Group Assignment

TECHNOLOGY PARK MALAYSIA

CT043-3-1-IN

INTRODUCTION TO NETWORKING

HAND OUT DATE: 31ST March 2020

HAND IN DATE: 27th November 2019

WEIGHTAGE: 50%

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1.0 Introduction

1.1 Objectives

As network technicians, our team aims to create a network design that is good in terms of its usability, reliability, security, and maintenance, also in terms of the architecture of the target buildings. In this network design, we are required to ensure the effectiveness of the planned network design through appropriate simulation software such as Cisco Packet Tracer. This software will simulate the functionality of design including network devices such as computers(end-devices), router and switches along with the IP addressing scheme.

1.2 Scope

The project with the design of a floor plan consisting of 2 blocks, block A with 3 floors and block B with 2 floors. The design will be constructed through the Microsoft Visio Professional tool, following a specific guideline to maintain the general promised quality of our system. Later the network devices, networking schemes, and IP configurations will be decided for use in the campus building. An appropriate justification of these will be given with a functioning network simulation through the Cisco Packet Tracer.

1.3 Limitations

Simulation is meant to serve as an estimation of the functionality of a real network, it must be understood that this estimation is rather limited and do not cover all the relevant aspects of the functionality of a network. One such example is the length of wire as well as the way it is used (twisted or turned around the corners) may limit its functionality. The same goes for the usage of wireless access points, the functionality of which may get affected by its surroundings as well as the number of users using it.

Switch in the packet has 24 ports if the number of end devices is more than 24 still only one switch is used in Cisco Packet Tracer.

1.4 Assumptions

Despite being an estimation, packet tracer gives an idea of the actual functionality of network design; The IP address used in the packet tracer for different things in a network, where a large number of five end-devices are used are represented by only one end device. This device is given the first and the last IP address of the range of IP addresses assigned to those five end-devices. Furthermore, the switch is used in packet tracer having 24 ports; some places the number of end devices is more than the number of available ports in a switch, but only one switch has been used in Cisco Packet Tracer, in real-life more switches are required for more end-devices to get the desired functionality.

2.0 Floor plan

The following floor plans are along with appropriate justification for each. These have been designed by our team for the new training centre that is managed by BOLTON International School. The secondary school in Cyberjaya two blocks, block A with 3 floors and block B with 2 floors.

2.1 Block A

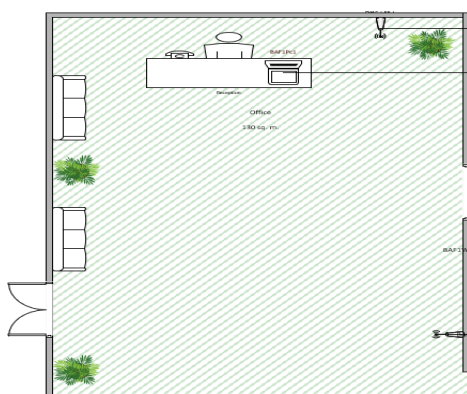As described Block A has three floors, starting with the first floor:

Block A Floor 1

Figure: 2.1.0

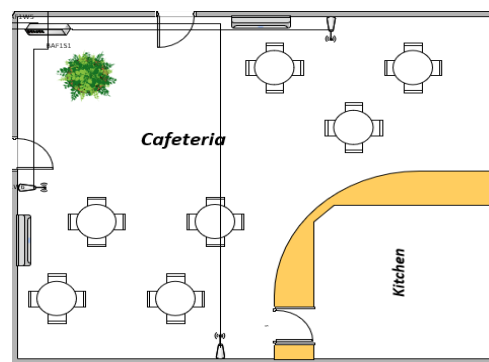**Figure: 2.1.1**

Figure: 2.1.2
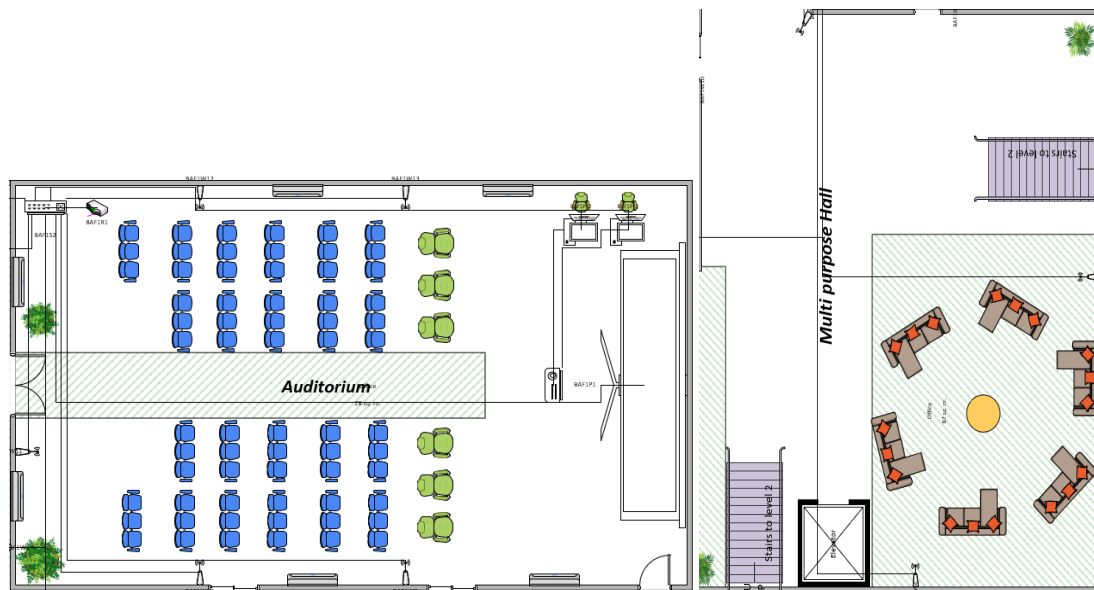
Figure: 2.1.3   **Figure: 2.1.4**

The first floor (Figure: 2.1) has an auditorium, cafeteria, Multipurpose Hall, and Reception along with one elevator and two staircases in different directions to go to other floors. The auditorium has a capacity of 72 people seating, 66 chairs for students, 6 chairs for VIPs and judges and staff, and the remaining 2 chairs for technical staff (teacher/student) to use computers to control the projector of the auditorium. The auditorium has a projector screen and two computers, both are connected to one projector and one of the switches of the first floor placed in the auditorium which is also connected to one of three routers of block A placed at first floor.

Furthermore, right outside the auditoriums is a waiting area with a couple of couches, where the students can wait for their lecture in the auditorium, the waiting area can also be used for parents and visitors too. For refreshment, there is a canteen right on the left side of the auditorium, they also have a sitting arrangement in the cafeteria where student and faculty can enjoy their meal easily, and inside cafeteria the is a kitchen along with the counter to buy the desired food.

There is one router that is connected to two switches which are further connected to three computers, two at the auditorium and one at the reception in and all the wi-fi extenders which are being used to connect wireless devices such as laptops and mobile phones. Well, only the auditorium and the cafeteria have the air conditioners remaining area such as Multi-purpose hall and reception area does not have any air conditioning facility because of it being an open area. Well, there is no washroom in the block A.
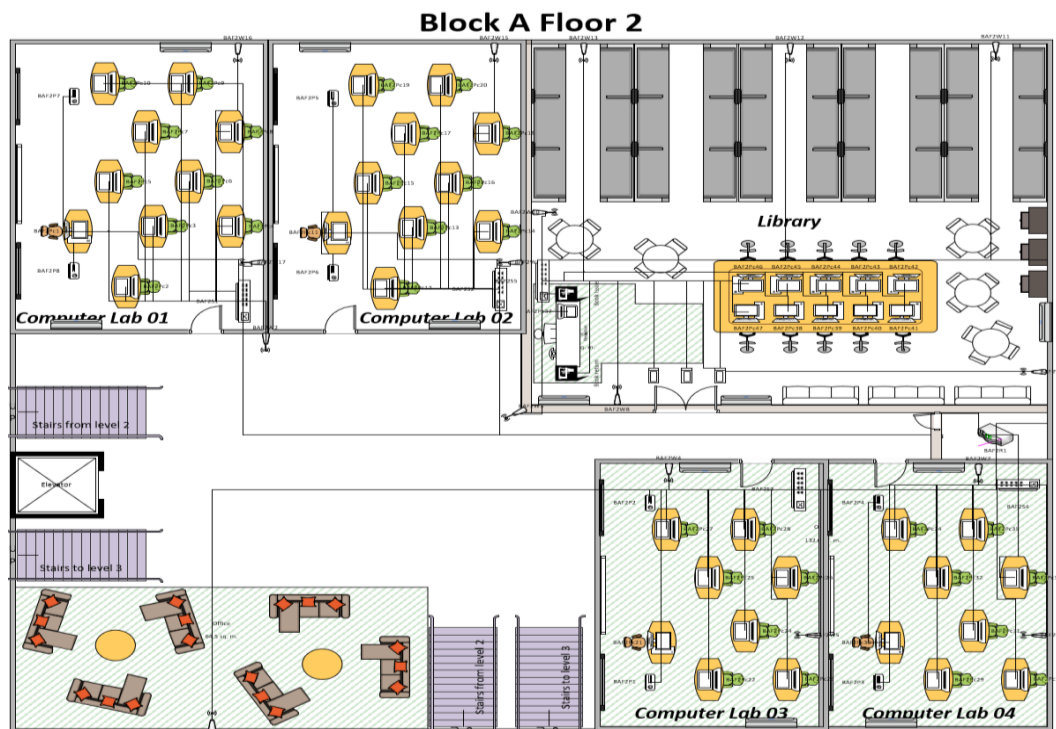
Block A Floor 2
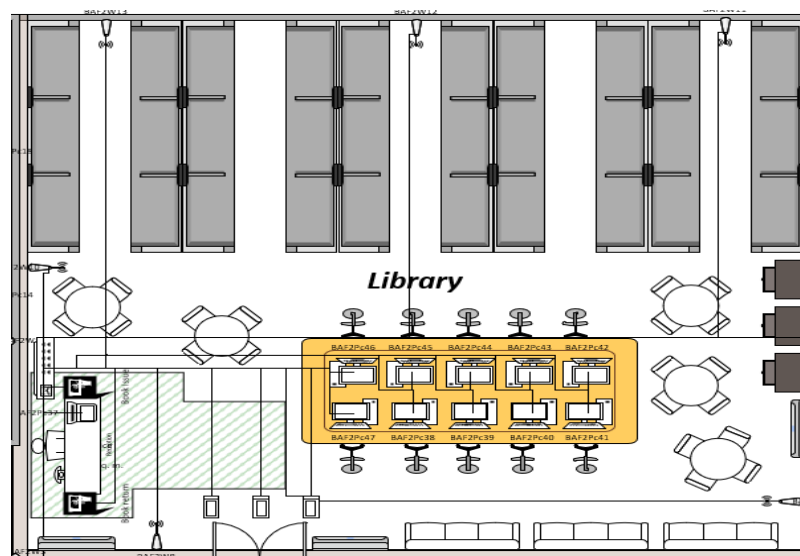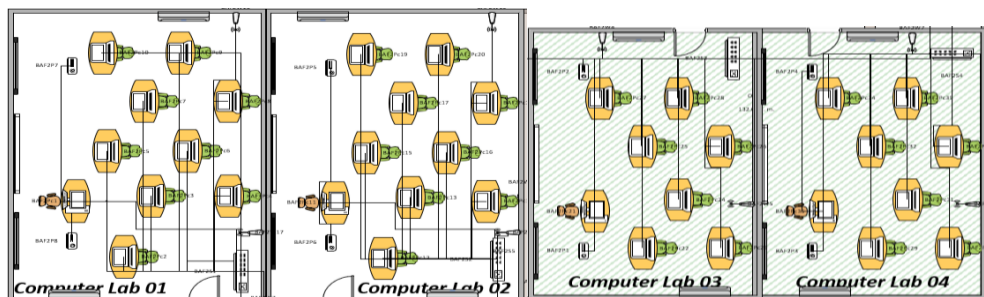
Figure: 2.1.5

Figure: 2.1.6

Figure; 2.1.6
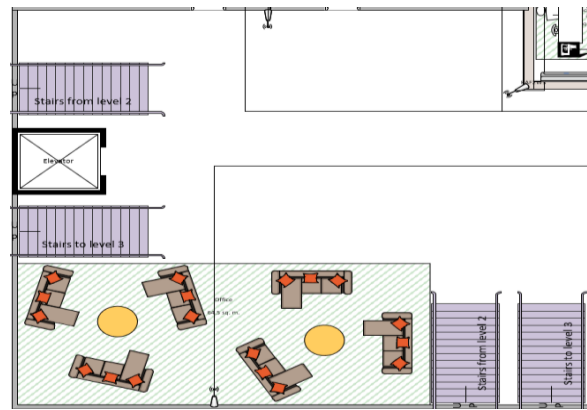
Figure: 2.1.7

Moving on to the second floor, it has four computer labs of almost the same sizes with a library and a somewhat common area along with the same one elevator and four staircases used to go to up and down to other floors. The library has a couple of bookshelves full of books and magazines, group study tables, personal study tables, couches, 10 computers for students all connected with the internet through library switch connecting the second-floor router.

There a library in-charge laptop connected to two machines to check-in and check-out books from the library and also connected to a scanner near the door of the library that beeps whenever there is any book taken out of the library without check-out of that book. Outside of the library on the second floor, there is a common sitting area with couches where the student can wait for their class.

The second floor has four computer labs of almost the same sizes full of several computers and with one whiteboard and two projectors, not only that but each class has a switch which is directly connected to the router of the second floor connects all the computers and Wi-Fi extenders in the computer labs. Same as the first floor there is no air conditioner in the common area but available in the library in computer labs, all second floor is covered with a range of Wi-Fi singles with the help of Wi-Fi extenders.

Block A Floor 3

Figure: 2.1.8

Figure: 2.1.9

Figure: 2.1.10

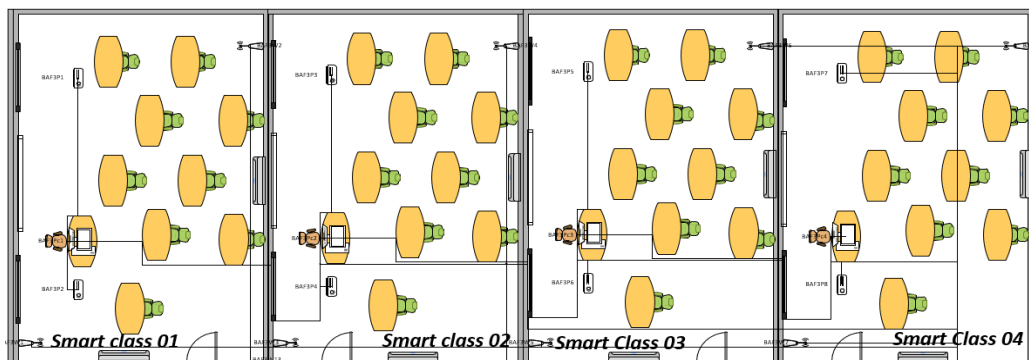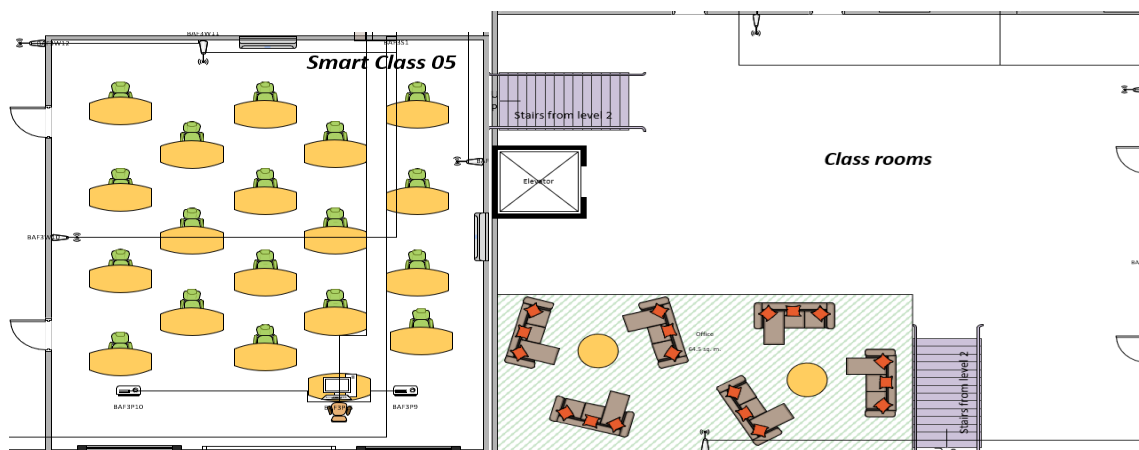At last, the third floor of block A, this floor is known for classroom area having five classes, out of which four classrooms have the same size and one classroom has the identical size, almost double the size of any other classroom where student capacity will be more too. There is also a common sitting area for students to wait for their class and one same elevator and two staircases to go to the second floor.

Just because there are not many computers on this floor that's why only one switch is used to connect to all the wi-fi extenders and few computers used by teachers only. Router and switch are placed in a small room separately on this floor too like it is placed on the second floor. All the classrooms have air conditioners along with a Wi-Fi extender, two projectors, one whiteboard and one computer which the only teacher is allowed to use.

Significant aspects of block A

One significant aspect which is the position, or the location of lift and stairs are in a similar position for either for the access or because in case of lifts and stairs, it is supposed to be in the same place. A specialist set of software programs that all students need, will be given to these students with access to appropriate software programs.

All the devices are named accordingly in the building of block A for example: If a computer is in the lab of the second floor of block A it will be named as BAF2Pc15, BA is used for Block A then F2 is for floor 2 and in the end, Pc15 is the number of computers placed on that floor. Another example speaking of Wi-fi extender, Wi-Fi extender placed on the first floor of block A will be named as BAF1W1, so again BA is used for block A, F1 is used for floor 1 and at last W1 is used for Wi-Fi extender 1, the same pattern is used for all the devices in the building.

2.2 Block A
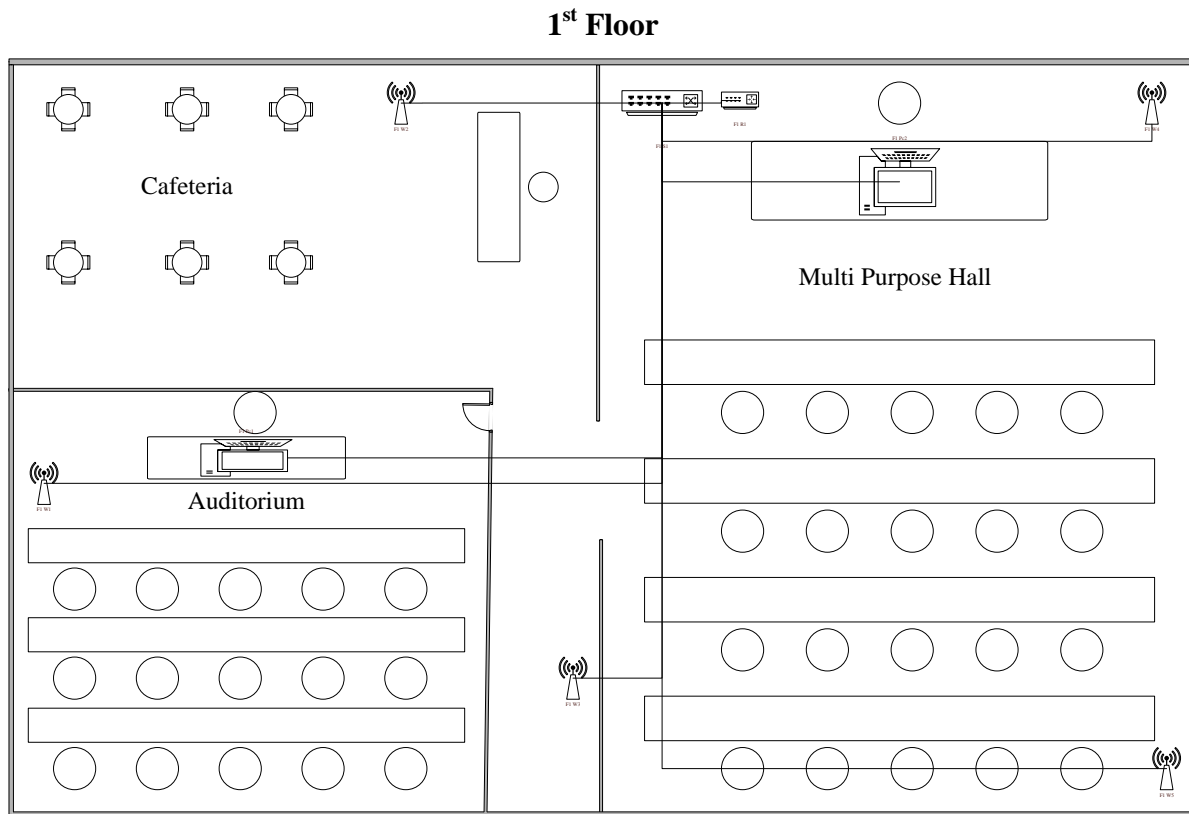
1ˢᵗ Floor

Figure: 2.2.0

Block A has an auditorium, cafeteria and multi-purpose hall located on the 1st floor. On the 1st floor, it has 5 Wi-Fi, 1 router and 1 switch connect with 2 computers. There are personal computers and around 50 seats available in the auditorium area. Students can bring their computers inside during their lecture classes. The cafeteria has a cashier area and it can fit more than 50 people inside to enjoy their food with friends. For the multi-purpose hall, it includes one personal computer and it can fit more than 100 students in the hall. Students can also bring their laptops inside when needed.

2nd Floor
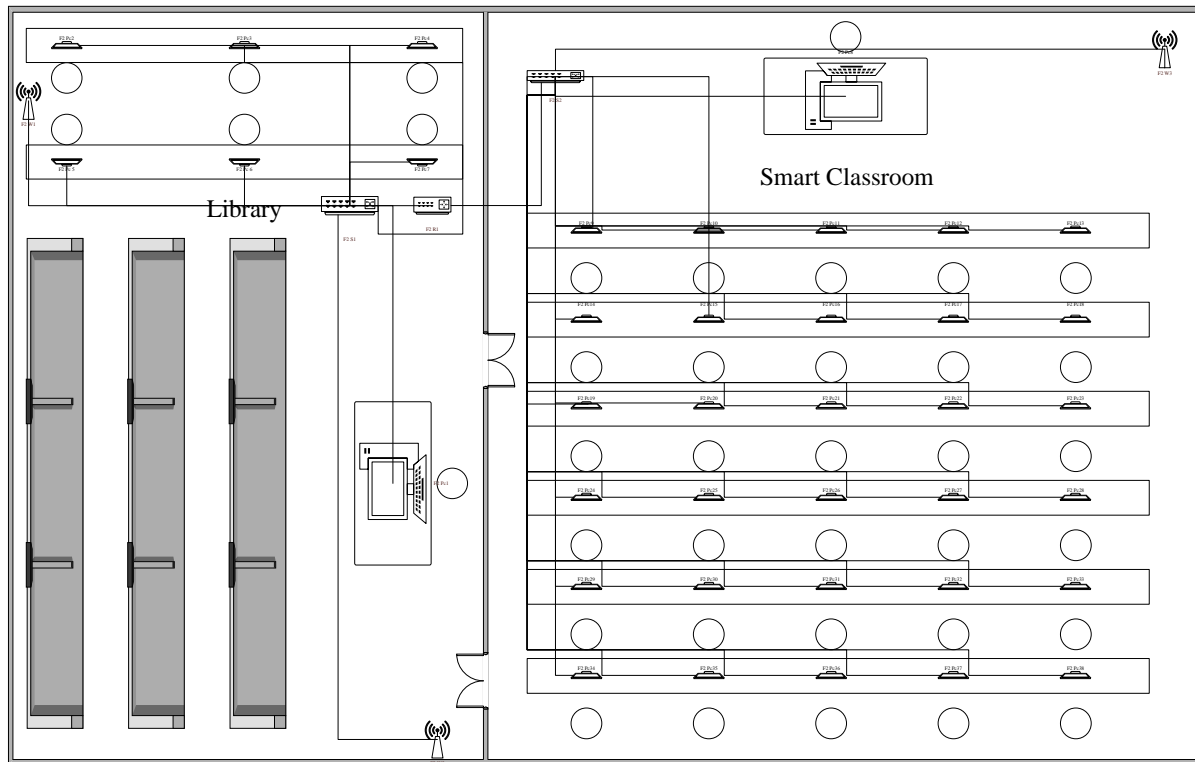
Figure: 2.2.1

The second floor consists of 1 library and 1 smart classroom. On this floor, it has 3 Wi-Fi, 1 router and 2 switches. It includes 6 computers in the library for students to do some research. The library has a wide range of books to help students with their studies and gas all the relevant material to aid them in their studies. There is a counter near the library door for students to borrow or return their books. The smart classroom on the second floor includes 30 computers for students to use during their lab class.
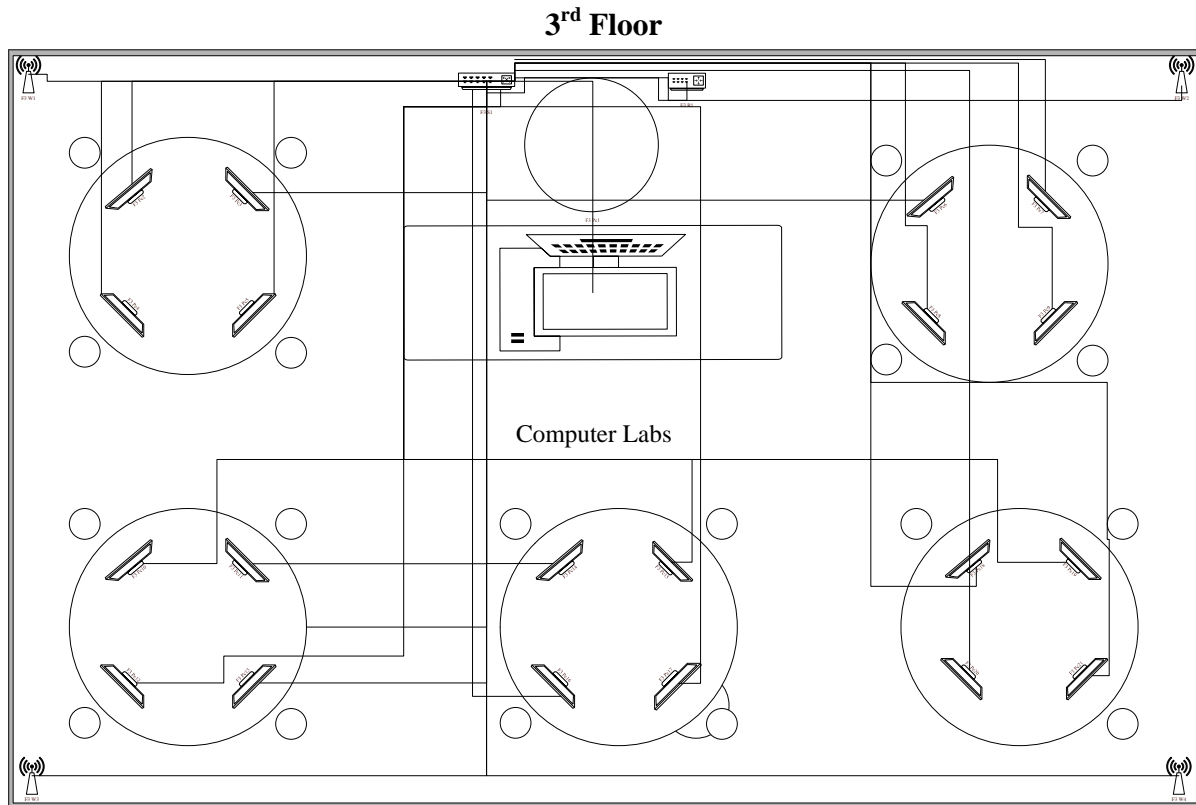
3rd Floor

Figure: 2.2.2

On the third floor, there is a computer lab with 20 computers for the students to practice their skills and 1 main computer for lecturer use for teaching the students. These computer labs include 4 Wi-Fi, 1 router and 1 switch. The computer internet speed will not be running slow as there is 4 Wi-Fi to support the internet speed in the computer labs. Students can also use these computer labs for a small meeting or discussion for their presentation or assignment if there is no class on the time.

2.3 Block B

The following floor plan shows the most appropriate design that's viable for building Block B following the requests made by BOLTON international School. As this is an administrative block and not a school block, we have made sure to restrict the Wireless Access Points to a bare minimum as a security precaution.

Block B Floor 1
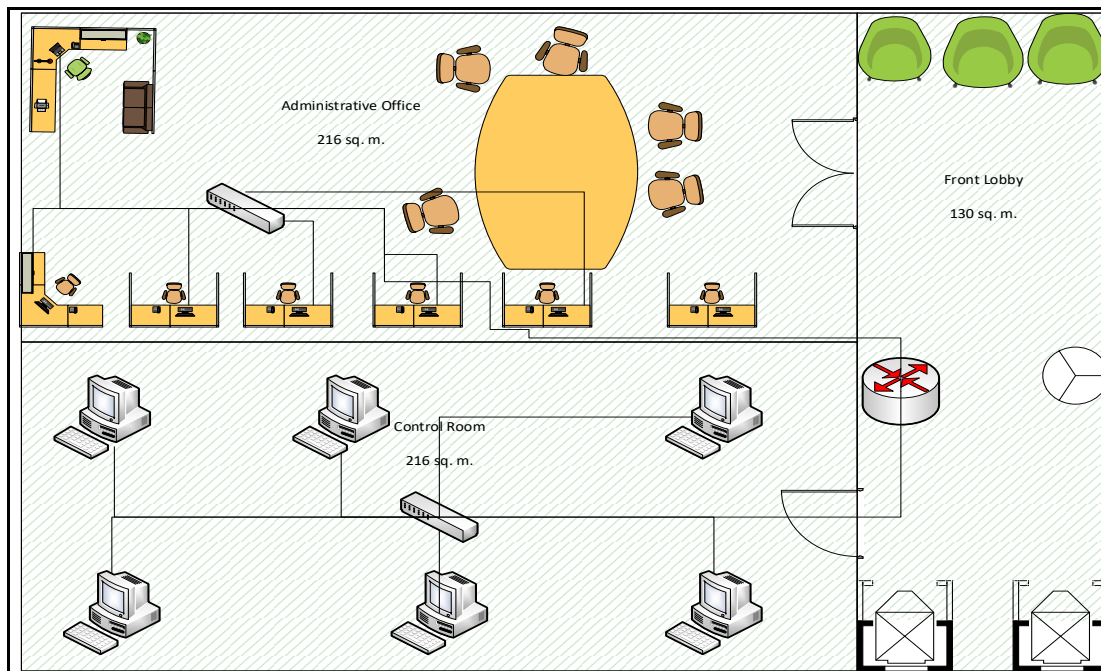
Figure: 2.3.0

As described in the request Block B has 2 Floors. Shown above in the layout for the first floor. The First floor has a Single entrance that also acts as the singular exit. It has sufficient space to have a Large Administrative office and a Similarly large Control Room.

The Administrative Office has Multiple PCs as well as a meeting table for important discussions in the middle of the room. All the PCs are individually connected to a switch to avoid any sort of collision from occurring like that which occurs in a bus topology.

The same thinking has been applied in the Control room where multiple PCs are individually connected to the Switch to not have any collision or destruction of packets sent from one PC to the other.

All the switches on the floor are connected to a router that is connected to the Router placed on the 2nd Floor. The first floor has a lobby with seats at one end for people to wait at and opposite to it are the elevators that take you to and from the 2nd floor of Block B.

Block B Floor 2

Staff Room
75 sq. m.

Staff Lounge
65 sq. m.

I.T Departement
92 sq. m.

Corporate Office
83 sq. m.

9 sq. m.

Server Room
154 sq. m.

2nd Floor Lobby
84 sq. m.
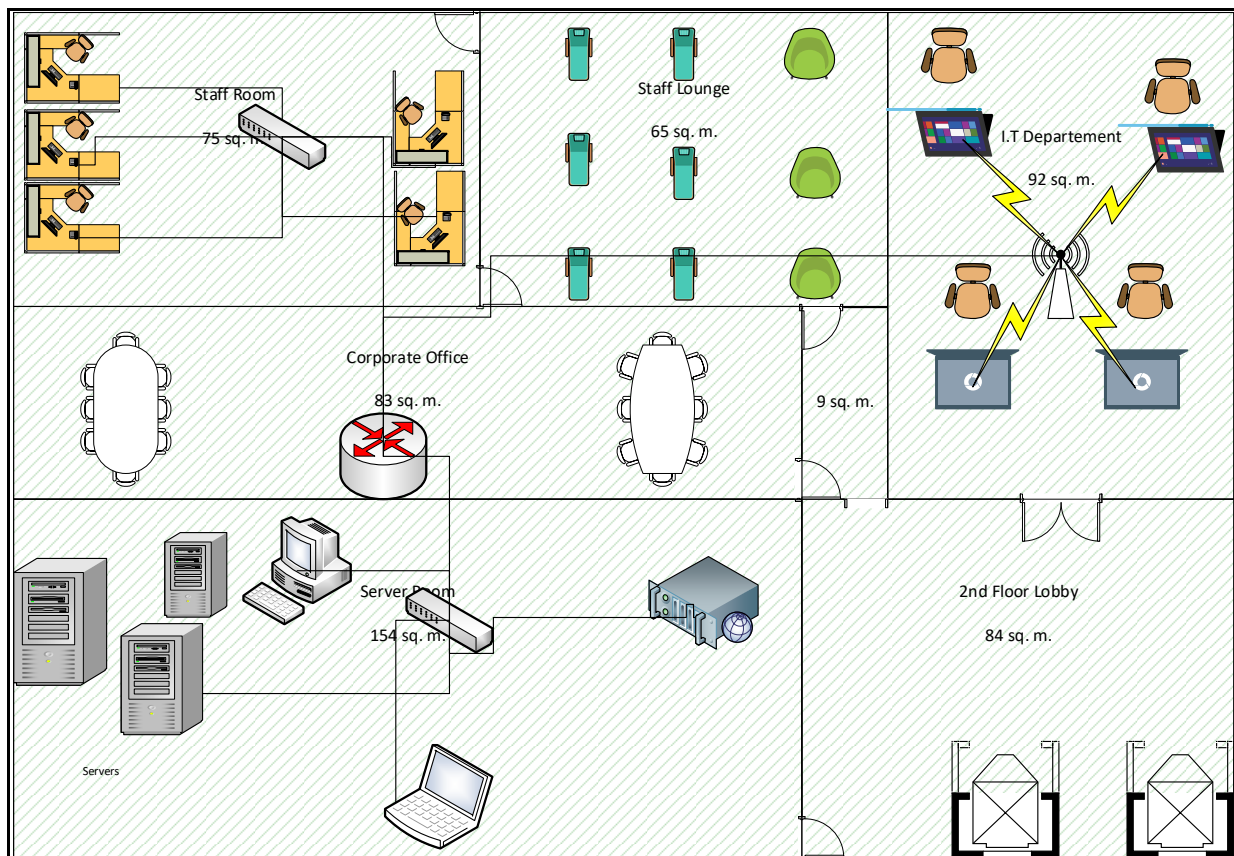
Servers

Figure: 2.3.1

As you can see in the figure above the 2nd floor of Block B houses the Staff Room, Staff Lounge, I.T Department, Corporate Office and the Server Room all on one floor.

Upon entering the second floor after exiting the elevator you are greeted with 3 doors.

One of the doors in front of the person leads to the I.T department. As the I.T people have to mobile most of the time so therefore they have been equipped with laptops and not PCs. Also, the network is accessed in their department using a wireless access point and not ethernet connections to maintain speed and efficiency that matches their on-the-go mode of Operandi.

The AP in this room is directly connected to the router. The second door on the left of the elevators leads to the Server room.

In the server rooms, multiple servers are connected to a switch along with a PC and Laptop that are also connected to the Switch. The Switch is connected directly to the Router. The PC and Laptop in this room have root access to the Servers for maintenance purposes. The rest of the PCs on the network can only access the services provided by the individual Servers and not gain Root access.
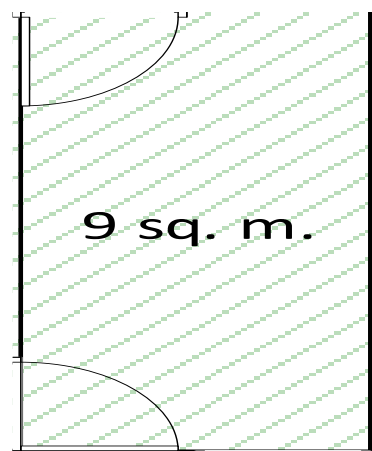
Figure: 2.3.1

The third door leads to a room with two doors in it. The First door to the left leads to the Corporate Office while the second door to the left leads to the Staff Lounge and eventually to the Staff Room.

The Corporate office is nothing more than a meeting room for the corporate portion of the administrative group. There are no PCs here or Access Points but this is the room where the Router has been placed in.

After crossing the second door you are greeted with the Staff Lounge. Yet again there are no PCs or Laptops in the Staff Lounge as it a purely recreational Place. As opposed to the Staff Room where teachers have complete access to the various PCs and cubicles placed there.

All the cubicles have PCs in them and all the PCs are connected individually to the Switch placed in the Room. This is done yet again to prevent any sort of collision of packets when requests are sent at the same time.

The Switch in this room is directly connected to the Router.

This Block is designed for maximum efficiency while also wasting zero space.

Block B is connected to Block A using the Router placed on Floor 1.

As the router placed on the first floor in the Lobby and not in the Corporate Office of the 2nd Floor. It makes much more sense in using that router to connect the 2 Blocks rather than using the 2nd floor one.

This Block also focuses on maintaining a sense of security as there are only 1 entrance and exit for all rooms on Both the floors. Using this method, it is pretty easy to log people's movement in and out of the rooms and in any case if there is some sort of intentional network damage or break-in the source of which can be found out quite easily.

2.4 Block B

The Block B building is composed of two floors, serving varying purposes. The figure below highlights a floor plan on the first floor.
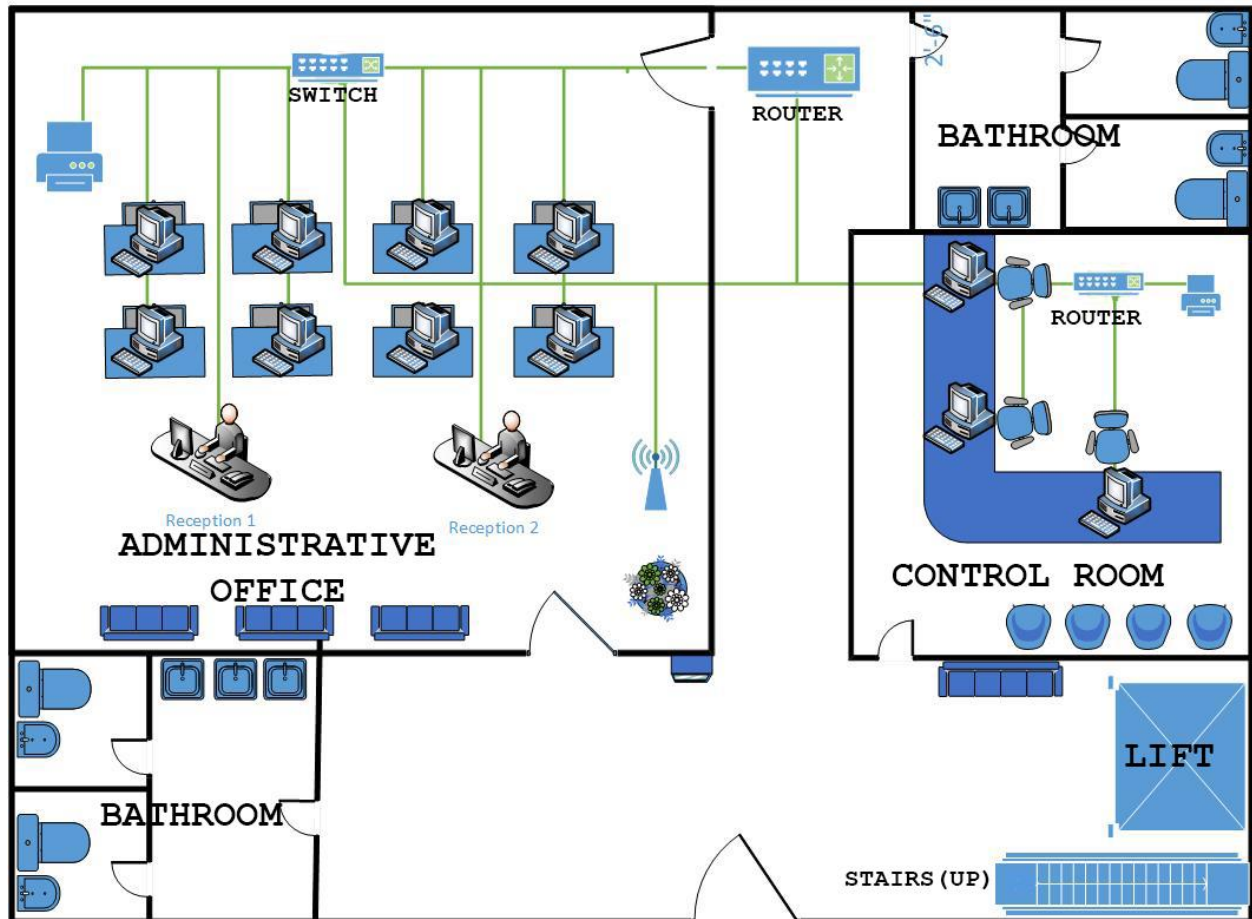
Upon entering the building, floor 1 primarily consists of two offices; the administrative office and the control room respectively. A router is located in the outer corridor of the building, linked to the respective office's switches. This router will further relay to the network located on the second floor.

Aside from these core components, two bathrooms are placed across the building in opposing corners, accommodating the relatively higher traffic contrary to the second floor. A set of stairs and an elevator can be used to access the second floor of the building.

The administrative office comprises of reception desks staffed with workstation computers, which are linked to the room's local switch located at the back. 2 reception desks are chosen to accommodate a large number of visitors and ensure quick service. Behind the reception desks, 8 additional workstations are arranged to allow administrative faculty to operate from within the room. This increases the efficiency of communication through the

department by eliminating delays, and the reception staff may directly consult staff. Furthermore, a printer/scanner is located within the office, which is also linked to the switch, as well as a Wi-fi access point to allow guests and staff to utilize internet access wirelessly.

The control room comprises an arc table facilitating the technical assistant faculty. 3 hosts have been chosen to fulfill this role, and their respective computers all connected to the office's switch, in addition to a printer/scanner independent of the administrative office to minimize inefficiency.

Moving on to the second floor, a larger array of offices is located here. Starting in the clockwise direction, are staff room, staff lounge, corporate office, bathroom, server room, then IT   department.
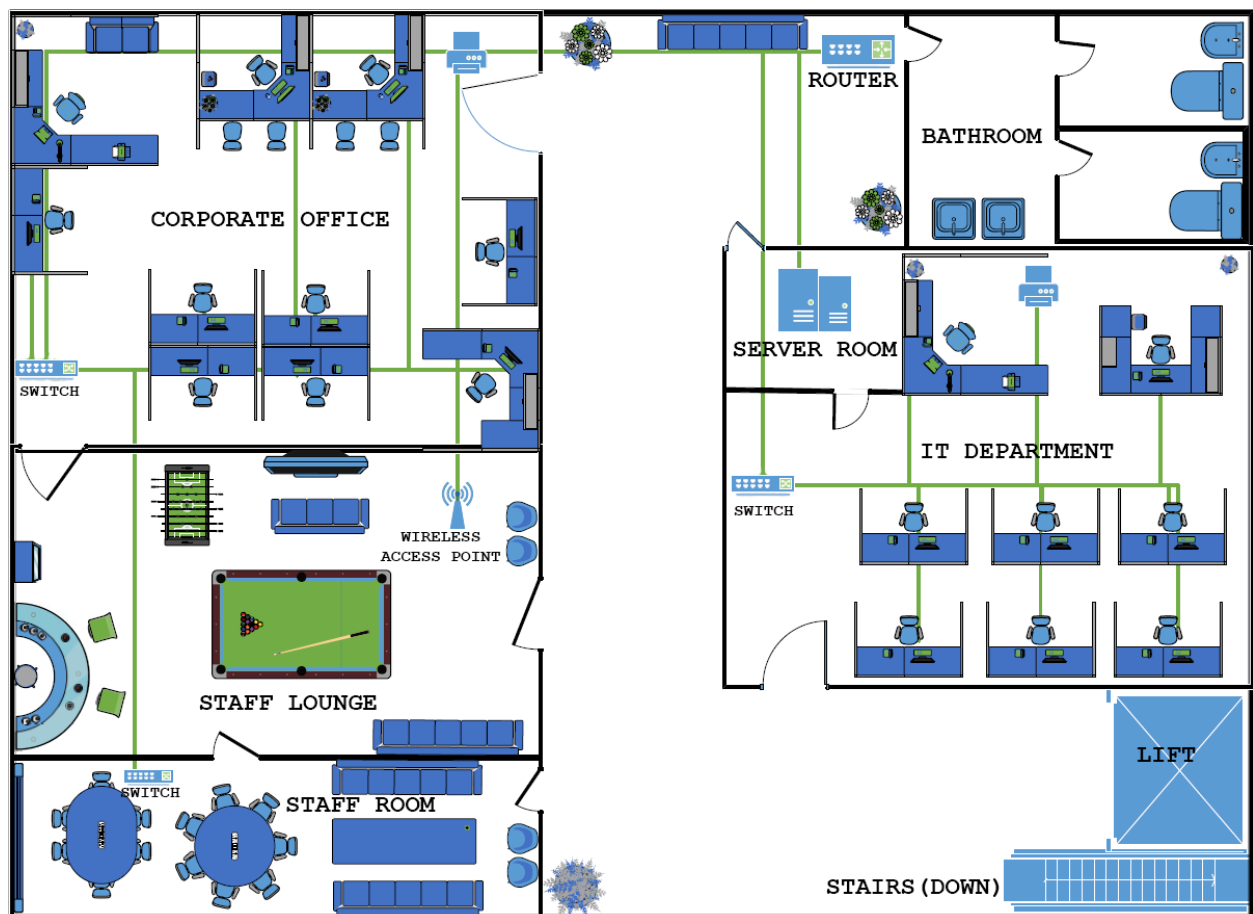
The staff room aims to allow faculty to perform activities and work in a more casual setting. Ample seating arrangements are made, provided with sofas, lounge chairs, and round desks with chairs. Additionally, a projector screen is also included for use in briefings or informal presentations. This projector, in addition to any computers the staff may like to use, can be connected to the local switch located within the room.

To go further, the staff lounge is placed to allow staff to unwind from work activities. It is located between the offices and staff room, accessible from both, to allow ease of access. The room features various recreational activities, including a pool table, foosball, television, vending machine, and beverage bar. Contrary to the rest of the rooms, the network switch is not provided in this room, instead opting for a wireless access point, which is further connected to the corporate office switch. This is to accommodate a larger number of wireless devices used within the room, as the staff is more likely to use their mobile devices. Any work necessitating the use of computers will automatically be redirected to either the office or the staff room due to the nature of connectivity in the lounge.

The corporate office, for illustrative purposes, consists of a layout featuring several workstations laid out in a cubicle style. This room intends to carry a large capacity of computers, all connected to the local switch. The layout is varied to break the monotony, and a printer/scanner facility is also provided. The majority of intensive work is intended to be carried out here.

The floor contains a single bathroom consisting of 2 stalls. As the remaining offices occupy a lot of space, only this single bathroom could be accommodated.

The IT department office contains both the offices for the IT staff, as well as houses the server room within. This serves a dual purpose of utilizing the floor space, as well as maintaining accessibility to the server room by maintenance staff. As the IT office is located right beside the server room, it will be very easy to promptly resolve any issues that might arise within the network.

The IT department office is composed in a similar style to the corporate office; laid out in a cubicle style. Two corner stations are present with additional workspace and desks for any staff who may require the extra room. An additional printer is independently provided in the room. All of the workstations within the room are connected to the network via the switch located in the corner of the room.

The server room houses the mainframe computer and its supporting equipment. In addition to the server, air conditioning is included to provide sufficient cooling to the computers. As it stands, the server room is not equipped with any input or display devices, nor is there a computer provided for operation. Instead, the intended protocol is for the server to be accessed remotely through a server administrative system, operated by the rightful staff.

3.0 network devices

A brief description of the network devices is given in this part, used to create network design in Packet Tracer.

3.1 Router

A router is a layer 3 device of the OSI Model, uses routing tables to understand where traffic is coming from and where it should go. And its main functionality is to stop broadcast from scattering across the channel, but it allows unicast and multicast communication between devices across its interfaces. Commonly for a single router, each of its interfaces represents a separate device. And unlike switches it is software-based, hence it is feature-rich and upgradeable.

A router is connected physically, through a network cable, to the modem to the internet, then physically, again to a network cable, to the network interface card. Modems and routers are different devices. A unique public IP address assigned to the internet connection. An assigned IP address usually works as the default gateway for the various devices on the network. The router also acts as simple network switches allowing the devices to communicate with each other. For example, share files and printers among devices.

Usage in the network design

The router used in the network design is Cisco's 2941 router, the picture is given below. For each floor, one router is used in both buildings. One more switch is used depending on the floor and the number of networks needed, just to provide the relevant isolation and connection between different networks. Furthermore, all the routers on each floor and a building and router in both the buildings are interconnected as well.

Figure: 3.1

3.2 Servers

A server is just like a computer that provides some form of functionality or service to other computer programs which are usually known as its clients or users (WhatIs.com, 2014). That means the server computer (client/user) is used to access data from another computer (server).

Usage of server in network design

In this case for our network, we are going to use a total of 3 servers with the following features.

FreeIPA on a Linux server for the AAA service

Linux servers are the primary choice because of being the opensource servers. The source code Linux operating is freely available under various open-source licenses including GPL. But, for the additional services, you need to buy a subscription from respective companies such as Suse in case of using their services for their operating system (Suse) or Red Hat in the case of Red Hat Enterprise Linux (RHEL).

FreeIPA can be used for (AAA) Authorization, Authentication, and Accounting of various members of the secondary school of BOLTON International School. FreeIPA includes other services such as DNS server, Kerberos authentication, and network time protocol (NTP) server, etc. These features fully provide quite a robust system for AAA.

Samba server

Samba is also an open-source package available on Linux servers under GPLv3. It is used primarily for robust interoperability of Linux and Windows by providing file and print service to various Microsoft clients, it very useful seeing that most of the members of the secondary school of BOLTON International School will be Microsoft Window users. (LINAGORA, 2019)

Apache HTTP server

Apache HTTP server is also called an Apache web server, it is open-source software released under apache license 2.0. (B, 2019) It mostly works with Linux servers provides similar functionality on Unix-likes servers and Microsoft servers as well.

MySQL as a database server

MySQL is an opensource relational database management system (MySQL Tutorial, 2019). MySQL is used to record key facts and figures about the members and various resources in the secondary school of BOLTON International School; this is especially useful for the library provided in Block A floor 2.

Postfix as a mail server

Postfix is an open-source and free mail transfer agent under IBM's public license 1.0 and it is available on various Linux distribution. (Postfix.org, 2019) This can be used to provide various members of the secondary school of BOLTON International School a centralized mail server.

3.3 Switch

A switch is a third-generation, layer 2 devices of the OSI Model; It serves as a single broadcast domain and multiple collision domains. In layman terms, a switch serves as a central connection point that centralizes communications among several connected devices in one local area network (LAN). Network switches are sometimes referred to as bridging hubs, switching hubs, or MAC bridges. It is ASIC chips that are meant to provide the same functionality as bridges, however, ASIC is hardware-based which bridges are software-based. Usually, ASIC switches can transmit data to the relevant port at a certain speed. While switches typically have 24 or 48 ports but these can be connected to serve large networks.

Usage in network design

The switch used in the network design is Cisco's 2960 24TT switch, the picture of which is given below. It has 2 Gigabit Ethernet ports and 24 Fast Ethernet ports. These switches

are allowed the access layer devices to communicate within a single network. Any link from a switch to a router or firewall went through Gigabit Ethernet port taking into consideration any high bandwidth requirements.

Figure: 3.3

3.4 Cables

Straight through

Straight through cable is also known as a patch cable; It is mainly used when there is no wireless connection is not available. This cable could be used mostly in four different ways-

- ➢ To connect a computer to a switch port
- ➢ Connecting a computer to a cable or DSL modem LAN port
- ➢ Connecting a routers WAN port to a cable or DSL modem LAN port
- ➢ Connecting a switch to a router's LAN port.

Straight-through is used in the project, the cable connects all the routers with switches and switches with firewalls and end devices present in the floor plan developed. This cable is technically the right option. It is the cable that is best connecting unlike devices together compared to the cross-over and the serial cable. (Anon, 2019)
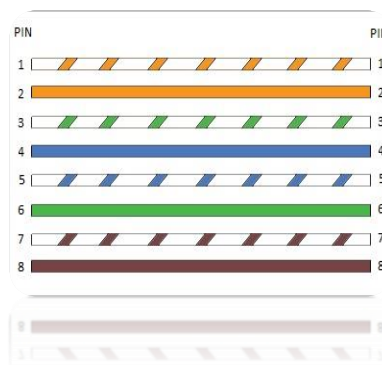
Figure: 3.4

Cross-Over Cable

A cross-over cable usually connects two computing devices. It is also known as an ethernet cable. It connects a LAN port of a router to a switch or a hub port and also to connect two switches by using a regular port.

In the project, the cross-over cable was mainly used to connect all the like devices such as two switches. A crossover able could be Cat5, Cat5e, Cat6. These cables are different quality of these cables due to their differing amount of twists of copper wire present in the cable.
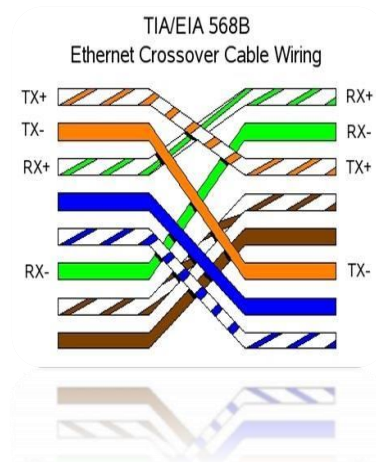
Figure 3.4.1

Serial cable

A serial port in a computer transfer information or data between devices using communication orbit to bit techniques. These cables are different according to their interface and standards. In the assignment, the serial cable is generally used to establish a connection between two routers. Some of the different types of serial cables used around the world are

Basic DTE-DCE

Null modem cable

Two-wire DTE-DCE

V.35 Crossover

Figure: 3.4.2

4.0 Network topology

4.1 Network Topology

Network topology is the description of how different nodes and connections are arranged in a network.

Network topologies come in various design patterns and standard layouts, and those should be chosen consequently as they are the fundamental building blocks of effective network design. Some of the most common topologies are bus, ring, mesh, tree, and star, etc. The following figure gives some example of various topologies
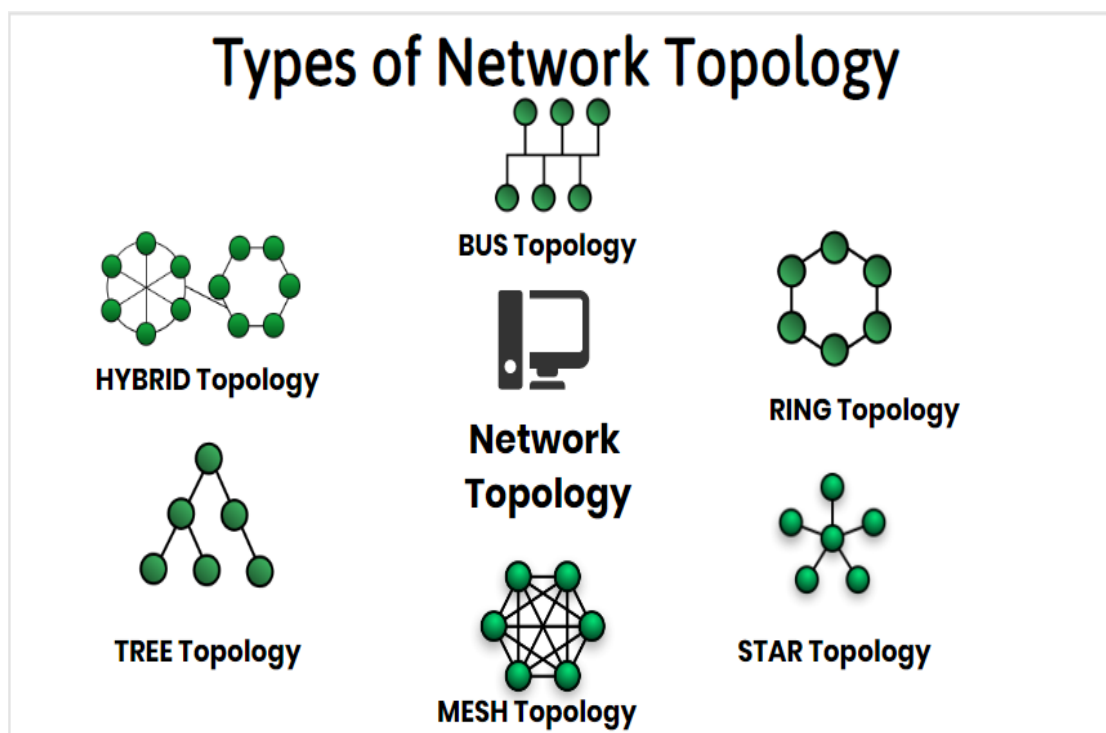
Figure: 4.1.0 (Google.com, 2019)

There are five basic models of topology which includes:

> ➢ Bus topology: all the devices are connected in the same transmission line sequentially, it's a simple and low-cost topology. All devices are connected to a single cable so there is no need to manage a complex topological setup, bus topologies have a single point of failure. If the cable fails then the entire network will go down. Bus topology is half-duplex, which means that data can't be transmitted in both directions simultaneously.

➢ Star topology: all the devices are connected to a single hub or switch in the center. The entire network can be managed from one location and also can add new end-devices without having to take the network offline, but if any devices have failure won't affect the network but if the center device (switch/hub) goes down it causes a network failure.

➢ Ring topology: it is the same as bus topology as all the devices are connected in the same transmission line except that it starts and ends with the same node making a ring. It uses of token-based protocols, which only allow one station to transmit data at a given time, failure of one node can take the entire network down.

➢ Tree topology: a root node is connected to one or more sub-level nodes it has features of both bus and star topology, this format also lends itself well to finding errors and troubleshooting, but If the root node fails then all of its subtrees become partitioned, the more nodes you add, the more difficult it becomes to manage the network.

➢ Mesh topology: all nodes are interconnected in the network because such interconnectivity of nodes makes it extremely resistant to failures, but they require an immense amount of configuration once they are deployed. It is a full-duplex topology that means data can transfer in the opposite direction at the same time.

➢ Hybrid topology: it uses a mixture of two or more topologies which can be from bus, ring, star, tree and mesh topology. Hybrid topology cannot accommodate and can incorporate multiple topologies into one hybrid setup, hybrid topologies can be quite complex.

Network topology refers to the physical and logical arrangement of devices in a network. It also represents how the data is exchanged between the devices in a network. Physical topology looks at the physical aspects of a network that how the devices are connected physically in a network whereas the logical topology goes through the logical aspects like how the data is exchanged or transferred among the network devices.

5.0 IP Addressing Justification

An IP address is the "digital address" given to a device that allows it to establish connections to other devices over the internet. The IP address used in secondary school of BOLTON International School is IPv4, which stands for "Internet Protocol Version 4". Example of an IPv4 IP address would be:

192.168.0.1

IPv4 is based on a 32-bit system. This is a limitation as the 32-bit system only allows 232 or 4,294,967,296 IP addresses. This was overcome by the introduction of IPv6.

In the table above the Device, the column contains the device name as stated in the network/packet tracer. The interface shows the interface the device is connected from the switch; IP address is the address given to each of the network devices. The Subnet Mast and Default Gateway is 255.255.255.0 and 192.168.40.1 respectively, for the subnetwork. As stated in the table the access points each have their IP addresses, thus stating that each of them does support TCP and UDP connections. This, in turn, increases network security.

The IP addresses used by the network shows, that more devices can still be connected. This allows the network to be more flexible as upgrades can be done to network very easily and in a pinch.

For first floor (Ground Floor of Block A)

The network used: 192.168.50.0

Subnet mask: 255.255.255.0

Default gateway: 192.168.50.1

Range of assignable IP addresses: 192.168.50.2 – 192.168.50.254

Broadcast ID: 192.168.11.255

Justification

In this case, there is a mix of end-devices using wired connections and wireless. The wired ones (such as those in labs) are going to be assigned fixed IPs while remaining cause use any from the large pool of over 200 available IPs.

For Second floor (Block A)

The network used: 192.168.60.0

Subnet mask: 255.255.255.0

Default gateway: 192.168.60.1

Range of assignable IP addresses: 192.168.60.1 – 192.168.60.254

Broadcast ID: 192.168.60.255

justification

This floor is full computers because of computer labs and a big library, most of connection is wired connection on the second floor

For the Third floor (Block A)

The network used: 192.168.70.0

Subnet mask: 255.255.255.0

Default gateway: 192.168.70.1

Range of useable IP addresses by hosts: 192.168.70.2 – 192.168.70.254

Broadcast ID: 192.168.13.255

Justification

Because there are only classes with not many computers that's why, a range of wireless and wired devices with getting connected to the network, hence a large pool of IP addresses is made available.

IP addresses assigned for links between routers

Router0 to Router1

192.168.50 .1 to 192.168.60.1 respectively

Router1 to Router 2

192.168.60.1 to 192.168.70.1 respectively

Router2 to Router3

192.168.70.1 to 192.168.50.1 respectively

Justification

Here the subnet mask of 252 is used seeing that each serial connection between routers needs only two IP addresses.

Static routing configuration on routers
Block A

Router 0

Network ID	Subnet	Next hop
192.168.10.0	255.255.255.224	192.168.9.2
192.168.60.0	255.255.255.0	192.168.6.2
192.168.70.0	255.255.255.0	192.168.7.2

Router 1

Network ID	Subnet	Next hop
192.168.10.0	255.255.255.224	192.168.15.2
192.168.50.0	255.255.255.0	192.168.15.2
192.168.70	255.255.255.0	192.168.8.1

Router 2

Network ID	Subnet	Next hop
192.168.10.0	255.255.255.224	192.168.14.2
192.168.50.0	255.255.255.0	192.168.6.1
192.168.60	255.255.255.0	192.168.8.2

Block B

Router 0

Network ID	Subnet	Next hop
192.168.0.1	255.255.255.224	192.168.8.1
192.168.10.0	255.255.255.224	192.168.8.1
192.168.50.0	255.255.255.224	192.168.9.1
192.168.50.0	255.255.255.224	192.168.14.1
192.168.50.0	255.255.255.224	192.168.15.1

Router 1

Network ID	Subnet	Next hop
192.168.20.0	255.255.255.224	192.168.8.2
192.168.30.0	255.255.255.224	192.168.8.2
192.168.40	255.255.255.224	192.168.8.2

6.0 Network characteristics

6.1 Network manageability training

Management of network can include installation of various software packages or patches on various end devices including clients and servers, to manage the switches or related layer 2 devices, to manage the routers (layer 3 devices), all the way to the management of interconnecting cablings (layer 1).

These devices can be managed either by approaching them physically and using an appropriate connecting device, such as console cable in case of the management of various cisco devices or by connecting them remotely by using SSH or telnet.

The physical presence of network or system administrator is required, when the device is not yet set up for SSH or telnet, a fresh unconfigured device for example, when the connectivity to the device is broken; After doing the basic configuration, these devices are managed through SSH or telnet, Both of these require basic IP addressing to be configured on the relevant devices. The difference between telnet and SSH is that telnet is insecure meaning that the data transferred through it is unencrypted or plain text, while SSH sends data after encrypting it essentially protecting the data from a man in the middle attack. Furthermore, telnet uses TCP port 23 (Grid Elli, 2018) while SSH uses TCP port 22 (Linux.com, 2017). Particularly these devices can either be password protected or for ease of manageability, keypairs can also be used in place of a password.

Various software packages, such as putty and Tera Term, can be used to manage these devices locally or remotely.

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Assessment Criteria: Marks Breakdown

Assessment Criteria	Group Assignment				
	Marks Awarded				
Digital Skills (60 marks)	Weight	Student 1	Student 2	Student 3	Student 4
Floor Plan	10				
Analysis & Justification	10				
Network Diagram	10				
Configuration	10				
Demonstration	10				
Referencing	10				
Teamwork Skills (40 marks)	Weight				
Topology Justification	10				
IP Addressing Plan & Justification	10				
Documentation	10				
Alternate Roles	5				
Peer Evaluation	5				
Total Marks	100				

	Individual Components (60%)				
Marking Criteria	**0-2** **(Fail)**	**3-4** **(Marginal Fail)**	**5-6** **(Pass)**	**7-8** **(Credit)**	**9-10** **(Distinction)**
Floor Plan	Not able to use a proper tool / software to design the floor plan. Floor plan is not visible.	Show minimal ability to use a proper tool / software to design the floor plan. Simple floor plan produced, with no label and legend	Show ability to use a proper tool / software to design the floor plan. Appropriate floor plan design but with less detail.	Show good ability to use tool / software to design the floor plan. Good floor plan design with sufficient detail.	Proficient use of tool / software to design the floor plan. Very detailed floor plan design, with good representation. Creativity shown in the design
Analysis & Justification	Almost no requirement analysis and no justification of the network devices (positioning) presented.	Limited requirement analysis. Very less detail in justification of the network devices (positioning).	Sufficient requirement analysis to design a floor plan. Minimal justification of the network devices (positioning) provided.	Good requirement analysis and comparison of facts. Sufficient justification of the network devices (positioning) but lack of critical discussion.	Very good requirement analysis and comparison of facts. Good justification of the network devices (positioning) with sufficient critical discussion.
Network Diagram	Not able to show good skills in using Cisco Packet Tracer tool. Network diagram is not clear.	Able to show sufficient skills in using Cisco Packet Tracer tool. Minor issues in network diagram (not feasible).	Able to show good skills in using Cisco Packet Tracer tool. Feasible network diagram, meeting the minimum requirement of a network.	Able to show very good skills in using Cisco Packet Tracer tool. Good network diagram, showing	Proficient in using Cisco Packet Tracer tool. Very good quality of network diagram, with some complexity of design

					complete layout of the network	
Configuration	Weak configuration skills. Not able to fully configure the design.	Limited configuration skills. Only able to meet minimum requirement on the configuration on router and PCs	Good configuration skills. Able to perform good level of configuration on router and PCs	Very good configuration skills. Able to perform some complex configuration on routers and PCs	Outstanding configuration skills. Complex configuration on routers, PCs and switches.
Demonstration	Not turn up for project demonstration.	Major issues in configuration (some parts are unable to ping).	Minimal issues in configuration – not fully working according to the proposed plan Able to modify the network configuration with help of friends during demonstration	Successful network configuration (able to ping to all devices) Able to modify the network configuration without any help during demonstration	Successful network configuration (able to ping to all devices) Excellent skills in modifying network configuration during demonstration
Referencing	Not able to use referencing tools in Microsoft Word. No in-text citation and very minimal references. Major issues in the referencing format.	Minimal use of referencing tools in Microsoft Word. Minimal in-text citation and references used. Minor issues in the referencing format.	Full use of referencing tools in Microsoft Word. Sufficient number of references and citation in the report. No issue in the referencing format	Good use of referencing tools in Microsoft Word. Recent source of references used, with proper reference list. Limited in-text citation in the report	Very good use of referencing tools in Microsoft Word. Very good quality of references used, with proper citation and reference list for all facts and diagrams used
Group Components (40%)					

Marking Criteria	1 (Fail)	2 (Marginal Fail)	3 (Pass)	4 (Credit)	5 (Distinction)
Topology Justification	Not able to propose for suitable Topology.	Propose incomplete Topology with weak justification	Propose complete Topology with minimal justification	Propose good Topology with justification, suitable for the scenario	Propose very good Topology with justification, suitable the scenario with supporting evidence.
IP Addressing Plan & Justification	No explanation to justify the selection of technique for IP addressing plan and segmentation	Almost no relevant explanation to justify the selection of technique for IP addressing plan and segmentation	Appropriate technique chosen for IP addressing plan and segmentation. Minimal explanation to justify the plan	Good technique chosen for IP addressing plan and segmentation. Lacking of supporting evidence to justify the plan	Very good technique chosen for IP addressing plan and segmentation. Supported with extensive research work for technical accuracy
Documentation	No table of content and page numbering, font size and type are not standardized Incomplete assignment requirements	Table of content exist but without page numbers, report structure not standardized Assignment requirements are partially completed.	Table of content included with proper page numbering, standardized report structure & headings. Proper introduction conclusion of the report	Good structure and flow of documentation with appropriate header & footer Good introduction and conclusion of the report	Very good structure and flow of documentation, appropriate header & footer with very good appearance Very good introduction and conclusion of the report.
Marking Criteria	1 (Fail)	2 (Marginal Fail)	3 (Pass)	4 (Credit)	5 (Distinction)

Alternate Roles	No clear evidence of ability to assume alternate role as a group leader and member.	Attempt to Demonstrate the ability to assume alternate roles as a group leader and member with limited effect and require improvements.	Able to demonstrate the ability to assume alternate roles as a group leader and member with some effect and require minor improvements.	Clear evidence of ability to assume alternate role as a group leader and member to achieve the same goal.	Very clear evidence to assume alternate role as a group leader and member to demonstrated in practice.
Teamwork **(Based on peer evaluation and reflection document)**	No clear evidence of ability to foster good relationship and work together effectively with group members.	Able to foster relationship and work together with other group members towards goal achievement but with limited effect.	Able to foster relationship and work together with other group members towards goal achievement with some effects, but still require improvements.	Able to foster good relationship and work together with other group members towards goal achievement.	High ability to foster good relationship and work together effectively with other group members towards goal achievement.