NETWORKS & NETWORKING

GROUP ASSIGNMENT

AICT003-4-2-NWN

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1.0 Introduction

The objective of the community centre is to provide IT related education at lower budget targeted to underprivileged people in Bukit Jalil, for them to be able to use the IT skills gained to improve their knowledge and quality of life. There is three strategic to achieve the goal. First is the performance, to ensure every user can enjoy the best internet service. Second, the security, to restrict user from using internet improperly such as hacking server. Lastly the reliability, decrease the server down time faced by users.

There are two limitations which are the high resource usage and the cost of the maintenance. Due to the large number of computer and router, the consumption for the electricity is very high. The cost of the maintenance is also very high because there is many switches, computers, routers and cables. The electricity of a computer is 60-250 watts. The cost of the electricity of a computer for 24hrs is 200 watts*24hrs= 4800 watts = 4.8kwh, then 4.8*RM0.218= Rm 1.05 for one computer per day. If 30 computers then it is RM1.05*30= RM31.5, one-month usage for computer electricity is RM945. Switches, routers and cables can cost few hundred to thousand ringgit depends on which model is being bought. Bear in mind it is not only one but need to maintenance all of them.

3 assumptions were made in this project, the number of staff breaking down according to respective departments: Helpdesk Department, Human Resource, Technical Assistant Department, Procurement Department and Security Department. The proposed number of customers for public is 180 and member is 60. Proposed information system for staff is laptop, tablet, mobile phone while customer is netbook, mobile phone and laptop. Customer are encouraging to bring their own device to connect the community centre network.

2.0 Floor Plan

2.1 Floor Plan Diagram

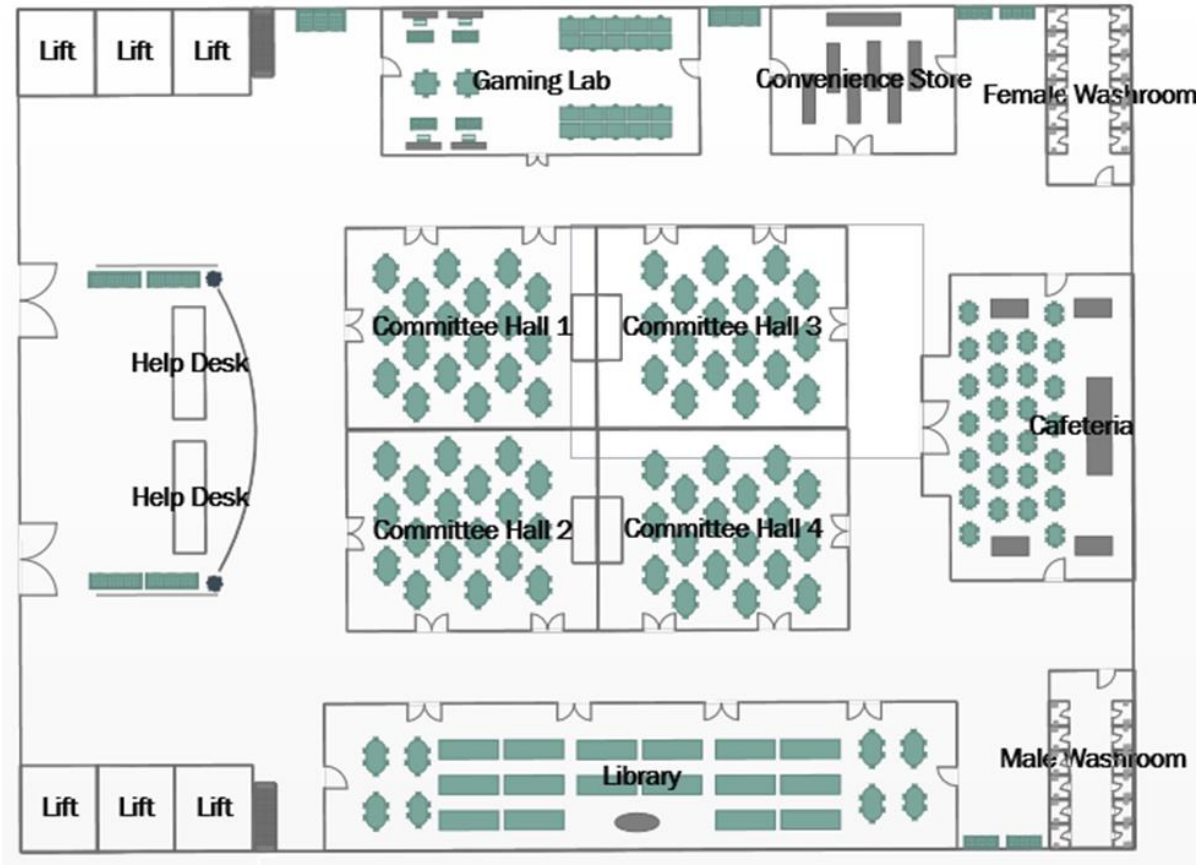


Figure 1: Ground Floor

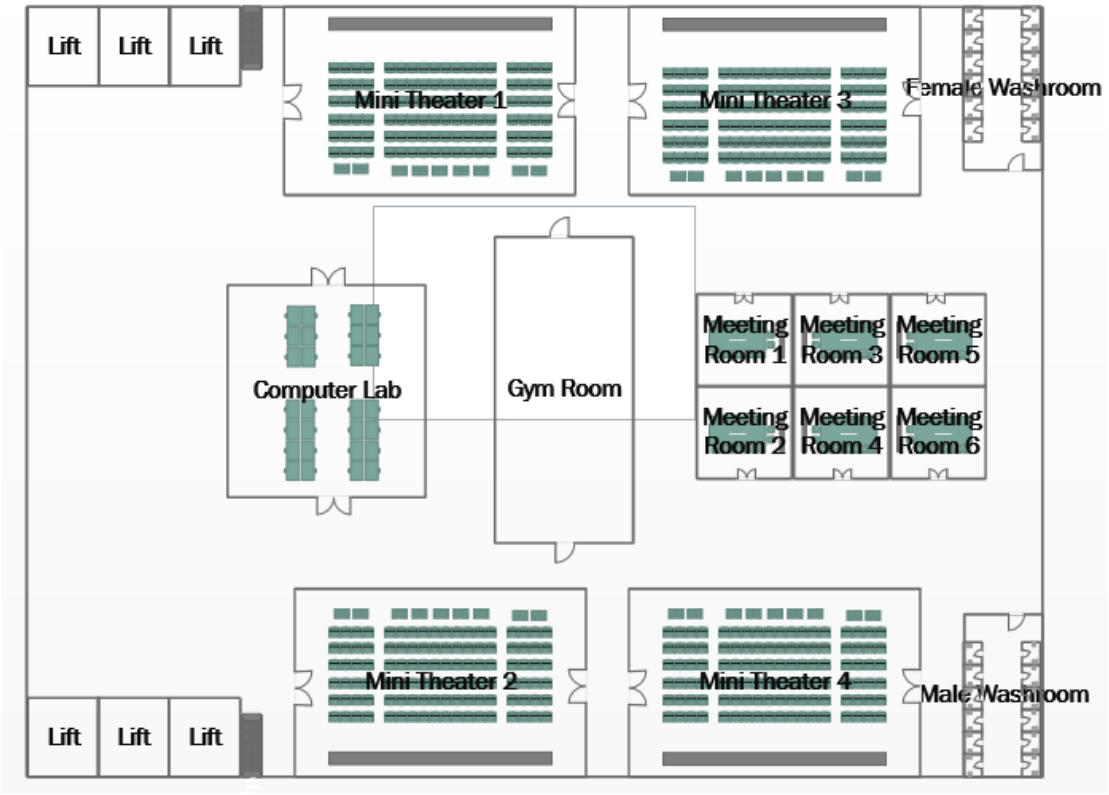


Figure 2: First Floor

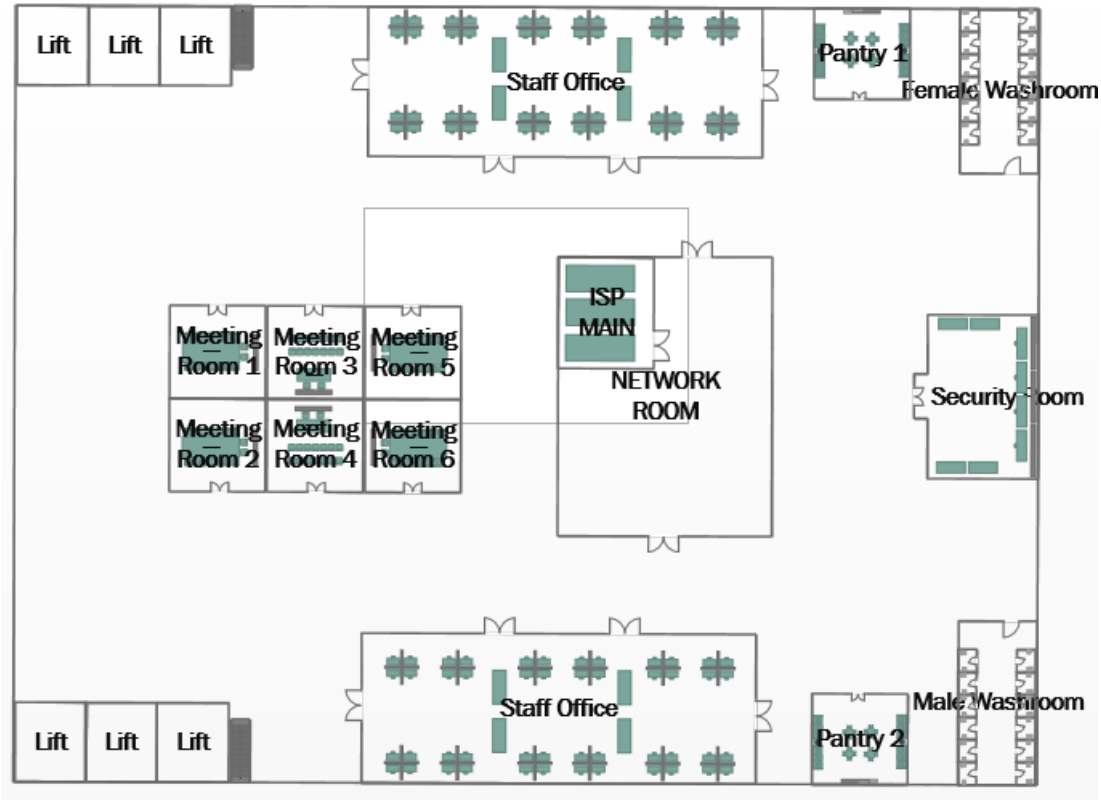


Figure 3: Second Floor

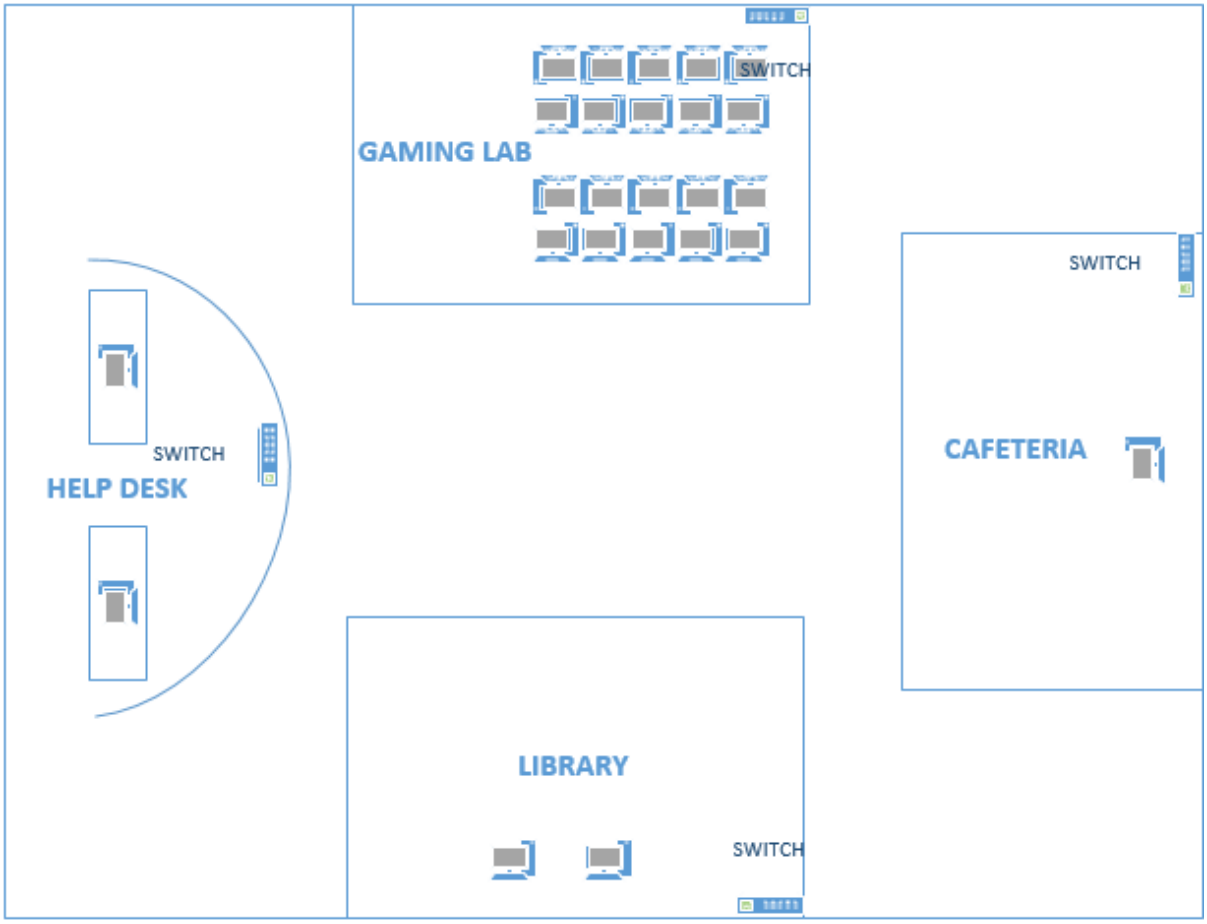


Figure 4: Ground Floor with Network Mapping

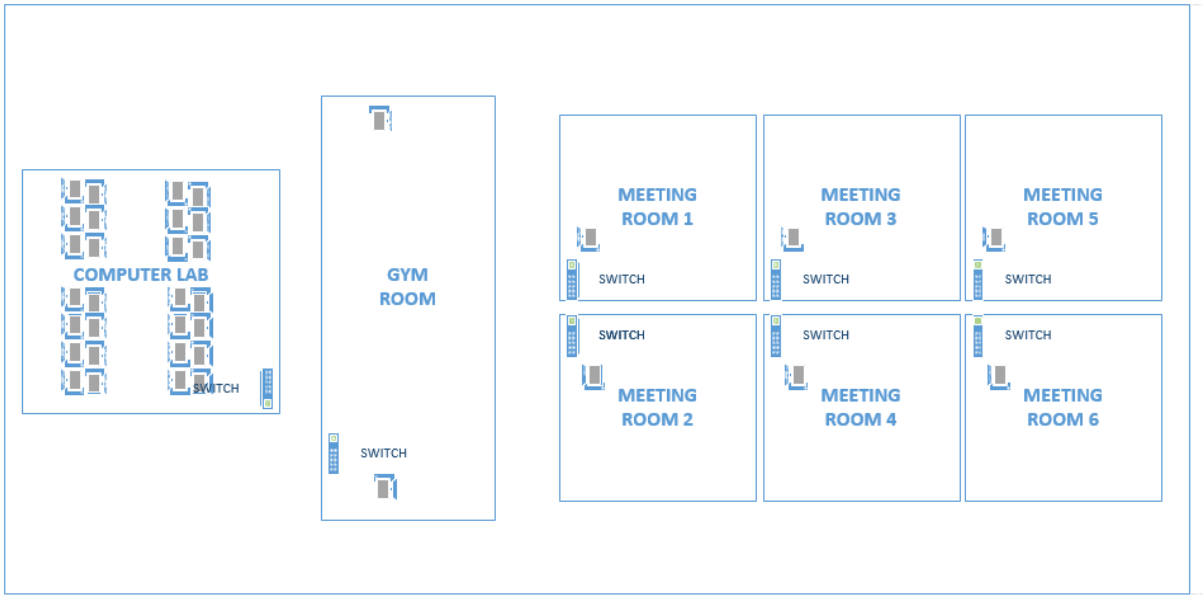


Figure 5: First Floor with Network Mapping

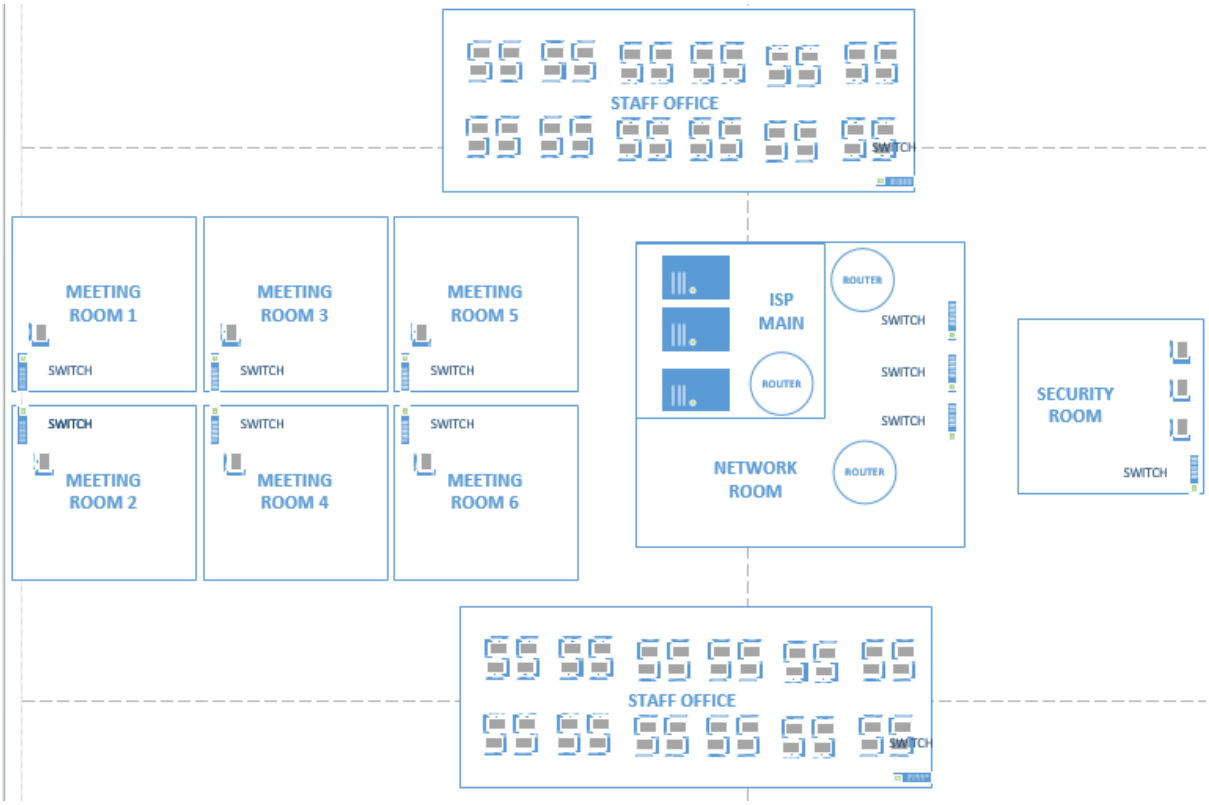


Figure 6: Second Floor with Network Mapping

2.2 Justification

According to floor plan diagrams above, there were two types of diagrams had been used to do a detail explanation which were facility diagram and network diagram? Facility diagram was a diagram that including the place's design while network diagram was a diagram that only stated which places will be accessing network with some devices example PC, router, and switch. Three floors will be using the same network design which is install single switch in every room to allow the data transmits faster and reliable from switch to switch and it is better because once a switch was not responding, the other switches were still working, it was follow Tree Network Topology. Therefore, switches installed at high position near to the ceiling was to avoid disrupting the network and all the switches may connect the devices including Wireless Access Point and peripheral devices to provide services for customers staffs.

Based on the network diagram in ground floor, two PCs and one switch had been installed in help desk are because it can enhance the efficiency of their response and setup a wireless access point to let customer to use while waiting for the customer services. In gaming lab, because of the concern that the gaming lab may require a high amount of network data

when gaming, a switch is added at the same time as the computer is installed, and they can be cabled to the switch if needed. In cafeteria, a PC and a switch has been installed because they were using point-of-sale system to do their transaction with customers. Therefore, library two PCs and one switch to run their borrowing books system.

Based on the network diagram in first floor, the equipment was similar with the ground floor, especially computer lab, needed a switch to stand by because they are also concerned that the computer lab may require excessive data usage. But in the gym room, there will be a switch and two PCs, first floor was belonged to the member so the gym room must have a member card to go in because the computer also records the active rate of the member. In member meeting room, each meeting room would have a PC and switch to let the member to use when during their meeting.

Based on the network diagram in second floor, there were also staff meeting room which same as member meeting room in first floor that needed a PC and switch in each room. On both sides of the staff office, also have a switch because in order not to affect their productivity and they can connect other devices if necessary. In network room, there were three switches which is the main switch of three floors and two routers. On the other hand, there were another small room which had servers and a main router name as ISP room. The main reason of this network room was to check whether the connection had a proper connect between switches and routers and all these components were the most confidential devices in the company due to some secure issues so only allow specific IT technician to access. In security room, there were three PCs and one switch to allow them to check all the connection were secure and install some CCTV or any security devices if necessary.

3.0 Network Diagram

3.1 Network Mapping Diagram

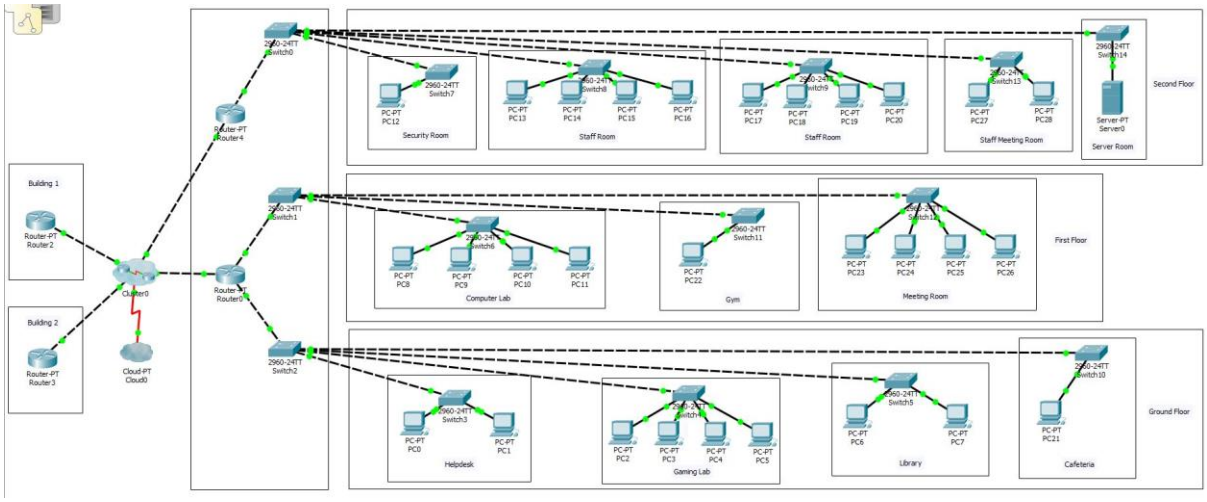


Figure 7: Network Mapping

3.2 Network Topology

3.2.1 Tree Network

Tree network topology is utilized to build a complete network mapping in this building. Tree network is a network topology which all the network nodes are connected itself to a central point individually, then those central points are connected to a main router. All the hosts will communicate to each other with the help of the main router (Amar, 2016).

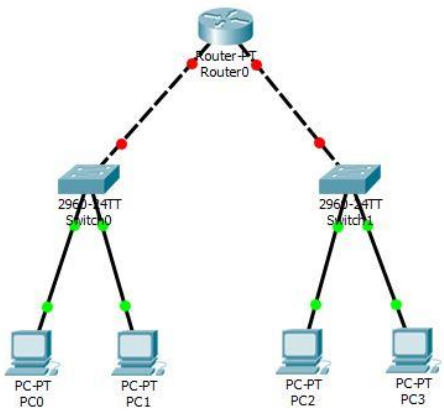


Figure 8: Tree Network

In this community centre, each of the computer in a room is connected to a switch separately. Then, all the switches in each floor will connect to a main switch located in the second floor. The main switches of ground floor and first floor will connect to a router. However, second floor which is used by the staffs in the community centre is connected to a different router separately because of the security concern. After that, the two routers connecting all the devices in community centre are connected to the ISP main router located in third floor.

3.2.1 Advantage of Tree Network

The advantage of tree network is when a host failed but will not affect the entire network to be fail also. Other than that, it is easy to diagnose which central point failed without disabling other network. In addition, new devices can be added easily without disabling the entire network. For example, when the switch in the cafeteria located in ground floor has down, the other switches located in ground floor also will not fail together. The network technicians can also diagnose which switch failed by just do checking on certain computers in a room because only the computers with failed switch in the room will not connect to network.

3.2.2 Disadvantage of Tree Network

The disadvantage of tree network is not cost effective as extra cable is needed by each hosts to connect to a central point. Moreover, if a central point fail, all the devices connected to it will fail together because the central point act as a medium connecting each different device. For example, the network technicians need to buy many Ethernet cables for each different computer to connect them to a switch. If there are 20 computers in the room, 20 Ethernet cables are needed to connect them to a switch. When the switch in the gaming lab in ground floor has down, all the computers in gaming lab will down together.

3.3 IP Addressing

3.3.1 Justification

According to the cisco packet transfer, the ground floor use 192.168.10.1 as IP addressing, first floor use 192.168.11.1 as IP addressing and second floor use 192.168.12.1 as IP addressing. Each individual router has been assigned a new IP addressing using Class C, which is start as 192.168.13.1. For each pc, the IP address will have assigned according to their floor IP address, for example PC0 has assigned 192.168.10.2 and PC1 has assigned 192.168.10.3 as IP addressing.

Router 4 has assigned the IP address 192.168.13.1, Router 0 has assigned the IP address 192.168.14.1, Router 2 in Building 1 has assigned the IP address 192.168.15.1, Router 3 in Building 2 has assigned the IP address 192.168.16.1, and server has assigned the IP address 192.168.17.1.

IP list for each floor

Subnet	Number of Host	Block Size	Subnet mask	Network Address	Range of usable IP address	Broadcast address
Helpdesk	2	30	255.255.255.224	192.168.10.0/27	192.168.10.2-192.168.10.3	192.168.10.4
Gaming Lab	4	30	255.255.255.224	192.168.10.0/27	192.168.10.5-192.168.10.8	190.168.10.9
Library	2	30	255.255.255.224	192.168.10.0/27	192.168.10.10-192.168.10.11	192.168.10.12
Computer Lab	4	30	255.255.255.224	192.168.11.0/27	192.168.11.2-192.168.11.5	192.168.11.6
Gym	1	30	255.255.255.224	192.168.11.0/27	192.168.11.7	192.168.11.8
Meeting Room	4	30	255.255.255.224	192.168.11.0/27	192.168.11.9-192.168.11.12	192.168.11.13
Security room	1	30	255.255.255.224	192.168.12.0/27	192.168.12.2	192.168.12.3
Staff room 1	4	30	255.255.255.224	192.168.12.0/27	192.168.12.4-192.168.12.7	192.168.12.8

Staff room 2	4	30	255.255.255.224	192.168.12.0/27	192.168.12.9-192.168.12.12	192.168.12.13
Staff meeting room	2	30	255.255.255.224	192.168.12.0/27	192.168.12.14-192.168.12.15	192.168.12.16
Router 0	1	30	255.255.255.224	192.168.14.0/27	192.168.14.2	192.168.14.3
Router 1	1	30	255.255.255.224	192.168.14.0/27 192.168.17.0/27	192.168.14.1 192.168.17.1	192.168.14.2 192.168.17.2
Router 2	1	30	255.255.255.224	192.168.17.0/27	192.168.17.3	192.168.17.4
Router 3	1	30	255.255.255.224	192.168.16.0/27	192.168.16.2	192.168.16.3
Router 4	1	30	255.255.255.224	192.168.13.0/27	192.168.13.2	192.168.13.3
Server	1	30	255.255.255.224	192.168.15.0/27	192.168.15.1	192.168.15.2
Cafeteria	1	30	255.255.255.224	192.168.10.0/27	192.168.10.13	192.168.10.14

3.3.2 Subnetting Plan

For subnetting plan, according to floor plan, each floor has the amount nearly to 30 PCs. The subnet mask 255.255.255.224 is selected because it can fit 30 host in the subnet. The total amount of host can used is 240.

4.0 Operational Requirements

4.1 Networking Devices

In this building, there are many kind of network devices used to make sure the community centre can be connected to Internet securely.

4.1.1 Router

Figure 9: Router

A router links computer to the Internet, so users can share the connection. A router acts as a dispatcher, choosing the best path for information to travel so it's received quickly. It allows for flexible cross-network communication and large networks to remain operational during redesign or outage (Walton, 2009). Modems are the main hardware used to access the Internet. But most users prefer routers instead of modems. It has the added benefit of using a single modem to access all your computers. When you use a modem, you must use a modem for each system, the more systems you have, the more modems you should prepare for getting networks. However, when you choose a router, you do not need to purchase every modem for all systems on your local network.

4.1.2 Switch

Figure 10: Switch POE 24 ports

A switch is a device that sends input data from any one of input ports to a specific output port that routes the data to its intended destination. In traditional circuit-switched telephone networks, one or more switches are used to establish dedicated temporary connections or circuits for the exchange between two or more parties. According to the picture, switch POE24 ports is used because 24 ports are just ready to be covered. Although there are still 48 ports but too many ports, these additional ports come in handy when you need to add peripherals. This is convenient because you can connect all the devices including Wireless Access Point and peripheral devices, one of the key benefits of switches is their added failover redundancy to the network to help reduce network downtime.

4.1.3 Server

Figure 11: PowerEdge T130 Tower Server

A server is a computer designed to process requests and deliver data to another computer over the internet or a local network. Most computer networks support one or more servers that handle specialized tasks. The "server" is the software that handles a certain task

(Mitchell, 2018). Besides, the powerful hardware that supports this software is also called a server because server software coordinating a network of hundreds or thousands of clients requires hardware much more powerful than what user will use for. They are many different type of servers but some are dedicated servers where the server operates one function only, some might use one server for multiple purposes. Normally a company using a large network will most likely to set up different types of servers. For this community centre, PowerEdge T130 Tower Server is selected as main server. This server very powerful, compact and agile. It is a powerful 1-socket, mini-tower first server for small office/home office and SMB to consolidate data and drive applications faster (Dell, 2018).

4.2 Software (Servers)

Windows Server 2012 is used as server software here. Windows Server is a group of operating systems designed by Microsoft that supports enterprise-level management, data storage, applications, and communications. Previous versions of Windows Server have focused on stability, security, networking, and various improvements to the file system (Microsoft, 2018).

Windows Server 2012 R2 and Windows Server 2012 emphasizes cloud support with features such as improved IP-addressing, updated Hyper-V, and a new file system (ReFS). Windows Server 2012 R2 includes enhancements to virtualization, management, storage, networking, virtual desktop infrastructure, access protection, information protection, web services, and application platform infrastructure.

Windows Server 2008 R2 and Windows Server 2008 includes many additional security and administrative features shared with Windows Vista: a re-written networking stack, improved Firewall, additional .NET Framework technology, and numerous improvements to the kernel, file, and memory systems.

Processor/Memory Feature	Windows Server 2008 R2	Windows Server 2012
Logical processors on hardware	64	320
Physical memory	1 TB	4 TB
Virtual processors per host	512	2,048
Virtual processors per virtual machine	4	64
Memory per virtual machine	64 GB	1 TB
Active virtual machines	384	1,024
Maximum cluster nodes	16	64
Maximum cluster virtual machines	1,000	8,000

Figure 12: Difference between Windows Server 2008 R2 and Windows Server 2012

Justification

We have make up our mind to choose for Windows Server 2012 because it comes with many features. Windows Server 2012 comes with an integrated and significantly updated version of Hyper-V over the Server 2008 version, an IP address management

function that supports both IPv4 and IPv6, a new file system called ReFS, and a big update to PowerShell, making it almost an operating system within an operating system. It also uses the same Metro interface as Windows 8.

While the OS itself sports many revisions from Server 2008, the advances in Hyper-V stand out. Hyper-V Replica alone is a gem because it helps with disaster recovery by logging changes to the disks in a virtual machine (VM) and uses compression to save on bandwidth. So, you can take multiple snapshots of a VM and decide which to use for recovery in the event of a disaster (Patrizio, 2015)

4.3 Routing

Routing is the process of selecting paths in a network along which to send network traffic and route is the path to send the network traffic. It is usually performed by dedicated devices called router. In packet-switched networks, routing is a higher-level decision to send network packets from a source address to a destination through an intermediate network node through a packet forwarding mechanism (Techopedia, 2018). Packet Forwarding is Logic Addressing Network packets are transmitted from one network interface to another. Intermediate nodes are usually network hardware devices such as routers, bridges, gateways, firewalls, or switches. Generic computers also forward packets and perform routing, though they do not have the hardware optimized for the task. Most routing algorithms use only one network path at a time. Multi-path routing technology allows the use of multiple alternative paths. There are two types of routing which are Static and Dynamic. For this building, secure network is needed so static routing is used. All the network is set manually by network administrator of the community centre.

4.3.1 Static Routing

Static routing is not a routing protocol, it is to manually configure and select the network routing, usually managed by the network administrator. It applies to network parameter; the environment is expected to remain unchanged. Static routing is only optimal in a few situations. Network degradation, latency, and congestion are inevitable consequences of static routes because no adjustments are made when the primary route is unavailable.

Advantages	Disadvantages
Easy to implement in a small network.	Suitable for simple topologies or for special purposes such as a default static route.
Very secure. No advertisements are sent, unlike with dynamic routing protocols.	Configuration complexity increases dramatically as the network grows. Managing the static configurations in large networks can become time consuming.
It is very predictable, as the route to the destination is always the same.	If a link fails, a static route cannot reroute traffic. Therefore, manual intervention is required to re-route traffic.
No routing algorithm or update mechanisms are required. Therefore, extra resources (CPU and memory) are not required.	

Figure 13: Advantages and disadvantages of static routing

From the image above, it is about static advantages and disadvantages, static routing allows the user to know how large the addressing range is because it uses manual changes the IP. Although users must remember each address, this also ensures some security and prevents more people from knowing it.

4.3.2 Dynamic Routing

Dynamic routing is a networking technology that provides the best data routing. Unlike static routing, dynamic routing enables routers to choose paths based on real-time logical network layout changes. In dynamic routing, the routing protocol running on the router is responsible for creating, maintaining, and updating dynamic routing tables. In static routing, these jobs are done manually by the system administrator. Dynamic routing uses a variety of algorithms and protocols. The most popular are Routing Information Protocol (RIP) and Open Shortest Path First (OSPF).

Advantages	Disadvantages
Suitable in all topologies where multiple routers are required.	Can be more complex to initially implement.
Generally independent of the network size.	Less secure due to the broadcast and multicast routing updates. Additional configuration settings such as passive interfaces and routing protocol authentication are required to increase security.
Automatically adapts topology to reroute traffic if possible.	Route depends on the current topology.
	Requires additional resources such as CPU, memory, and link bandwidth.

Figure 14: Advantages and disadvantages of dynamic routing

As can be seen from the figure, this is about the advantages and disadvantages of dynamic routing, although the dynamic address automatically adjusts very convenient, but its security is not high because of this so the chance of being attacked will be higher.

4.4 Cloud Services

Cloud Computing is a model for enabling universal, convenient, on-demand network access to a shared pool of configurable computing resource for example servers, networks, applications, storage and services that can be provisioned by the Service Provider. The main cloud characteristics include resource pooling, on-demand self-service, broad network access, measured service and rapid elasticity

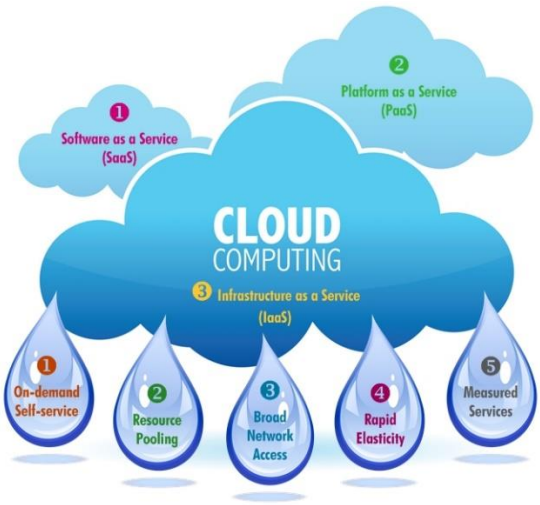
User can put their information on the platform instead of on their own desktop Pcs and their own servers. Users can also use the servers within the cloud to do processing and data manipulations. They can insert their application on the cloud. There is 3 types of cloud services,

a) SaaS - Software as a Service
b) IaaS - Infrastructure as a Service
c) PaaS - Platform as a Service

SaaS refers to a new and alternative way of accessing software, as opposed to more traditional methods of access.

IaaS is one of the 'layers' in the Cloud Computing model (Interoute Communications Limited, 2018).

PaaS, is a category of cloud computing that provides a platform and environment to allow developers to build applications and services over the internet. PaaS services are hosted in the cloud and accessed by users simply via their web browser.



Selection

IaaS Provider	Windows Azure	Google Compute Engine
Description	Despite the name, Windows Azure is not a Windows-only IaaS. The compute and storage services offered are typical of what you'll find in other IaaS providers, and administrators used to Microsoft platforms will find working with Windows Azure much easier. The IaaS offers ready access to virtual networks, service buses, message queues, and non-relational storage platforms as well.	Google Compute Engine is well suited for big data, data warehousing, high performance computing and other analytics-focused applications. It is well integrated with other Google services, such as Google Cloud Storage, Google BigQeury and Google Cloud SQL. Although Google Compute Engine is still relatively new in the IaaS market, the fact that it runs on Google's global infrastructure, including the company's private global fibre network and high efficiency data centres sets it apart.

Comparison

IaaS Provider	Windows Azure	Google Compute Engine
Features	Easy-to-use administration tool, especially for Windows admins. Windows Azure can also be used as a PaaS.	With the Google infrastructure backing it up, this IaaS is designed to scale.
Limitations	Minimal, easy-to-use portal interface may not be so appealing to command line gurus.	Lacks ease of administration features. Running Hadoop on Google Compute Engine, for example, requires more from

		users; because it's not integrated you have to download the Hadoop package, a patch for Hadoop and a set of JDK packages along with several other steps (outlined here) to deploy a Hadoop cluster.
Pricing	$0.02 to $1.60 per hour. Storage prices range from $0.07/GB/month to $0.12/GB/month, depending on level of redundancy.	Instances range from $0.019/hour to $1.659/hour. Provisioned storage is $0.04/GB/month; snapshot storage is $0.125/GB/month.
Bonus	Free 30-day trial with a limit of up to $200 is available for new users.	Google charges by the minute after a minimum of 10 minutes in an hour.

Justification

We will select Microsoft Azure as our IaaS provider since it is easy-to-use administration tool, especially for Windows admins, it is also less limitation compare to the Google Compute Engine (Sullivan, 2014). Google Compute Engine lacks ease of administration features which is not suitable for our staff to use. The pricing is also more flexible because Microsoft Azure has more package to choose to compare with Google Compute Engine.

5.0 Transmission medium

There are two type of transmission medium such as guided transmission media (wired) and unguided media (wireless) are normally used in computer communications from one place to another. Many factors to be considered while selecting a transmission medium for this community centre like rate of data transmission, cost and ease of installation, resistance to environmental conditions and distances between devices. To determine the best and reasonable price for wired the entire networking of the community centre, section below shows the selection, comparison and justification of three several types of data transmission medium (ninjacraze, 2016).

5.1 Physical data transmission media

Twisted pair cable is the best solution in this case than other cables. This is because Coaxial cable has less susceptible to EMI (electromagnetic interference) than other types of copper media but it has higher risk when one of the cable has damaged can bring down the whole entire network. Fibre optic has higher data transmission rate than coaxial and twisted pair cable and it is not susceptible to EMI. But, Fibre Optic is difficult to terminate, and it can be a burden for Welfare Department because it is very costly just only for the cabling which not even included the routers and switches. The best option is choosing twisted pair cable. This is because it is affordable and easy for installation.

5.1.1 Twisted Pair Cable

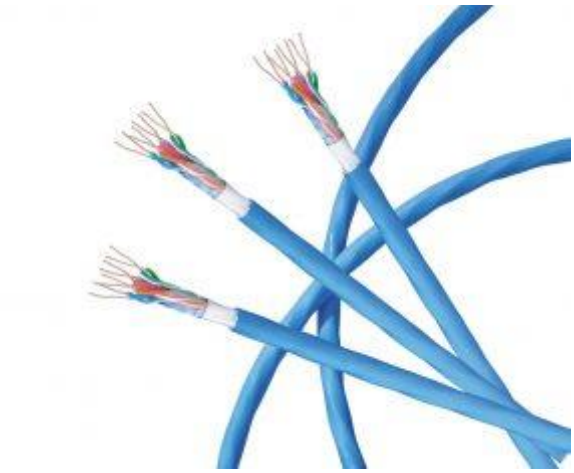


Figure 15: Twisted pair cable (Laven, 2016)

It usually used in telephone communications, installed in residential industries and most of the Ethernet networks. It made of pairs of solid or stranded copper twisted along each other. It reduces vulnerably to EMI and cross talk. The copper core is usually 22-AWG or 24-AWG as measured on American wire gauge standard. However, there are two types of twisted pairs cabling which is unshielded twisted pair (UTP) and Shielded twisted pair (STP) (ninjacraze, 2016).

5.1.2 Unshielded Twisted Pair

UTP is more commonly used because it is one of the least expensive wires and works for modern Ethernet solutions. UTP cable usually has an impedance of 100 ohm. UTP is cheaper than STP because widely available due to its many use. It categorized into few types of copper cable.

UTP Categories - Copper Cable				
UTP Category	Data Rate	Max. Length	Cable Type	Application
CAT1	Up to 1Mbps	-	Twisted Pair	Old Telephone Cable
CAT2	Up to 4Mbps	-	Twisted Pair	Token Ring Networks
CAT3	Up to 10Mbps	100m	Twisted Pair	Token Rink & 10BASE-T Ethernet
CAT4	Up to 16Mbps	100m	Twisted Pair	Token Ring Networks
CAT5	Up to 100Mbps	100m	Twisted Pair	Ethernet, FastEthernet, Token Ring
CAT5e	Up to 1 Gbps	100m	Twisted Pair	Ethernet, FastEthernet, Gigabit Ethernet
CAT6	Up to 10Gbps	100m	Twisted Pair	GigabitEthernet, 10G Ethernet (55 meters)
CAT6a	Up to 10Gbps	100m	Twisted Pair	GigabitEthernet, 10G Ethernet (55 meters)
CAT7	Up to 10Gbps	100m	Twisted Pair	GigabitEthernet, 10G Ethernet (100 meters)

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Figure 16: UTP categories (Copper Cable) (Administrator, 2013)

5.1.3 Shielded Twisted Pair

It like UTP but has a mesh shielding that protects it from EMI which allows higher transmission rate by reducing noise from outside sources. STP used for large-scale enterprises for high-end application. Hence, the best cable selection would be UTP because it solves Welfare Department issues and requirements. There are five types of STP cables.

Type 1: STP features two pairs of 22-AWG

Type 2: Type 1 with 4 telephone pairs

Type 6: Two pairs of standard shielded 26-AWG

Type 7: Consist of 1 pair of standard shielded 26-AWG

Type 9: Shielded 26-AWG wire.

Selection

Coaxial Cable, Twisted cable (UTP), Twisted cable (STP), Fibre Optic cable

Features/Type of cable	Coaxial cable	Twisted cable - UTP/STP	Fibre Optic cable
Speed and throughput (Mbps)	10 to 100	10 to 1000/ 10 to 100	100 to 100 000
Average cost per node	Inexpensive	Least expensive/ Moderately expensive	Most expensive
Media and connector size	Medium	Small/ Medium to large	Small
Maximum cable length (m)	500 (medium)	100 (short)/ 100 (short)	2000 (long)
Cost	Costly than UTP	Least expensive/More expensive than UTP	Expensive
Advantages	Less susceptible to EMI interference	Easy to install, widely used, reduced crosstalk	High security, high data rate
Disadvantages	Damage to cable can bring down entire network	Can cover only limited distance	Difficult to terminate
Common used of cables	RG59, RG6	CAT5e, CAT6	Single mode, multimode plastic optical fibre (POF)

Comparison

Factors/ transmission type	Coaxial Cable	Twisted Paris	Fibre Optics
Rate of data transmission	High	Medium	Very high
Cost and ease of installation	Inexpensive/ easy to install	Least expensive and easy to install	Expensive and hard to install
Resistance to environmental conditions	High	Medium	High
Distances between devices.	Short	Medium	Long

Justification

In my opinion, CAT6 copper cable is suitable install in the ground floor especially in Staff Office compare to CAT5 categories. This is because CAT6 is a standard of cabling installation with supporting the speeds of 1GB and better reduction of electromagnetic interference. CAT5e was specified in improving the crosstalk specification and support speeds of 1 Gbps.

CAT5 STP Cables

It separates to two which is CAT5 and CAT5E cables. The different of these two is CAT5E's performance is faster than CAT5 in terms of speed. CAT5 and CAT5E can be installed in the gaming rooms, library, Staff office, Computer labs and meeting rooms.

CAT6 STP Cables

It used as the backbone to networks because it can handle 10 Gigabits of data and maximum bandwidth to 164 feet. CAT6 cables can be installed in the Server room and Security room for database and backup purposes. It protects data from EMI with high speed and better data transmission rate with 250 MHz.

In conclusion, CAT6 allows two ways communications on each pair of wires, better crosstalk reduction and lesser delay for signal receive.

5.2 Wireless

It is a form of unguided media where has no physical link connection between devices but communicating using signal spread over in the air. Figure below shows the types of signal frequency.

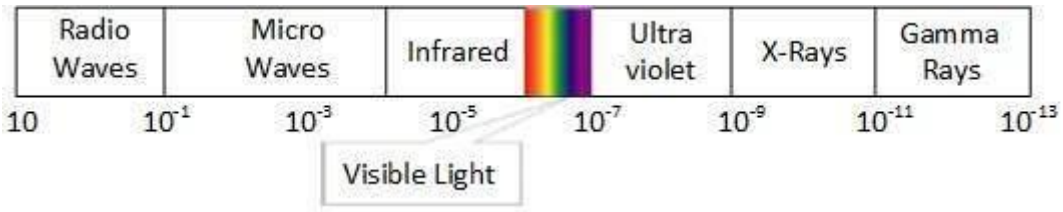

Figure 17: Type of signal frequency (Limited, 2018)

In this case, Welfare Department are strongly recommended to use Wireless Networking (Wi-Fi), Bluetooth Technology or Satellite as wireless communication technology. Radio communication is a common medium to choose as wireless network. Based on the geographic range of Welfare Department, Local Area Network(LAN) is the most suitable for them because it is to connect the entire networking within the building wirelessly. The most standards for wireless networking as we called Wi-Fi is IEEE 802.11. We will choose the latest Wi-Fi signalling in which is 802.11ac which utilizes dual-band wireless technology. It supports simultaneous connections on 2.4 GHz and 5 GHz Wi-Fi bands. Next, 802.11b/g/n and bandwidth rated up to 1300 Mbps on 5 GHz to 450 Mbps on 2.4 GHz. The pros of 802.11ac is because they improved their bandwidth and more flexibility in terms of connection support while the cons of it is the cost has increased and still prone to interference on 2.4 GHz frequency. Connection is the most important to an organization regardless wired or wireless. They are suggested to use Wi-Fi, Bluetooth, wireless router, wireless adapter and wireless repeater to communicate within buildings using these types of wireless communication.

Type of wireless data communication	Reasons	Limitations
Wi-Fi	All devices can communicate with others	Limited range, Security problems
Bluetooth	Transfer data with higher speed, good security	Limited distance
Wireless router	A network set up with security: Firewall	-
Wireless adapter	Enable hardware devices able to access internet	-
Wireless repeater	Receive signals and amplifies signal strength	-

Recommendation for IEEE 802.11

Type of wireless data transmission	Suggestion
Wi-Fi	802.11ac
Bluetooth	Bluetooth-Equipped Printer Bluetooth-Enabled Webcam
Wireless router	2.4GHz / 5.0 GHz Dual band Synology RT2600AC
Wireless adapter	Archer T2UHP
Wireless repeater	NETGEAR NIGHTHAWK EX7000

These can be installed in all the floor in the building but with different network class. To have efficiency of an organization in terms of productivity, a high-speed connectivity is a must. Therefore, IEEE 802.11ac is chosen to increase performance of Welfare Department.

6.0 Reliability Issues

There are few elements that is related to reliability. For instance, Wi-Fi runs very slow due to the interference between the access points which is often called network congestion. To fix this, we will need to set up different Wi-Fi channel for different access point.

Besides, most of the time, the internet breaks down is unplanned and often caused by weather like lightning and big winds. However, we can still manage to work with Distributed File System (DFS) Replication that is available in Windows Server 2012. DFS Replication is a role service in File and Storage Services. It enables you to efficiently replicate folders (including those referred to by a DFS namespace path) across multiple servers and sites.

Sometimes router overload disconnect can be very crucial. This is because many computers connect to only one router. In order to avoid this, we have to make sure each router only has specific number of pcs, if it is full, then we need to purchase a new router for another set of computers.

7.0 Security Issues

Network security is playing a very important role in this company because information such as customer information, transaction details, company information, and other details must be well protected, it can be easily abused especially though internet. This is a very serious problem because it may cause huge personal losses. To avoid these problems happens, Firewall was implemented to back up the data and keep the data save. Firewall is a type of network security appliance that monitors incoming and outgoing network traffic and decides whether to allow or block specific traffic based on a defined set of security rules (TechTarget, 2000). Allow remote access to your network only through a secure manner such as a properly configured Virtual Private Network (VPN) because hackers are now using some illegal ads and links to explore a user's profile, it is not legitimate for a firewall to examine all websites or networks while a user is running each program. If it is illegal, the firewall will display a message stating that the URL is illegal and prevent the user from continuing to access it.

Therefore, data theft refers to stealing digital information stored on an unknown victim's computer, server or electronic device with the intent to compromise privacy or to obtain confidential information. This information can include any financial information, such as credit card numbers or bank accounts, as well as personal information. As soon as only large enterprises and organizations have problems, data theft is a growing problem for everyday computer users (Cybercrime, 2007). To prevent this kind of problem, password protection is fully recommended because it can be used for all devices, including laptops and smartphones, as well as access networks and accounts especially all the employees and customers are required to have a unique username and a strong password that changes at least quarterly so when they login, the system will automatically run id validation to confirm whether this person is legal or illegal.

Finally, there is a security issue with server software data leaks. Now hackers also use some means to steal data from server software because they know that some server software has a high chance of data leakage, especially in the case of server software outdated so it can bring security to an unreliable environment or confidential information. To reduce this problem, the company must train some technicians to periodically check the update date of each server software and update it perfectly. Because once the update succeeds, the secure key may have to be changed so only a few Technical staff know it to avoid the data leak.

8.0 Sustainability Issues

There are few sustainability issues faced by the department which are electricity consumption, environment-friendly and power backup supply. First, electricity consumption is a big issue because most of the building is full of electronic devices and it consume a lot of electric and lead to a burden for an organization. Therefore, we proposed a solution where make a rules and regulation which users must shut down or put sleeping mode to their devices when they are not in use. Those who does not follow will have a heavy punishment depends on the management. Second, management are suggested to buy a computer monitor with power saver and eco-friendly such as ASUS MB169 and ASUS VN248 which only consume energy 115 Volts (kWh/year). Third, many organization has their own power backup supply (UPS). It is necessary to do so to ensure your networking and productivity do not stop. Tripp Lite battery is suitable for server rooms to avoid power failure and lead to data loss. Uninterruptible power supply (UPS) system is strongly recommended for long-term protection to prevent interruption of service. UPS system is good in supplying power to the loads continuously no matter what to utility power. Welfare Department can contact Power Solutions Sdn. Bhd. where they are specialized in UPS for further information. With these proposed solution, Welfare Department can ensure their community centre go smoothly even though interruption that can be solved instantly.

9.0 Conclusion

In conclusion, starting a network in a company is not easy because user must know each IP address as it appears in this report, user must step by step first to start the network diagram and explicitly specify network devices because the quantity is too large, it will cost the company a lot. After completing the diagram, the user can use CISCO Packet Tracer software setup IP addressing because the user will know which topology to use to support this network, as the network topology shown in this report will use the tree topology because it can avoid if a switch broken and caused the entire network disconnection problem. In addition, the user must also know which routing to use in this network, because static routing is done by manually key in IP address for each network devices so it would be better for the user but if the user decides to facilitate dynamic routing it will automatically change the IP addressing but It's not safe. Thus, to complete a network, one have to examine each structure and reduce the chances of the problem occurring.

9.1 Reflective Essay

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Appendix

Work Breakdown Structure

Gantt Chart

No	Task	Week											
		2	3	4	5	6	7	8	9	10	11	12	13
	Group Part												
1	Introduction												
2	Floor Plan												
3	IP Addessing												
4	Network Diagram												
	Individual Part												
5	Operational Requirement												
6	Transmission Medium												
7	Reliability Issue												
8	Security Issue												
9	Sustainability Issue												

Figure 18: Gantt Chart

Marking Scheme

	GROUP COMPONENT									**INDIVIDUAL**			
	Assumptions (5)	Documentation (10)	Diagrams and/or Figures (10)	Network Design (10)	Configuration (10)	Referencing (10)	Presentation (10)	Progress Report (5)	**Group Total (70)**	Report content (10)	Analytical and Critical Thinking (20)	**Individual Total (30)**	**Grand Total (100)**
Name 1: Wong Jun Hao													
Name 2: Wong Yi Heng													
Name 3: Ng Hen Shen													
Name 4: Chai Wen Xuan													

Progress Report

Report 1 - Week 3

Achievement of the week:

- We begin to distribute the following set of tasks equally as below:
- We also complete introduction and floorplan diagram.

Plan for the following week:

- Complete network diagram
- Complete IP addressing

Report 2 – Week 6

Achievement of the week:

- We have completed the network diagram and IP addressing and checked that IP addressing is fully connected.

Plan for following week:

- Compile all the group work
- Spilt the task of individual part

Report 3 – Week 10

Achievement of the week:

- We have completed the group part, then each member has also selected an as below in the individual part:

Plan of the following week:

- Complete all the individual part and compile all the files.

Report 4 – Week 12

Achievement of the week:

- Each of our members has completed an individual part and compiled into an entire complete assignment.