, the group are needed to come out with the networking floor plan and should be done clearly and exactly concerning the network plan will be use through the task 2 until 5. As the case study expressed the floor plan should be a similar size as the initial digital logic lab working in School of Computing faculty and require 2 floor levels and load up with 4 labs and 2 video conferencing room. The labs and rooms should be long-last network plan alongside 4th industrial revolution promising.

After that, we need to portray the floor plan. The task executed with every part tosses out their thoughts and thought about the network plan by sharing their representations of the floor plan. At first, it was confused for us to decide what software application we are going to use to sketch the floor plan. After we look up for a few online software applications, we decided to use Floor Planner software application. The software was easy to use which make us faster doing our plans. It is easier to make the shape, line, and to add some words. Other than the other tools that we find quite difficult to use it. After a couple of portrayals are pleasantly done and acknowledged by among the team members. Our group continues to make sketches of the representations into legitimate networking floor configuration utilizing a software application on the web.

Chapter 2

2. Floor plan

For the phase, the team are required to come out with the networking floor plan and need to be done clearly and precisely as for the network plan will be use through the phase 2 until 5. As the case study stated the plan must be the same size as the initial digital logic lab building in School of Computing faculty and require 2 floor levels and fill with 4 labs and 2 video conferencing room. The labs and rooms need to be long-last network plan along with 4th industrial revolution promising.

2.1. Task Execution

The task executed with each member throws out their ideas and thought of the network plan by sharing their sketches of the floor plan. After a few sketches are nicely done and accepted by among the members. The teams proceed to translate the sketches into proper networking floor design using an architecture software online.

2.2. Floor plan for each level

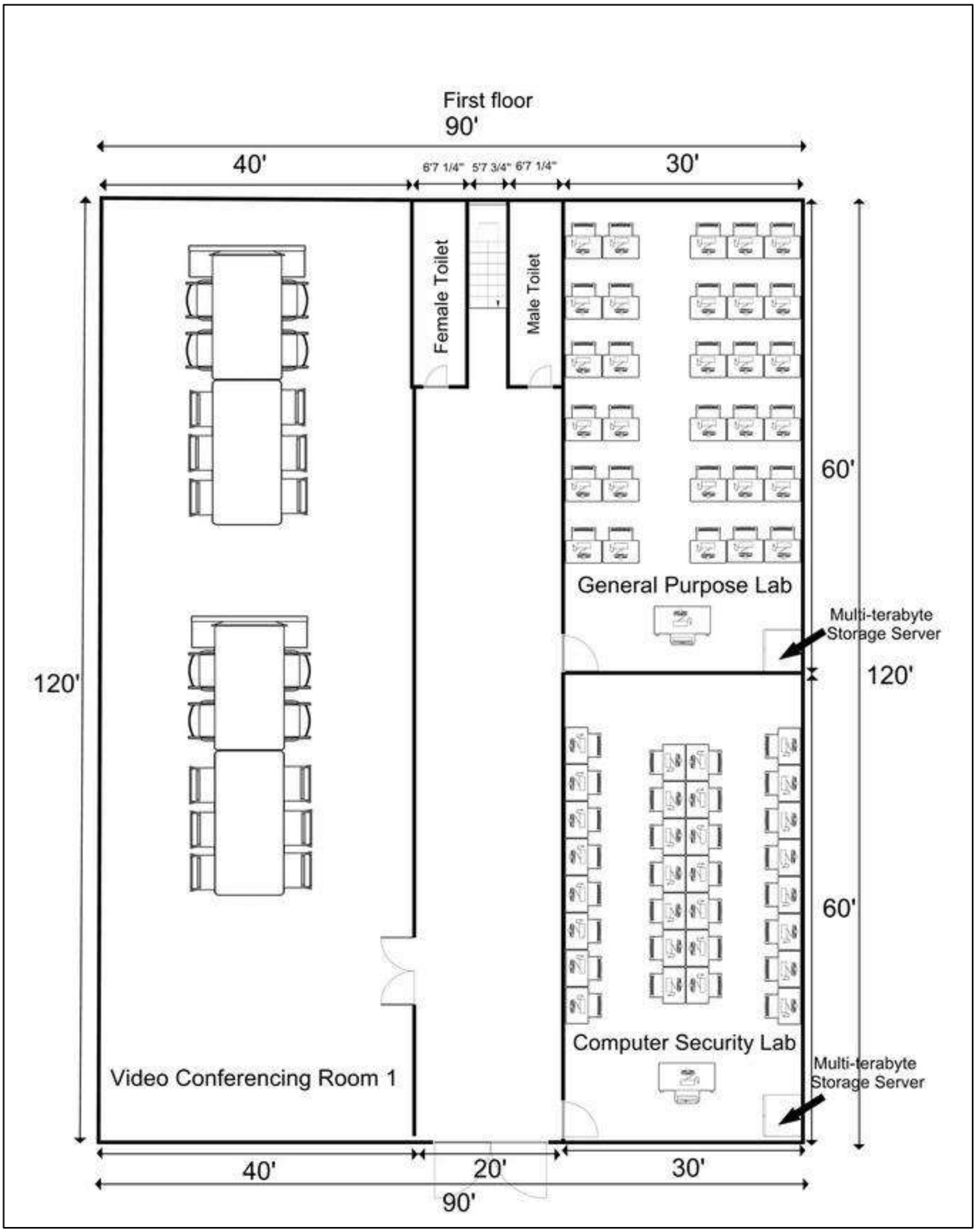

Figure 2.2.1 Shown is the floor plan for first floor

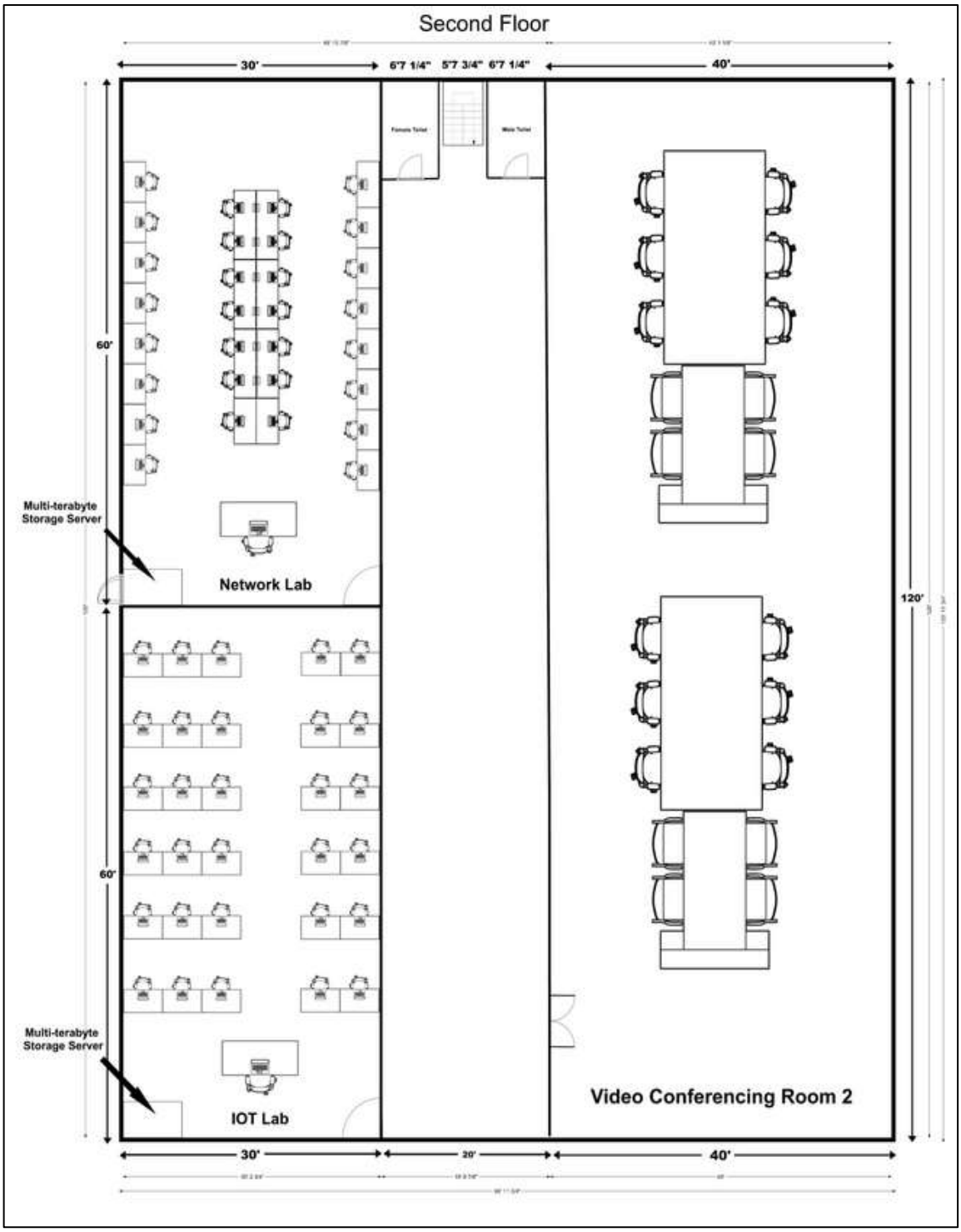

Figure 2.2.2 Shown is the floor plan for second floor

2.3. Floor plan details

As the building planned to house 4 labs and 2 video conferencing room, we need to ensure the networking plan propose are meet the requirement as the faculty stated. The building is expecting a huge number of growths of the user in School of Computing, from students and staff, both users will be using the building. The team has come out a suitable networking floor plan to house 30 working station in each lab.

The floor plan was design in commercial design as we need to follow the previous digital logic floor plan as stated on the initial case study. The team chose to use the commercial networking design is because of to avoid any complications on network wiring, to avoid the amount are exceeding the budget.

Despite with commercial design used, our network plan is meet the requirement on the case study which should be reliable, efficient, and secure network and need to be easy for maintaining with effective bud t given. The floor plan is divided into two floors and each of the floor are installed with high-speed internet router with Wi-fi placed at the most use spot in the building.

On the ground floor, both General Purpose Lab with Computer Security lab will be on east side, while the conferencing room 1 will be on the west side. This arrangement is followed for IOT lab and Network placed on the upper floor and reverse the position. Also, the network floor plan is consisting other facilities such as:

1. Toilet
2. Wi-fi spot
3. Network Lab
4. Computer Security Lab
5. IOT Lab
6. General Purpose Lab
7. Public Lounge
8. Video conferencing room 1 & 2

As mentioned previously, all the facilities provided installed on the network plan will be interconnected to each host as the team were decided to use Hybrid topology of Mesh topology and Star topology as the network topology. Even though, this topology quite expensive to developed but its reliable enough for a long-time usage, because it easy to maintain. The topology will be used for all the building proposed on the network plan.

The labs will be facilitated by 30 workstations along with other proper devices used in the class such as projector, monitor, and CPU. With all the devices listed will be interconnected to each other, using Cat6 cable.

2.4. Reflections

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Chapter 3

3. Preliminary Analysis

On this chapter, will be introduce and explain in deep for preliminary analysis towards our initial network floor plan. The goals for this phase is to find the feasibilities study to achieve the reliable network plan. Thus, this portion is usually be done through meetings and interviews. Hence, the team has construct 17 questions with analysed answers. Below are the details of the questions along with the explanation.

3.1. Inquisitions

1. What safeguard do you put in network design to minimize data loss?
    a. The data would be backup on a separate site, meanwhile Firewall and Antivirus software will be installs to avoid any malware hijacked the forms of sensitive information which leading to even greater data breaches. After all the steps implemented, a duo of IT Security Experts or Staff are needed to observe the network behavior.

2. Is it suitable to place the server in the lab most of the time, especially after working hours?
    a. The servers will be maintaining by the IT Staff assigned, while the server need to keep on, the specific air conditioner will be installed in order to avoid the server from getting too much heat and to guarantee the server are available in long term.

3. What type of cable would be compatible to connect the end systems to the DSP (modem/router) or a server?
    a. Ethernet cables are the most common cables use in computer networking. Ethernet cable are the most common and main type of networking cable, and most of the cable connected to a PCs, routers and switches withing a Local Area Network and promising stay connected. This cable always supports one or more industry standard including Cat (5). Cat (6) which we will provide on the networking plan.

4. What kind of access network will be implemented or installs on your networking plan?
    a. Ethernet and Wireless LAN will be used for this building. While the building will fill with 30 workstations and need to be connected towards each workstation ethernet will be suitable for the task meanwhile, wireless LAN will provide stable connections to any mobile devices on daily routine in the building by using: smartphone, smart TV or wireless projector on both education purposes and conferencing meeting.

5. Which type of switching is preferred to develop your network?
    a. Packet switching is more affordable and easier in maintaining. While the bandwidth can be used at once, packet switching is more efficient since it does not have to deal with a limited number of connections that may not be using all the bandwidth.

6. What network protocol will be applying on this network (e.g.: Ipv4, Ipv6)?
    a. IPv6 will be fit with the networking plan since a lot of working station will be connected to the internet and need to be reliable for a long term, IPv6 can be reliable for the responsibility. Since IPv6 is the newest protocol and can support up to 128-bit of internet addresses.

7. What type of network architecture will be used? (Peer-to-Peer or Client-Server)
    a. We will be using client-serve as the security as a single server administers the shared resources while it contains the centralized system. Therefore, the data will be backup easily and dedicated server will improve the network system.

8. Do you have any requirements regarding the network plan?
    a. Besides having a good connection to the internet, we need another requirement for the network such as having a network diagnostic tool as system check to analyses the bandwidth. It will be used different days and times of day to assess the available bandwidth and network traffic.

9. Do we need to enable VPN?

a. VPN is needed in order to protect the server with prevents corporations and cybercriminals from accessing the sensitive information which lead to data leaks and cyberattacks. VPN will encrypt all the data travel over the network to avoid cybercriminal and ISP to observe the data behavior in network built.

10. What type of network topology will be used in this network design?

a. For the network plan design, Hybrid topology which mix of star topology and mesh topology will be use. The reason of hybrid topology used is a lot of workstations will connect to the switch and end devices will connect to central hub on network device. Additionally, it is scalable as device can be added or removed without taking the entire network offline.

b. On the flipside, if the central networking device goes down, the rest of the network cannot function. But if the central hub is properly managed and kept in good shape and no issues. On the other hand, mesh topologies are reliable and the interconnectivity between all nodes makes the network resistant to failure.

3.2. Feasibilities Studies

With 10 questions has been answered on previous page, the team has analysed all 4 the feasibilities studies which include technical studies, economic studies, operational studies, and scheduling studies. All 4 studies will determine all the workload on this team are reliable and succeed on achieving the goals aimed.

1. **Technical Feasibility**

   This network plan project focuses on the technical resources available to the case study. It helps to determine whether the technical resources meet capacity and whether the technical team is capable of converting the ideas into working plans. Technical feasibility also involves the evaluation of the hardware, software, and other technical requirements of the proposed network plan project.

   Currently, we do not possess the necessary technology to complete the plan. Also, we do not possess the necessary technical expertise, but the manpower can be hired to complete certain parts.

   What kind of technology will we need?

   - Some organizations like to use mature and proven technology.
   - A mature technology has a larger customer base for obtaining advice concerning problems and improvements.
   - The technology is available and have the capacity to handle the solution based on the network plan.
   - **Hardware:** multi-terabyte storage severs, Routers, Desktop with high resolution monitors
   - **Software:** Video conferencing Software, Browser software

2. Economic Feasibility

This network plan project typically involves a cost and benefits analysis of the project, determine the viability, cost, and benefits associated with a project before financial resources are allocated. It also serves as an independent project and enhances project credibility by helping decision-makers determine the positive economic benefits to the proposed project will provide.

Budget: Cost is one of the most common limiting factors when producing any design. Limited resources may require some compromises in design due to the costs of equipment, software, or other components. For this project, **we were given RM1.5M** to be spent on the overhaul of hardware and software.

Reduce operational cost: Reduce the cost of maintaining multiple networks for the plan.

The cost and benefits of each alternative can be calculated.

Cost-benefit analysis:

Things to consider:

- Hardware and software selection.
- Selection among alternative financing arrangements.

Difficulties:

- Benefits and costs can both be intangible or hard to estimate.

3. Operational Feasibility

The following is a typical classification of the requirements, some of which might be provided directly and some of which can be implied or indicated based on other requirements and goals.

The problems identified are the scalability and management of the network, the performance of the whole network, the level of protection against breaches and attacks on the network and the connectivity of the network.

The alternative solutions are using higher performance hardware to build the network, utilizing hierarchical network design, utilizing suitable network topology, installing necessary network security technologies, and installing wireless area network in the building.

Resistance:

- The management will support the network plan project.
- The end users think the requirements suit as the user wants.
- The end users will not resist the new system as it is similar to their current system, just better in performance.
- The existing IT professionals can train new staff if there is not enough manpower to handle the new system.

4. Scheduling Feasibility

This is the most important for project success. After all, a project will fail if not completed on time. In scheduling feasibility, **an organization estimates how much time the project will take to complete.**

Scheduling: The network plan project time frame should be aligned with the user schedules.

We may have the technology, but that does not mean we have the skills required to properly apply that technology.

- We may need to hire new people.
- Need to re-train existing systems staff.

This will impact the schedule.

Assess the schedule risk: The deadline is mandatory, so we need to follow the alternative schedule.

The Constraint to deliver:

- If the project overruns, we need to reschedule.
- Deliver a properly functioning information system on time.

3.3. Reflections

From task 2, we learned that every time we are about to do or build a project, it is crucial to do the preliminary steps where we need to collect all basic information regarding a particular project. From our project requirements, we were required to collect possible questions regarding networking and needed to find the answers to every of the questions. We did a lot of research from one article to another to find common basic questions that usually been asked. Besides, we also asked people around regarding networking. We asked those people who had experience or had more knowledge about networking as for our reference. While doing the findings, we realized that there is a lot of lack of knowledge that we had, too many things that we are unfamiliar with

.

Also, we gained a lot of knowledge on this task especially on doing research and gathering all the information found on the internet. This step is advanced by analyzed every result found to make sure all the information gathered would meet the requirement needed. The team also performed preliminary analysis to found the suitable equipment to make a complete LAN for the building purpose. Not forgetting the analysis, for every information found to make a feasibility studies. It is vital for every development to make a feasibility study because to deliver the outcome meet the requirement. For this task, every member did their job along with the responsibilities given precisely to deliver the task perfectly done.

Chapter 4

4. Choosing Appropriate LAN Devices

After 3 weeks given to complete this phase 3, our team has come out with the best result for choosing the suitable devices on setting up Local Area Network for our initial networking floor plan. As stated on the case study, there is 4 Lab and 2 Conference Room planned to be built on the new building, since this is institutional building using LAN is suitable choice to made. On this phase, our team will explain and include the objective of this phase, the LAN Devices and Reflection at the end of the report.

a. Phase Objective

On this phase there is a few goals were aimed to achieve:

i. To find a suitable and reliable device to build set up the complete LAN.
ii. Fulfilling the requirement and needs of the organization.
iii. Providing long-lasting network.

b. Phase Execution

This phase has been done by fairly schedule by the project manager and agreed on the plan. The task executes with:

i. Detailing the Hybrid Network topology of Mesh and Star.
ii. Analyse the suitable devices on network topology detailed.
iii. Research on the devices from Web and collecting them.
iv. Construct a simple comparison on the same devices found.
v. Make reflection to the phase.

4.1. Network Topology

On previous session of phase 1, our team has discussed on choosing which topology would be reliable for a long time of use. After a few discussion and comparison, the team has decided to use Hybrid Topology of Mesh topology and Star topology. This is because of Hybrid topology are more reliable on flexibility and networking.

a. Hybrid Network Topology Illustration

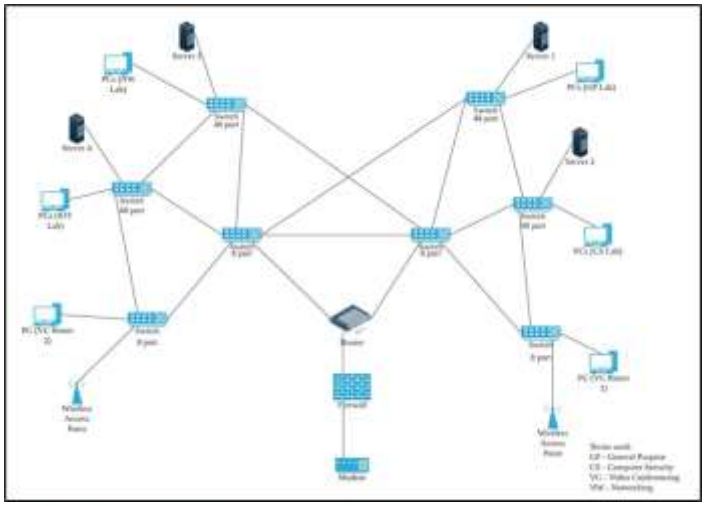


Figure 4.1 Shown the illustration of Hybrid Network Topology

b. Clarification on Hybrid Network Topology

At the access layer, since a lot devices will be connected to the switch, star topology will be used. In a star topology, each end device has a direct connection to a single networking device. Because each of the nodes is independently connected to the central hub, if one goes down, the rest of the network will be unaffected, making the star topology a secure network topology. Additionally, it is scalable as devices can be added or removed without taking the entire network offline. On the flipside, if the central networking device goes down, the rest of the network cannot function. But if the central hub is properly managed and kept in good health, there should not be any issues.

Although it is safer to use mesh topology, we had to resort to star topology because we want to save budget and it needs only minimal configuration. At the distribution layer, a partial mesh topology will be implemented. Partial mesh topologies are mostly interconnected, with a few nodes with only two or three connections, creating sufficient redundancy without the complexity of a full mesh.

4.2. List of Devices

As stated on the case study, each of the team of networking provided with certain budget in order to set up the best Local Area Network. Our team has been provided with RM 1.5 Million. Refer to **Appendix B** for the detail list of devices, on this section will be detailed on main component on developing our network plan. Also, a simple comparison between main component will follow below.

a. Main Components

NO	DEVICE	FEATURE	PER UNIT(RM)	QUANTITY	TOTAL (RM)
1	ROUTER (Cisco RV042G-K9-EU Gigabit Dual WAN VPN Router) 	• Dual gigabit ethernet wan ports for load balancing and / or business continuity • Built-in 4-port gigabit ethernet switch • Strong security: Proven stateful packet inspection (spi) firewall and hardware encryption • High-capacity, high-performance ip security (ipsec) vpn capabilities • Allow the set up up separate virtual networks and access rules to secure sensitive data	995.63	1	995.63

2	SWITCHES (Cisco SF200-48 48-Port 10/100 Smart Switch) 	• Ports: 48-port 10/100. • Expansion Ports: 2 combo mini-GBIC. • Capacity: 10.12 mpps. • Switching Capacity: 13.6 Gbps.	813.86	4	3,255.44
	SWITCHES (8-Port Switch 10/100 PoE) 	• 10/100 with IEEE 802.3af and Cisco prestandard Power over Ethernet (PoE) • High performance and reliability • Fast, easy setup and configuration	684.41	4	2,737.64
3	SERVERS (Dell EMC PowerEdge T140 MT VFC7D Xeon E-2200 1TB) 	• DIMM Speed up to 2666MT/s • Work more efficiently with 50% more cores with Intel Xeon E-2200 processor, 11% faster data transfer speeds, and 20% more PCIe lanes* • Protect your server from malicious changes with iDRAC9 Enterprise Server Lockdown mode	4779.99	4	19,119.96
4	ACCESS POINT (Cisco Aironet 1602I IEEE 802.11n 300) 	• IEEE 802.11n 300 Mbps Wireless Access Point • CleanAir Express technology • Ism Band - Unii Band Aironet 1600 11agn 300mb 2.4ghz and 5ghz AES Integrated ANT 4DBI • MIMO Technology • 300 Mbps • 235 ft	373	2	746.00

5	MODEM  ı MB8600 DOCSIS Modem)	• Wirecutter recommends this as the best cable modem for people using Gigabit Internet plans. Built-in DOCSIS 3.1 and DOCSIS 3.0 32x8 capabilities give top Internet speeds for all cable Internet services, from the slowest to the fastest. • Active queue management (aqm) significantly reduces internet latency • A broadcom chipset provides security from denial of service attacks	610.28	1	610.28
The list of devices will be on Appendix B					
TOTAL					**423,819.45**

Table 4.1.1 List of the main component on Developing the LAN

b. Comparison between same devices on Main Components

i. Router

ROUTER			
MODEL/BRAND	**PRICE**	**PROS**	**CONS**
ASUS ROG Rapture GT-AC2900	RM 870.87	• Excellent 802.11ac performance at up 10m • Dual WAN ports • Support for DFS • Remote router management	• 802.11 ac performance drops off fast beyond 10m • Requires boots for most features • 4 Gigabits for Ethernet Ports
D-Link Covr-2202	RM 1025.51	• Great performance dedicated to backhauls • Easy to install	• High price • No bridge mode operation • Lacks malware protection

Table 4.1.2 Shown is the difference between same routers

ii. Switches

SWITCHES			
MODEL/BRAND	**PRICE**	**PROS**	**CONS**
TP-LINK T1600G-52TS (TL-SG2452) JetStream 48-Port Gigabit Smart Switch	RM 1786	• 4 Gigabit SFP Slots • 48×10/100/1000Mbps RJ45 Ports supporting Auto Negotiation and Auto MDI/MDIX • Bandwidth/Backplane 104Gbps	• Bad reliability • Expensive
NETGEAR PROSAFE 48-PORT GIGABIT SMART SWITCH WITH 4 SFP (GS748T) - GREATPRO	RM 2699	• PoE-capable on all Ports of the Switch • 48 auto-sensing gigabit RJ45 ports • Bandwidth/Backplane 100Gbps	• Expensive

Table 4.1.3 Shown is the difference between same switches

iii. Access Point

ACCESS POINT			
MODEL/BRAND	**PRICE**	**PROS**	**CONS**
TP-link wireless n300 2t2r	RM 100.99	Cheap Easy to setup	Cannot operate in bridge mode This device comes with a PoE injector which needs
Ubiquiti unifi ap-ac long range	RM 443.58	More users access Flexible networking Broader range of transmission	Bad reliability

Table 4.1.4 Shown difference between same access points

iv. Server

SERVER			
MODEL/BRAND	**PRICE**	**PROS**	**CONS**
LENOVO ThinkStation P920 Tower	RM 11,769.56	• More bandwidth and capacity, the new 2666 Mhz DDR4 memory (up to 2 TB) responds faster than its predecessor	• Expensive • No **iDRAC** (Integrated Dell™ Remote Access Controller (iDRAC) is a piece of hardware that sits on the server motherboard that allows Systems Administrators to update and manage **Dell** systems, even when the server is turned off)
Dell PowerEdge T340 Tower Server	RM 6479	• 8M cache • iDRAC9 • 30gb RAM	• Expensive

Table 4.1.5 Shown is the difference between same server

c. Access point coverage

Our team has come out an idea to install an access point as the solution for a user with mobility devices since the LAN only uses guided media to stay interconnected with the network. This step taken is to make the other users who preferred stay connected with the network using our Access point provided. The access point proposed is to install 2 devices of Access Point of 802.11n with 235 feet of coverage. This device will be installed on both floor of ground floor and the first floor. Below, is the diagram pictured the coverage of the access point install for both floors (**Refer to Appendix C**).

4.3. Reflections

Budget Given	RM 1,500,000.00
Cost for this project	RM 423,819.45
Balance (Budget-Cost)	RM 1,076,180.55

Table 4.3.1 Shown the summarize of estimated cost used on this project

As stated on the case study on phase 3, the team are aimed to gather all the components with detail information to develop the Local Area Network for two floors on **Blok N28** building. As the number of growths in students and staff on the next years and ahead, the building planned need to be permanence. In order to achieve the goals, our team had taken an alternative on deciding the most reliable and advance network topology, Hybrid Topology of Mesh and Star Topology Beside of the cost on developing Hybrid Topology needed a big cost, it is reliable enough to accommodate the number growth predicted.

On the other hand, the team are expected the cost will become huge. This is because of to make the usability of the networking plan will be long lasting. The process on researching and gathering all the devices need to be precisely analyze the features described. The team learnt using the online store on web properly. 3 weeks were given to finish the phase are enough, the period fully focused and used on analyzing the components in detail. The step needs to be done to achieve the goals aimed, to make the network is reliable for long-term use.

Next, the team had considered the cost might be a factor on choosing a certain network

Topology. With the budget provided, the team are required to do deep research on picking the right network in order to reach the goals on providing good network for **Blok N28** building. As stated in the table above, the numbers of our estimated cost are big because of the each of the components each are offering best function and long-term guarantee.

Hence, the team has gave the one hundred percent of effort and time to make the motive into reality.

Chapter 5

5. Making LAN Connections

On this phase 4, SANI Team are required to putting all the infrastructure and devices implementing those on the initial floor plan. By using the devices gathered on the previous phase 3, the team have identified the 4 physical area planned especially on working area, telecommunication access, backbone cabling the distribution or horizontal cabling. The purpose on this phase is for developing a successful networking system.

a. Phase Objective

On this phase there is a few goals were aimed to achieve:

a. To find suitable and reliable networking design.
b. Providing better connection.
c. Determined a suitable length for cable.

b. Phase Execution

This phase has been distributed fairly schedule by the project manager and agreed on the plan. The task executes with:

i. Find the suitable length cable along with suitable type of cable.
ii. Estimating the total cost of the cable.
iii. Arranging cable with suitable places.

5.1. Describing the Physical Areas

Before proceeding the phase 4, the team has decided to do rough sketching in order to have deep understanding on networking area inspection on our initial plan. The sketch is describing the horizontal cabling and vertical cabling with other few connection area.

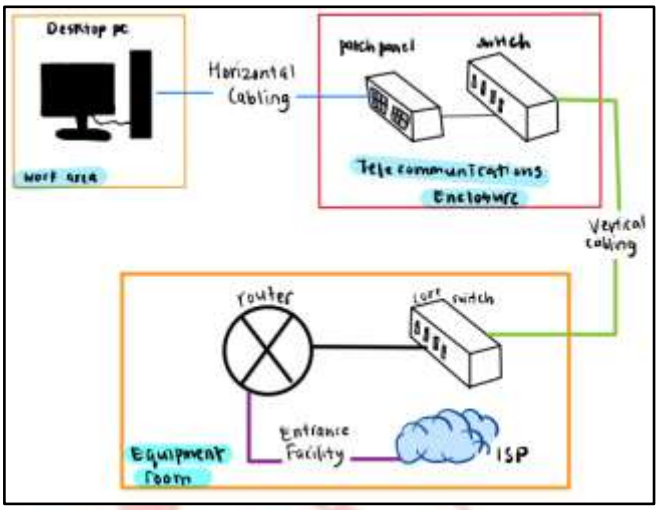


Figure 5.1.1 The illustration of horizontal and vertical cabling

5.2. Work Areas on the floor plan

Based on the case study, the team are required to identify the work area on the initial networking floor plan proposed before. With all the devices found and gather on phase 3, SANI has inspected the initial floor plan and succeed to identify the working area on the floor plan. In order to connect the devices, the region and its necessities are needed to prioritize first.

Once the working was characterized as the territory of the working environment where tasks are performed which typically comprises as the whole working environment and workstation.

Based on figure 5.2 below, this is the summarize working were identified

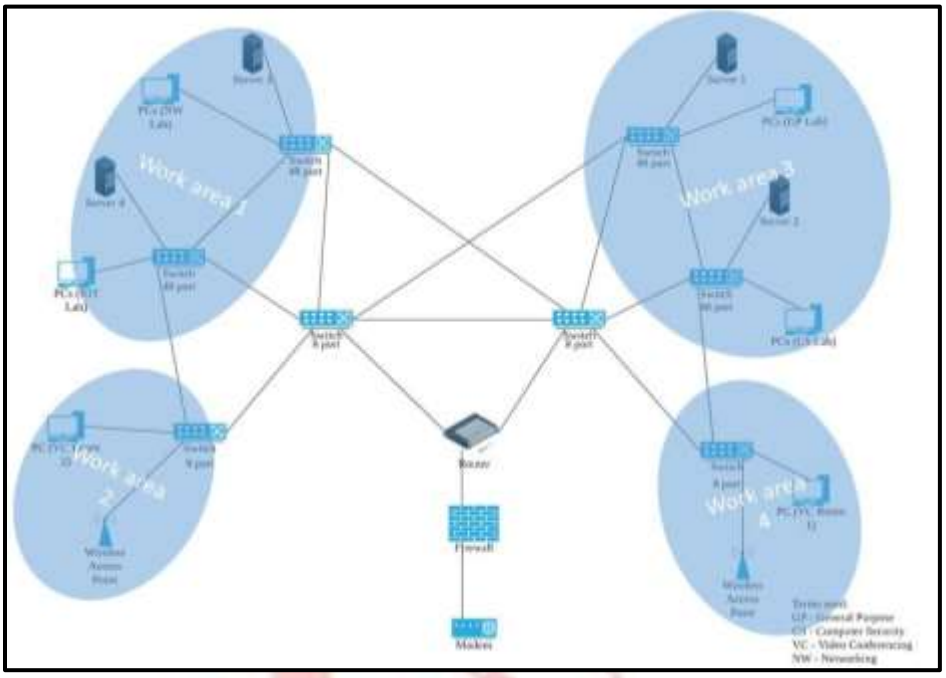


Table 5.2.1 Shown is the total 6 connections found

With the working area identify, the team has concluded into 4 working area found based on the illustrations above. The working area classified which will be determined with specific details followed by the descriptions in the table below.

Work Area	Description
1	In Work Area 1, it contains 2 labs which are IOT lab and Networking lab. We used 48 port switches for each lab to connect 30 workstations (lecturer and student PCs) including the server.
2	In Work Area 2, it contains one 8 port switch to connect the PC and other video conferencing devices in the Video Conferencing Room 1 and the wireless access point.
3	In Work Area 3, it contains 2 labs which are General Purpose lab and Computer Security lab. We used 48 port switches for each lab to connect 30 workstations (lecturer and student PCs) including the server.
4	In Work Area 2, it contains one 8 port switch to connect the PC and other video conferencing devices in the Video Conferencing Room 2 and the wireless access point.

Table 5.2.2 Shown of description of work areas

a. Connection Found

Based on the previous topology attached on 2.1 there is a few connections identified. Also, the details of the connection attached on **Appendix D** for detailed references

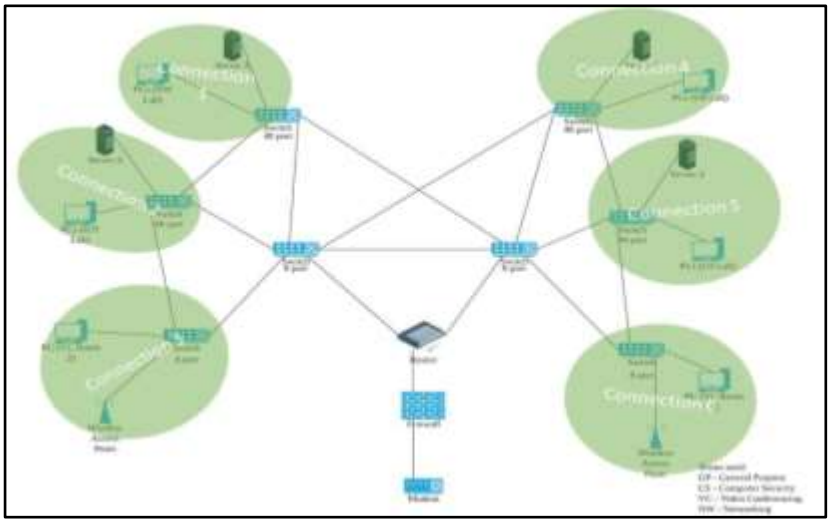


Table 5.2.3 Shown is the floor plan for first floor

b. Device Placing

Wireless devices also will be included on this phase thus the team are ensured to make the wireless connection are reliable enough to provide strong and long-lasting connection to the user as expected. With the devices gathered and found on the previous phase 3, placement is made to make sure the coverage is surely accessible strongly.

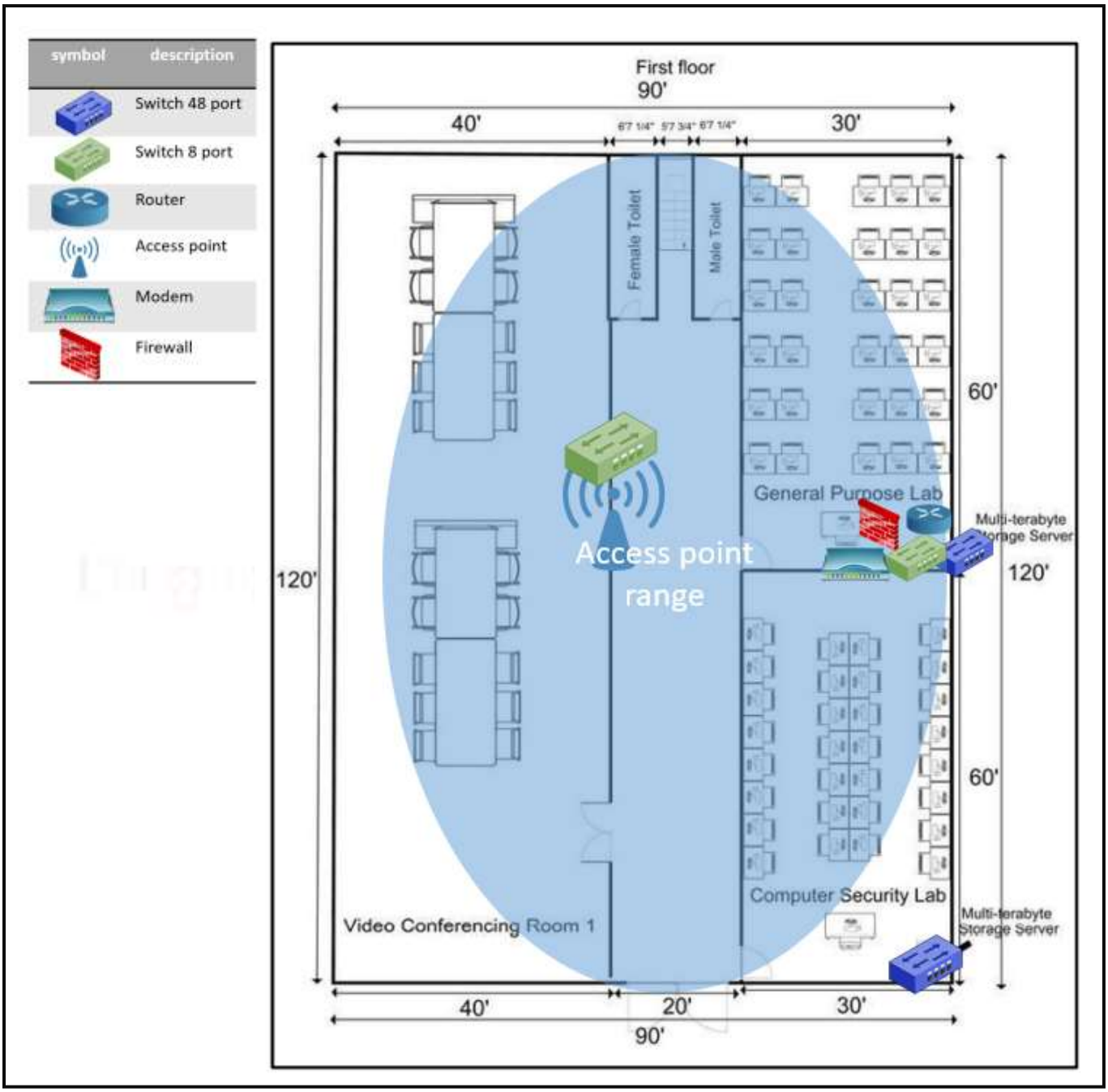


Table 5.2.4 Shown is the floor plan for first floor

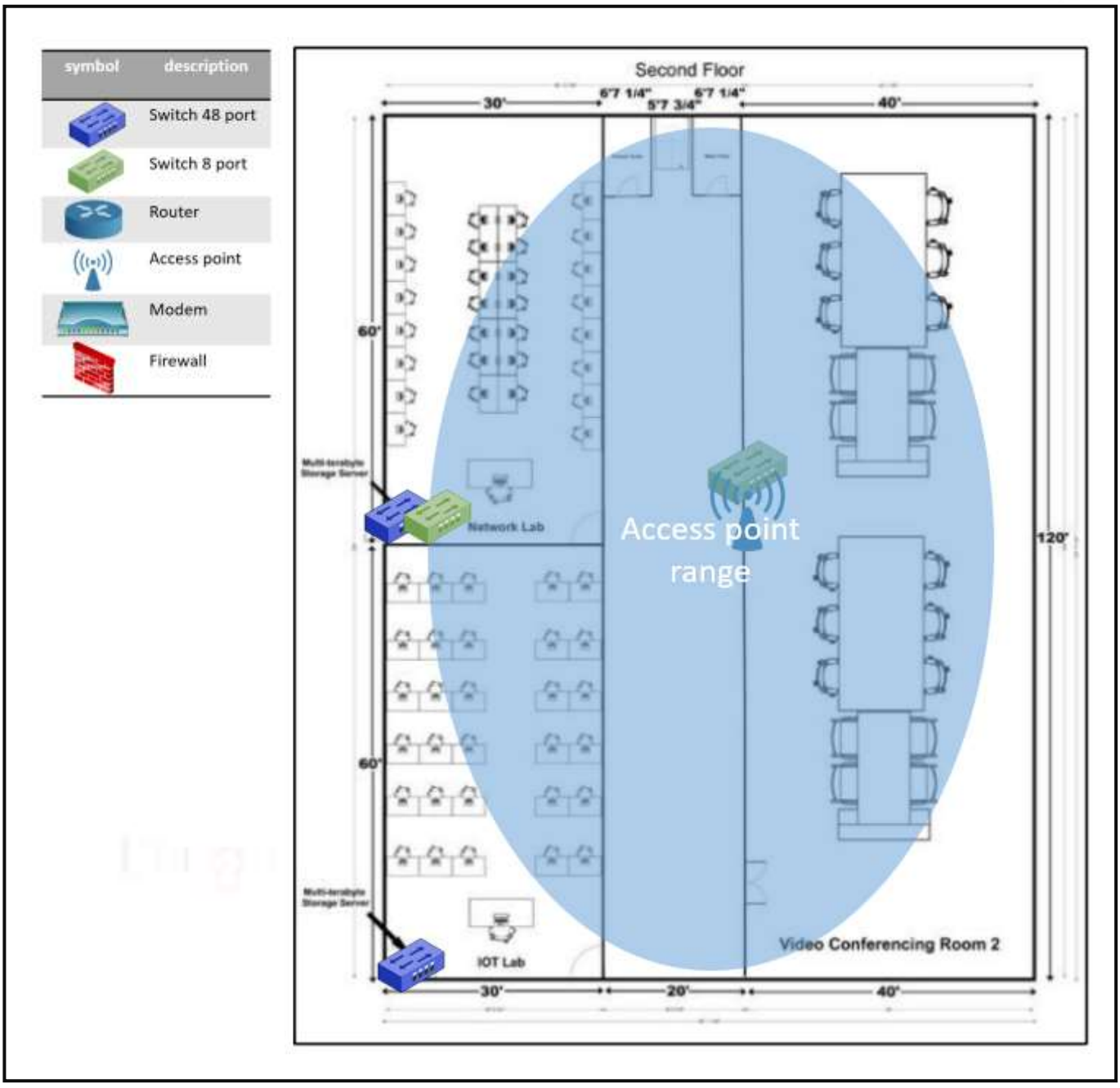


Table 5.2.5 Shown is the floor plan for second floor

5.3. Vertical Cabling

Once the device placement and working area are identified, SANI proceed on cable arrangement and do the length measurement of the cable based on the cable proposed on phase 3. Backbone cabling used **Cat6** cable is used because it can create a high-speed computer network and operate at optimal performance if other components in the network are compatible with gigabit speeds. The cable can handle speed performance of up to 250 MHZ. This fast performance makes it possible to use it with a fast ethernet network including Gigabit Ethernet and 10-Gigabit Ethernet. **Fibre optic** cable is used to connect each server to switch, the router to the firewall and the firewall to the modem. We did not choose copper cable in this case as fibre optic cable has a lot more advantages such as it has extremely high bandwidth. The volume of data that fibre optic cables transmit per unit time is far greater than copper cables. Besides, in fibre optic transmission, optical cables can provide low power loss, which enables signals can be transmitted to a longer distance than copper cables.

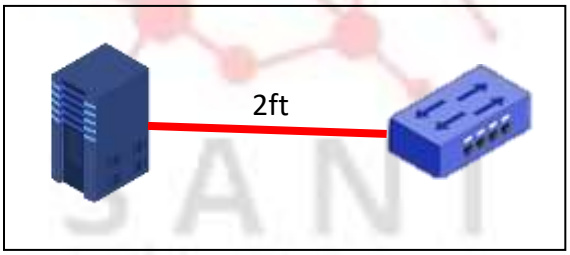


Figure 5.3.1 The simple illustration of connection made from server to the DSP

The diagram above shows the placement of the devices and the cable path. All the devices in the four labs are placed in a rack located in each lab. The device in video conferencing room will be placed in a cabinet. The cable length of one device to another device that resides in the same rack is approximately 2 feet. The cable will span from one room the another through the ceiling. Since the first floor and second floor have the same structure, the measurements for the wire that span to other rooms on the first floor will also be applied on the second floor.

This is to ensure:

a. Total measurement use on the cable is fixed with cost stated.

b. The labs are neat and comfortable to fill in.

c. Consistency and reliable connection.

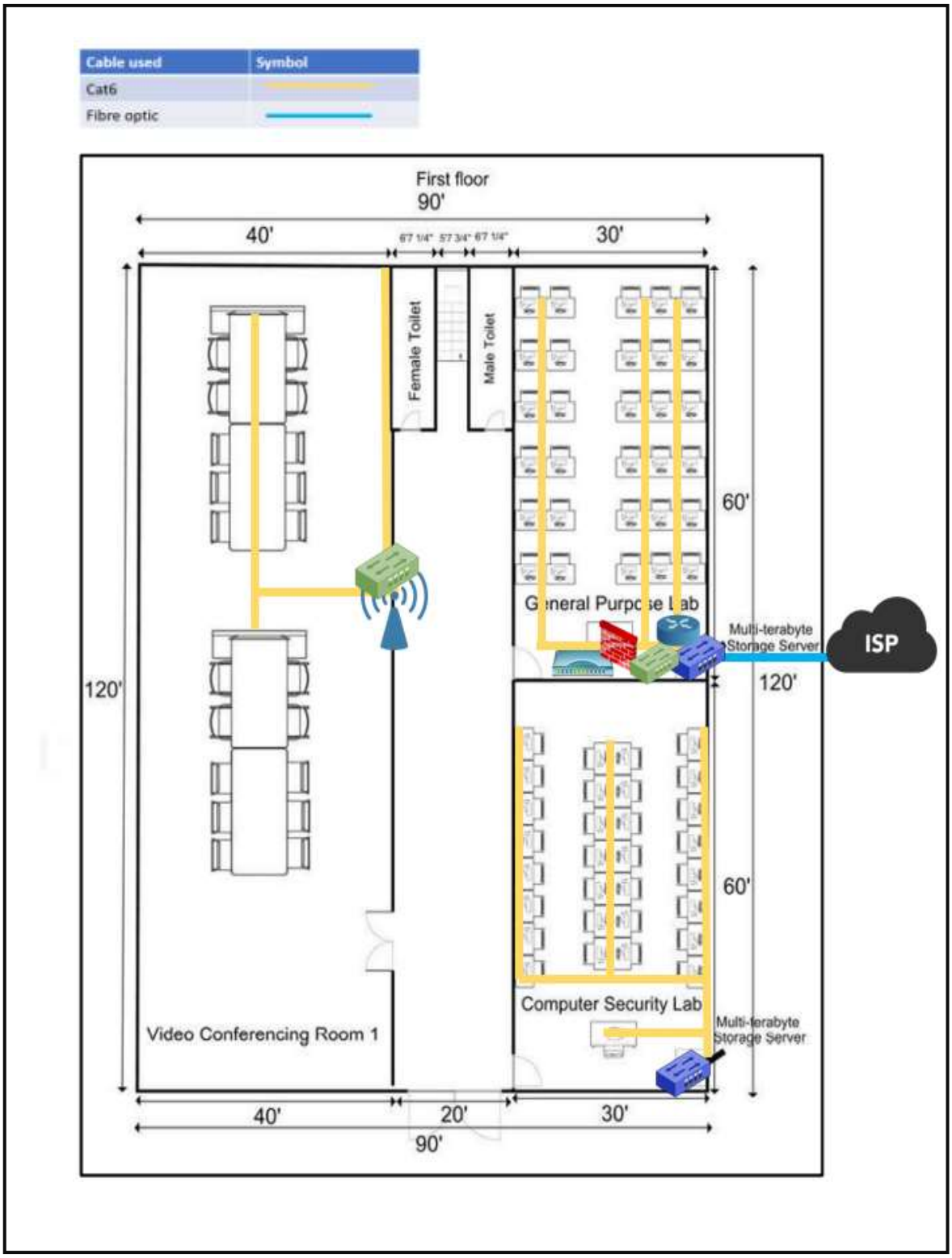


Figure 5.3.2 Shown is the floor plan for first floor

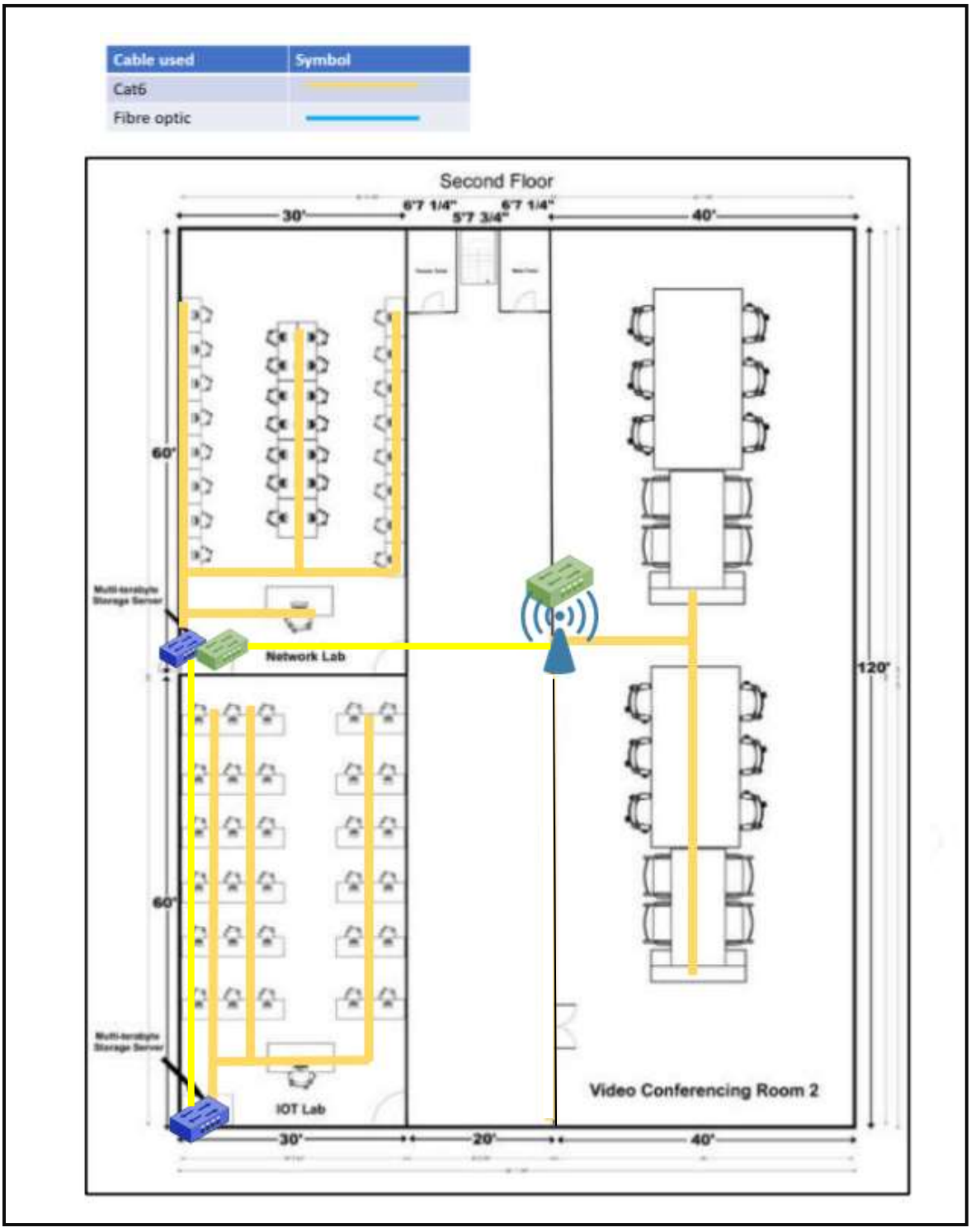


Figure 5.3.3 Shown is the floor plan for second floor

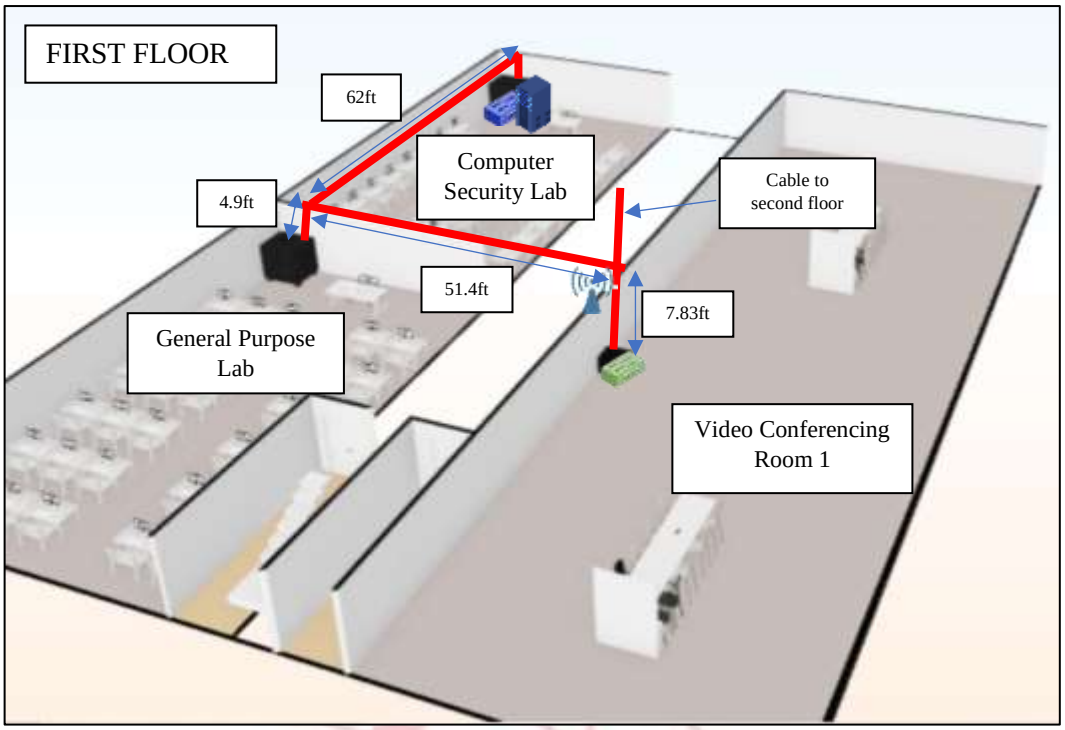


Figure 5.3.4 3D illustration for the first floor

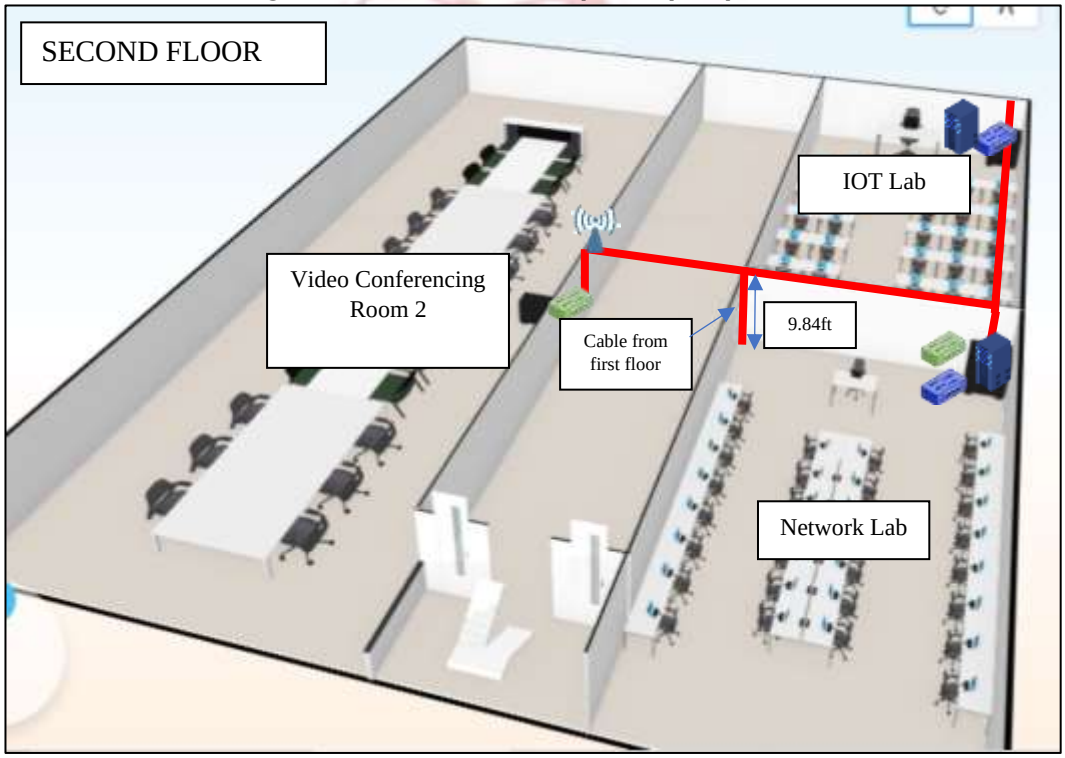


Figure 5.3.5 3D illustration for the second

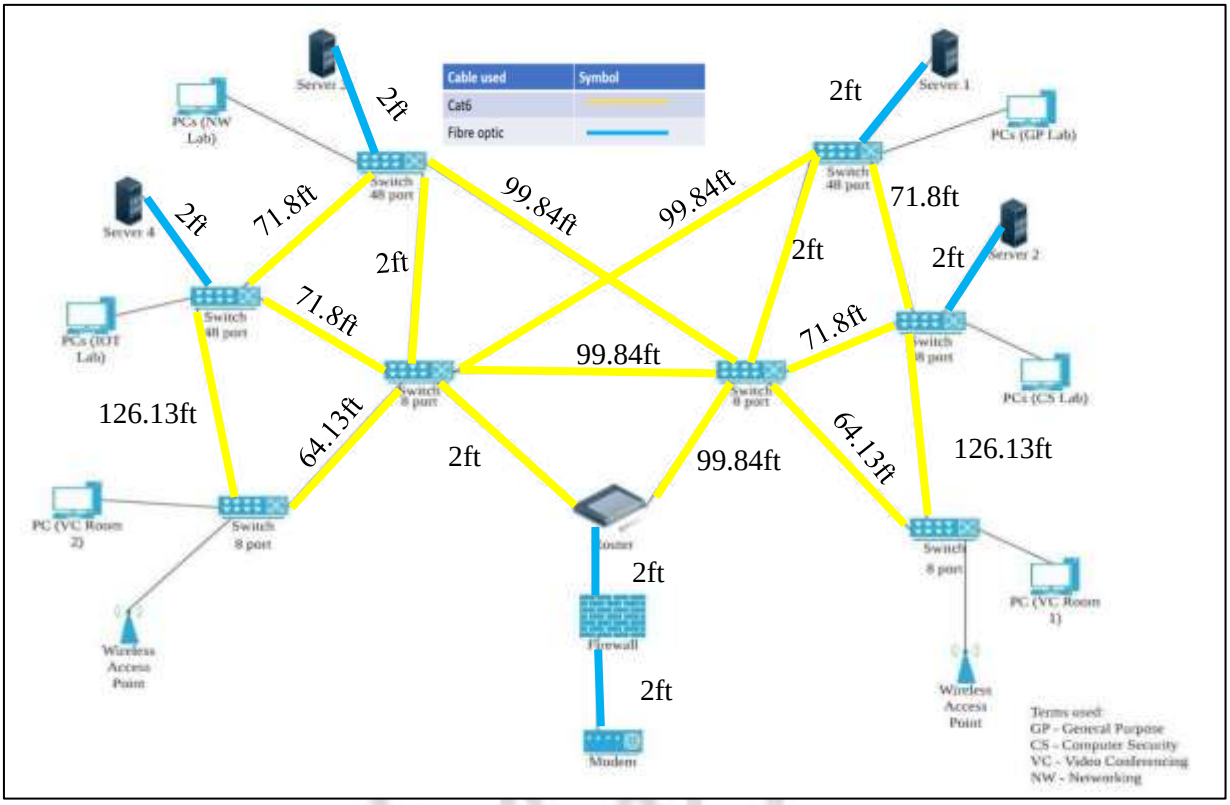


Figure 5.3.6 total measurement and connection

Calculations:

Total length of cat 6 cable needed = (71.8ft * 4) + (99.84 * 4) + (64.13ft * 2) + (126.13 * 2) + (2ft * 3)

= **1073.08ft**

Total length of fiber optic cable needed = **0.5 meter patch cord * 6 units**

Equipment:

Number of cat6 connector needed = 16 connection * 2 = **32 units**

Transreceiver = 6 connections *2 = **12 units**

5.4. Horizontal Cabling

Horizontal Cabling is any cabling that is used to connect a floor's wiring closet to wall plates in the work areas to provide local area network (LAN) drops for connecting users' computers to the network Horizontal cabling is most easily installed during construction or renovation of the building because proper installation might require opening false ceilings or walls. If this is not feasible, installing external cable trays and conduits might be the best solution, because loose cables on the floor pose a hazard and should be avoided at all costs. On this chapter, the team will summarise the total length of cable use and illustrate the floor plan in both diagram of 2D and 3D. Starting with all 4 labs and followed by the conferencing room.

a) Labs

Based on the case study, the team are required to place 4 computing labs which includes General Purpose Lab, IOT lab, Computer Security Lab and Programming Lab. By connected to vertical cabling, each of the lab are inter-connected with Cat RJ45 keystone jack which will be place on wall plate meanwhile 62 units of RJ45 connector will be use to allow the cable to connect from one device to another. The purpose of using these items is to make sure the connection is secure and more efficient when using the lab. This placement method is follows and install on the 4 labs, this is necessary in order to provide and consistent connection along with high-end devices. For detailed reference please refer to **Appendix E** attached at the end of the report

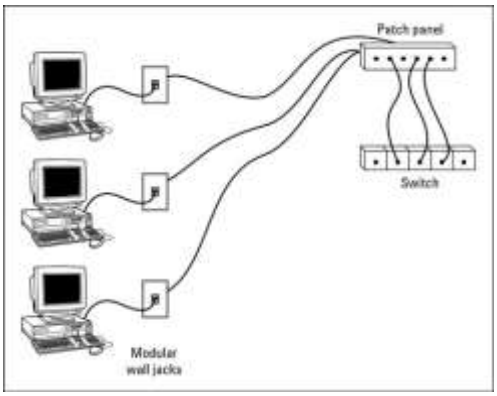


Figure 5.4.1 shown the illustration on connecting the host with the patch panel and switches

Below, are the few 3D illustrations shot taken on very particular angle to shows the cable length and height in the lab, the cable used on this lab are Cat6. The cable length from face plate on the floor to PCs LAN port are estimated on 3.2 feet, meanwhile the cable length from patch panel to the floor are estimated on 4'0 feet. This measurement is equally applied on all 4 labs.

Figure 5.4.2 shown the illustration on the height between cable and the table

Figure 5.4.3 shown the illustration on the height between cable and the table

With the floor plan illustrate above, the calculation can be shown for each lab facilitate on the building. Both of the equipment and calculation is the exact total measurement length are applied on the other labs, this is to ensure the cost spend on cable installation are the same and exceeding the budget provided.

a) Calculation with Equipment for IOT Lab & General Purposes Lab

Total length cable use:

Cable length from face plate(on the floor) to PCs LAN port = 3.2ft * 31 = 99.2ft

Cable length from patch panel to the floor = 4ft *31 = 124ft

Total Cable length on the floor = (582.4ft * 2) + 13ft = 1177.8ft

Total cat6 cable needed = 99.2ft +124ft + 1177.8ft = **1401ft**

5ft cat6 patch cord to connect from switch to patch panel = **31 units**

Equipments:

2-port wallplate = **19 units**

cat6 RJ45 keystone jack = **31 units** (to be place at wallplate)

RJ45 connector = **62 unit** (to connect face plate to PC)

b) Calculation with Equipment for Computer Security & Network Lab

Total length cable use:

Cable length from face plate(on the floor) to PCs LAN port = 3.2ft * 31 = 99.2ft

Cable length from patch panel to the floor = 4ft *31 = 124ft

Total Cable length on the floor = (213ft*2) + 243ft + (333ft*2) + 16.1ft = 1351.1ft

Total cat6 cable needed = 99.2ft +124ft + 1351.1ft = **1574.3ft**

5ft cat6 patch cord to connect from switch to patch panel = **31 units**

Equipments:

2-port wallplate = **16 units**

cat6 RJ45 keystone jack = **31 units** (to be place at wallplate)

RJ45 connector = **62 unit** (to connect face plate to PC)

b) Video Conferencing Room

With high-end equipment and devices proposed on the previous task 3, **SANI** team has come out with the best placement on video conferencing room for both floors. With 120’0 x 40’0 ft, the space is enough to support 20 people in a room installed with SmartTV, modem and router for wireless connection. To connect both of the TV and the router, there will be 1 device of 8 port switches between 2 SmartTV. Meanwhile on the other side of the wall, there will be an access point which will be the connected to the switch using Cat6 cable. Since the measurement for both video conferencing room are the exact measurement, this method is applied on each other room this is to ensure the consistency of the network access while providing the reliable connection.

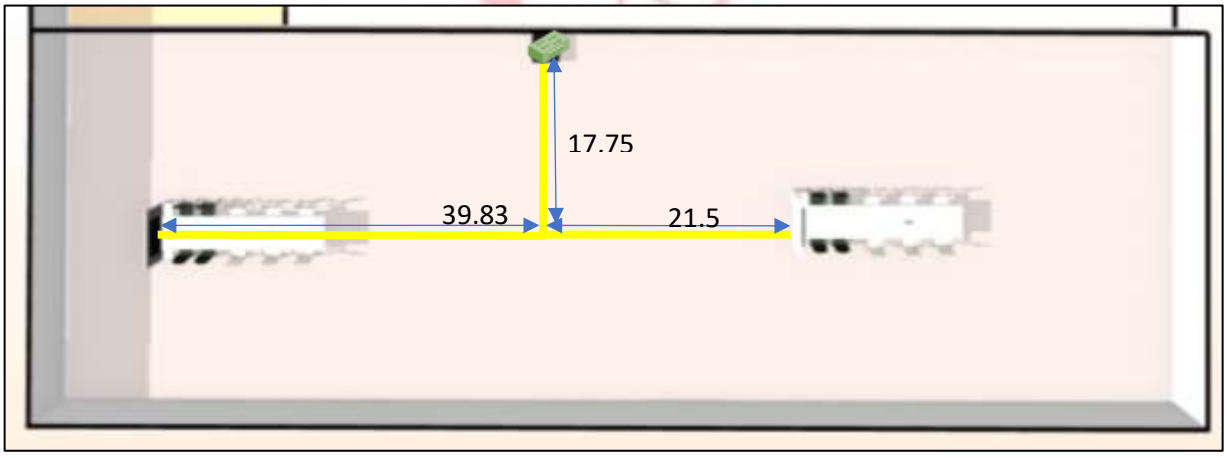


Figure 5.4.4 shown the illustration on the height between cable and the table

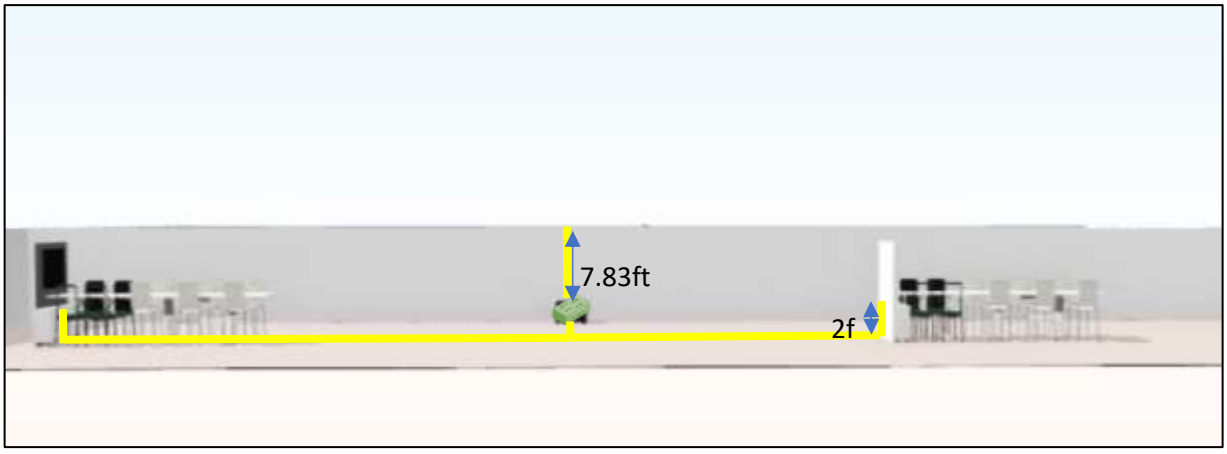


Figure 5.4.5 shown the illustration on the height between cable and the table

Based on the illustration above, measurement length of the cable is fixed and applied on both of the conferencing room. With the number stated, the team has calculated the estimated is **108.66ft** as the calculated below.

a) Calculation with Equipment for Video Conferencing Room

Calculations:

Cat6 Cable length = 17.75ft + 21.5ft + 2ft +17.75ft + 39.83ft + 2ft + 7.83ft

= 108.66ft * (2 rooms)

= 217.32ft

Equipments:

RJ45 connector = 3 connections * 2 * 2 rooms

= 12 units

b) **Cost**

From the calculations above, we found out that the estimation of some cables and equipment in task 3 are not enough and some important equipment are not in the list. We produced an additional device list to compensate the list in task 3.

Overall cable length and equipment needed

Total length of cat6 cable = 217.32ft + (1574.3ft * 2) + (1401ft * 2) + 1073.08ft

= 7240.4ft

5ft cat6 patch cord = 124 units

0.5 meter fiber optic patch cord = 6 units

Transreceiver = 6 units

2-port wallplate = 35 units

RJ45 keystone jack = 124 units

RJ45 connector = 292 units

5.5. Reflections

On this phase, the team has gained a lot of new knowledge, especially on gathering the item and devices. The implementing devices process took a while for the team to analysing the device placement especially for access point devices based on the user needs. The team also required to identify the connections in the topology used, there was total 6 connections found which leads the team to another process on doing the vertical cabling and horizontal cabling.

Before proceeding on the cable implementing, the team need discussed and do the rough sketch as attached on 2.0 above. With the sketches made, the team can illustrate the diagram with the proper cable. Along the process the team has gained more knowledge on arranging the cable in more proper and neater instead of doing more complex method and need more cost which exceeding the total amount proposed before. On the process, the team are able to learn analysing the device placement which will provide the best connection and reliable for long-use.

Lastly, the team has able to learn using an online source to do some research on devices implementation with cable management. This is to ensure our cabling and devices placement are reliable and meet the requirement as stated on the case study.

Chapter 6

6. Assigning IP Addresses

a. Introduction

According to case study, the team are required to do IP addressing with subnetting all the devices planned on to installed on our initial network floorplan. On this phase we will explain on how we determined our IP address and their subnet assigned.

a.1. Phase Objective

a) Allowing each device working properly by accessing them to connected to the internet

b) Allowing device to send and receive information to and from specific computer given network

a.2. Phase Execution

a) Identified the correct address

b) Find the unique address for each device

c) Divided the unique address and assigned on each lab

b. IP Addressing Scheme

On the phase, our IP address has been assigned by the lecturer, Dr Muhalim Mohamed Amin. The detail of IP Address detail as followed below:

Group	IP Address
6	192.21.0.0/18

b.1. IP Subnetting Address

IP Subnet is a subnetwork or most known as subnet is logical subdivision of an IP Network. The practice of more networks is called subnetting. Computers that belong to a subnet are addressed with an identical most-significant bit-group in their IP addresses.

Based on the IP address assigned is on Class C, there is a method use for this IP Address on this class to be assigned a unique IP Subnet Address. Based on the IP Address assigned to our team **192.21.0.0/18**, it can be concluded

Subnet Mask	255.255.192.0
Wildcard Subnet Mask	0.0.63.255
Total	16384
Usable	16381
Network	192.21.0.0/18
Gateway	192.21.0.1
Broadcast	192.21.0.0
First	192.21.0.2
Last	192.21.63.254

6.1. Making Connection

This is where we going to assign the unique IP Address to the devices on all 4 labs the VC Rooms and other devices used. This is to ensure our networking plan are reliable and working for long-used term. In order to achieve the goals, all devices need to have a unique IP address without having a conflict network since the team has been assigned.

Before proceeding the connection details, the team has decided to use DHCP, Dynamic Host Configuration Protocol as IP Protocol. This is because of easier for administrator to removes the repetitive task on assigning multiple IP addresses to each device on the network. Plus, DHCP does not need any manual configuration to connect a local device or gain access to the web. Also, DHCP used for avoiding IP Address Conflict occurs in the network.

Without further ado, the team has calculated the estimated IP address which uniquely assigned to the devices based on the labs and rooms on the floorplan.

No.	Segment	Host Requirement	Nearest Block Size	Valid hosts
1	Access point 1	200	256	254
2	Access point 2	200	256	254
3	GP Lab	33	64	62
4	Network Lab	33	64	62
5	CS Lab	33	64	62
6	IOT Lab	33	64	62
7	VC Room 1	3	8	6
8	VC Room 2	3	8	6

Subnet	Location	CIDR	Subnet mask	Network address	Broadcast address	Valid host addresses
1	Access point 1	/25	255.255.255.0	192.21.0.0	192.21.0.255	192.21.0.1 to 192.21.0.254
2	Access point 2	/25	255.255.255.0	192.21.1.0	192.21.0.255	192.21.1.1 to 192.21.0.254
3	GP Lab	/26	255.255.255.192	192.21.2.0	192.21.2.63	192.21.2.1 to 192.21.2.62
4	Network Lab	/26	255.255.255.192	192.21.2.64	192.21.2.127	192.21.2.65 to 192.21.2.126
5	CS Lab	/26	255.255.255.192	192.21.2.128	192.21.2.191	192.21.2.129 to 192.21.2.190
6	IOT Lab	/26	255.255.255.192	192.21.2.192	192.21.2.255	192.21.2.193 to 192.21.2.254
7	VC Room 1	/29	255.255.255.248	192.21.3.0	192.21.3.7	192.21.3.1 to 192.21.3.6
8	VC Room 2	/29	255.255.255.248	192.21.3.8	192.21.3.15	192.21.3.9 to 192.21.3.14

6.1.1. CIDR (Classless Inter-Domain Routing)

Classless inter-domain routing (CIDR) is a set of Internet protocol (IP) standards that is used to create unique identifiers for networks and individual devices. The IP addresses allow particular information packets to be sent to specific computers. CIDR improves the efficiency of address distribution and replaces the previous system based on Class A, Class B and Class C networks. CIDR IP addresses consist of two groups of numbers, which are also referred to as groups of bits. The most important of these groups is the network address, and it is used to identify a network or a sub-network (subnet). The lesser of the bit groups is the host identifier.

The host identifier is used to determine which host or device on the network should receive incoming information packets. In contrast to classful routing, which categorizes addresses into one of three blocks, CIDR allows for blocks of IP addresses to be allocated to Internet service providers. The blocks are then split up and assigned to the provider's customers. Until recently, IP addresses used the IPv4 CIDR standard, but because IPv4 addresses are nearly exhausted, a new standard known as IPv6 has been developed and will soon be implemented

6.2. Assigning Subnet

Every device has an IP address with two pieces which is the client or host and the server or network address. IP address are either configured by a DHCP server or manually configured which commonly known as Static IP Addresses. The Subnet mask splits the IP address into the host and network addresses, thereby defining which part of the IP address belongs to the device and which part belongs to the network. Subnetting is the technique used for logically partitioning a single physical network into multiple smaller sub-network or subnets. By enabling an LAN to conceal network complexity and lessen the network traffic by adding the subnets without a new network number. This is to ensure the broadcast of volume and network traffic are smalls and smooth and allowing user to surpass LAN constraint such as maximum number of hosts.

6.2.1. IP Subnet Address

On this section, there will be followed the list of IP Subnet mask address which uniquely assigned to the host in the labs and room. The address has been divided into specific lab and Conferencing rooms. This is to make sure the network traffic is consistently smooth and reducing the chances for network conflict occurred.

The method used on assigned the subnet are:

$2^{n \text{ (numbers of bits remaining from the host)}} - 2$ (usable host/subnet)

a) General Purpose Lab

Subnet mask: 255.255.255.192

Subnet address: 192.21.2.0/26

DEVICE NAME	IP ADDRESS	DEVICE NAME	IP ADDRESS
Lecturer's PC	192.21.2.1	PC17	192.21.2.18
PC1	192.21.2.2	PC18	192.21.2.19
PC2	192.21.2.3	PC19	192.21.2.20
PC3	192.21.2.4	PC20	192.21.2.21
PC4	192.21.2.5	PC21	192.21.2.22
PC5	192.21.2.6	PC22	192.21.2.23
PC6	192.21.2.7	PC23	192.21.2.24
PC7	192.21.2.8	PC24	192.21.2.25
PC8	192.21.2.9	PC25	192.21.2.26
PC9	192.21.2.10	PC26	192.21.2.27
PC10	192.21.2.11	PC27	192.21.2.28
PC11	192.21.2.12	PC28	192.21.2.29
PC12	192.21.2.13	PC29	192.21.2.30
PC13	192.21.2.14	PC30	192.21.2.31
PC14	192.21.2.15	Server	192.21.2.32
PC15	192.21.2.16	Router	192.21.2.33
PC16	192.21.2.17		

b) Network Lab

Subnet mask: 255.255.255.192

Subnet address: 192.21.2.64/26

DEVICE NAME	IP ADDRESS	DEVICE NAME	IP ADDRESS
Lecturer's PC	192.21.2.65	PC17	192.21.2.82
PC1	192.21.2.66	PC18	192.21.2.83
PC2	192.21.2.67	PC19	192.21.2.84
PC3	192.21.2.68	PC20	192.21.2.85
PC4	192.21.2.69	PC21	192.21.2.86
PC5	192.21.2.70	PC22	192.21.2.87
PC6	192.21.2.71	PC23	192.21.2.88
PC7	192.21.2.72	PC24	192.21.2.89
PC8	192.21.2.73	PC25	192.21.2.90
PC9	192.21.2.74	PC26	192.21.2.91
PC10	192.21.2.75	PC27	192.21.2.92
PC11	192.21.2.76	PC28	192.21.2.93
PC12	192.21.2.77	PC29	192.21.2.94
PC13	192.21.2.78	PC30	192.21.2.95
PC14	192.21.2.79	Server	192.21.2.96
PC15	192.21.2.80	Router	192.21.2.97
PC16	192.21.2.81		

c) Computer Security Lab

Subnet mask: 255.255.255.192

Subnet address: 192.21.2.128/26

DEVICE NAME	IP ADDRESS	DEVICE NAME	IP ADDRESS
Lecturer's PC	192.21.2.129	PC17	192.21.2.146
PC1	192.21.2.130	PC18	192.21.2.147
PC2	192.21.2.131	PC19	192.21.2.148
PC3	192.21.2.132	PC20	192.21.2.149
PC4	192.21.2.133	PC21	192.21.2.150
PC5	192.21.2.134	PC22	192.21.2.151
PC6	192.21.2.135	PC23	192.21.2.152
PC7	192.21.2.136	PC24	192.21.2.153
PC8	192.21.2.137	PC25	192.21.2.154
PC9	192.21.2.138	PC26	192.21.2.155
PC10	192.21.2.139	PC27	192.21.2.156
PC11	192.21.2.140	PC28	192.21.2.157
PC12	192.21.2.141	PC29	192.21.2.158
PC13	192.21.2.142	PC30	192.21.2.159
PC14	192.21.2.143	Server	192.21.2.160
PC15	192.21.2.144	Router	192.21.2.161
PC16	192.21.2.145		

d) IOT Lab

Subnet mask: 255.255.255.192

Subnet address: 192.21.2.192/26

DEVICE NAME	IP ADDRESS	DEVICE NAME	IP ADDRESS
Switch 48 port	192.21.2.193	PC17	192.21.2.210
Lecturer's PC	192.21.2.193	PC18	192.21.2.211
PC1	192.21.2.194	PC19	192.21.2.212
PC2	192.21.2.195	PC20	192.21.2.213
PC3	192.21.2.196	PC21	192.21.2.214
PC4	192.21.2.197	PC22	192.21.2.215
PC5	192.21.2.198	PC23	192.21.2.216
PC6	192.21.2.199	PC24	192.21.2.217
PC7	192.21.2.200	PC25	192.21.2.218
PC8	192.21.2.201	PC26	192.21.2.219
PC9	192.21.2.202	PC27	192.21.2.220
PC10	192.21.2.203	PC28	192.21.2.221
PC11	192.21.2.204	PC29	192.21.2.222
PC12	192.21.2.205	PC30	192.21.2.223
PC13	192.21.2.206	Server	192.21.2.224
PC14	192.21.2.207	Router	192.21.2.225
PC15	192.21.2.208		
PC16	192.21.2.209		

e) Conferencing room 1

Subnet mask: 255.255.255.248

Subnet address: 192.21.3.0/29

DEVICE NAME	IP ADDRESS
PC1	192.21.3.1
PC2	192.21.3.2
Router	192.21.3.3

f) Conferencing room 2

Subnet mask: 255.255.255.248

Subnet address: 192.21.3.8/29

DEVICE NAME	IP ADDRESS
PC1	192.21.3.9
PC2	192.21.3.10
Router	192.21.3.11

g) Access Point 1 (First Floor)

Subnet mask: 255.255.255.0

Subnet address: 192.21.0.0/24

DEVICE NAME	USABLE IP ADDRESS RANGE
Access point	192.21.0.1 – 192.21.0.253
Router	192.21.0.254

h) Access Point 2 (Second Floor)

Subnet mask: 255.255.255.0

Subnet address: 192.21.1.0/24

DEVICE NAME	USABLE IP ADDRESS RANGE
Access point	192.21.1.1 – 192.21.1.253
Router	192.21.1.254

6.3. Reflection

For this task, we were required to divide the subnetwork from the network address assigned to our group. During the process of doing this task, we found out that proper subnetting is important as it reduces congestion and can help to route traffic more efficiently. Because of that, we brainstormed on how the best way is to divide the network address to different subnets for the whole building.

At first, we were confused because our network address starts with 192 and the subnet mask should be /24 because it is a Class C address. After some extensive research we found out that we are using CIDR (Classless Inter Domain Routing) and classful addressing is no longer use by the world today. After that, we identify the number of hosts needed by each subnet and from there we decide the block size.

We were slightly confused when doing this because we were not sure if the switches need an IP address each, so we did some research and found out that switches that we use are unmanaged switches hence they do not need an IP address. Then we arrange the subnets in descending order based on the block size and we allocate the IP address for each subnet. This task is slightly easier than the previous tasks as we were already taught about IP addressing in class, we just need to do a little research and apply what we learned in class to complete it.

Chapter 7

7. Conclusions

From all the task explained and elaborated above, the team can conclude that all members have gave countless of effort to deliver the task with project manager's supervision and guidance. Next on giving the best result of providing the reliable network plan, the teamwork their very best and provided the best teamwork. Without any doubt, on this project there is a lot of knowledge gained and learnt by each of the team members, from task 1 to the last task on this project. The main knowledge gained is to adapt with user's requirement on developing a solution. This is important for us to learn because most of the students would work with different user with different requirement along with different environments as one of the job scopes in the future. This is vital for a developer to make user's requirement as priority on developing a solution.

Next, the team also gained a lot of new information on developing a network architecture system. Firstly, the team learnt on doing better research on gathering all the information on the internet, journal and article written by the expertise from other universities. This is important in order to team to deliver the best outcome on every task for providing reliable network architecture which meet the user's requirement. Other than that, the team also learn on implicated all the information gathered and analysed which information would fit the objective for every task. This step plays huge responsibilities on delivering the task to provide the reliable network.

This was a long-term design project, and everything was fresh to the team. Patience was the crucial and essential factor that was needed in such a long project in our view. Fortunately, we learned and gained the patience. Besides, communication was another extremely significant factor. It was essential to communicate and discuss with the lecturer and the teammates regularly. For the information our lecturer was the most useful advice in the process of major project. Overall, we achieved these two important factors which also could be described as strengths.

Chapter 8

8. Appendices and References

8.1. Appendices

Appendix A – Meeting Log

Meeting Log 1 –

Date : 21st October 2020
Venue : WhatsApp Group Text
Attendance : All Member

Objective		
1. First meeting starts with assigned the roles and pick a suitable name **2.** Do a simple ideas and rough sketches on floor plan **3.** Draw the floor using the software online		
Members	**Contribution**	**Signature**
MUHAMMAD NABIEL IZZUDDIN BIN RADZUAN	• Giving an idea on group names and suggesting the roles • Do the rough sketches	
NURFATIN IWANINA BINTI ABDUL RASHID	• Do the drawing of floor plan according the sketches	
NURUL ALIS ALIA BINTI MOHD ZAMRI	• Do the drawing of floor plan according the sketches	
NUR ALEEYA SYAKILA BINTI MUHAMMAD SUBIAN	• Suggesting the floor plan with drawing rough sketch	

Meeting Log 2 –

Date : 25th October 2020
Venue : WhatsApp Group Text
Attendance : All Member

Objective		
1. Do a simple ideas and rough sketches on floor plan **2.** Draw the floor using the software online **3.** Deliver the task 1		
Members	**Contribution**	**Signature**
MUHAMMAD NABIEL IZZUDDIN BIN RADZUAN	• Compile and do the double checking the work sent and suggest the correction	
NURFATIN IWANINA BINTI ABDUL RASHID	• Deliver the task	
NURUL ALIS ALIA BINTI MOHD ZAMRI	• Deliver the task	
NUR ALEEYA SYAKILA BINTI MUHAMMAD SUBIAN	• Do the double checking on the floor plan	

Meeting Log 3 –

Date : 25th October 2020
Venue : WhatsApp Group Text
Attendance : All Member

Objective		
1. Do a simple ideas and rough sketches on floor plan **2.** Draw the floor using the software online **3.** Deliver the task 1		
Members	**Contribution**	**Signature**
MUHAMMAD NABIEL IZZUDDIN BIN RADZUAN	• Compile and do the double checking the work sent and suggest the correction	
NURFATIN IWANINA BINTI ABDUL RASHID	• Deliver the task	
NURUL ALIS ALIA BINTI MOHD ZAMRI	• Deliver the task	
NUR ALEEYA SYAKILA BINTI MUHAMMAD SUBIAN	• Do the double checking on the floor plan	

Meeting Log 4 –

Date : 4th November 2020
Venue : WhatsApp Group Text
Attendance : All Member

Objective		
1. Construct the questions and analysis the answer by researching on Internet **2.** Determine the feasibility of the project and explain		
Members	**Contribution**	**Signature**
MUHAMMAD NABIEL IZZUDDIN BIN RADZUAN	• Distribute the task and suggesting the right task. Constructs the questions with analysed the previous questions	
NURFATIN IWANINA BINTI ABDUL RASHID	• Giving the details on feasibility study	
NURUL ALIS ALIA BINTI MOHD ZAMRI	• Giving the details on feasibility study	
NUR ALEEYA SYAKILA BINTI MUHAMMAD SUBIAN	• Constructs the questions and answers	

Meeting Log 5 –

Date : 11st November 2020
Venue : WhatsApp Group Text
Attendance : All Member

Objective		
1. Double check the task and deliver the task **2.** Do corrections and deliver		
Members	**Contribution**	**Signature**
MUHAMMAD NABIEL IZZUDDIN BIN RADZUAN	• Deliver the task on learning	
NURFATIN IWANINA BINTI ABDUL RASHID	• Giving the details on feasibility study	
NURUL ALIS ALIA BINTI MOHD ZAMRI	• Giving the details on feasibility study	
NUR ALEEYA SYAKILA BINTI MUHAMMAD SUBIAN	• Constructs the questions and answers	

Meeting Log 6 –

Date : 18th November 2020
Venue : WhatsApp Group Text
Attendance : All Member

Objective		
1. Do some research and collecting the item on constructing the LAN **2.** Analyse the amount the item needed **3.** Do reflections on the cost collected with the budget given.		
Members	**Contribution**	**Signature**
MUHAMMAD NABIEL IZZUDDIN BIN RADZUAN	• Do the reflections with the items found	
NURFATIN IWANINA BINTI ABDUL RASHID	• Do some research and collecting the item	
NURUL ALIS ALIA BINTI MOHD ZAMRI	• Do some research and collecting the item	
NUR ALEEYA SYAKILA BINTI MUHAMMAD SUBIAN	• Construct a floor plan with access point coverage.	

Meeting Log 7 –

Date : 25th November 2020
Venue : WhatsApp Group Text
Attendance : All Member

Objective		
1. Do correction and detailing the item **2.** Double check the task before deliver on E-Learning		
Members	**Contribution**	**Signature**
MUHAMMAD NABIEL IZZUDDIN BIN RADZUAN	• Do the reflections with the items found	
NURFATIN IWANINA BINTI ABDUL RASHID	• Correct the items	
NURUL ALIS ALIA BINTI MOHD ZAMRI	• Correction on the total amount	
NUR ALEEYA SYAKILA BINTI MUHAMMAD SUBIAN	• Construct a floor plan with access point coverage.	

Meeting Log 8 –

Date : 25th November 2020
Venue : WhatsApp Group Text
Attendance : All Member

Objective		
1. Do correction and detailing the item **2.** Double check the task before deliver on E-Learning		
Members	**Contribution**	**Signature**
MUHAMMAD NABIEL IZZUDDIN BIN RADZUAN	• Do the reflections with the items found	
NURFATIN IWANINA BINTI ABDUL RASHID	• Correct the items	
NURUL ALIS ALIA BINTI MOHD ZAMRI	• Correction on the total amount	
NUR ALEEYA SYAKILA BINTI MUHAMMAD SUBIAN	• Construct a floor plan with access point coverage.	

Meeting Log 9 –

Date : 2nd December 2020
Venue : WhatsApp Group Text
Attendance : All Member

Objective		
1. Do correction and detailing the item **2.** Double check the task before deliver on E-Learning		
Members	**Contribution**	**Signature**
MUHAMMAD NABIEL IZZUDDIN BIN RADZUAN	• Deliver the task	
NURFATIN IWANINA BINTI ABDUL RASHID	• Correct the items	
NURUL ALIS ALIA BINTI MOHD ZAMRI	• Correction on the total ammout	
NUR ALEEYA SYAKILA BINTI MUHAMMAD SUBIAN	• Construct a floor plan with access point coverage.	

Meeting Log 10 –

Date : 8th December 2020
Venue : WhatsApp Group Text
Attendance : All Member

Objective		
1. Identified the work area **2.** Determined the total item used on the floor **3.** Determined the total length of the cable		
Members	**Contribution**	**Signature**
MUHAMMAD NABIEL IZZUDDIN BIN RADZUAN	• Identified the backbone/vertical cabling and determined the total cable on Labs	
NURFATIN IWANINA BINTI ABDUL RASHID	• Determined the total cable on Labs	
NURUL ALIS ALIA BINTI MOHD ZAMRI	• Determined the total cable on VC room	
NUR ALEEYA SYAKILA BINTI MUHAMMAD SUBIAN	• Do measurement on backbone cabling and identified the work areas	

Meeting Log 11 –

Date : 16th December 2020
Venue : WhatsApp Group Text
Attendance : All Member

Objective
1. Do double check on the item collected **2.** Do the correction if error occurred **3.** Do reflection on the task

Members	**Contribution**	**Signature**
MUHAMMAD NABIEL IZZUDDIN BIN RADZUAN	• Do the reflection on the task	
NURFATIN IWANINA BINTI ABDUL RASHID	• Determined the total cable on Labs	
NURUL ALIS ALIA BINTI MOHD ZAMRI	• Determined the total cable on VC room and double check the overall task, did correction	
NUR ALEEYA SYAKILA BINTI MUHAMMAD SUBIAN	• Do measurement on backbone cabling and identified the work areas	

Meeting Log 12 –

Date : 22nd December 2020
Venue : WhatsApp Group Text
Attendance : All Member

Objective		
1. Do double check on the item collected **2.** Deliver the task		
Members	**Contribution**	**Signature**
MUHAMMAD NABIEL IZZUDDIN BIN RADZUAN	• Deliver the task	
NURFATIN IWANINA BINTI ABDUL RASHID	• Determined the total cable on Labs	
NURUL ALIS ALIA BINTI MOHD ZAMRI	• Determined the total cable on VC room and double check the overall task, did correction	
NUR ALEEYA SYAKILA BINTI MUHAMMAD SUBIAN	• Do measurement on backbone cabling and identified the work areas	

Meeting Log 13 –

Date : 27th December 2020
Venue : WhatsApp Group Text
Attendance : All Member

Objective		
1. Determine the IP Address, **2.** Assigned the IP Address to the end system		
Members	**Contribution**	**Signature**
MUHAMMAD NABIEL IZZUDDIN BIN RADZUAN	• Get and determine the IP Address	
NURFATIN IWANINA BINTI ABDUL RASHID	• Giving ideas and suggestions on IP Addresses into Subnet mask addresses	
NURUL ALIS ALIA BINTI MOHD ZAMRI	• Determined the IP Addresses and assigned to end systems	
NUR ALEEYA SYAKILA BINTI MUHAMMAD SUBIAN	• Giving ideas and suggestions to IP Addresses into Subnet Addresses	

Meeting Log 14 –

Date : 6th January 2021
Venue : WhatsApp Group Text
Attendance : All Member

Objective		
1. Determine the IP Address, **2.** Assigned the IP Address to the end system		
Members	**Contribution**	**Signature**
MUHAMMAD NABIEL IZZUDDIN BIN RADZUAN	• Get and determine the IP Address	
NURFATIN IWANINA BINTI ABDUL RASHID	• Giving ideas and suggestions on IP Addresses into Subnet mask addresses	
NURUL ALIS ALIA BINTI MOHD ZAMRI	• Determined the IP Addresses and assigned to end systems	
NUR ALEEYA SYAKILA BINTI MUHAMMAD SUBIAN	• Giving ideas and suggestions to IP Addresses into Subnet Addresses	

Meeting Log 15 –

Date : 11th January 2021
Venue : WhatsApp Group Text
Attendance : All Member

Objective		
1. Final Inspections on the task report **2.** Do correction on smalls error **3.** Delivering the task		
Members	**Contribution**	**Signature**
MUHAMMAD NABIEL IZZUDDIN BIN RADZUAN	• Do final inspections and giving ideas and suggestions on the task	
NURFATIN IWANINA BINTI ABDUL RASHID	• Do the corrections	
NURUL ALIS ALIA BINTI MOHD ZAMRI	• Do the corrections	
NUR ALEEYA SYAKILA BINTI MUHAMMAD SUBIAN	• Giving ideas and suggestions to IP Addresses into Subnet Addresses	

Meeting Log 16 –

Date : 15th January 2021
Venue : WhatsApp Group Text
Attendance : All Member

Objective		
1. Compiling the task into one report with final inspections **2.** Do correction on report **3.** Delivering the task		
Members	**Contribution**	**Signature**
MUHAMMAD NABIEL IZZUDDIN BIN RADZUAN	• Compiling the task into one report	
NURFATIN IWANINA BINTI ABDUL RASHID	• Giving ideas and suggestions on compiling	
NURUL ALIS ALIA BINTI MOHD ZAMRI	• Do final inspections and giving ideas	
NUR ALEEYA SYAKILA BINTI MUHAMMAD SUBIAN	• Collecting the previous task's illustrations	

Appendix B – List of all devices

NO.	DEVICE	FEATURE	PER UNIT(RM)	QUANTITY	TOTAL (RM)
1.	ROUTER (Cisco RV042G-K9-EU Gigabit Dual WAN VPN Router) 	• Dual gigabit ethernet wan ports for load balancing and / or business continuity • Built-in 4-port gigabit ethernet switch • Strong security: Proven stateful packet inspection (spi) firewall and hardware encryption • High-capacity, high-performance ip security (ipsec) vpn capabilities • Allow the set up up separate virtual networks and access rules to secure sensitive data	995.63	1	995.63
2.	SWITCHES (Cisco SF200-48 48-Port 10/100 Smart Switch) 	• Ports: 48-port 10/100. • Expansion Ports: 2 combo mini-GBIC. • Capacity: 10.12 mpps. • Switching Capacity: 13.6 Gbps.	813.86	4	3,255.44
	SWITCHES (8-Port Switch 10/100 PoE) 	• 10/100 with IEEE 802.3af and Cisco prestandard Power over Ethernet (PoE) • High performance and reliability • Fast, easy setup and configuration	684.41	4	2,737.64

3.	ACCESS POINT (Cisco Aironet 1602I IEEE 802.11n 300) 	• IEEE 802.11n 300 Mbps Wireless Access Point • CleanAir Express technology • Ism Band - Unii Band Aironet 1600 11agn 300mb 2.4ghz and 5ghz AES Integrated ANT 4DBI • MIMO Technology • 300 Mbps • 235 ft	373	2	746.00
4.	SERVERS (Dell EMC PowerEdge T140 MT VFC7D Xeon E-2200 1TB) 	• DIMM Speed up to 2666MT/s • Work more efficiently with 50% more cores with Intel Xeon E-2200 processor, 11% faster data transfer speeds, and 20% more PCIe lanes* • Protect your server from malicious changes with iDRAC9 Enterprise Server Lockdown mode	4779.99	4	19,119.96
5.	MODEM (Motorola MB8600 DOCSIS 3.1 Cable Modem) 	• Wirecutter recommends this as the best cable modem for people using Gigabit Internet plans. Built-in DOCSIS 3.1 and DOCSIS 3.0 32x8 capabilities give top Internet speeds for all cable Internet services, from the slowest to the fastest. • Active queue management (aqm) significantly reduces internet latency • A broadcom chipset provides security from denial of service attacks	610.28	1	610.28

6.	CABLE (5ft (1.5m) Cat6 Snagless Unshielded (UTP) PVC) 	• Length : 5ft • Improved transmission performance, superior immunity from external noise, fewer retransmission, and fewer lost packets.	11.00	124	1,364.00
	CABLE (100ft-Belkin Cat6 UTP Gigabit Bulk Solid Cable) 	• Length : 1000ft • Cable Characteristic: Unshielded twisted pair (UTP) • Cable Type: Bulk cable - CAT 6	634.80	3	1,904.4
	Commscope RJ45 Cat6 keystone Jack 	• a standardized snap-in package for mounting a variety of low-voltage electrical jacks or optical connectors into a keystone wall plate, face plate, surface-mount box, or a patch panel	6.50	124	806.00
7.	RJ45 Cat6 Network Connector 	• is an 8-position, 8-contact (8P8C) modular plug and jack, which is commonly used to connect computers onto Ethernet-based local area networks (LAN).	1.60	292	467.20

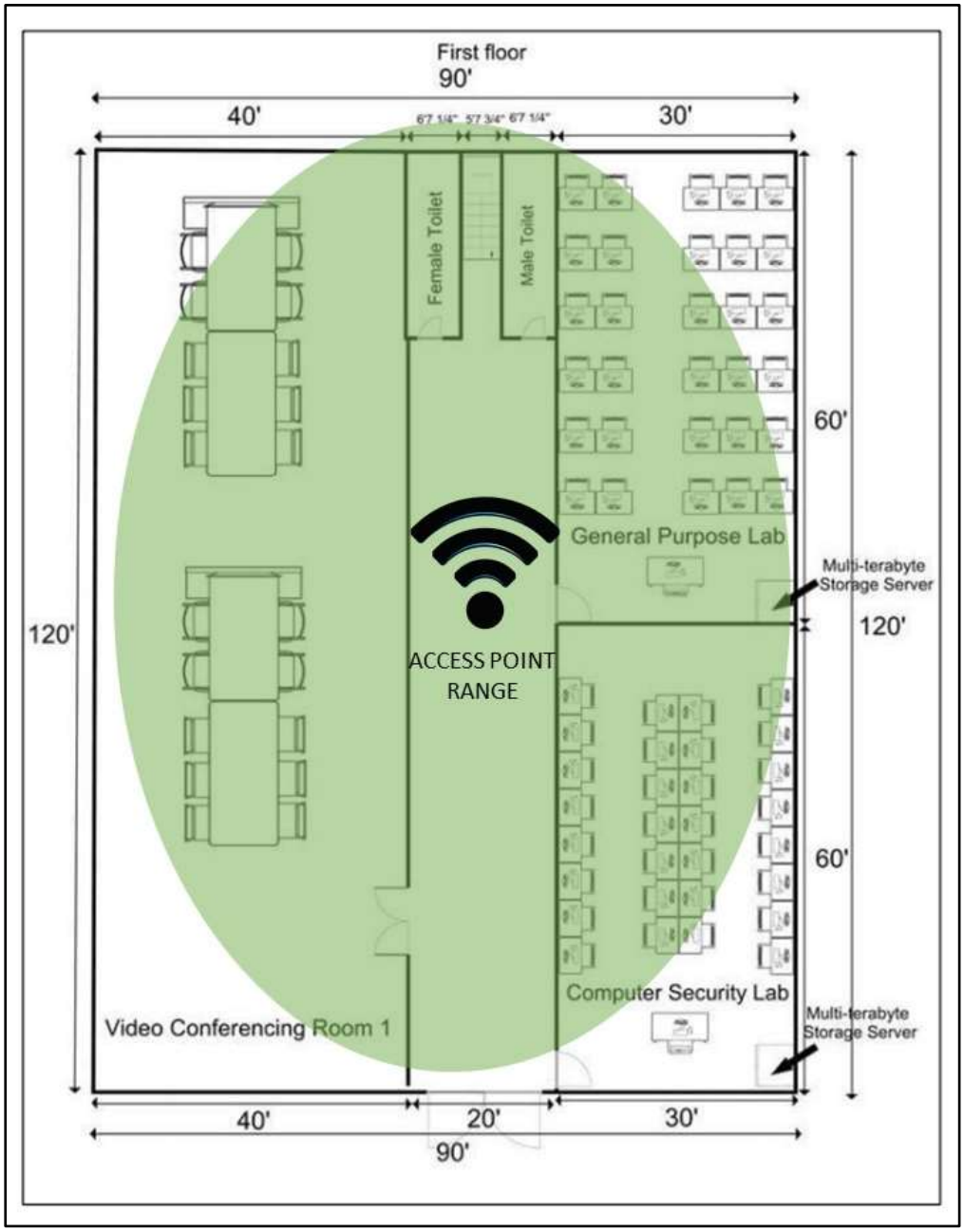
8.	TRANSCEIVER (Dell Networking SFP-1G-SX) 	• Dell Networking SFP-1G-SX Compatible 1000BASE-SX SFP 850nm 550m DOM Transceiver Module	25.00	6	150.00
9.	PATCH PANEL (Patch Panel 48-Port) 	• Patch Panel 48-Port (CAT6 / CAT-6) CAT6 UTP PATCH PANEL 48PORT	259.00	4	1,036.00
10.	2-PORT DATA WALLPLATE (2 port ivory wallplate unloaded 86t2176) 	• Accepts QuickPort Snap-in Modules	4.37	10	43.7
11.	FIREWALL (Cisco Firewall ASA 5508-X with Cisco Firepower ASA5508-K9) 	• Firewall protection, VPN support, VLAN support • threat-focused next-generation firewall (NGFW) designed for a new era of threat and malware protection. • Maximum new connections per second: 10000 • Maximum concurrent sessions: 100000 • IPsec site-to-site VPN peers: 100	7081.60	1	7,081.60

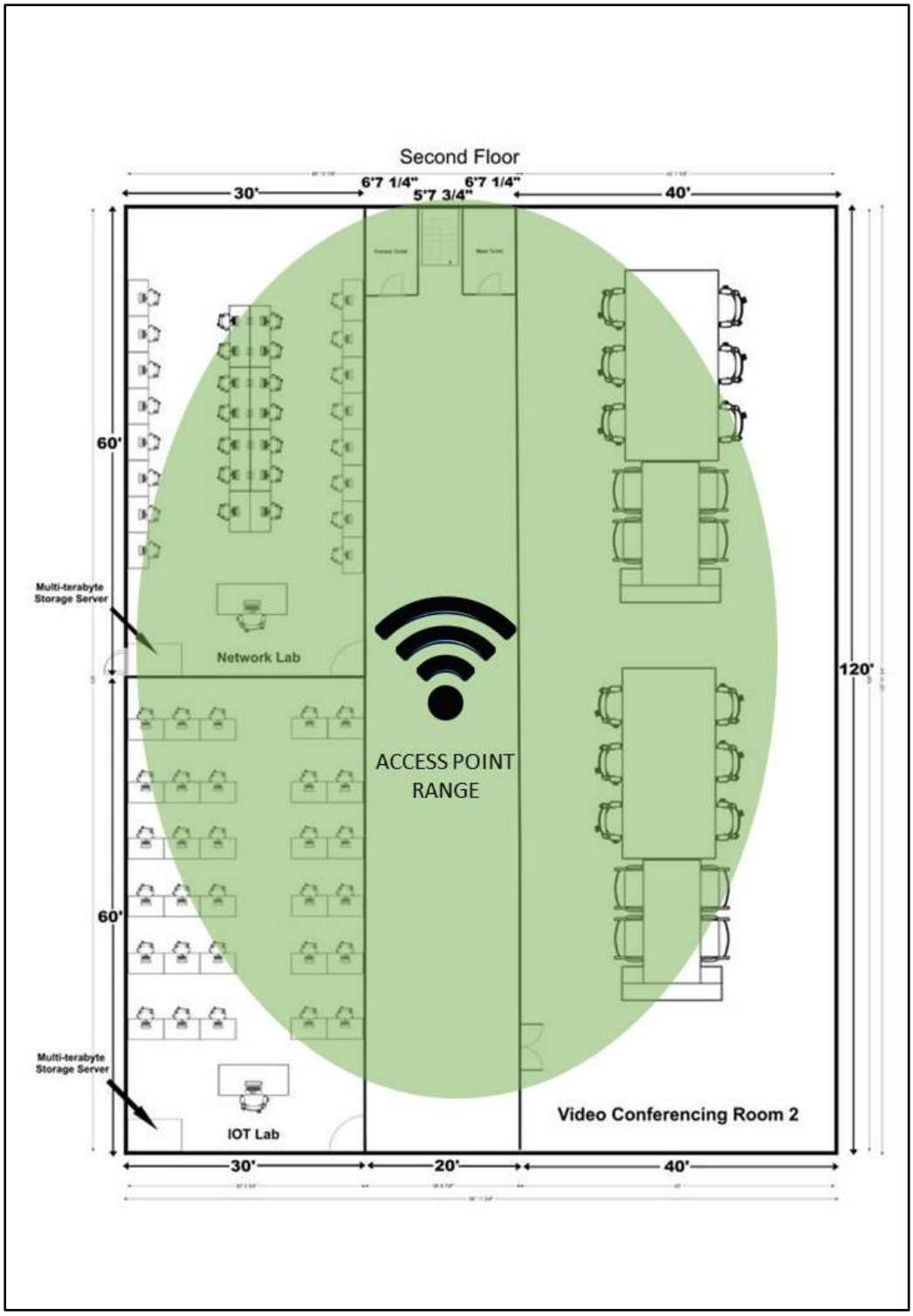
12.	PC (DELL Dell XPS/8500/V470/8700) 	• The combination of Intel's new Core i7 860 CPU • plenty of RAM makes this PC a versatile performer, and competitive among other desktops in its price range	1740.00	124	208,800.00
13.	MONITOR (Dell 22 Monitor: P2219H) 	Native Resolution • Full HD (1080p) 1920 x 1080 at 60 Hz Dimensions (WxDxH) - with stand • 48.73 cm x 16.6 cm x 35.34 cm Input Connectors • HDMI, VGA, DisplayPort	669.00	124	82,956.00
14.	ANTIVIRUS (Kaspersky Total Security-package for 50 desktop) 	• Anti-cryptor capabilities stop cryptolockers and ransomware in their tracks. Attempts at malicious encryption trigger automatic backup and restore. • Stop spyware, phishing and malicious Internet links from hijacking your business.	4935	4	19,740.00

15.	SERVER RACK (GrowV 42U 600x800 Floor Stand Equipment) 	• 19" server compatible mounting element • 2 x Ventilation Fans • 13A power point channel complete with socket • Flexible front PERFORATED or Tempered Glass Door c/w cam lock	1499.00	4	5,796.00
16.	VIDEO CONFERENCING EQUIPMENT (Logitech CC3500e) 	• Full HD camera with smooth motorized pan, tilt and zoom controlled from remote or console • Speakerphone with full-duplex performance and noise reduction technology • Compatible with video conferencing, recording, and broadcasting applications that support USB cameras	6850.00	4	27,400.00
17.	VIDEO CONFERENCING MONITOR (Dell C5519Q) 	• 55” LED-backlit LCD flat panel display • 4K UHD (2160p) display • Video interface via HDMI • PC interface via VGA (HD-15), DisplayPort, USB	3859	4	15,436.00

18.	VIDEO CONFERENCING PC (DELL OptiPlex 7080 Micro Desktop) 	• Intel® Core™ i7-10700T • Windows 10 Pro (64bit) English • Intel® Integrated Graphics • 8GB, 1x8GB, DDR4 non-ECC Memory • M.2 256GB PCIe NVMe Class 40 Solid State Drive	3903.95	4	15,615.80
TOTAL					**RM 426,400.90**

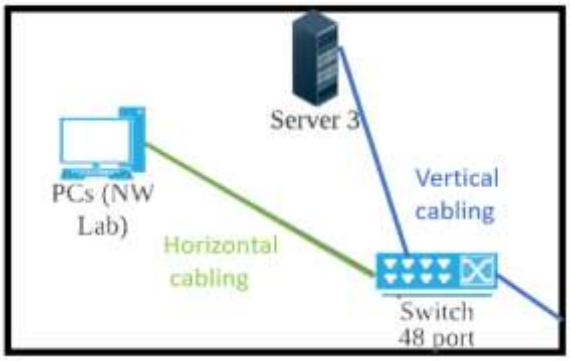
Appendix C – Access Point Coverage



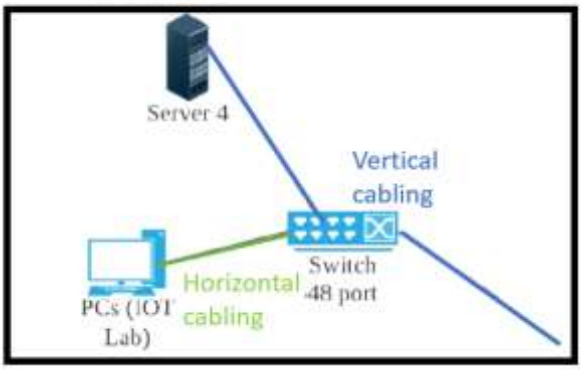

Second Floor
30'
6'7 1/4"
5'7 3/4"
6'7 1/4"
40'
60'
120'
Multi-terabyte Storage Server
Network Lab
ACCESS POINT RANGE
60'
Multi-terabyte Storage Server
IOT Lab
Video Conferencing Room 2
30'
20'
40'

Appendix D – Connection Found

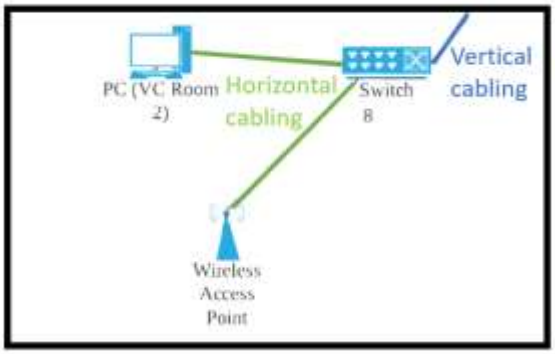
Connection 1



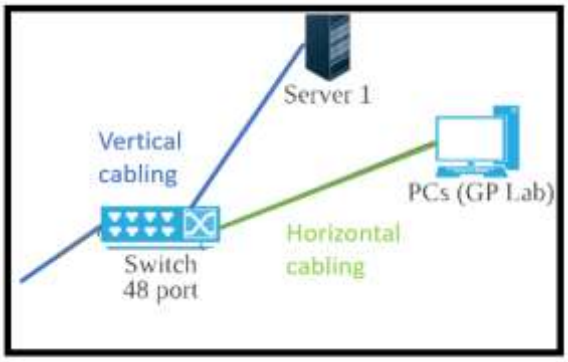
Connection 2



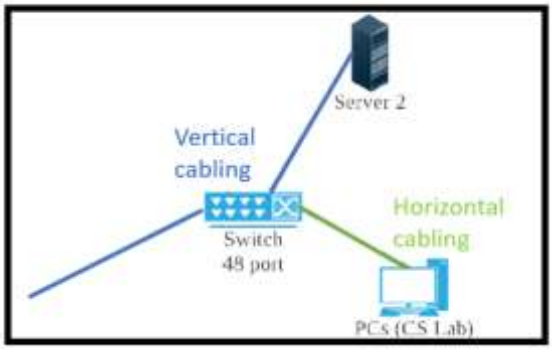
Connection 3



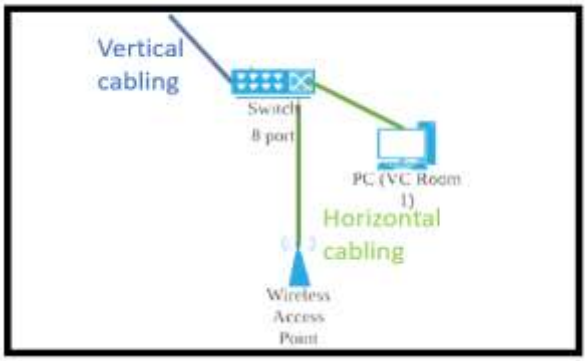
Connection 4



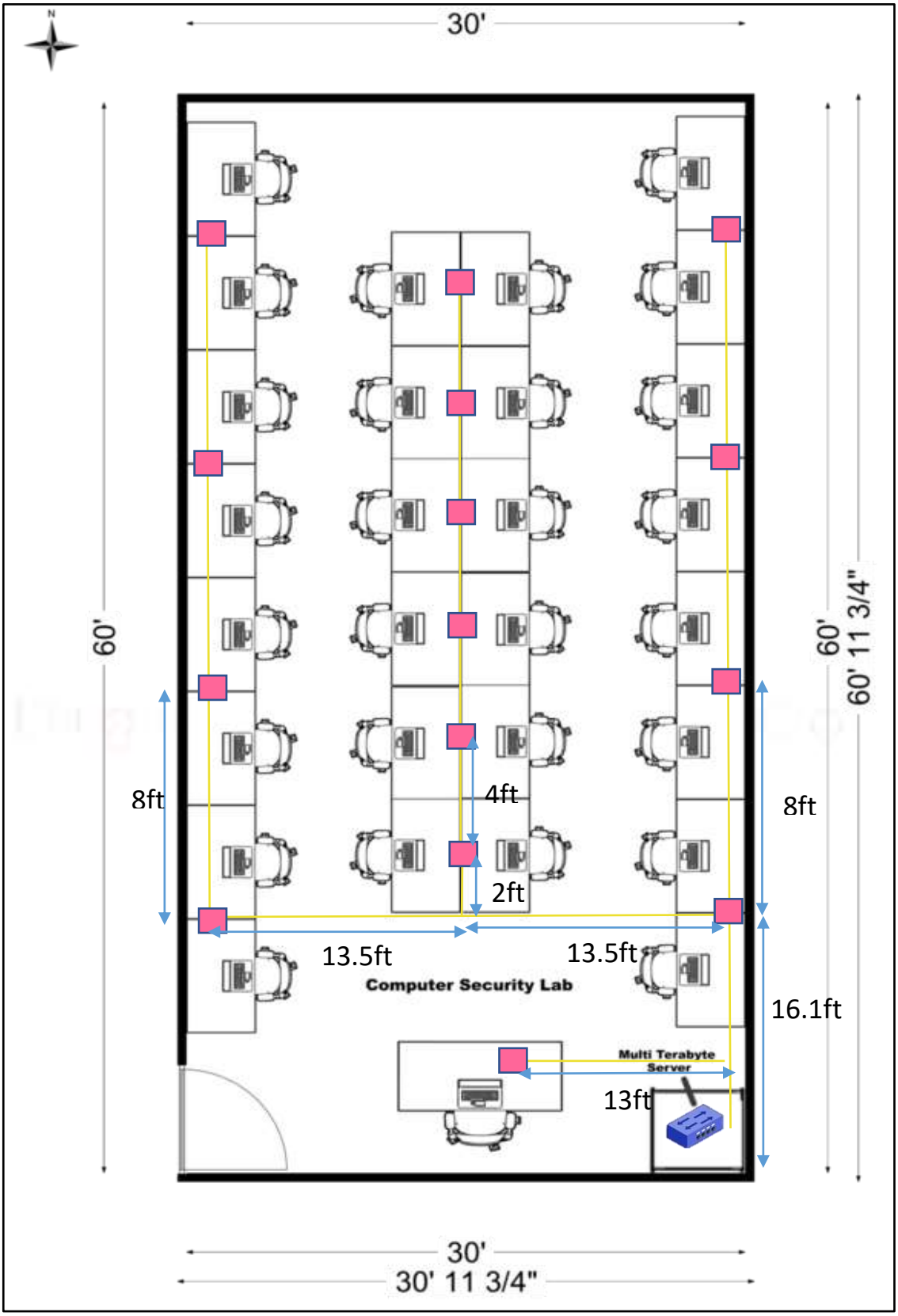
Connection 5

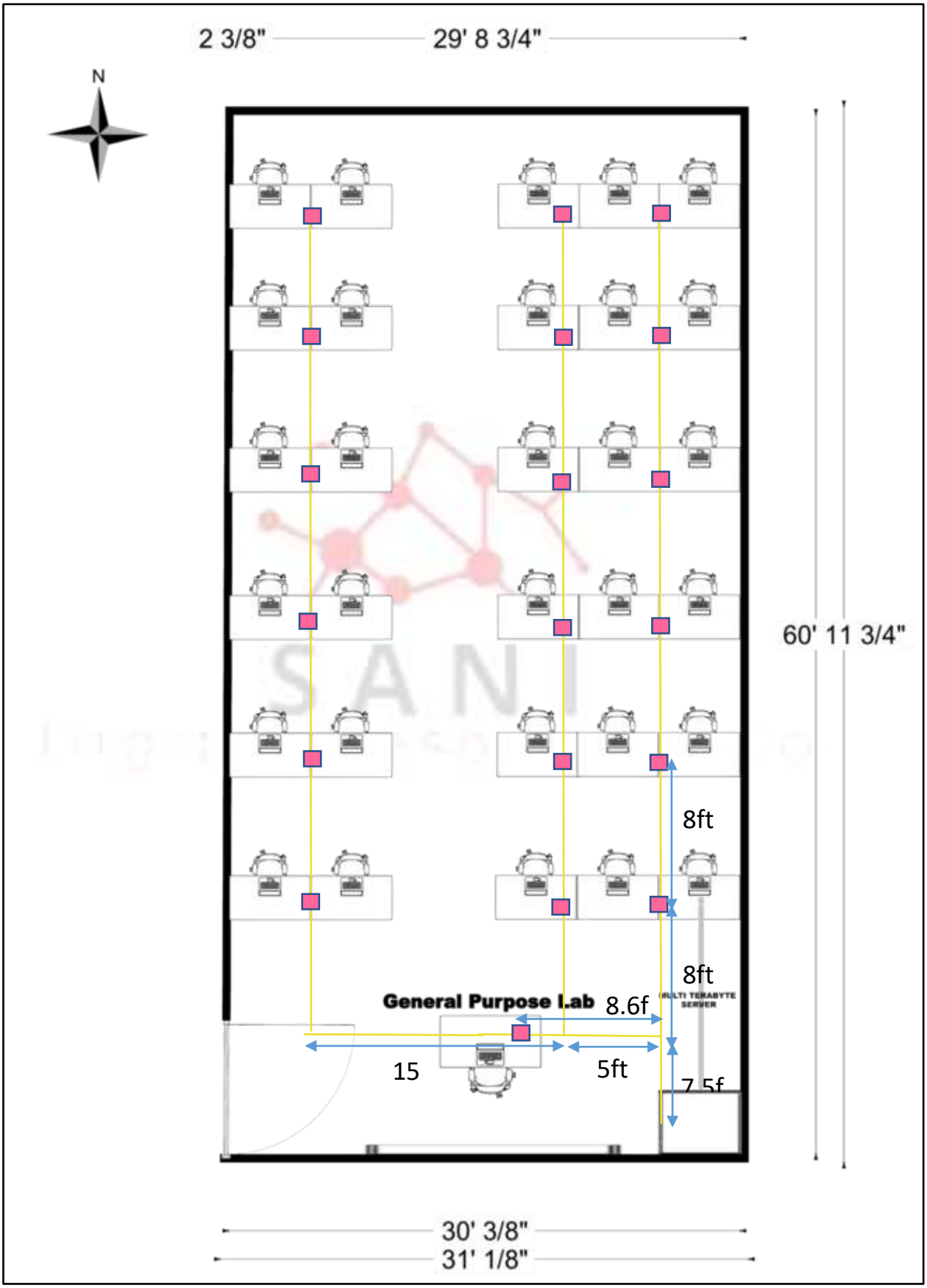


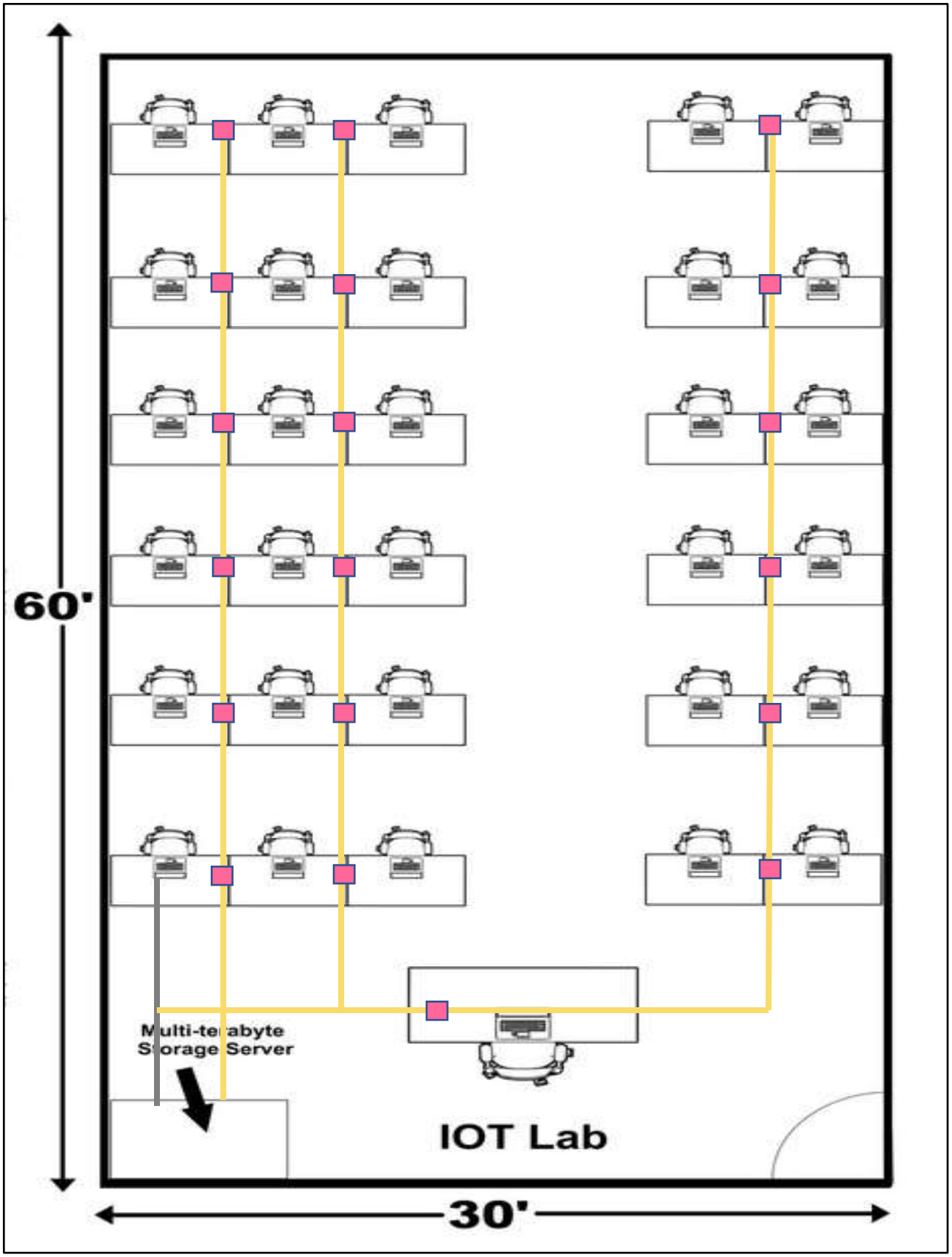
Connection 6

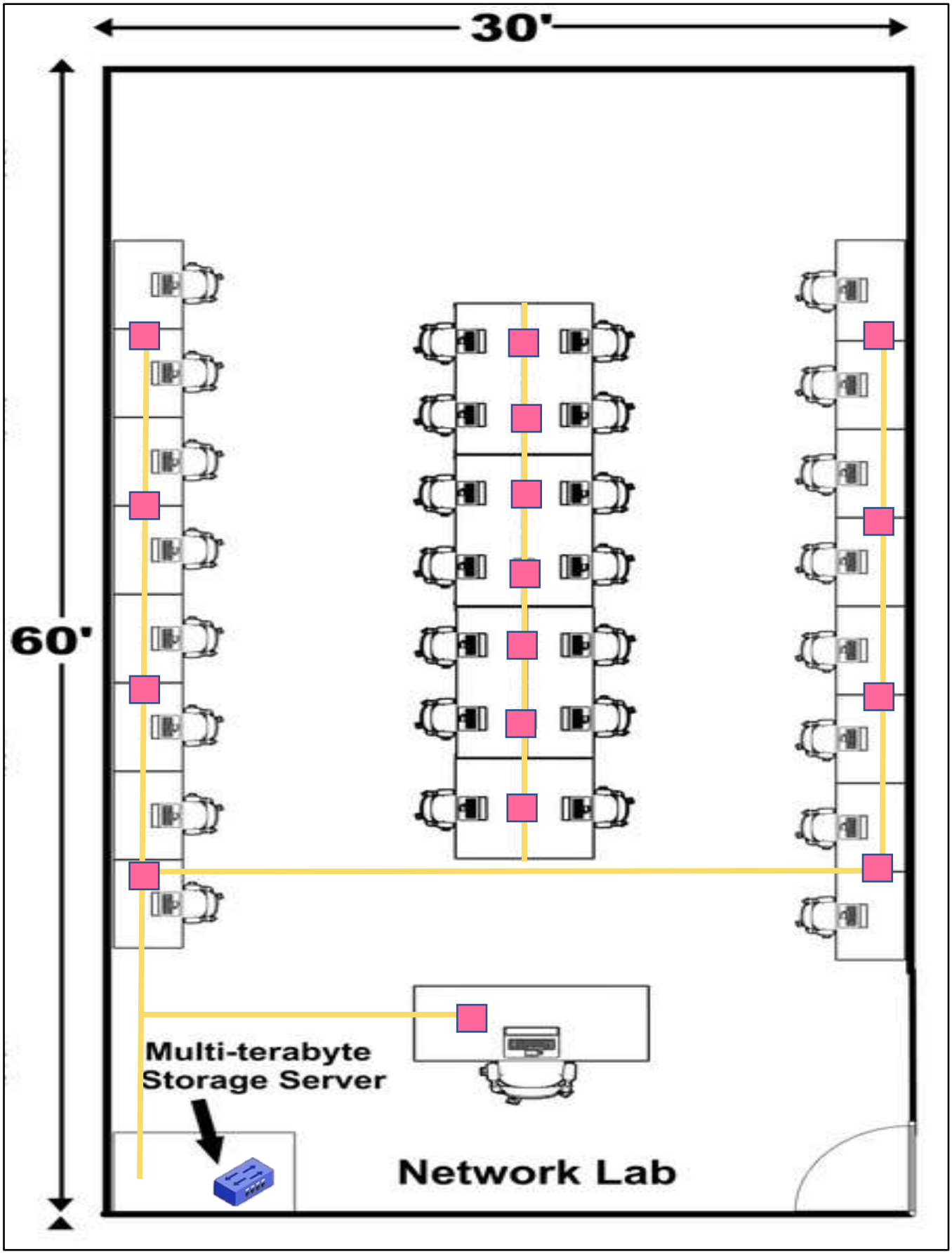


Appendix E – Total Length of cable on each Lab




2 3/8"
29' 8 3/4"
N
60' 11 3/4"
8ft
8ft
General Purpose Lab
8.6f
15
5ft
7.5f
30' 3/8"
31' 1/8"


60'
30'
Multi-terabyte
Storage Server
IOT Lab


30'
60'
Multi-terabyte
Storage Server
Network Lab

8.2. References

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8.3. Indexes

8.3.1. List of figures

8.3.2. List of tables