SCHOOL OF COMPUTING
Faculty of Engineering

SECR1213 - NETWORK COMMUNICATIONS

Network Design for School of Computing Block N28B
by ATLANTIS.INC

SECTION : 03 – 2SECR

COURSE NAME : BACHELOR OF COMPUTER SCIENCE – COMPUTER NETWORKS & SECURITY

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Abstract

This report was about our case study of network design for school of computing block N28B.We, Group ATLANTIS.INC with member of 4 were given 5 tasks to help us produced a solution for this upgrade. Moreover, we were given budget of RM3,000,000/ RM3 millions & network address of 172.182.0/18 to help us planned our solution.

The 5 tasks were project setup, preliminary analysis, choose the appropriate LAN devices, make the connections of LAN & WAN, and IP addressing. Later at the following part of this report, we included our suggested floor plan in task project setup and 12 questions regards to the requirements and other information that is necessary to develop a network plan in task preliminary analysis. Moreover, we also included feasibility of this project with reasons in task preliminary analysis as well. At task 3, choosing the appropriate LAN devices, we gave the list of devices that we thought should be used in our building with the total cost not more than our budget given. In task 4, we showed the connection and measurement of cable and devices in our building and gave the IP addressing of each labs of this building in task 5.

This report started with the introduction of our project in general terms as well as project's aims, scope, and objective. Then, it continued with the project background and an overview of the client's status and issue. The next part was the compiled solutions of Task 1-5 including our team reflection of the task as well. After that, we provided conclusion of our team achievements, strength, weaknesses, and suggestions for project improvement. We ended the report with team members responsibilities, references, and appendices.

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Introduction

Our project was about building a building that completed with facilities and networking arrangement. In our project, we needed to design a double storey building that included 4 labs and 2 video conferencing rooms within budget given of RM3,000,000.

We started our project by determine our floor plan. We discussed and decided what to built in in our building other than the labs and video conferencing rooms. To ease the cabling and networking at the following task, we also scale our floor plan with 1:500 using millimetre. Then, before we started the network arrangement, we did some preliminary analysis by the help of Internet. We asked ourselves some questions that we need to solve throughout this project. At the same time, we also made five feasibilities that being determined in our project. Since we had given a budget, hence we took some time to find the suitable LAN devices that needed in our building with suitable budget because we trained ourselves to not to exceed the budget given. After choosing the right devices, we started making the connection of the building. We planned the connection from router to each switch and hence to each access point. Not only like that, but we also arranged the cable arrangement from main cables to each rooms and labs. Lastly, we used the network address given by Dr. Raja Zahilah Raja Mohd. Radzi, 172.18.2.0/18 to plan the IP addressing for each labs and rooms.

This project aimed to provide a chance for us to apply the knowledges we learnt in the course Network Communication. In Task 1, we asked to include 1 general purpose lab, 1 Computer Security lab, 1 Network lab, and 1 IOT lab. We need to set up a total of 30 workstations and one multi-terabyte storage server for each lab for the purpose of cabling in Task 4 later. Regarding the floor plan made, we needed to provide a clear and readable plan with appropriate labels and scale. In Task 2, we focused our goal on figure out what condition we need to consider in following tasks. That was why we asked to give questions and feasibility. Task 2 was done in the method of question and answer. We asked questions to ourselves and we answered it with reference and citation from Internet or other resource. We also provide feasibility with logical and appropriate reasoning which were economic, technical, legal, operational, and scheduling feasibility.

Next, Task 3 not only want us to choose the suitable LAN devices for our building but at the same time provided us the chance to understand and know variable types of LAN devices and their characteristics especially the different between Cisco and Huawei Routers. We compared the differences by considering the appearance interface, network operating system of IP-based business platform, open interconnectivity of operating systems and more. We choose the suitable LAN devices and explain the reason and make reflection on the research we get regarding the pricing and the cost of devices in Task 3. Moreover, we get to have a rough picture of the situation of the reality market when we are planning our LAN devices with given budget, we get the chance to understand the range of the budget to get a complete set of LAN devices for a building. In Task 4, we asked to arrange the networking and cabling in our building. After identified connections, patch cord, switch port, cable length and types, we sketched the PC and network device arrangement including cable with appropriate scale and labelled. In this task, we get to know the important of cable length and types in planning cabling. Lastly for Task 5, we get to apply our knowledges of creating subnet based on network address given. We learnt it in lab exercise before we applied it in our project. We divided out 11 network to be used in each labs, video conferencing rooms, staff rooms and office.

Throughout the project, we kept in mind that always made planning that allowed the increasing number of students and staff in the next 20 years. It was a challenge, but we managed to solve it and solutions were provided at the solution parts of our report.

Project Background and Overview

As seen in our title, "Network Design for School of Computing Block N28B", this project was based on a case study of our course's upgrade needs. We were asked to propose a new double storey building that consists of 1 general purpose lab, 1 Computer Security lab, 1 Network lab, and 1 IOT lab as well as two video conferencing room in basic. To make it "ready for anything" as mentioned by SC Chair in the case study, we were also needed to include any other rooms or facilities that we think is necessary for a School of Computing Building. Moreover, we were asked to consider the availability built up space for around 1.3k peoples (1200 students, 97 academic and 35 supporting staffs) and a 10% growth of this amount in the next 3 years. Hence, the built-up square feet were not limited, and we can unleash our creativity when proposing the floor plan.

We were not only given requirement from physical appearance of the building in case study but also the software and network application. The goals were to propose a new building that can boost student performance and achievement in academic with the help of providing completed facilities needed and comfortable environment. In this case, SC (School of Computing) required us to propose system that easy to manage and scale with better overall performance. At the same time, the proposal of our project based on this case study also require providing protection from network breaches and had capability to support high-performance to the core backbone. This was because the network breaches could steal data, compromise software, or install viruses once it was inside the network. We knew that a network security breach could spell disaster for any IT professional, MSP, or his or her clients, and even the biggest companies with enterprise-level security had fallen victim to a breach.

Based on the case study, our project also required ability to support features such as Quality of Service and security in hardware via access control lists (ACL). Quality of Service (QoS) is a set of technologies that worked on a network to guarantee its ability to dependably run high-priority applications and traffic under limited network capacity while ACL was mainly to provide security to our building's network. ACL were network traffic filters that could control incoming or outgoing traffic, they are common in routers or firewalls, but they could also configure them in any device that ran in the network, from hosts, network devices, servers, or others. Not only like that, but this case study was also asking us to enable secure VPN connections from remote locations in our project as well as a scalable network for future growth and wireless connectivity in the future.

Overall, we learnt to create a building from 0 to ready to use status throughout this project from the aspect of construction, networking, cabling and even security. From the first task, project setup up to task 5, IP addressing scheme, we learnt to distribute job among team members to propose a well use double storey building with all criteria asked met. We advised to think logical and mature when constructing suitable floor plan, we questioned ourselves to provide better solution to our project, we did research and discussion within our group to grasp concepts and made decisions on which device to use and why. We also given the chance to understand and designed the physical connections of cable and networking and what the best way to divide the limited subnetwork from the network address assigned to our group.

Task 1: Project Setup

Floor plan

Figure 1

36000

42000

STORE

SURAU M.

SURAU P.

PANTRY AREA

STORE ROOM

VR2

VR1

STORE ROOM

STAFF ROOM

DICUSSION AREA

33000

33000

VOID

STAFF ROOM

36000

DICUSSION AREA

STAFF ROOM

PANTRY AREA
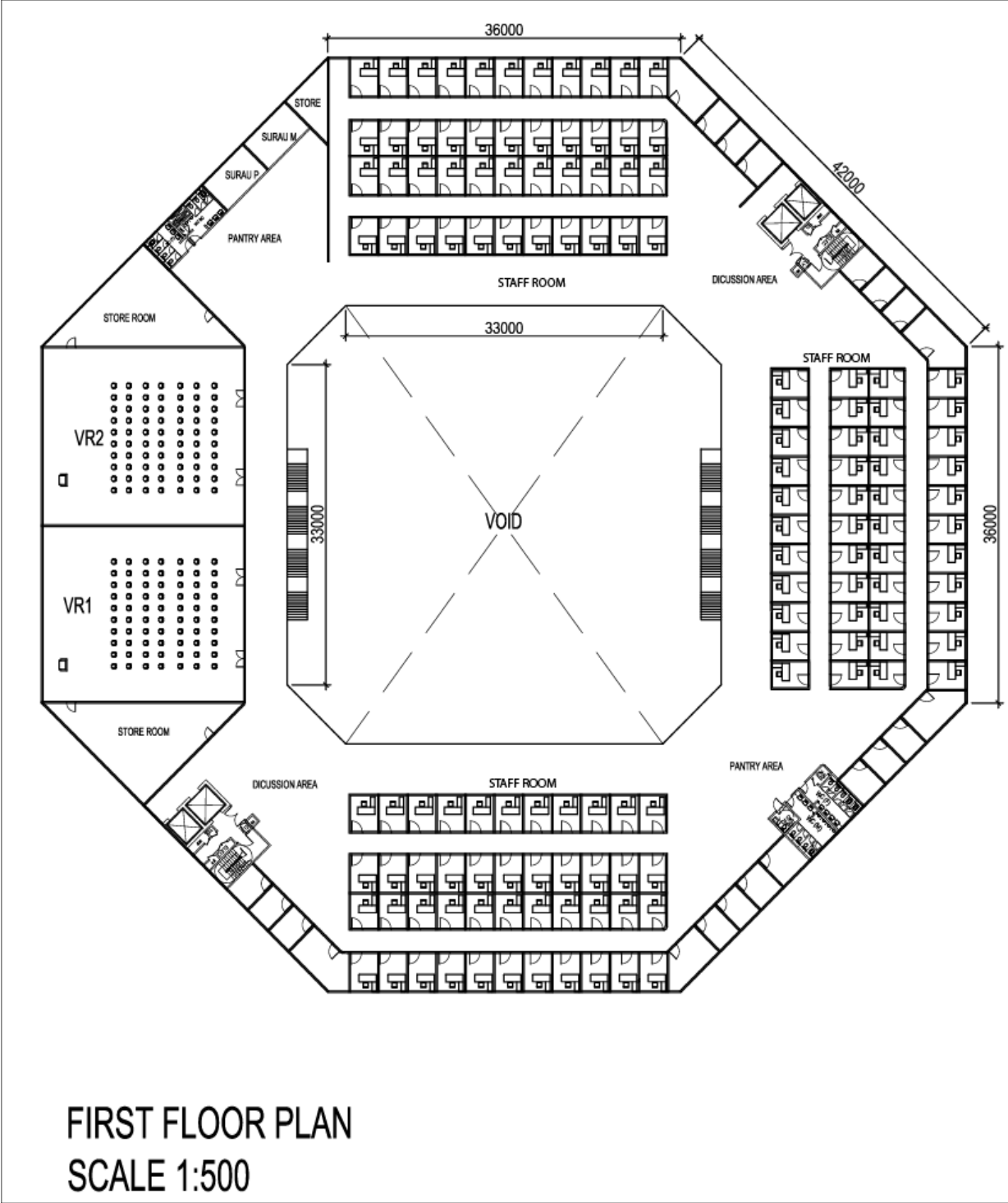
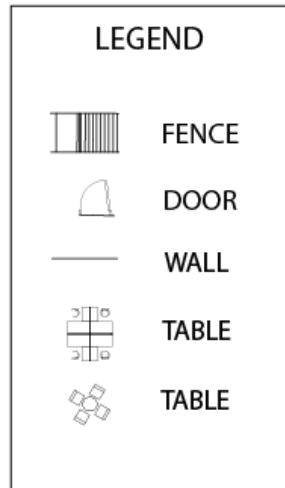**FIRST FLOOR PLAN**

SCALE 1:500

Figure 2

Figure 3

Reflection on floor plan

Regarding the floorplan made, we found that it was creative and eco-friendly. It was shaped in octagon with a central garden. Other than the labs and the video conferencing rooms, we designed staff rooms, management office, meeting room, washroom, front office, elevator, surau, resting area, kitchen, restaurant, and discussion areas in our building. We aimed to propose a building that completed with every facility that ease for our students and staffs.

There were around 150 units of staff rooms in first floor which each located at north wing or east wing or south wing of our building. There were also some empty units to support the growth of number of staffs and lecturers in future. Management office was located at the ground floor with meeting room next to it. We set up a front office beside the main entrance as well. When our student needed any guidance or information advise, they could check it out with front office once they entered our building. There were two corners of washroom in both floors to ease the users of entire building. We did set up surau at north west side of our building as well for all the Muslim prayers. Moreover, we set up restaurant, open air restaurant and restaurant with air conditional for our students and staffs. They would save up their time for going to other place else to have their meal.

Overall, our team was satisfied with the floor plan we made as it was completed with every facility that we thought should be included in an academic building.

Task 2: Initial Design – Preliminary Analysis

Questions

1. Is the equipment in the labs should be the same?
2. How to obtain most effective WIFI coverage?
3. Would soundproof be used in the video conferencing room?
4. What type of connection is suitable for the lab?
5. How you maintain security for the network?
6. Will there be one domain server that will manage the whole network?
7. What will you do in regards of break time for the employees?
8. Will you use WIFI or LAN for your main connection?
9. Is the building enough to fit in the maximum number of students, academic and supporting staffs in future growth?
10. Do we have redundancy and backing up plan for this building?
11. Are we going for standardization of hardware and software?
12. Is our building user friendly to our students and staff?

Answers

1. Is the equipment in the labs should be the same?
   - *No, because the use of the lab is different.*
2. How to obtain most effective WIFI coverage?
   - *Use and connect as many wireless access points as possible to a network to provide adequate coverage.*
3. Would soundproof be used in the video conferencing room?
   - *Yes, to avoid the disturbance from outside.*
4. What type of connection is suitable for the lab?
   - *LAN, because it can reach the whole lab and have more stable and faster connection.*
5. How you maintain security for the network?
   - *There will be a SOC team with their own lab to manage everything regards for security.*
6. Will there be one domain server that will manage the whole network?
   - *Yes, there will be a central domain server that will be responsible for administration.*

7. What will you do in regards of break time for the employees?
   - *There will be a break room which includes entertainments, food, and relaxing rooms.*
8. Will you use WIFI or LAN for your main connection?
   - *Mainly it will be LAN (RJ45 Ports) and there will also be WIFI but will lower privileges.*
9. Is the building enough to fit in the maximum number of students, academic and supporting staffs in future growth?
   - *Yes, there are up to 153 rooms for academic staffs on first floor and management office that can fit in up to 36 supporting staffs at ground floor.*
10. Do we have redundancy and backing up plan for this building?
    - *Yes, we will build in extra switch and power plug for every labs and rooms, as well as wireless router and spare laptop onsite for ensuring that downtime is kept to a minimum.*
11. Are we going for standardization of hardware and software?
    - *Yes, every computer in labs will be same model, same word processing, with software and hardware patch across the organization to reduces costs associated with maintenance, updates, and repairs.*
12. Is our building user friendly to our students and staff?
    - *Yes, we have restaurant, meeting room, storeroom, surau, central garden and discussion areas for our students and staff beside those important labs and rooms.*

Feasibility

There were five feasibilities that being determined in this project which were:

•**Economic feasibility**- Involved a cost benefits analysis to identify how well or how poor the project will be conduct with the budget given. In this project, the budget given to Group Atlantis.INC is RM3 million.

•**Technical feasibility** – Validating the technical resources and capabilities to convert the ideas such as the floor plan idea into working system.

•**Legal feasibility** – To understand if the proposed plan that has been created conform the legal and ethical requirement.

•**Operational feasibility** – To understand well a proposed system solved the problems such as whether the system could be secure from network breaches or not, or was the system was easy to manage or not.

•**Scheduling feasibility**- To measure how reasonable the project duration would be whether it will finish according to the plan or not.

Reflection

The purpose of preliminary analysis was to determine whether our project was feasible. Hence, we started our Task 2 by asking question to ourselves, then we solved the questions, then we summarize the answers and determine the feasibility of our project.

We considered the setting up of network, the user experience of our building, the hardware and software, the redundancy and back up plan for our building. Lastly, we came up with 12 questions in total and provided answers. We then determined our feasibilities from the aspect of economic, technical, legal, operational, and scheduling after summarizing the answers we get from the questions. We thought that the feasibilities mentioned was important because we were building an academic building based on the requirement from case study, hence we needed to help our clients to consider their situation from each aspect.

Task 3: Choosing the Appropriate LAN Devices

List of devices

Description	Part Number	Price	Quantity
Server	Cisco SG350-52P 350 Series 52-Port PoE+ Managed Gigabit Ethernet Switch	RM 5,081	12
Cat6 1000'	Belkin# A7L504-1000-BLU	RM 634.80	1000' * 12
48-Port Cat6 Punchblock	Hubbell# P5E48UE	RM 1,410.08	4 (1 per room + VR)
5' Patch Cable Cat6	Belkin# A3L980-05-BLU	RM 11.00	132
15' Linecord Cat6	Belkin# A3L980-15-BLU	RM 12.00	24
24-Port Switch 10/100/1000	Cisco# ws-c3560g-24ts-s	RM 21,568.35	12
24-Port Switch 10/100	Cisco# ws-c3560-24ts-s	RM 5,253.72	12
8-Port Switch 10/100	Cisco# ws-c3560-8pc-s	RM 5,676.95	6
1000base-t SFP	Cisco# glc-t	RM 1,607.45	1
1000base-mm SFP	Cisco# glc-sx-mm=	RM 2,034.75	1
2-Port Data Faceplace	Hubbell# IFP12EI	RM 13.84	300
Data Insert Cat6	Hubbell# PR HXJ6B	RM 31.25	132
Access Point	Cisco# air-ap1242ag-a-k9	RM 4,065.43	24
2821 Integrated services router	2GE, 1 NME-X, 1 EVM, 4 HWICs, 2 PVDM slots, 2 AIMs, and Cisco IOS IP Base Software	RM 10,755.69	1
CISCO2821-HSEC/K9	2821 Security Bundle,AIM-VPN-EPII-PLUS,Adv. IP Serv,64F/256D	RM 13,417.14	1
CISCO 2851	Dual Gigabit Ethernet integrated services router with AC power, 2GE, 1 NME-XD, 1 EVM, 4 HWICs, 3 PVDM slots, 2AIMs, and Cisco IOS IP Base Software	RM 17,043.07	1
Cisco 2691	High Perf 10/100 Dual Eth Router w/3 WIC,1 NM,32F/256D	RM 1,474.27	1

Figure 4

References

1. All Routers Products. Cisco. Retrieved from https://www.cisco.com/c/en_my/products/routers/product-listing.html
2. AP 3800 and Multigigabit Ethernet(mGig). Cisco. Retrieved from https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-3/b_cisco_aironet_series_2800_3800_access_point_deployment_guide/b_cisco_aironet_series_2800_3800_access_point_deployment_guide_chapter_0101.pdf

Does LAN devices chosen accomplish needs/requirements?

Yes, the devices that we had chosen had achieved the needs. The devices had a scalable connectivity because the number of cables and wireless access points enabled the connection throughout the building. Although, it was not very cost effective, but the performance was very good even for a distant future.

Characteristic of LAN devices that being choose.

In our project, we had come into solution of what characteristic of LAN devices that should be used for the SC School.

1. **High-capacity load balancing** – In line with the SC goals that preferred wireless network, so it should be planned perfectly for capacity. We knew that we should take in the high-capacity load balancing which meant that if one access point was overloaded, therefore system will continue to shift the users to another depended on the capacity that still available.

2. **Scalability**- As the LAN devices were going to use in very big area of coverage, the network needed to expand the scales in terms of capacity and coverage but there was no need to have it overhauled.

3. **Network management system**- As wireless networks in the SC Schools were being more complex and consisted of thousand access point, firewall and many more other components, deploying the network management system that could control the LAN devices would be an advantage.

4. **Indoor and outdoor coverage options**- The internet coverage that being provide by the LAN devices should be in the Schools area but outside with the radius of 2km which gave more comfortability for the students and staff.

5. **Network access control**- It would be a good if the school to have a secure method for registration and securing the devices that it did not own such as mobile phone and laptop that owned by students and staff.

6. **Shared** – The LAN devices that we provided also it offered the facility to share a single internet connection among all LAN users even in laboratory or in the staff rooms.

Report

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

Yes, I am surprised by the prices. This is because it is our first time to involve ourselves in this huge project. We get to know the cost of the LAN devices including the routers, switches, patch panels, wireless devices, cables and more. Hence, we surprised that it is not a small amount for us to manage and arrange the networks nicely throughout one building while we still need to include the cost of overhead, workers salary, computer hardware and other factors.

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

Yes. We considered cost as a factor for choosing networking devices because that no matter what transmission medium is chosen for a LAN, it must be physically installed in our building. It involves the installation of cables and other devices through raceway. We aim to minimize the installation cost so that our Network can be cause effective. To achieve our target, we need to use the proper hardware linking the cables, proper communication devices between the buildings, proper servers and minimizing the distance involved. All these devices and hardware mentioned will cost us money hence our budget will largely be determined by what kind of Network communication to apply.

Furthermore, we know that the cost of a switch is determined by its capacity and features. We need to consider the cost when choosing the better switch capacity. Another cost consideration is how much to invest in redundancy. This is because the operation of the entire physical network is affected if there are problems with a single central switch.

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

The major differences between the same devices from different brands are the appearance interface, network operating system of IP-based business platform, open interconnectivity of operating systems and more.

Network operating system of IP-based business platform. For example, the realization of the Huawei VRP system fully maintains and gives full play to the simplicity and efficiency of the IP protocol family while CISCO IOS is not as efficient and stable as CISCO mentioned itself.

CISCO support for AppleTalk, DecNet and other networks is precisely its weakness. When Cisco IOS performs IP packet transmission, it may also consider maintaining compatibility with classical network protocols.

Openness of platform standards. The Huawei VRP system has always been an open system that can communicate well with the IP products of other data communication vendors/telecom vendors in all protocol features while the software of Cisco IOS lacks the ability to tailor the software and the ability to customize the software according to the needs of user network deployment. All services, features, and protocols are solidified together. Furthermore, I also compare the major differences between Cisco and Huawei Routers in the factor of strength of the system, encryption and key exchange technology and address translation.

Strength of the system. When an accident occurs to the main version, the standby version of Huawei can be switched online while the Cisco 75 router active/standby switchover means the restarting the main version in time. This is because Huawei uses the same redundant hot backup technology as telecom switches.

Encryption and key exchange technology. Huawei Routers supports a variety of commonly used software encryption algorithms including DES, 3DES while Cisco encryption products exceeding 56 bits cannot be exported to China. Huawei VRP supports various encryption algorithms, DES and 3DES encryption have been implemented in VRP 1.3, and encryption algorithms such as cast, blowfish and skipjack have been implemented in VRP 3.0 while Cisco IOS only has DES and 3DES encryption algorithms. The software encryption efficiency of Huawei VRP is higher than Cisco IOS. Compared with the 56-bit DES encryption of the Huawei 2630 and the Cisco 2620, Cisco has a throughput rate of only 1Mbps but Huawei 2630 reaches 3.2Mbps.

Address Translation (NAT/PAT). Huawei VRP has distributed address translation (each interface can do address translation without affecting the sending of other interfaces, which is fast and stable) while Cisco IOS only supports centralized processing.

Reflection

The purpose of task 3 was to achieve the objective of fulfilling the requirements and needs of the organization. To ensure that we did not exceed the budget given, we did research

and determined the devices needed for our project. The server, the cable, the port switch, the access point, the Cisco Router, and the others. We get the part number of each devices we had chosen as well as the estimated market price and the quantity. Although the devices chosen were not very cost effective, but the performance was good even for a distant future. Moreover, we figured out the characteristic of LAN devices that should be used for our project which were high-capacity load balancing, scalability, network management system, indoor and outdoor coverage options, network access control and shared. We found that choosing the suitable devices for our building was not an easy job as we need to consider their cost performance. We ended up with the decision of choosing the better performance devices even though it might be more expensive as we had a good amount of budget.

As mentioned in the report of task 3 above, we were surprised by the prices. Although we were having a big amount of budget, RM3 million, but still we were not confident enough to use up all the budget in choosing devices as we knew that we still need to use the budget in other aspect. For example, we needed to consider the hardware arrangement like computers, chairs, and tables. When completing the task 3, budget was not the only factor we needed to consider when choosing the suitable devices, but we found out that the devices with better price always have the better performance.

In Task 3, we were also asked to do research on difference between different brand's routers. We compared Cisco Routers and Huawei Routers in our Task 3. We found out that each brand had their advantages and their disadvantages. We could not really point out which brand was the best as different people had different requirement. In our project, we choose Cisco Router as it was the eco-friendliness. Used Cisco routers and switches could cut down on electric bills based on the low amount that they used. Also, used Cisco routers and switches were easy to set up. It was a good factor to consider as we need to minimize the overhead cost like electric bill when we considered about future growth. However, we still surprised with the benefit provided by Huawei Routers when we were doing research on it. As mentioned above, for example it had network operating system of IP-based business platform and openness of platform standards which were better in that field when comparing to Cisco Routers.

Task 4: Making the Connections – LAN and WAN

Work Area

To connect the devices, first we needed to define each area network and its needs. The work area was the space inside a building where a person or people used the network equipment. Here we divided the work area into 2, each with different floor.
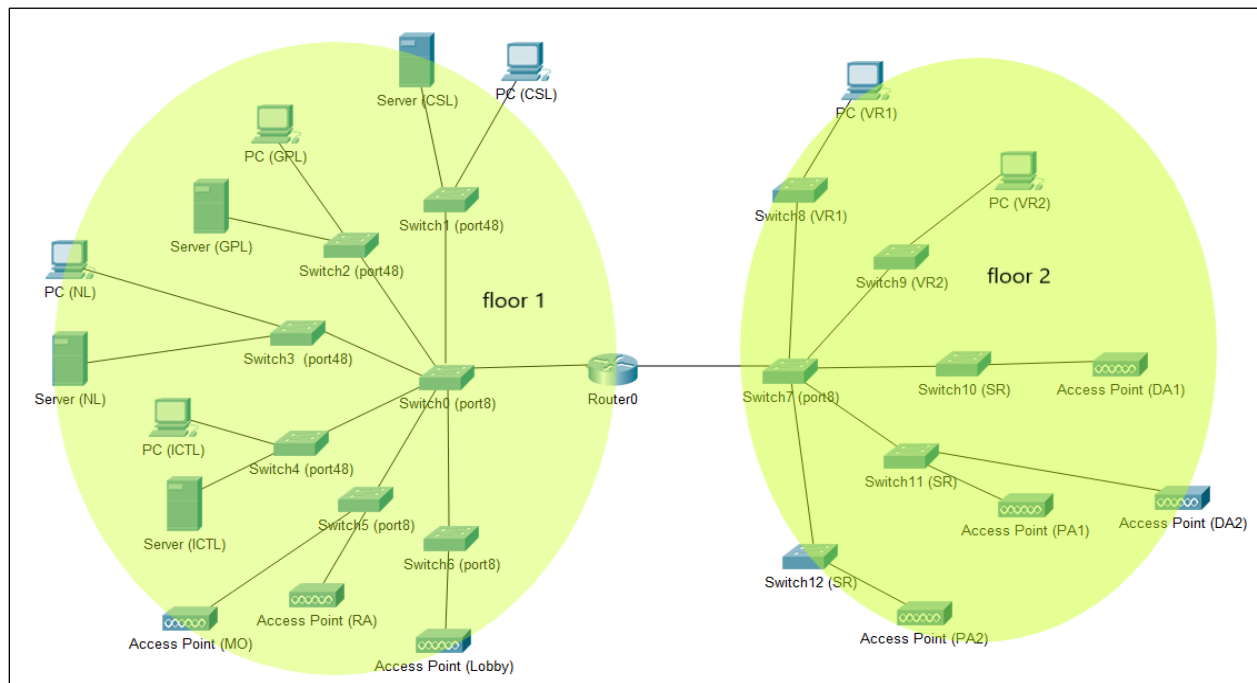

Figure 5

Floor 1 - contained all the lab which were Computer Science lab (CSL), General purpose lab (GPL), Network lab (NL) and IoT lab (IOTL). This floor also contained a lobby, management office, meeting room, resting area and restaurant.

Floor 2 - had 2 conference room and all the staff room were on this floor. In addition, this floor also contained 2 pantry area and 2 discussion area.
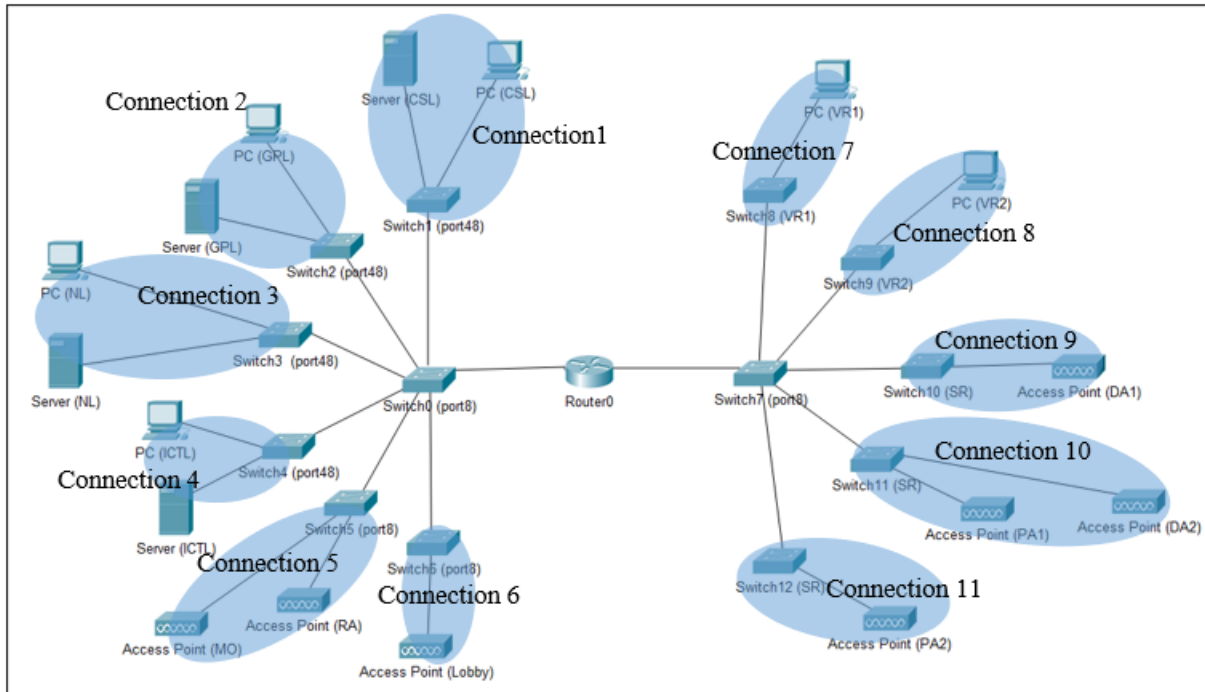
Connectivity

Figure 6

From the topology above, we determined that we needed eleven (11) connections in the building. The first 6 connections were contained in floor 1 while the next 5 connections were for floor 2.

Connection 1 - The network was provided to Computer Science lab.

Connection 2 - The network was provided to General Purpose lab.

Connection 3 - The network was provided to Network lab.

Connection 4 - The network was provided to IoT lab.

Connection 5 - This connection provided network to management office and resting area.

Connection 6 - This connection provided in the lobby.

Connection 7 - The network was provided to Video Conference Room 1.

Connection 8 - The network was provided to Video Conference Room 2

Connection 9 - This connection provided network to Staff room and Discussion Area 1.

Connection 10 - This connection provided network to Staff room, Discussion Area 2 and Pantry Area 1.

Connection 11 - This connection provided network to Staff room and Pantry Area 2.

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Patch cords

From our discussion, we concluded to use 5' Patch Cable Cat6(Belkin#A3L980-05-BLU). It was a standardized twisted pair cable for ethernet and others. The price stated for a unit was RM20.00. As we knew, these short cables will be used in 96 patch cords as we consider connecting it to the switch in Computer Lab, General Purpose Lab and Network Lab. The total altogether was about RM1920.00

Switch ports

We decided to use 4 Port-48 and 3 Port-8. The Port-48 was being used in ICT lab, CS lab, General Purpose Lab and Network Lab. The Port-8 was being used in connect all the access point to the network,

The price for one unit of Port-48 was RM14,928.00 and for Port-8 is RM680.00, Therefore the total was RM63,112.00. In addition, we choose switches that had Power over Ethernet (POE). It allowed the electric current needed for the operation of each devices to being carry by the data cables. It also helped in transmitting the data traveled in high speed.

Cable Types and Length

Floor 1 - The length of cables needed to manage the lab will be as figures below.

LAB	Per PC	Per Table	Total
Network lab	2.2 m	5.4 m	(2.2)(64) + (5.4)(8) = 184 m
ICT lab	2.2 m	5.4 m	(2.2)(64) + (5.4)(8) = 184 m
Security lab	2.2 m	5.4 m	(2.2)(64) + (5.4)(8) = 184 m
General lab	2.2 m	5.4 m	(2.2)(64) + (5.4)(8) = 184 m
Mangers office	2.4 m	7.8 m	(2.4)(36) + (7.8)(9) = 156.6 m
Main (core) cables: 125m			

Figure 7

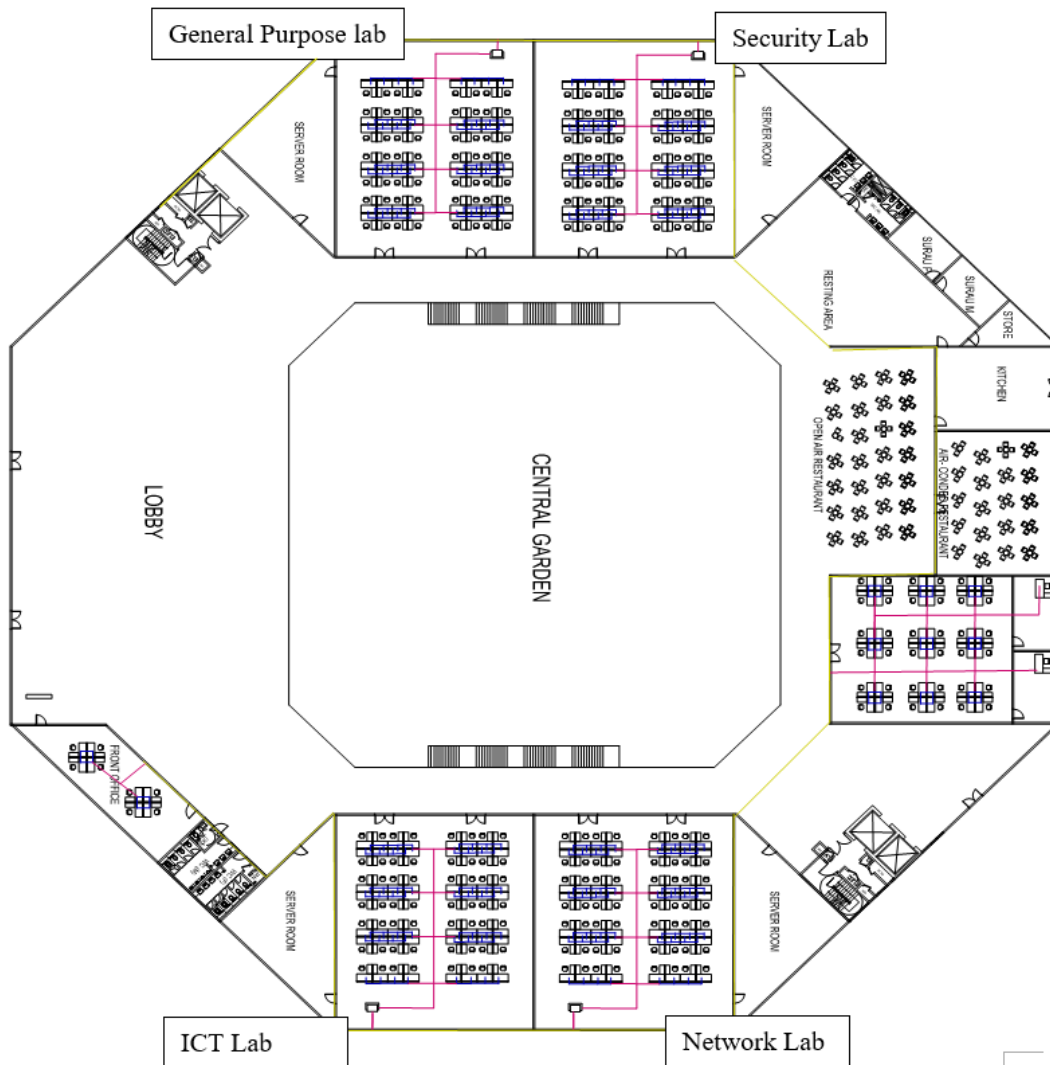**Total cables:** 125 + 184 + 184 + 184 + 184 + 156.6 + 10 (estimated for font office) = **1027.6m**

Figure 8

Floor 2 - The length of cables needed to manage the lab will be as figures below.

LAB	Per Room	To Room	Total
West staff rooms	1.8 m	2.1 m	(1.8)(44) + (2.1)(44) = 171.6 m
East staff rooms	1.8 m	2.1 m	(1.8)(44) + (2.1)(44) = 171.6 m
South staff rooms	1.8 m	2.1 m	(1.8)(44) + (2.1)(44) = 171.6 m
Main (core) cables: 300m			

Figure 9

24

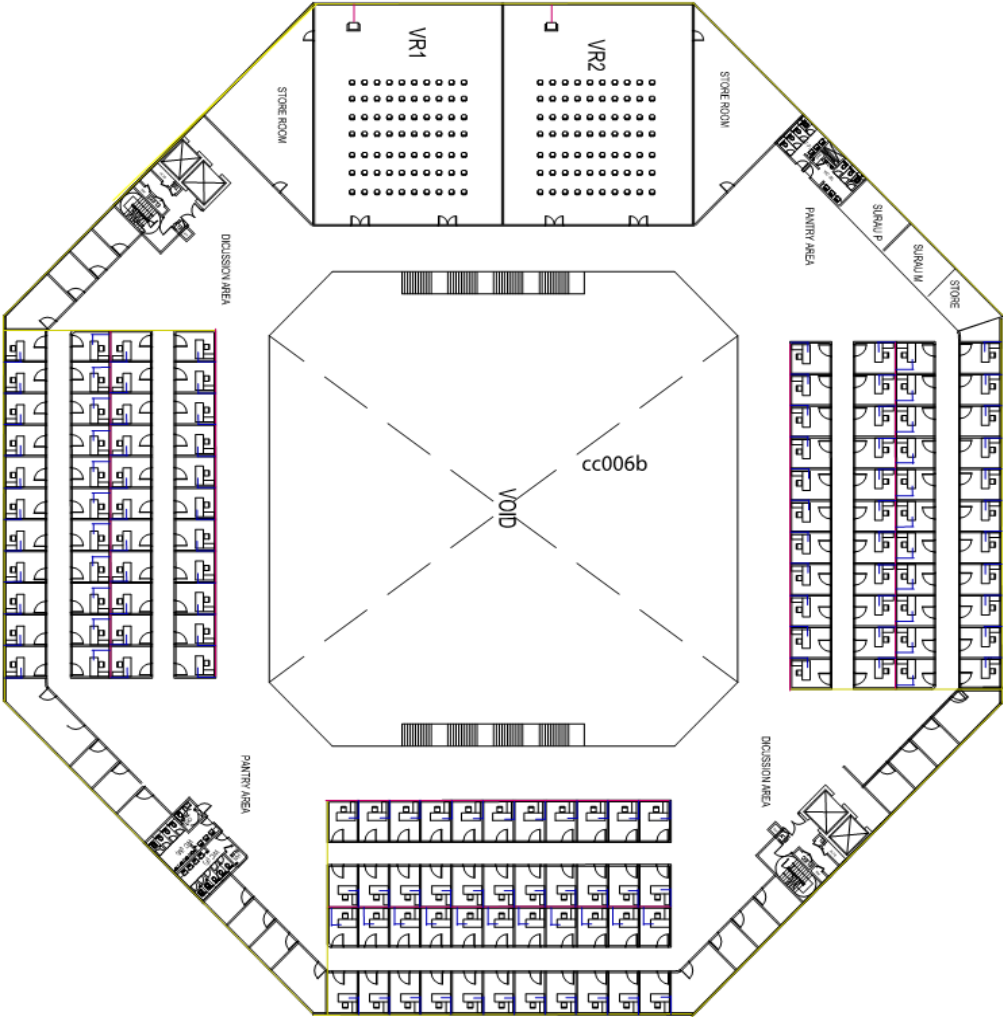**Total cables:** 171.6 + 171.6 + 171.6 + 300 + 10 (estimated VR room) = **824.8m**

Figure 10

We briefly show the cabling of switch to server, switch to access point & the PC arrangement and allocation for labs, staff rooms, management office and video conferencing room (VR1, VR2)

Symbol Used in The Diagram Below

Cable Colour	Represent
Yellow	Main(bone) cables
Red	Switch to tables
Blue	Direct Connection
Green	Switch to Server
Purple	Switch to Access Point
Shape	**Represent**
	Switch
	Cable Entrance
	Server
	Access Point

Figure 11

Cabling between ground floor & first floor

Cabling connection between ground floor & first floor at front elevator area (beside main entrance at ground floor & beside VR1 at first floor)
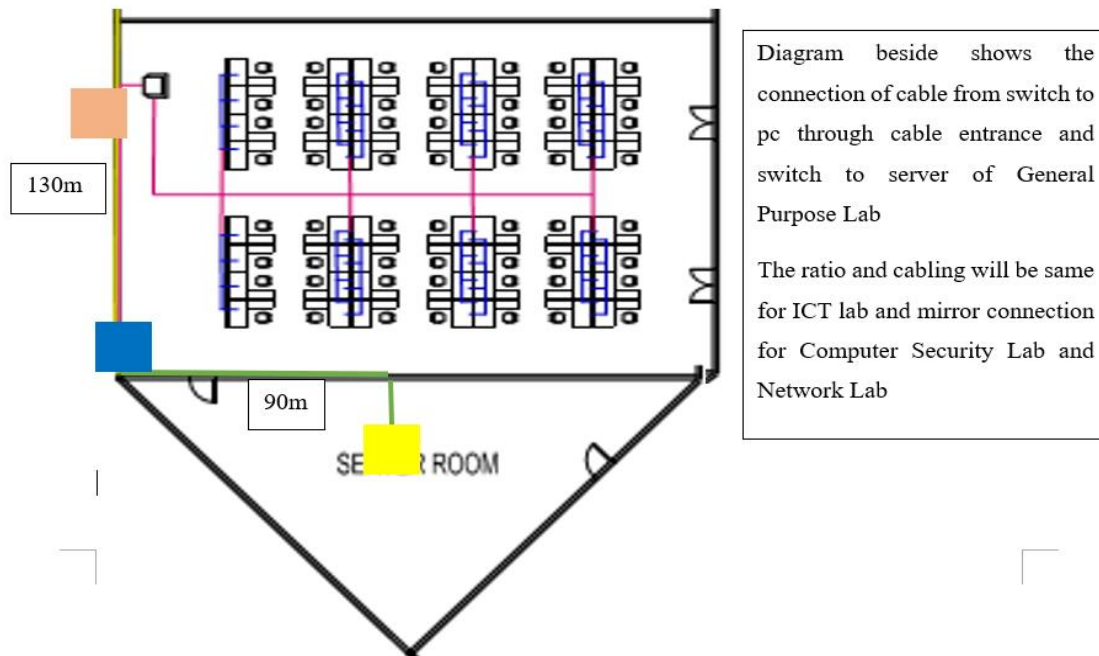
Network Lab | ICT Lab | Security Lab | General Lab

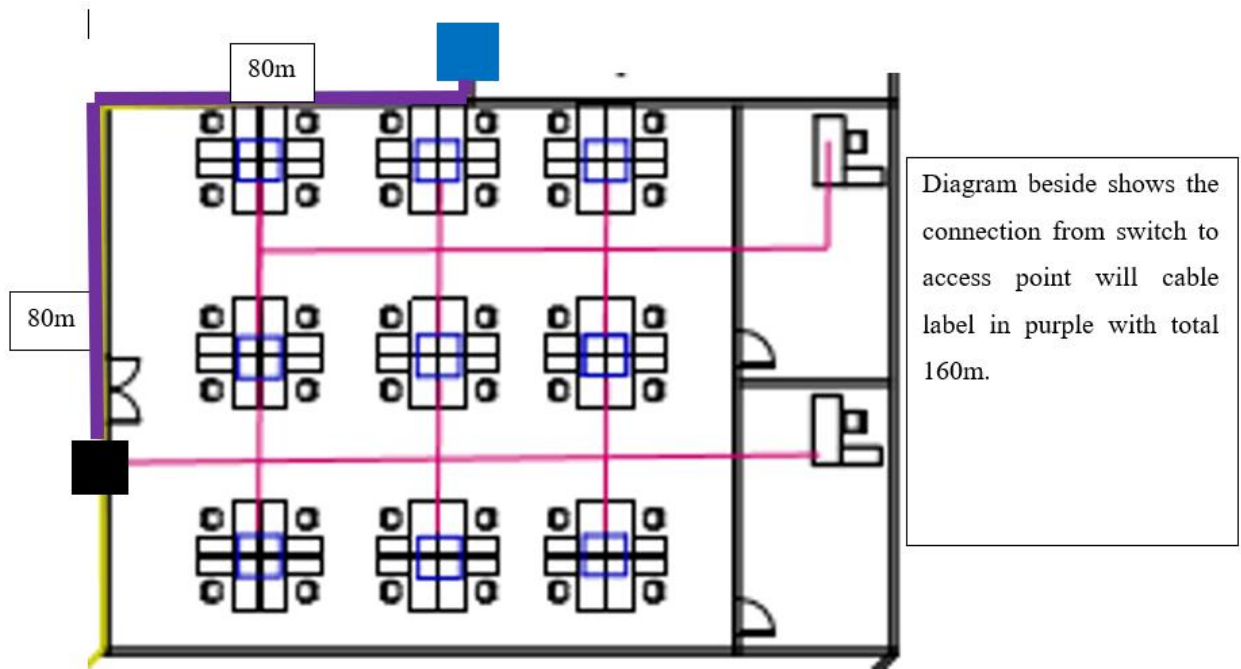Diagram beside shows the connection of cable from switch to pc through cable entrance and switch to server of General Purpose Lab

The ratio and cabling will be same for ICT lab and mirror connection for Computer Security Lab and Network Lab

130m

90m

SE⬛R ROOM

Figure 12

26

Management Office

80m

80m

Diagram beside shows the connection from switch to access point will cable label in purple with total 160m.

Figure 13

VR1 | VR2

VR1

PC

Diagram beside shows the connection of cable from switch to PC in VR1.

The connection will be same go to VR2.

Figure 14

Staff Rooms

Diagram beside shows the connection for switch to access point. We put the switch and access point together so that we can reduce the cable use to connect switch to access point.
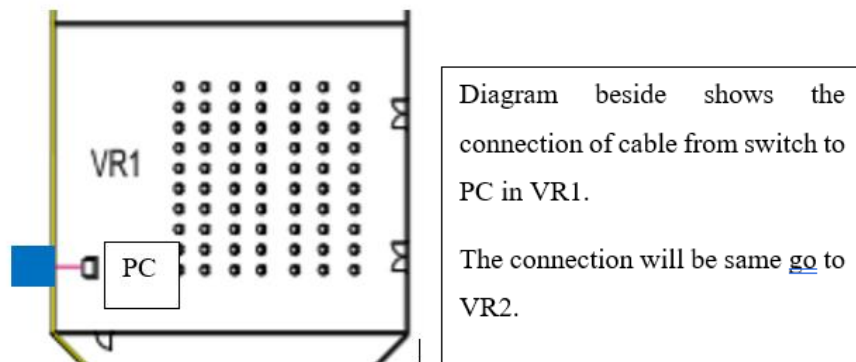
Same goes to all the staff room sides.

Figure 15

PC arrangement

1) Network Lab | ICT Lab | Security Lab | General Lab

- For lab, each row had 4 PC allocation, and had a total of 14 rows (7 for the left side and 7 for the right side). We had a total of 56 PCs allocated for each lab. Diagram below showed the example of arrangement of PCs of one row. (the same arrangement will go to each row)
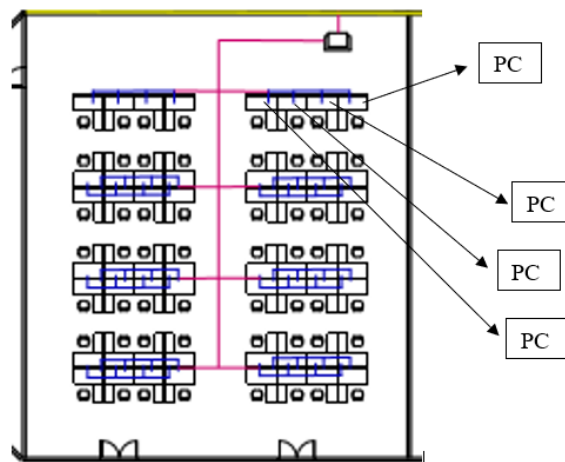

Figure 16

2) Management Office

- For management office, there were 9 groups of tables and two individual room. For each group of tables, there consisted of 4 PCs, and 1 PC for each individual room. In total, there were 38 PCs in management office. Figure below showed the arrangement of PCs for one group of tables and one individual room. The same arrangement went to the other groups of tables and another individual room.
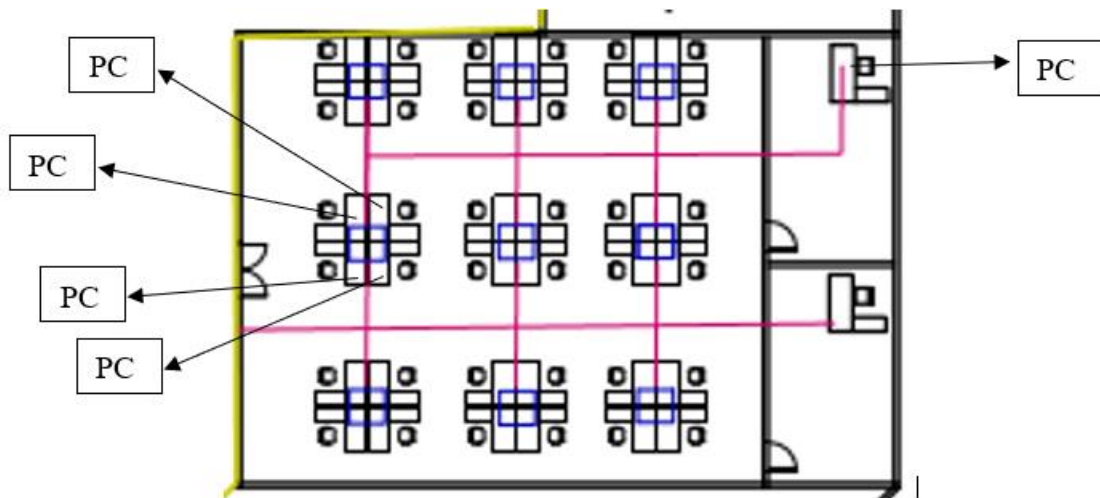

Figure 17

3) VR1 | VR2

- For VR rooms, we did not provide PC for students, hence only had 1 PC for each VR room for the purpose of education and presentation.
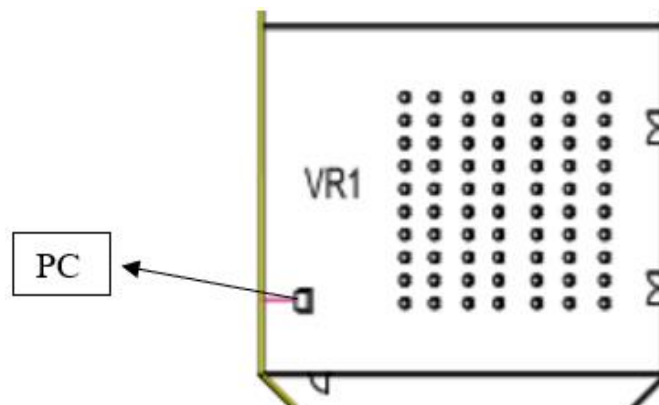

Figure 18

4) Staff Rooms

- For Staff Rooms, each individual Staff room had one PC allocated. Diagram below showed how PC was allocated in a specific staff room.
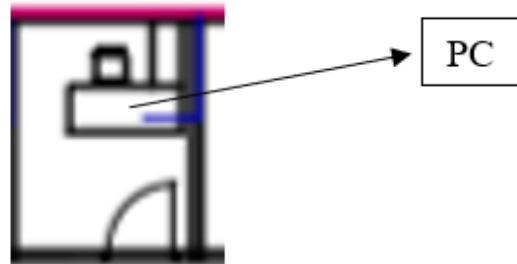

Figure 19

Reflection

We were putting all the infrastructure and devices into place especially focused on the connection of cable, switch, and routers. Throughout this task, we found that it was not an easy job to connect all the cabling and network devices together in this double storey building. However, we managed to come out with the arrangement after discussion. We get to measure how long the cable needed to connect router to each computers or access point in each rooms and labs. Besides, we also arranged the allocation of computers in each labs and rooms in the way to ease the network connection.

We labelled different cables with different colours and we found that it was efficient to identify the type of the cables. We used yellow for main(bone) cables, red for cables that connected switch to tables, blue for direct connection, green for connection from switch to server and purple for cabling from switch to access point. We did label them clearly at the figures shown above from figure 11 to figure 19.

We found that when arranging the connections, it was important for us to review our floorplan again to produce the suitable connections. For example, we found that we missed out the gateway for network connection that we added on later in elevator area. Furthermore, we found that we lacked knowledge on imagined the measurement of the cabling. However, we managed to scale the cabling with the help of appropriate scaling we did in floor plan.

Task 5: IP Addressing Scheme

IP Addressing

Given IP address = 172.18.2.0/==18==

Used IP address = 172.18.2.0/==20==

We changed the subnet mask, so that we could make more subnet. More subnets brought more benefits such as higher speed, less congestion, boost security, control network growth and ease for administration.

Subnet mask = 255.255.240.0

Ip address	==10101100.00010010.0000==0010.00000000
Subnet mask	==11111111.11111111.1111==0000.00000000

To get the network ID we used AND operator for IP address and subnet mask in binary form.

Network address	10101100.00010010.00000000.00000000

Network address: 172.18.0.0

For broadcast address, we compared between IP address and subnet mask. According to the rules, if the octet in the subnet mask was 255, wrote down the IP address octet value, and if the subnet mask was 0, then wrote 255 in the address. In addition, if the subnet contained the value in between, we must use the formula 256-the value-1. So, from the rules we could come to conclusion that our broadcast address will be 172.18.15.255.

Broadcast address: 172.18.15.255

For the maximum number of hosts, we used the formula $2^{(32-subnet\_length)}-2$. From the formula we got the maximum number of hosts was 4,094. Hence, we could get the host address range which was 172.18.0.1 - 172.18.15.254.

Delegation of network

First floor

Network Number	Network ID	Host ID	Broadcast ID
1	172.18.0.0	172.18.0.1 - 172.18.15.254	172.18.15.255
2	172.18.16.0	172.18.16.1 - 172.18.31.254	172.18.31.255
3	172.18.32.0	172.18.32.1 - 172.18.47.254	172.18.47.255
4	172.18.48.0	172.18.48.1 - 172.18.63.254	172.18.63.255
5	172.18.64.0	172.18.64.1 - 172.18.79.254	172.18.79.255
6	172.18.80.0	172.18.80.1 - 172.18.95.254	172.18.95.255

There were 6 networks, each for each connection. The divisions were as follows:

1. Lobby: network 1
2. IoT lab: network 2
3. Network lab: network 3
4. General purpose lab: network 4
5. Computer security lab: network 5
6. Management office: network 6

Second floor

Network Number	Network ID	Host ID	Broadcast ID
7	172.18.96.0	172.18.96.1 - 172.18.111.254	172.18.111.255
8	172.18.112.0	172.18.112.1 - 172.18.127.254	172.18.127.255
9	172.18.128.0	172.18.128.1 - 172.18.143.254	172.18.143.255
10	172.18.144.0	172.18.144.1 - 172.18.159.254	172.18.159.255
11	172.18.160.0	172.18.160.1 - 172.18.175.254	172.18.175.255

For this floor, each network was for each connection. The divisions were as follows:

1. Video conferencing room 1: network 7
2. Video conferencing room 1: network 8
3. Staff room: network 9
4. Staff room: network 10
5. Staff room: network 11

For the rest of the subnet or network was not used since the one that we put was enough. Therefore, the unused subnet could be reserved in the future since this project was worth 20 years of product.

Reflection

In Task 5, we needed to be careful when distribute each network to avoid conflict of addresses. Before we started distributing the networks, we changed the subnet mask to make more subnet. We found that more subnet could help improved network performance and security which were the goals of our case study. We also listed down how we get our broadcast address and the host address range according to the rules we learnt in our network communication syllabus. We were glad that we met a good lecturer that helped us a lot in enhance our understanding of the related topic so that we can finished this task successfully.

For the delegation of network, as we did the arrangement of networks in previous task, we only needed to divide the network id, host id and broadcast id for each network. We remembered that one of the goals of our case study was that the project we did can support the growth of number of users in next three years, hence we reserved the unused subnets to be used in future.

Conclusion

Conclusion, our project was to design a new double storey building that can facilitate the growth of students, academic and supporting staffs of School of Computing. In this new building, we were asked to house 4 new labs which were general purpose lab, Computer Security lab, Network lab and IOT lab. Not only like that, but we were also needed to include 2 video conferencing rooms and the other common facilities & rooms that needed for an academic building. From software aspect, the requirement of new building was to have new equipment and

overall improve performance which could provide a secure and safe network for students and staffs.

To smooth up our progress, we were given 5 tasks before this report writing which were project setup, preliminary analysis, choosing appropriate LAN devices, connections of LAN and WAN, and IP addressing. In Task 1, we managed to design a floorplan of octagon shape double storey building that housed all the labs and rooms required with appropriate scale. While in Task 2, we managed to question and answer 12 questions that resulted in determined our project feasibility which were economic feasibility, technical feasibility, legal feasibility, operational feasibility, and scheduling feasibility. In task 3, we managed to determine the devices used in our new building with the total cost did not exceed the budget given. Moreover, we got to study about the characteristic of LAN devices and the strength and weaknesses of different brand's routers. Next, we get to arrange the cabling and networking of our new building from the main routers to each access points and every computer. Lastly, we managed to distribute 11 different network ID for 11 different networks that used in our new building. All these network ID were produced from the given IP address, 172.18.2.0/18.

Throughout the days in completing this project, we found out that our team's strength was that we had good communication between each other and had clear job distribution. Furthermore, our team always submitted our task on time even when we were in exam week or heavy assignment period. We always encourage each other and support each other; we did not blame each other, and we were glad that there was no conflict happened among us. However, we admitted that we still had some drawbacks on professional knowledge of constructing a good network arrangement. Also, we met some problem when to determine the most suitable devices for LAN, routers, cables, and other thing as there was a lot of factors that we needed to consider.

As a project for network communication, we thought that it was good enough to examine our practical skills. However, as a computer science student, we met a big challenge when need to produce the floor plan with appropriate scale. We knew that it was important too if we wanted to involve ourselves in this field in our career pathway, hence, we hoped that we get some guidance to help us enhance our sketching scale if we got the similar project in future.

Team Members and Responsibilities

NO.	NAME	RESPONSIBILITIES
1	SIAH WENG TZE	**Task 1** Produced floor plan with appropriate scale. Produce Legend. **Task 2** Listed 4 questions and answered. **Task 3** Handled report parts. **Task 4** Pc arrangement and overall compilation **Task 5** Network address **Task 6a** Overall compilation, introduction
2	AHMAD RAMADHAN SYUKRI BIN JAMALUDIN	**Task 1** Suggested layout design for first floor. **Task 2** Listed 4 questions and answered. **Task 3** LAN devices requirements. **Task 4**

		Connection parts and distribute connection. **Task 5** Broadcast address **Task 6a** Background and overview, reflection on task 1, task 2
3	ANIS SOFEA ASYIKIN BT ABDULLAH	**Task 1** Suggested layout design for ground floor. **Task 2** Determined feasibilities. **Task 3** Characteristics of LAN devices **Task 4** Switch ports and patch cords **Task 5** Delegation of network of first floor **Task 6a** Reflection on task 3, task 4
4	ANAS ROUBI ABDELSATTER ROUBI	**Task 1** Listed rooms, facilities needed in our new building. **Task 2** Listed 4 questions and answered. **Task 3**

		Looked for reference to be used. **Task 4** Cable types and length and cable arrangement **Task 5** Delegation of network of ground floor. **Task 6a** Reflection of task 5, conclusion

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Appendices

Meeting minutes

Date, Time, Venue	Participant	Title	Outcomes
26th Oct 2020 at WhatsApp	All members	Self-introduction and briefing of project	Decided group name – ATLANTIS.INC. Know each other. Selected team leader – SIAH WENG TZE
27th Oct 2020 at WhatsApp	All members	Discuss and assign job for Task 1	Decided job distribution among us. Determined the rough idea of our floor plan
28th Oct 2020 at WhatsApp	All members	Cross check Task 1 and submit	We cross check the floor plan and submit
2nd Nov 2020 at WhatsApp	All members	Discuss and assign job for Task 2	Decided job distribution among us. -each of us prepare 4 question and 1 person determine the feasibilities.
9th Nov 2020 at	All members	Cross check Task 2	We cross check the questions to avoid

WhatsApp		and submit	overlapping and submit. We updated the file to bigger font and bigger spacing.
25th Nov 2020 at WhatsApp	All members	Discuss and assign job for Task 3	Decided job distribution among us. -based on the rubric, one person handled part 1.1,1.2, one person handled part 1.3, one person handled part 1.4, one person handled part 2.1,2.2,2.3.
30th Nov 2020 at WhatsApp	All members	Cross check Task 3 and submit	We compile all works into one file and edited it to be more organized.
28th Dec 2020 at WhatsApp	All members	Discuss and assign job for Task 4	Decided job distribution among us. - One person worked for work areas and identify cable types and length, one person does for patch cords and switch ports, one person do for

			connection and one person do for cabling arrangement and pc arrangement.
7th Jan 2021 at WhatsApp	All members	Cross check Task 4 and submit	We compile all works into one file and edited it to be more organized.
14th Jan 2021 at WhatsApp	All members	Discuss and assign job for Task 5	Decided job distribution among us. -one person determined the network address, one determined the broadcast address, one does the delegation of network for ground floor, one does the delegation for first floor.
17th Jan 2021 at WhatsApp	All members	Cross check Task 5 and submit	We compile all works into one file and edited it to be more organized.
18th Jan 2021 at WhatsApp	All members	Discuss and assign job for Task 6a	Decided job distribution among us. -one person does the introduction and

			overall compilation, one person does background review and task 1, task 2 reflection, one person does task 3 and task 4 reflection, one person does task 5 and conclusion.
21st Jan 2021 at WhatsApp	All members	Cross check Task 6 and submit	We compile all works into one file and edited it to be more organized.

Pictures of progress

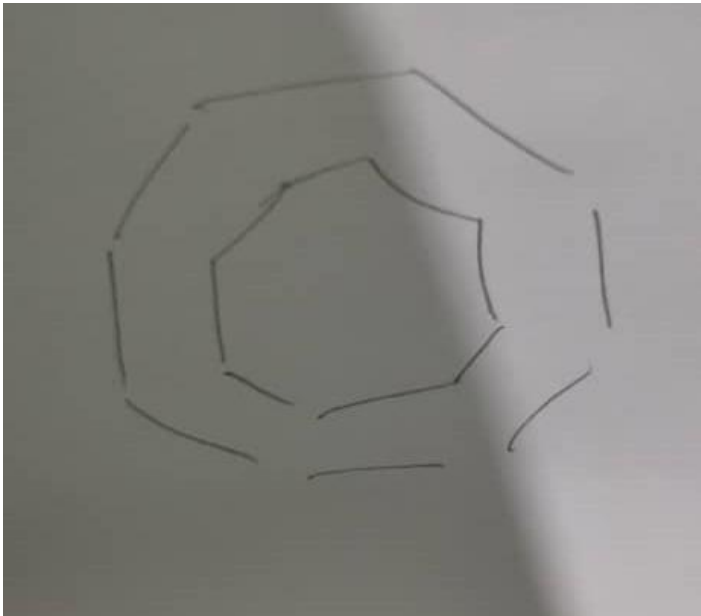1. Figure below was our first draft idea of our building.

Figure 20

2. We will send an evidence into group whenever we submitted the task.

Figure 21

3. Progress of editing the compilation file.

Figure 22

4. We always refer to the rubric to get the idea of the task.

Figure 23