

## **CA170 Introduction to Operating Systems: Group Report**

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*We have read and understood the referencing guidelines found recommended in the assignment guidelines.*

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*Abstract:*

We decided on Question 2 for this assignment. Our answer is a server OS but we also looked at alternatives based on different aspects of the company. We decided that 4 OS types were relevant to the situation given in Q2. Each OS was researched and wrote by a single person. Overall, Jack had Network OS. Tomas had Server OS and reference format. Suhyb had Mainframe and Mainframe vs Server. Theo had Distributed. Shane wrote the abstract, intro, multi-user and ending.

## CA170 Operating System Assignment

Question 2 describes a company with 100 employees in 4 different locations. They employ 2 full-time IT experts and two part-time. The company also need their computers to be available at all times. From this, three pieces of key information can be taken. Firstly, the company is in multiple locations. This means they need some connection between all the companies or they all have to be connected to one central hub. Next, they have 100 employees, 4 of which are IT experts. This means the majority of people have basic to no computer skills, so the main interactions between employee and OS have to be simple and intuitive. Also, we can use the IT experts to maintain a more complicated OS if necessary. Lastly, their system has to be accessible 24/7, meaning stability is required.

There are four possibilities of OSs for this company: server, mainframe, network, or distributed system OS. Each OS is tightly linked to the computing system underneath it. The choice of an OS is a choice of a work distribution system, or the requirements of that work. While there are a few parameters, some are not given like cost, security and computing power. Considering this and the variety of OSs, there are a lot of different models and combinations that would suit this company.

## Server Operating System

The server OS is a program that runs on a server, and a server is a piece of software or hardware that does “serving”. That is to say, the server or host computer, as part of the client-server model, sends responses to the requests that it receives from (multiple of) its clients or other computers. This architecture can essentially distribute XYZ Ltd.’s workload and network its computers together. The server can store its clients files, provide shared applications, do computations for a client, and so on; it can “serve” internet, intranet, web pages, web applications, files, databases, printers, email, caching, terminal apps, network administration, and much more. Tied to the server software are server devices or hardware - powerful computers specifically designed to run as servers. Returning back to the server OS, this software does everything that an “operating system” does(acts as an extended machine, a software interface, a resource manager, etc), but also adds extra server-related functionality.

The company can pick from many currently trending instances of server operating systems. The Unix OS family has suitable operating systems like Oracle(Sun Microsystems) Solaris and IBM AIX. Linux server distributions like Ubuntu, Debian, CentOS, and Red Hat Enterprise Server are also common. There are many other Unix-like server operating systems such as FreeBSD. On the commercial side, Microsoft specifically provides ‘Windows Server’ operating systems, the newest being ‘Windows Server 2016’. In the area of Apple Macintosh operating systems, since 2011 (release of ‘Mac OS X Lion’) there are software packages for the desktop macOS that add server administration tools to the installed system. However, XYZ Ltd. can also obtain pre-2011 standalone macOS server operating systems, the newest including 2009 ‘Mac OS X Server Snow Leopard’.

There are many reasons to pick a server OS. Just looking back, XYZ Ltd. can pick out of the many operating systems a free, open source, and non-commercial (often Unix or Unix-like) OS, or licensed(per client access or per CPU), proprietary and commercial (Windows, macOS) one. About two

thirds of all (web) servers use an (often free, open source) Unix(-like) operating system, decreasing their overall costs. These operating systems, with their focus on uptime, stability, and security, provide many tools relevant to servers. They help the server's management (with 'Server Health Reports'), networking, memory (such as with redundant RAID levels, advanced backups with restores, etc), performance, security (encryption, certificates, antivirus programs), and OS control of its programs through privileged mode for the kernel(OS core) and 'Protected' process(programs in execution) states. Server OSs support many types of "serving". Some need additional server software, and some come built in (many operating systems include web servers by default) The server OS also provides opportunity for growth. For example, the company can migrate its server software onto some scalable Cloud service(eg: Microsoft Windows Server 2016 connected to Microsoft Azure Cloud).

But really the advantages of a server OS lie in the advantages of a server as a whole (in the client-server model). A server provides multi-user access to frequently business-critical and networked applications. It is the one controlling all the customer data and access permissions. This centralisation makes maintenance and updates easier. To maintain or repair the server, I.T. employees can each take a different part of the server and use tools like server maintenance checklists. And while the server changes, clients, however, would be encapsulated from those changes. They could access the server almost all the time as maintenance would rarely make the server go down("99.9% uptime").

The server devices or hardware itself can be scaled (many servers together could turn into server clusters or farms). To start out the company may need to purchase some server hardware. But there are also hosting companies that rent servers (virtual or dedicated). Thus hardware costs and maintenance can in a way be outsourced.

But admittedly the server OS has disadvantages as well. A server OS like anything else has minimum system (hardware) requirements, compatibilities, and extra conditions. The OS software is often very rigorous. For example, sometimes it can only serve a certain number of clients and to serve more a

costly update is required. Often OSs are primarily accessed by a command-line user interface (as opposed to a graphical user interface), so non-technical users can't easily directly access the OS. Finally, administering a server is a technical job that almost always requires I.T. employees.

Besides the OS, the client-server model itself is disadvantageous. It is centralised, and centralisation implies a "single point of failure". If the server goes down(stops working), so do the clients relying on it. If too many clients send requests to the server, traffic congestion, significant slow-downs, and crashes can occur. Yet for a server to serve many clients, a lot of specialised and powerful hardware is needed for the server device, including other infrastructure like network connections and server rooms. The bottom line here is money. Besides that another usual consideration for XYZ Ltd. is the ever-fast changing world of I.T. The industry changes and so the company and its I.T. staff may need to keep up. Nevertheless, while the server OS has disadvantages, those may be overcome by the advantages in the end, and the more severe drawbacks of other systems.

The server OS is particularly relevant to XYZ Ltd, a small-to-medium sized company with a hundred employees, with four having I.T. expertise. A "light" server could approximately serve these hundred clients. The four technicians could set up, configure, and manage the server. The company's computers across its four premises can also be networked with a server (via an intranet server). This lets the employees collaborate and teamwork better. The location of the server (in one of the four premises or at a fifth external location) will affect costs and latency. At last, the company needs their computers to be online 24/7. A server can make this happen. Going beyond the specification, it is not indicated for what purpose the company needs its computers to have such uptime. If it's for work, then there are file, print, email, and other servers. For ecommerce, there are web, database, and application servers. More distinct uses could include gaming servers. But in any case, a server and subsequently a server OS is a good choice.

## **Network Operating System**

An NOS, short for Network Operating System, is the software that allows multiple computers to communicate, share files and hardware devices with one another. Some examples of network operating systems include Novell Netware, Microsoft Windows NT, Microsoft Windows XP and Sun Solaris. It is useful for creating, maintaining and transferring files as well as managing a networked computer system. A network operating system controls a network and its message traffic and queues, controls access by multiple users and it also provides administration functions and security.

There are two types of network operating system: peer to peer network and a client and server network and each of these come with their own advantages and disadvantages. The advantages of a peer to peer network is that it is easy and inexpensive to set up. Files are stored on any device and can be accessed by any other device on the network. There is however a security issue with the peer to peer network operating system and there is no control over all the computers. This is more suited to small to medium sized organisations in comparison to the client and server network. In this type of network one computer acts as a central server managing and controlling other computers. This is much more secure than the peer to peer system and resources can be easily added as well as easily removed. However, it is quite expensive to configure and it takes more staff to maintain.

As this is more suited to a larger company, it would seem that XYZ Ltd would be more suited for a peer to peer network operating system due to their lack of trained IT staff which would be needed to maintain a client to server network. It must also be taken into account that XYZ Ltd require their computers to be available 24/7 and with the security issues that come with a peer to peer network it would be difficult to achieve that.

## Mainframe Operating System

The term mainframe comes from the way the machines are built, the second part of the word, frame comes from the device that holds the electronics. Mainframes are multi-programming, multi-user and high-performance computers. A multi-user operating system is user to access the computer at one time. A mainframe computer may has several microprocessors watch allow them to operate at a very high speed. Microprocessors is an integrated circuit that has all the functions of a central processing unit of a computer. A single mainframe computer can be used by hundreds of people at once. Mainframes are complex and it provides each user with a terminal and all of these terminals are connected back to the mainframe. As many users can access it at the same go, it has very large storage capacity and so it can handle the workload that is given by the users. Mainframes are normally centralized form of computer. By centralized the date in a single mainframe there is no need for the user to update the data more than once. Until the mid 1990s, mainframe where the only ones that provided the acceptable means of handling the data processing that where need for a large company.

Some of the Advantages of mainframe computer are as follow; mainframes are virtual machine , which means that the computer can be divided into different logical partitions. Each virtual machine can work with one processor and performs some specific task. No additional hardware is needed for such virtual machines and each virtual machine behave as a standalone server. another advantage is Better usage of software and hardware, Due to the special operating system used in this system, the software, and hardware work nicely with each other and give reliable, efficient and effective results. The last advantage I would like to mention is, problem solving. If a problem shows up in this system then it can be self-detected and solved without affecting any other application.

Some of the disadvantages of mainframe are one, high skilled people are required to manage these systems. Most of the work is done by commands on these systems. Developing programs for these systems is also not easy and

efficiency and speed of these programs are also very critical. Developers have to perform very well in coding so that program will run fast without using extra processor and memory. Another one is cost of them are significantly high. The software and hardware used in such system are also expensive. Maintenance of such system is also very costly. It requires high internet bandwidth and very skilled staff.

You might have been thing and saying to yourself that you have definitely never used or interacted with a mainframe but in a fact, most of us today have, if you think about it this way, when you access your bank account either form the bank machine to access your bank account, you have used a mainframe. Most of the top banks today use mainframe because they are very secure unlike the smaller-scale machines.

## **Distributed Operating System**

A distributed OS is, in basic terminology, an interface to all resources in a network. What this means is that programs can be run over multiple machines – in a distributed fashion. Definitively, distributed operating systems are actually an extension of network OS. They enable high levels of machine to machine communication and integrate separate machines or “nodes” on a network.

Appearance wise, distributed OS works like a regular single-user operating system, but in fact it consists of multiple machines, or nodes. This means it seems like a monolithic operating system although it is distributed on multiple independent central processing units.

Ultimately, a distributed OS manages a group of separate computers and provides an interface to make them appear to the user like a single computer. A widely used example of a distributed operating system is Hadoop Distributed File System (HDFS). *“HDFS provides high throughput access to application data and is suitable for applications that have large data sets.”*



Distributed operating systems first originated when local-area networks were invented in the 1970s. During the 1960s, ARPANET was invented and brought about the implementation of email. Email is one of the earliest, if not the first large-scale distributed application. Other worldwide computer networks of similar caliber to ARPANET are Usenet and FidoNet. Both of these networks provided support for distributed discussion systems. Gradually, distributed computing got more attention and soon became its own branch of computer science in the late 1970s to 1980s.

The advantages of using a distributed operating system are as follows. It is highly fault tolerant - can sustain computer failures without crashing, enables the usage of parallel computation - offering huge performance gains and is scalable - Easy to scale a distributed network to suit your demand. The disadvantages are as follows. Many applications are not suitable for distributed computing, there is often large amounts of overhead, security risk due to sharing and it is far more difficult to operate than a single user system.

So to conclude, a distributed operating system would not be suitable or applicable for the case of XYZ Ltd. It is evident that XYZ Ltd. needs an easy to manage operating system as they have a limited number of IT specialists. A server OS would provide availability and is relatively simple to interact with and access from different locations. The company would not need a distributed OS as they do not require high processing power or scalability.

Having 100 employees would mean, perhaps, that some employees would have their own machines - this is another reason why a distributed OS would be unbecoming in comparison to using a server OS. In a distributed system, computers would need to be configured to work in the network, whereas with a server OS, employees could access their computers from home, or from any computer with internet access.

## Server VS Mainframe

To better understand this comparison between the utilisation of a client-server model and a mainframe, the following lines shall briefly outline the definition of a client-server OS and a mainframe OS.

Mainframes are multi-programming, multi-user and high-performance computers. A mainframe computer has several CPUs which allow them to operate at a very high speed. They are used for big-data operations. Mainframes require high skill to operate and are expensive. This would be unsuitable for XYZ with their limited IT staff. One major advantage of mainframes is stability - they are suitable for risk intolerant institutions such as banks - evidently dissimilar to XYZ Ltd.

Client-server model allows ease of access from any location, provides shared file-system and availability. They are relatively low maintenance in comparison to mainframes, and are not costly. This fits the specifications of XYZ Ltd. Consequences of using a client-server model is stability and security. Possibly a downside, but not a critical one for XYZ Ltd.

In the case of XYZ Ltd. the most suitable route to choose would be the client-server model, using server operating systems. It would provide everything the company requires, while still being lightweight and not costing too much. A mainframe would perhaps serve the same function but the overhead and maintenance would exceed the benefit of implementing it.

A server operating system allows the company to access, and work from all locations in the company. Server OS' are scalable, perfect for the large numbers of employees and future employees. Taking this all into account, it is evident that choosing a server OS instead of mainframe OS is definitely the right choice. The most viable option to put on the server as it does most of what the organisation are looking for it to do.

## **Multi-user OS vs Single user OS**

Another aspect the company should look at is a multi-user OS over a multiple single users. A single user system provides facilities to be used on one computer by one user. This means its sole focus is on tasks given by a single individual user and runs one task at a time. Windows is the main example of a single user Operating system, especially Windows 95 and Windows XP. Its advantages are its simplicity. It is easy to maintain as there are only small resources being used and minimal requests. The disadvantages are its idle time and slow task completion. The OS waits for commands by the user. This means when there are no commands or the computer is not in use, the computer is doing nothing and wasting resources. Also, as the OS only runs one task at a time, a waiting task will have to wait until the CPU is free to be completed. This will increase the response time.

A multi-user OS is designed for more than one user to access the computer at the same or different time. It works off a time sharing system which divides the CPU time evenly between users evenly. It is most commonly found in mainframes, but can also be seen in some UNIX and Linux machines. The biggest advantage is the lack of idle time. As multiple people can use the same machine, the chance of it going unused is reduced. On the other hand, wait times for tasks will depend on the amount of users on the machine at one time. More users mean longer response times.

In relation to this business, a multi-user OS would be more suitable. This would mean less idle time on their machines and could be set up and maintained by the IT experts. It would also be cheaper than buying individual single user machines for each employee. One downside is its complexity. Multi-level OS would confuse the majority of employees who only limited computing knowledge. Some other interface would need to be in place to hide the multi-level OS. Another issue is the scale of the company. 100 people on the same computer would most likely cause some issues.

There are numerous different options for this company, each with their own advantages and disadvantages. One thing that is necessary for this company is some sort of server OS. This is to ensure that its computers are

available at all times. A server would also be able to connect the four different locations to one another. Some interface between system and user would also need to be implemented to accommodate for those with little knowledge of technology. This could be created by the IT employees, who could also perform maintenance on the OS and support to employees.

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