NETWORK DESIGN

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INTRODUCTION

This network design report consists of a detailed information regarding upgrading software/hardware of your computers. What appropriate features you would need in order to run daily tasks efficiently. It consists of tables that explain the differences, advantages, and disadvantages of different vendors, operating systems, backups, internet service providers, and virtual machines. Within this report, there is a section that includes a network diagram of the office area for a better understanding of the network.

PROJECT BACKGROUND

We started this project in a group of 3 individuals. Haeytham Almalak and Hazkeel Qureshi who are from Canada and Nagma Sharma who is from India. We collaborated with each other over email throughout working on this project. Our professors helped us out during few of our set backs which included one of our members dropping out before we began the project. However, we divided the workload with each other and worked on our assigned tasks. Finally, we were able to complete and combine or works to prepare a detailed report to submit to our professor.

Q1: ***What kind of operating system would you install on the server (Windows Server 2012/2016 or Linux)? and on client computers (Windows 8 or 10 or any other) and why? For the operating system of your choice, discuss***

- the recommended hardware specifications for the server (CPU, memory, disk, network card [speed, type], etc.), as well as client computers
- associated costs of the server and client operating systems (Hint: client access licensing for server);
- features of the operating system you choose (Windows 2012/2016 or Linux for server and windows 8 /10 or any other);
- any other related costs.

Are the client system specifications adequate for the customer's needs? If not, what upgrades would you recommend and how would you carry out the implementation?

1.1 Operating system (OS)

1.1.1 Server OS - Advantages and disadvantages or strength and weakness and various features of the Operating systems (OS) of your choice (minimum 2 different OSs are to be compared for server) – discuss why you choose the OS.

Server OS – Various features and strength and weakness of 3 of the most popular Operating systems (OS) for server are compared in this section, namely Windows 2012, Linux, and Mac OS X; as well as the discussion for the choice of OS to be used in the Network Design project.

Windows 2012
Features

Fewer versions allows for easier licensing	Microsoft has made life easier, with only two versions to choose from: Standard and Datacentre. The key difference between the two choices is the number of virtual machines (VMs) you're able to run.
Data Deduplication	Efficient data storage demands and requirements. Deduplication eliminates the duplicated space by as much as 90% across operating system installations, resulting in hundreds of gigabytes, even terabytes of space reclaimed.
GUI-less install options	minimal user interface which reduces disk space, saves on administration effort, and reduces your attack surface from hackers and other digital malcontents by restricting installed files to the absolute minimum
Hyper-V 3.0	Virtualization feature set
IP Address Management (IPAM)	provides a new internal framework for locating and managing IP address spaces on networks; manage and monitor servers running Domain Name Service (DNS) and Dynamic Host Configuration Protocol (DHCP); does automatic IP discovery and provides a host of other IP-related tasks focused on management, monitoring, and auditing

Network virtualization changes	Eliminates one of the more problematic aspects of virtual machine management and provision, which is dealing with the rules and limitations of IP address management; helps pave the way for private cloud adoption
ReFS	ReFS (Resilient File System) uses metadata to store information about files, and provides various features for auto correction and data verification.
Shared Nothing- Live Migration	Allows you to move a VM between servers, however, the servers must be able to see each other via an Ethernet connection

Storage Spaces	Allows you to create virtual disks that have the same characteristics as physical devices: they can be attached, removed, backed up, and otherwise managed exactly the same as traditional physical disks
PowerShell 3.0	For improved web access, the ability to schedule jobs, support for disconnected sessions, enhanced and editable help files, and dozens of other new features

CHKDSK changes	Rather than spending vast amounts of time laboriously scanning through sectors on large disks, the new and improved CHKDSK now scans disks in two phases: An online phase that detects errors and logs defects (and which also can run in the background), and an actual repair phase that does the actual fixing of corrupted drive data. Time differences between the old and new CHKDSK are dramatic: Some scans that took more than 150 minutes to complete are done in less than 4 seconds

Table 1. Windows 2012 Features

Windows 2012 Strengths and Weaknesses	
Strengths	● Supports more memory, a greater number of processors and more disk space than its predecessor ● The OS boasts several cloud and security enhancements well suited for cloud management. For example, Microsoft's Hyper-V virtualization software includes new security features such as simplified authorization. ● Other new features include the ability to encrypt only the drive space that is used, improved deployments, dynamic access control, Active Directory Domain Services and Direct Access. ● These features make Windows Server 2012 easier to use and more secure by reducing or eliminating errors and more closely tailoring the OS to today's critical security needs.

Weaknesses	● Drivers for Windows Server 2012 must be available prior to upgrading an existing server. Normally those are obtained from the server manufacturer. ● No access to source code, only members of the selected group will have access to it ● Very few customization options available ● Based on a number of licenses – we can install only on those number of computers ● In order to fix any problem, we need to reboot at run level 3 as an administrator/ root to find and fix the problem. ● Windows is the major target for developers of viruses and malware and it is most vulnerable without anti-virus software.

Table 2. Windows 2012 Strengths and Weaknesses

Linux Server Features	
Free and Open Source	Linux or GNU/Linux (if you like) is free and open source; you can see the source code used to create Linux (kernel). You can check the code to locate bugs, explore security vulnerabilities, or simply study what that code is doing on your machine(s).
Stability and	Linux is Unix-based and Unix was originally designed to provide an environment that's

Reliability	powerful, stable and reliable yet easy to use. Linux systems are widely known for their stability and reliability, many Linux servers on the Internet have been running for years without failure or even being restarted.
Security	Linux is without doubt the most secure kernel out there, making Linux based operating systems secure and suitable for servers. To be useful, a server needs to be able to accept requests for services from remote clients, and a server is always vulnerable by permitting some access to its ports.
Flexibility	Linux is so powerful and flexible. You can tune it to meet you server needs: it allows you to do whatever you want (if possible). You can install a GUI (graphical user interface) or simply operate your operate your server via a terminal only.
Hardware Support	Linux has a rock-solid support for a mix of computer architectures, on both modern and moderately old hardware. This is one of the most significant factors that make Linux better than Windows for servers that is if you have a small budget for hardware acquisition.
Total Cost of Ownership (TCO) and Maintenance	The total cost of owning and maintaining a Linux server is lower compared to a Windows server, in terms of licensing fees, software/hardware purchase and maintenance costs, system support services and administrative costs.

Table 3. Linux Server Features

Linux Server Strengths and Weaknesses	
Strengths	● User has access to the source code of kernel and alter the code according to his need. It has its own advantages like bugs in OS will fix at a rapid pace. ● Has various distributions which are highly customizable based on user needs ● Users are free to modify the software, can re-use in any number of systems and even they can sell the modified version ● Has inbuilt ability to stop at different run levels with this we can work using a command line and GUI if anyone has an issue ● Has support via a huge community of user forums/websites and online search ● Users have full control of updates, we can install whenever we needed and it will take less time without any reboot. ● More secure than Windows where hackers or developers of viruses will find it difficult to break through Linux ● High security, high stability, ease of maintenance, runs on any hardware, ease of use
Weaknesses	● Complicated to install ● Developers may take advantage of any weakness in OS if they found any

	● No single way of packaging software ● No standard desktop environment ● Learning Curve ● Some programs will not run on it ● Users have raised issues related to the Linux driver as certain hardware or old hardware were not compatible with the operating system. ● No Standard Edition

Table 4. Linux Server Strengths and Weaknesses

Mac OS X Features	
File Sharing	Share folders, exchange files, and access documents on a Mac, iPad, iPhone, or PC. iOS 9 users can securely store and access documents from OS X Server on your local private network. With file-sharing connection monitoring, you can see who's accessing your server, who's connected, and for how long.
Caching Server	Speeds up the downloads. Caching Server reduces the amount of data that needs to be uploaded or downloaded to devices on your network.
Profile Manager	The master multitasker. Profile Manager simplifies deploying, configuring, and managing the Mac computers and iOS devices in your organization.

Time Machine Backups	OS X Server can act as a designated Time Machine backup location for all the Mac computers on your network. Centralizing your backup storage helps protect valuable data and free up disk space on individual drives.
Xcode Server	Team development. Xcode Server makes it easier than ever for development teams to create high-quality software.
Wiki Server	Share expertise. OS X Server makes it easy for groups to collaborate and communicate through their own wiki-powered website. The wiki is accessible from a browser, so anyone can access it anytime.
Calendar, Contacts, and Mail Servers	Everyone's in the loop. Calendar Server makes sure everyone on the network knows where to be and when to be there. Contacts Server makes it easy to share contacts and keep them in sync on Mac, iPad, and iPhone. And Mail Server works with email clients on Mac, iPad, iPhone, and PC.
Xsan 4	Advanced by volumes. Xsan is a powerful and scalable solution for storage consolidation. Everyone in your organization can have fast, concurrent access to terabytes of centralized data.
VPN Server	Connect securely. Virtual private network (VPN) access enables your offsite users to securely connect to your network and its services, while preventing access by

	unauthorized individuals.

Messages Server	Quick collaboration. Messages Server brings the collaborative power of instant messaging to your organization. Workgroups can transfer files securely, share group messages, conduct audio conferences, even broadcast a presentation, movie, or photo slideshow to other Messages users running OS X.

Table 5. Mac OS X Features

Mac OS X Strengths and Weaknesses	
Strengths	● Makes it easy to collaborate, develop software, host websites and wikis, configure Mac and iOS devices, and remotely access a network ● Simple to install, set up, and manage

	● iOS 9 users can now open, edit, and save documents on OS X Server
Weaknesses	● Expensive ● An Apple-exclusive. If you want to assemble a PC or get a budget laptop (with DOS) and expect to install Mac OS, it's almost impossible. Mac comes baked in with the system Apple manufactures. ● There are malware and adware targeting Mac OS X and the number is growing every day ● No access to source code, not customizable ● High Learning Curve ● Does not provide you with the full control of its platform

Table 6. Mac OS X Strengths and Weaknesses

Choice of Server OS for the Network Design Project: **Linux**

Linux distributions, or distros, are open-source operating systems that run on the Linux kernel, meaning they are flexible operating systems and often free, which is beneficial if you are on a budget. Because the Linux kernel is open-source, it is highly customizable, where proprietary platforms are more rigid and controlled, at the liberty of the vendors regarding changes and updates; and there are a variety of user interfaces available that you can choose from on any device.

1.1.2 Client OS - Advantages and disadvantages or strength and weakness and various features of the Operating systems (OS) of your choice (minimum 2 different OSs are to be compared for client) – discuss why you choose the OS.

Client OS - Various features and strength and weakness of 3 of the most popular Operating systems (OS) for client are compared in this section, namely Windows 10, Linux, and Mac; as well as the discussion for the choice of Client OS to be used in the Network Design project.

Mac OS Features	
Reliability	Often easier to use, faster, and far more reliable compared to Windows
Applications	The company, Apple, has established different comprehensive applications under their own operating system. This results to a fully rounded computer, fit for home or office use.
	Every Mac computer has its own iChat application. This allows having a four way video conference and chat. It also allows for the sharing of contents on screen. It also comes with iLife, a software that can beat different things that a regular PC has to offer, from the production of music, videos, photos, and even DVDs.

Web Browser	By far, the most impressive inclusion of Mac is its own browser, Safari. This is referred to as the fastest web browser running on any type of platform in the virtual world. It has features that makes searching very convenient and effective.
System Transition	Allows for the transition from the use of PC to Mac. This is done by running Windows, in the same way that it is run on PC. Both systems can also be run side by side. Switching in between platforms is highly possible in this regard.
Environment-Friendly	The design considerations on a Mac also extend to the product's impact of the environment. Generally, Macs run quietly, and uses the latest technological advancements that allow users to reduce the use of energy and power. Apple, as a company, also uses a recycling scheme, allowing for trade-ins. This results to the least possible harm done on Mother Earth.
Moving files	The process of shifting your documents from a PC to a Mac is straightforward. Just down load the files to a USB or FireWire difficult force after which plug this into your Mac. Alternatively, use a network, or ask your Apple keep to do the process for you.

Table 7. Mac OS Features

Mac OS Strengths and Weaknesses

Strengths	• Simple but powerful user interface • Fewer viruses and other security issues • Seamless integration between OS and hardware • Comes preloaded with productivity apps • Effective and unparalleled multitasking feature • Integration with other Apple products such as iOS devices
Weaknesses	• iMac desktop computers and MacBook laptops are very expensive • Limited options or flexibility for upgrading the hardware • Lack of game titles and advanced gaming experience • Limited number of apps available in the App Store or other sources • App ecosystem is still lacklustre

Table 8. Mac OS Strengths and Weaknesses

Windows 10 Features	
New Start Menu	Microsoft has brought back the Start Menu. Now, when you click on the Start button at the

	bottom left of the screen, you get two panels side by side, with the left column showing pinned, recently and most-used apps.

Cortana Integration	Similar to Siri and Google Now, you can talk to this virtual assistant with your computer's microphone. Cortana can answer questions like “What's the weather like today?”, perform simple tasks like remind you to take out the trash, and much more.
Web Browser	Internet Explorer was replaced by Microsoft Edge, which features a new rendering engine called EdgeHTML. Edge also integrates with the Cortana Digital Assistant to provide voice control, search, and personalized info to users.
Multiple desktops and Task view	Instead of keeping everything open on the same desktop, you can move some of your windows to a virtual desktop to get them out of the way. And the new Task view feature makes it easy to manage all of your open windows.
Universal Apps	To make the transition across devices more seamless, Microsoft is introducing a new category of software called Universal Apps, which use the same code but adapt their interface to the device in your hand. Microsoft is also bundling its own set of Universal apps with the OS, including Photos, Videos, Music, Maps, People & Messaging and Mail & Calendar, which all function the same way on tablets, phones and PCs. The content is stored and synced via Microsoft’s cloud service OneDrive so you can pick up where you left off on another device.
Windows Security	Windows Defender is now called simply Windows Security. Its virus and threat protection has been improved, and made more understandable in the redesigned Fluent interface. Ransomware protection locks your folders to trusted apps. The Windows Security window now has a Security provider page that gives access to your Norton, McAfee, ESET, or whatever protection tools you have installed.

Table 9. Windows 10 Features

Windows 10 Strengths and Weaknesses	
Strengths	● Simple setup and migration experience ● Minimal learning curve, familiar user experience ● Improved setup and recovery tools (rollback), backup ● Stable, robust modern entertainment and productivity apps ● Customizable Universal (modern) apps – ability float on desktop, resize, snap ● Cortana digital assistant productivity benefits and accuracy ● Clean, powerful modern web browser – Microsoft Edge ● Includes universal Microsoft Office app ● Great for multitasking with multiple desktops and task view ● It is safer to use the latest Windows operating system ● Better integration with Windows phone
Weaknesses	● Oldest windows versions such as Windows 2000, windows 2001 etc., are not upgradable to Windows 10 ● Limited options or flexibility for upgrading the hardware ● Personal information will be shared with Microsoft for better service and improvement

Table 10. Windows 10 Strengths and Weaknesses

Linux OS Features	
Open-source OS	Linux distributions, or distros, are open-source operating systems that run on the Linux kernel, meaning they are flexible operating systems and often free, which is beneficial if you are on a budget.
Portable	Portability means software can work on different types of hardware in the same way. Linux kernel and application programs support their installation on any kind of hardware platform.
Multi-User	Linux is a multiuser system which means multiple users can access system resources like memory/ram/application programs at the same time.
Multitasking	More than one function can be performed simultaneously by dividing the CPU time intelligently.
Security	It provides security in three ways namely authenticating (by assigning password and login ID), authorization (by assigning permission to read, write and execute) and encryption (converts file into an unreadable format).
Live CD/USB	Almost all Linux distros provide live CD/USB so that users can run/try it without installing it
Graphical User Interface	Linux is command line based OS but it can be converted to GUI based by installing packages.

Application support	It has its own software repository from where users can download and install many applications.

Table 11. Linux OS Features

Linux OS Strengths and Weaknesses	
Strengths	● Low cost ● Stable ● Less vulnerable to computer malware ● High security level ● Typically does not slow down over time ● Compatible with old computers ● Many choices in a wide variety of Distros
	● Very smooth and seamless software update ● Access to many free software
Weaknesses	● Many programs will not run in Linux such as iTunes, Microsoft Office, Internet Explorer ● No standard edition of Linux ● Smaller selection of peripheral hardware drivers

	● Learning curve for people who are new to Linux

Table 12. Linux OS Strengths and Weaknesses

Choice of Client OS for the Network Design Project: **Windows 10**

Windows is compatible with a number of programs but is convenient if you are used to using other Microsoft products, such as Microsoft Office. The integration with Microsoft Office also makes it a popular choice if you are searching for an operating system for your business. “Windows 10 is not only more familiar from a user experience standpoint, but it also includes so much of what businesses need—including enterprise-grade security, identity and information protection features, which reduces complexity and proves a better experience for the modern needs of business” (NH Learning Solution, 2017, para. 1).

1.2 Hardware

1.2.1 Advantages and disadvantages or strength and weakness and various features of the brand name computer of your choice (minimum 2 different vendors are to be compared for both server and client)

Strength and weakness and various features of 3 popular brand name for Server and Client computers, namely Dell, Lenovo, and HP, are to be compared in this section.

Features of Server Computer Brands

Dell	● Good for watching movies and other videos, as they have high-quality video graphics cards built into them ● Mid-sized desktop tower ● Has an optical drive ● 1 GB Ethernet card built into the computer itself ● 9th Gen Intel® Core™ i7 9700 (8-Core, 12MB Cache, up to 4.7GHz with Intel® Turbo Boost Technology) ● Windows 10 Pro 64-bit English ● NVIDIA® GeForce RTX™ 2060 6GB GDDR6 ● up to 64GB (Additional memory sold separately)
Lenovo	● Dual Intel Core i3-4130 3.40GHz processors and 4GB DDR3 memory up to Intel Xeon and 32GB of RAM if you're don't mind spending more, or higher ● Comes with four empty 3.5" bays, which means it can support RAID 0, 1 and 5 ● Can mix and match SSDs and HDDs if you want to cut costs by only using an SSD for your server OS ● Four PCIe slots open up additional expansion and upgrade options, including swapping your hard-interface from SATA to SAS ● Has an Intel HD Graphics 4400 card and a DVD-R optical drive.
HP	● Uses a square chassis to avoid taking up more space than necessary

	● Easy access to hard drive bays, memory slots and PCIe plugs make upgrading this little server a breeze ● Exceptionally cheap small office No hard drives are included with the cheapest HPE ProLiant Gen10 version, though up to four can be installed server ● The starter processor is an underwhelming 1.6-3.0 GHz dual-core AMD Opteron CPU. 8GB of memory is included as standard, though you can upgrade to 32GB.

Table 13. Features of Server Computer Brands

Features of Client Computer Brands	
Dell	● Intel Core i7-8700, a six-core chip with a base frequency of 3.2GHz and a turbo frequency of 4.6GHz; 16GB of RAM, 4GB Nvidia GeForce GTX 1050 GPU power the 4K display ● Compact chassis, stellar display, and strong performance ● Anti-glare screen coating and wide viewing angles ● A speaker bar runs the width of the system below the display; The audio output more than suffices for video conferences ● A 2-megapixel infrared (IR) webcam sits above the display in a pop-up module ● Ports and Connections: SD-card slot, a headphone jack, and two USB 3.1 ports, of both kinds: an older Type-A, and a newer, smaller Type-C that supports USB 3.1 Gen 2, DisplayPort and HDMI ports, four USB 3.1 ports (all of them Type-A), an Ethernet jack, an audio-out jack, and the

	power connection
Lenovo	● Intel Core i5-8400T CPU, 8GB of DDR4 RAM, integrated Intel UHD Graphics 630, and a 256GB M.2 SSD ● A low-lying small-form-factor PC ● Intel Core i5 desktop processor inside a compact chassis for space-constrained offices and cubicles ● 2.5-inch SATA hard drive or SSD ● Basic wired keyboard and mouse set ● Security features: Smart USB Protection, which lets your IT staff restrict which USB devices can access the PC; data encryption via a Trusted Platform Module (TPM); and a Kensington-style locking notch lets you cable down the PC if you'll have it in a public space, so someone doesn't walk off with its little body ● Ports and Connections: two USB 3.1 ports (one Type-A and the other Type-C), along with separate headphone and microphone jacks; DisplayPort and HDMI outputs, an Ethernet jack, and four straight-up USB Type-A ports: two are USB 3.1 Gen1 and two are USB 3.1 Gen2

HP	● Intel Core i9-9900K CPU and an Nvidia Quadro RTX 5000 GPU ● 64GB dual-channel setup via four 16GB DIMMs ● PCI Express card-based SSDs in the two PCI Express slots ● Standard three-year onsite warranty ● Compact for a mid-tower ● four DIMM slots for DDR4-2666 memory
	● wired USB keyboard and mouse ● Ports and Connections: two USB 2.0 legacy ports, four USB 3.0 Type-A ports, an Ethernet jack, a pair of DisplayPort 1.2 video-out connectors, plus line-in and line-out audio jacks.

Table 14. Features of Client Computer Brands

1.2.2 Server - Recommended hardware specifications for the server (CPU, memory, disk, network card [speed, type], etc.)

Recommended Hardware Specs for Server	
Processor	2-3 GHz, 4 cores

RAM	16 GB for standard server operations without data deduplication and node replication 24 GB for data deduplication or node replication 32 GB for node replication with data deduplication
Disk Space	Minimum: 32 GB
Other requirements	Gigabit (10/100/1000baseT) Ethernet adapter DVD drive (if you intend to install the operating system from DVD media) Super VGA (1024 x 768) or higher-resolution monitor Keyboard and Microsoft® mouse (or other compatible pointing device) Internet access (fees may apply)

Table 15. Recommended Hardware Specs for Server

1.2.3 Client - Recommended hardware specifications for the client (CPU, memory, disk, network card [speed, type], etc.)

Recommended Hardware Specs for Client	
Processor	2 gigahertz (GHz) or faster processor or System on a Chip (SoC)
RAM	1 gigabyte (GB) for 32-bit or 2 GB for 64-bit
Disk Space	16 GB for 32-bit OS 32 GB for 64-bit OS
Other requirements	Gigabit (10/100/1000baseT) Ethernet adapter DVD drive (if you intend to install the operating system from DVD media) Super VGA (1024 x 768) or higher-resolution monitor Keyboard and Microsoft® mouse (or other compatible pointing device) Internet access (fees may apply)

Table 16. Recommended Hardware Specs for Client

1.4 Associated costs of the server and client operating systems (Hint: client access licensing – discuss different options)

Type of Server OS	Number of License	Unit Cost Per License	Total Cost (excluding tax)	13% GST	TOTAL
Windows 2012	1	$199.00	$199.00	$25.87	$224.87
Mac OS X	1	$19.99	$19.99	$2.60	$22.59
Linux Server	Cost-free				

Table 17. Associated cost for Server OS

Associated Cost for Client OS					
Type of Client OS	Number of License	Unit Cost Per License	Total Cost (excluding tax)	13% GST	TOTAL

Windows 10 Pro	25	$259.99	$6,499.75	$844.97	$7,344.72
Mac OS	Cost is included when you buy MAC computers as it comes with built-in OS				
Linux OS	Cost-free				

Table 18. Associated cost for Client OS

1.5 Costs of server and client systems (hardware)

Hardware Cost of Server					
Brand Name	Number of Unit	Unit Cost	Total Cost (excluding tax)	13% GST	TOTAL
Lenovo	1	$750.00	$750.00	$97.50	$847.50
Dell	1	$600.00	$600.00	$78.00	$678.00

HP	1	$400.00	$400.00	$52.00	$452.00

Table 19. Hardware Cost of Server

Hardware Cost of Client					
Brand Name	Number of Unit	Unit Cost	Total Cost (excluding tax)	13% GST	TOTAL
Lenovo	15	$512.00	$7,680.00	$998.40	$8,678.40
Dell	15	$832.37	$12,485.55	$1,623.12	$14,108.67
HP	15	$849.00	$12,735.00	$1,655.55	$14,390.55

Table 20. Hardware Cost of Client

Q2: ***If the customer is to have a flexible installation that will accommodate future expansion needs, what network architecture, topology and layout would you recommend and why? Discuss***

- ease of installation, performance characteristics and
- Features and overall cost for networking hardware chosen, as well as installation costs, including network cable installation.

  Also provide your solutions for
- additional support for some limited wireless network options, apart from the mainstream wired connections for this office/client and
- Maintaining a high degree of reliability, in terms of providing redundancy.

  To answer for this question we have to see what pints we have to recover:

1- Flexible installation that accommodate future expansion.
2- 2- Ease of installation.
3- Features and overall cost
   i) Hardware.
   ii) General Installation.
   iii) Network cable installation.
4- Additional support for some (limited network options – wired)
5- Maintaining a high degree of reliability in terms of providing redundancy.

The office:

1- We have 16 rooms (without kitchen)
2- The rooms have the (administration of a business room) and (security server room).
3- We have ceiling with plenum.
4- External walls are solid and insulated.
5- All inertial walls are hollow.
6- All computers are located by electoral source.

Starting the plan:

1- I will use the (security server room) as a cabinet room. I will take a part of this room half with security room; I will not use Patch Panel for 2 reasons.
   a- It’s easy to divide the network to this office.
   b- It’s flexible to setup security system at the office.
   c- Its enable to extend in future

d- To make life easy I will use the Patch Panel with switches for 5 parts

a. North side rooms from (1 to 8).
b. ADMIN office.
c. Rooms 9 and 10.
d. Rooms 11 and 12.
e. Wi-Fi network in case we use cellophanes
f. Rooms 13.
g. DEMO room

Why this partition?

In rooms 1 to 8 we have small rooms in case we have small network will never be more than 3 or 4 computers so when we need have network will be easy to make is as one part and will make the stitches control any extending.

The ADMIN room for security stuff we give it s suppurated line.

But maybe we need small networks in DEMO room and room number 13 because it is big room.

If we take look to the all office will be 3 parts so using security room as source to the all network will be good chaise also it is close to ADMN room

What we need as hard where?

1- Not need than 15 computers.
2- Need not less 2 VOIP phones.
3- Need 1 fax machine.
4- We need 1 HP 41CCN printer.

6 switch to give the flexibility to the network in future.

5- 1 router
6- A Server.

The flexibility: this network will be very flexible for 3 reasons:

1- Wi-Fi will give easy access to the visitors.
2- The server will give very secure cabling network also will save all files in much secured environment.

Cabling:

We need 2 kinds of cables we use cat 6A:

1- Soled cables to connect the stable parts.
2- Flexible cables.

The server:

Will use 2016

About hard where:

1- The storage [TerraMaster F5-221 NAS 5-Bay Cloud Storage Intel Dual Core 2.0GHz Plex Media Server Network Storage (Diskless)]

- More information from Intel “POWERFUL HARDWARE: Intel Apollo 1.5GHz quad-core CPU, and 4GB of RAM (expandable up to 8GB). Blazingly fast speed of 405MB/s reading and 396MB/s writing.
- AES hardware encryption engine encrypts shared folders and network data transmission to keep data from unauthorized access.
- Advanced Btrfs file system offering 71,680 system-wide snapshots and 1,024 snapshots per shared folder.
- Real-time hardware transcoding of up to two concurrent 4K video streaming
- Features an aluminum-alloy shell and intelligent temperature control ultra-quiet fan, good in heat dissipation. Support Seagate IHM. Seagate IronWolf NAS HDD’s are recommended. Warranty: 24 Months.”

2- Alienware Aurora R8 - Nvidia RTX 2080 - i7-8700- 16GB - 512GB SSD + 1TB HD -WIN 10 Home - Certified Refurbished.
3- LG Electronics 24-Inch Screen LCD Monitor (24BK400H-B)
4- APC UPS 1500VA Smart-UPS with Smart Connect, Pure Sine wave UPS Battery Backup, Line Interactive, 120V Uninterruptible Power Supply
5- Logitech MK235 Wireless Keyboard and Mouse

Other materials

1- HP Color LaserJet Pro MFP M281fdw Wireless All-In-One Laser Printer (T6B82A#BGJ)
2- Refurbished Lenovo M93Z Intel I5-4th Gen, 8GB / 500GB HDD Win10 Pro Preloaded Keyboard and Mouse Included
3- D-LINK AC1750 High Power Wi-Fi Gigabit Router (DIR-859)

4- Cables cat 6a.

5- TP-Link TL-SG108 8-Port 10/100/1000Mbps Desktop Gigabit Steel Cased Switch, IEEE 802.1p QoS, Up to 72% Power Saving

6- VCE 4 Port Cat6 Female to Female Connector Wall Plate, UL Listed RJ45 Keystone Jack Inline Coupler FacePlates - White

Generally:

We will use the server to save information in save environment and will avoid any losing to the information.

Also the office will use wife just for quick use.

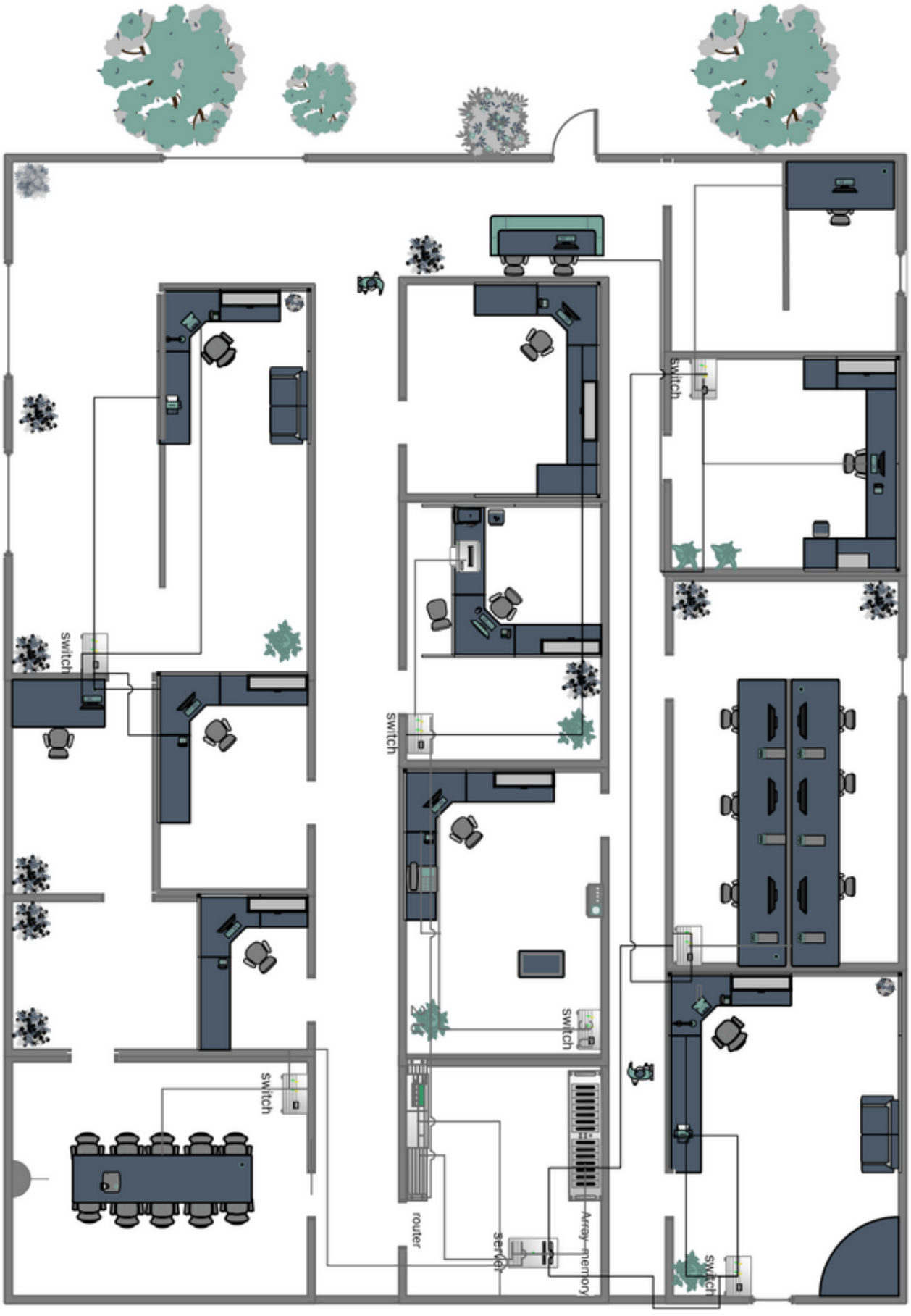
costes						
the server						
#	patrs	MODEL	HOW MANY	costs	taxes	TOTAL
1						
2	computer sever	computer core i5 3400 16GB ram tTB hdd	1	224.42	29.1746	253.5946
3	keybouard and mouse	LOGITECH MK235		39.99	5.1987	45.1887
4	monitor	LG 24 inch - LCD	1	135.99	17.6787	153.6687
5	UPS	apc 1500va smart-ups 120v	1	487.62	63.3906	551.0106
6	WUICKBOS (MEMORY STORAGE)	alinware aurora R8 i7	1	959.99	124.7987	1084.7887
					TOTAL $	2088.2513
OTHER MATERIALS						
#	patrs	MODEL	HOW MANY	costs	taxes	TOTAL
1	PRINTER	HP 41 CCN PRINTER	1	529.99	68.8987	598.8887
2	COMPUTERS TO THE ROOMS	INTEL + KEYBOURS, MOUSE MONITER	18	399.99	51.9987	451.9887
3	ROUTER	DLINK AC1750 HIGH PWERED	1	100.46	13.0598	113.5198
4	CSBLES 100 METER	CAT6A	100M	88.99	11.5687	100.5587
5	ETHERNET WALL PLATE	VC4 POINTS CAT6 FEMELE	17	180.03	23.4039	203.4339
6	SWITCHES		7	29.99	209.93	239.92
7					TOTAL $	1109.4211
work cost and total						
1	work of setup the network				900	
2	totoa $				4097.6724	$
3						
	total					

Q3: ***Indicate directly on a network diagram (please redraw the office layout professionally):***

- How the wiring would be implemented; that is, the location of any switches/router used, and how the computers/printers will be connected.
- Also indicate how the LAN would connect to the Internet.

NOTE: The diagram should be larger than the standard paper size (11” X 8.5”).

See the diagram please.


switch
switch
switch
switch
switch
router
server
Array_memory

Q4:* *The customer is also interested in a backup solution (tape drive, external hard drive-based NAS or cloud) that is cost effective, reliable and reasonably fast.

4.1 Various types of backups and the advantages and disadvantages or strength and weakness of each one of them.

Upon reviewing the layout of the office. We can conclude that it is a small office with roughly 15 computers. In a business office, keeping confidential files and documents safe is a top priority. Whether that means keeping them safe for hackers, being stolen, getting accidentally deleted by an inexperienced employee, or being destroyed in a natural disaster or a fire. During the planning stage of enforcing an effective backup procedure we need keep these mentioned scenarios into consideration. FBI results have shown that 97% of stolen devices are never recovered. If an employee lost a phone with crucial documents on a public transit. That will without a doubt have a negative effect on a business. In that case a backup option to consider would be cloud storage. It is easy to setup, access, and it automatically backs up files onto it. However, because it is controlled by a third party, if that third party was breached, your content would be in danger.

Another backup strategy includes NAS (Network-Attached Storage). This type of backup is possibly the best out of every other choice for backup. Unlike cloud storage which is controlled by an external organization. NAS is your personal storage which only you have access to. Clients on a local area network can access the storage via ethernet connection. Cons for this back up is that it is vulnerable to fires and natural disasters. If there was a fire in your building and NAS is your only back up, everything on it will be lost in the fire. Therefore, in order to protect your data, you would need a backup for your NAS. Either you hire someone, or you do it yourself, but someone would have to backup everything on NAS to an external hard drive and keep that hard drive in a safe location out of the building. It doesn't matter where you hide that drive, either at your house or your parents' house.

Lastly, I would suggest that having three different backup options would be the best practice for keeping your data safe because you can never be too safe. Having a cloud storage, NAS backup, and an external hard drive in a safe place outside the building is the best practice.

4.2 For the selected backup type, discuss the offering from at least 2 vendors / products – h/w & s/w detail and cost (including media)

In case of online cloud storage backup, two vendors I would suggest are Google Drive and One Drive. As for someone who is looking for a cost effective and smooth backup. These two options would suffice because they are free for the first 10 to 15 GB of storage. After that they only charge $10/month.

Upon my research, I do not have any two specific vendors regarding choosing a NAS. It depends on the customer, how much storage they would need because NAS comes with different number of hard drives. The NAS that supports more hard drives, usually 6, is over $600 to $1,000. The NAS that supports fewer hard drives, usually 2 or 3, are $200 to $400. A choice to consider here is Synology DiskStation 5-Bay Diskless Network Attached Storage. Another thing to consider is the amount of space each hard drive in NAS contains. Drive with more space will cost way more.

Lastly, we need to backup our NAS with an external hard drive. Therefore, we must keep in mind that an external hard drive has less space compared to a NAS, unless your hard drive has more storage than your NAS. However, its up to the customer how many external hard drives they need and with how much space. The best hard drives for back up purposes would be 3TB to 5TB hard drives, which range from $200 to $300. Recommended hard drive in this case is Seagate Backup Plus 8TB Drive. This way you do not have to go through the trouble of buying new hard drives for a long time.

Q5: ***Finally, the customer would like to be connected to the Internet and deploy a web site. In particular, they would like to have Internet connectivity on all stations to allow for web browsing and e-mail access (web and e-mail services will be hosted by an ISP).***

5.1 Internet connection to all computers

5.1.1 Compare 2 vendors/ ISPs (Internet service provider) offerings, their cost, features like upload and download speed, etc.

When choosing an ISP (Internet Service Provider) you can never be too careful. That is why choosing the best one is essential to running your daily tasks smoothly. Bell's Business Gigabit Fibe offers up to 940 Mbps download speed and 940 Mbps upload speed for a total of $104.95/month. Second option is Rogers's Business Internet offers up to 1 Gbps download speed and 50 Mbps upload speed for a total of $119.99/month.

5.2 Detailed comparison of various features for web hosting/ browsing and e-mail services from at least 2 ISPs (Internet service providers).

Bell's internet package includes wi-fi modem and unlimited usage. On top of that they also provide Online security to protect you against internet threats, spyware, viruses, and hackers. Rogers's internet package includes a rental modem, network level security, and business specialist support. Regarding the e-mail services, Office 365 is arguably the best, because this allows you to use multiple Microsoft apps for work. However, another option the customer can choose from is G Suite which is like Office 365 in terms of using apps as well as cloud storage.

5.3 Discussion on any hardware and Software requirements.

When discussing the required hardware and software. We need to find router and switches which will be cost effective and provide fast internet speed. Upon reviewing the office layout, we can see that there will be at least 15 computers in the office, besides mobiles/tablets. Therefore, it would be best to connect the computers to a switch for fast internet connection without interferences. Routers can we used to mobiles, printers, TVs, and tablets, etc.

5.4 Discussion on choice of vendor / technology

A vendor for the switch should be NETGEAR 24-Port Gigabit Ethernet Unmanaged Switch which provides more than enough ports to connect all desktops. It also has additional ports in case the customer wants to connect more devices. When buying a router, we need to keep the area into consideration, whether the wi-fi will be able to reach in every corner of the office. Therefore, TP-Link Archer C7 AC1750 Dual Band Wireless AC Gigabit Router (2.5GHz 450Mbps + 5GHz 1350Mbps) would be an exemplary choice.

Q6: The customer wants to create VMs (Virtual Machines) for its DNS server, File server, DHCP server, File server, remote access server, and a database server on a single physical machine. You must choose a software from several virtualization programs to create and manage VM. Compare any 2 products for their functionality, features, interfaces, and ease of use. By this the customer is able to create a network for combining physical and virtual elements. Also discuss the operating system for the virtual machines, include licensing.

Answer

6.1 **Virtual machines** are software computers that provide the same functionality as physical computers. Like physical computers, they run applications and an operating system. However, **virtual machines** are computer files that run on a physical computer and behave like a physical computer.Virtualization is a virtual or simulated version of a software that is in a computing environment instead of physical environment. It can create virtualized (computer generated) version of storage, network, application and operating systems. It can increase productivity of one machine for multiple workloads.

6.2 Comparing two virtualization software

Name	Creator	Host CPU	Guest CPU	Host OS	Guest OS	License
bhyve	FreeBSD	x86-64	x86, x86-64	FreeBSD, Illumos	FreeBSD, FreeNAS, pfSense, OpenBSD, Linux, Windows, Illumos[1]	BSD
Bochs	Kevin J. Lawton	Any	x86, x86-64	Windows, Linux, FreeBSD, Unix/X11, Mac OS 9, macOS,	Windows, Linux, DOS, BSD, OS/2, Haiku	LGPL

				BeOS, MorphOS, OS/2[2][3]		

VMM	OpenBSD	x86, x86-64	same as host	OpenBSD	OpenBSD and Linux guests	BSD

Hyper-V (2008)	Microsoft	x86-64 with Intel VT-x or AMD-V	x86-64, x86 (up to 8 physical CPUs)	Windows Server 2008 (R2) w/Hyper-V role, Microsoft Hyper-V Server	Supported drivers for Windows 2000, Windows 2003, Windows 2008, Windows XP, Windows Vista, FreeBSD, Linux (SUSE 10 released, more announced)	Proprietary
Hyper-V (2012)	Microsoft	x86-64 with Intel VT-x or AMD-V	x86-64, (up to 64 physical CPUs)	Windows 8, 8.1, 10, and Windows Server 2012 (R2) w/Hyper-V role, Microsoft Hyper-V Server	Supported drivers for Windows NT, FreeBSD, Linux (SUSE 10, RHEL 6, CentOS 6)	Proprietary. Component of various Windows editions.

VMware Vsphere:

>6 CPU licenses of vSphere Essentials (for 3 servers with up to 2 processors each) and 1 license for vCenter Server Essentials.

The vSphere Essentials Kit consists of the following:

vSphere Hypervisor (ESXi)vCenter Server Essentials (no end date)

Advantages:

- Provide business continuity and always-available IT
- Reduce IT footprint and simplify management
- Save on IT hardware costs
- Improve service levels and application quality
- Strengthen security and data protection

Cost: $560.00

Hyper V:

It is available on all Windows servers and it's free.

Can host many types of systems. eg. database system, which is cost effective

Advantages:

1.Rapid migration. Move easily from active virtual machines to another server with minimal downtime.

2.Hyper-V is optimized for Windows and is easy to implement. After a while it is really easy to use and manageable for the administrators.

3.Hyper-V is cost effective and flexible, meaning a lot of hardware are compatible for the host systems.

4.Hyper-V has free support for it on online website. Most issues and questions can be fixed by doing researching.

Disadvantages:

1.Hyper-V doesn't support some of the more cost-effective storage systems such as GlusterFS. It's

2.Relative poor manageability

3.No monitoring of virtual machines performance

4. Built-in backup tools are insufficient.

Operating Systems

For VMware Vsphere you can run a guest Operating system. But for Hyper V you will need windows server, which can cost CDN$ 399.98 for 2012 base version (Standard OEM 2 CPU/2 VM)

7.0 TOTAL COST & TAX

Type of Server OS	Number of License	Unit Cost Per License	Total Cost (excluding tax)	13% GST	TOTAL
Windows 2012	1	$199.00	$199.00	$25.87	$224.87
Mac OS X	1	$19.99	$19.99	$2.60	$22.59
Linux Server	Cost-free				

Associated Cost for Client OS					
Type of Client OS	Number of License	Unit Cost Per License	Total Cost (excluding tax)	13% GST	TOTAL
Windows 10 Pro	25	$259.99	$6,499.75	$844.97	$7,344.72
Mac OS	Cost is included when you buy MAC computers as it comes with built-in OS				

Linux OS	Cost- free

Hardware Cost of Server					
Brand Name	Number of Unit	Unit Cost	Total Cost (excluding tax)	13% GST	TOTAL
Lenovo	1	$750.00	$750.00	$97.50	$847.50
Dell	1	$600.00	$600.00	$78.00	$678.00
HP	1	$400.00	$400.00	$52.00	$452.00

Hardware Cost of Client					
Brand Name	Number of Unit	Unit Cost	Total Cost (excluding tax)	13% GST	TOTAL
Lenovo	15	$512.00	$7,680.00	$998.40	$8,678.40

Dell	15	$832.37	$12,485.55	$1,623.12	$14,108.67
HP	15	$849.00	$12,735.00	$1,655.55	$14,390.55

		costes				
		the server				
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7					TOTAL $	1109.4211
		work cost and total				
1		work of setup the network			900	
2		totoa $			4097.6724	$
3						
		total				

8.0 CONCLUSION

Ultimately, this report includes all the essential guides and resources to help the customer understand what they require in order to build a network, what changes they require, and what installations they require whether they are hardware or software. After reading this thoroughly, they can also understand what is required of them to accommodate for future expansions if needed.

9.0 LIST OF ALL STUDENTS IN-GROUP AND WHO DID WHAT PORTION OF THE PROJECT

Haeytham Almalak:

Completed Question #2, Question #3, and Total Cost & Tax Table

Hazkeel Qureshi:

Completed Question #4 and Question #5, Introduction, Table of Contents, Project Background, Conclusion

Nagma Sharma:

Completed Question #1, Question #6, and Total Cost & Tax Table

11.0 REFERENCES

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