**ASSIGNMENT 1 BRIEF**

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| **Qualification** | **BTEC Level 5 HND Diploma in Computing** | | |
| **Unit number** | Unit 16: Cloud computing | | |
| **Assignment title** | Understand Cloud Computing Solutions | | |
| **Academic Year** | 2020 – 2021 | | |
| **Unit Tutor** | Nam Lam | | |
| **Issue date** | | **Submission date** | |
| **IV name and date** | | | |

| **Submission Format:** |
|---|
| *Format:* The submission is in the form of 1 document<br>You must use font *Calibri size 12, set number of the pages and use multiple line spacing at 1.3. Margins must be: left: 1.25 cm; right: 1 cm; top: 1 cm and bottom: 1 cm.* The reference follows Harvard referencing system.<br>*Submission* Students are compulsory to submit the assignment in due date and in a way requested by the Tutors. The form of submission will be a soft copy posted on http://cms.greenwich.edu.vn/<br>*Note:* The Assignment *must* be your own work, and not copied by or from another student or from books etc. If you use ideas, quotes or data (such as diagrams) from books, journals or other sources, you must reference your sources, using the Harvard style. Make sure that you know how to reference properly, and that understand the guidelines on plagiarism. *If you do not, you definitely get failed* |
| **Unit Learning Outcomes:** |
| **LO1** Demonstrate an understanding of the fundamentals of Cloud Computing and its architectures.<br>**LO2** Evaluate the deployment models, service models and technological drivers of Cloud Computing and validate their use. |
| **Assignment Brief and Guidance:** |
| Scenario<br>ATN is a Vietnamese company which is selling toys to teenagers in many provinces all over Vietnam. The company has the revenue over 500.000 dollars/year. Currently each shop has its own database to store |

transactions for that shop only. Each shop has to send the sale data to the board director monthly and the board director need lots of time to summarize the data collected from all the shops. Besides the board can't see the stock information update in real time.

The table of contents in your technical report should be as follows:

1. Explain to the board director the fundamentals of cloud computing and how it is popular nowadays (500 words)
2. Persuade the board director to use Cloud Computing in ATN (300 words)
3. Proposed solution (higher level solution description – around 200 words).
4. Explain the appropriateness of the solution for the scenario (350 words with images and diagrams).
5. Architectural design (architectural diagram and description).
6. Detailed design:
   a. Deployment model (discussion on why that model was chosen).
   b. Service model (discussion on why that model was chosen).
   c. Programming language/ webserver/database server chosen.
7. Summary.

<table>
<tr><th colspan="3">Learning Outcomes and Assessment Criteria</th></tr>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Demonstrate an understanding of the fundamentals of Cloud Computing and its architectures</td><td rowspan="5">LO1 & 2<br>D1 Justify the tools chosen to realise a Cloud Computing solution.</td></tr>
<tr><td>P1 Analyse the evolution and fundamental concepts of Cloud Computing.<br><br>P2 Design an appropriate architectural Cloud Computing framework for a given scenario.</td><td>M1 Discuss why an organisation should migrate to a Cloud Computing solution.</td></tr>
<tr><td colspan="2">LO2 Evaluate the deployment models, service models and technological drivers of Cloud Computing and validate their use</td></tr>
<tr><td>P3 Define an appropriate deployment model for a given scenario.<br><br>P4 Compare the service models for choosing an adequate model for a given scenario.</td><td>M2 Demonstrate these deployment models with real world examples.</td></tr>
</table>

# Table of Contents

# List of Figures

**LO1 Demonstrate an understanding of the fundamentals of Cloud Computing and its architectures**

**P1** Analyse the evolution and fundamental concepts of Cloud Computing.

**Question 1.** Explain to the board director the fundamentals of cloud computing and how it is popular nowadays

## I. Client-sever model

### 1. Definition

- The client-server model is a distributed application structure that partitions tasks or workloads between the providers of a resource or service, called servers, and service requesters called clients. Often clients and servers communicate over a computer network on separate hardware, but both client and server may reside in the same system. A server host runs one or more server programs, which share their resources with clients. A client usually does not share any of its resources, but it requests content or service from a server. Clients, therefore, initiate communication sessions with servers, which await incoming requests. Examples of computer applications that use the client–server model are Email, network printing, and the World Wide Web.

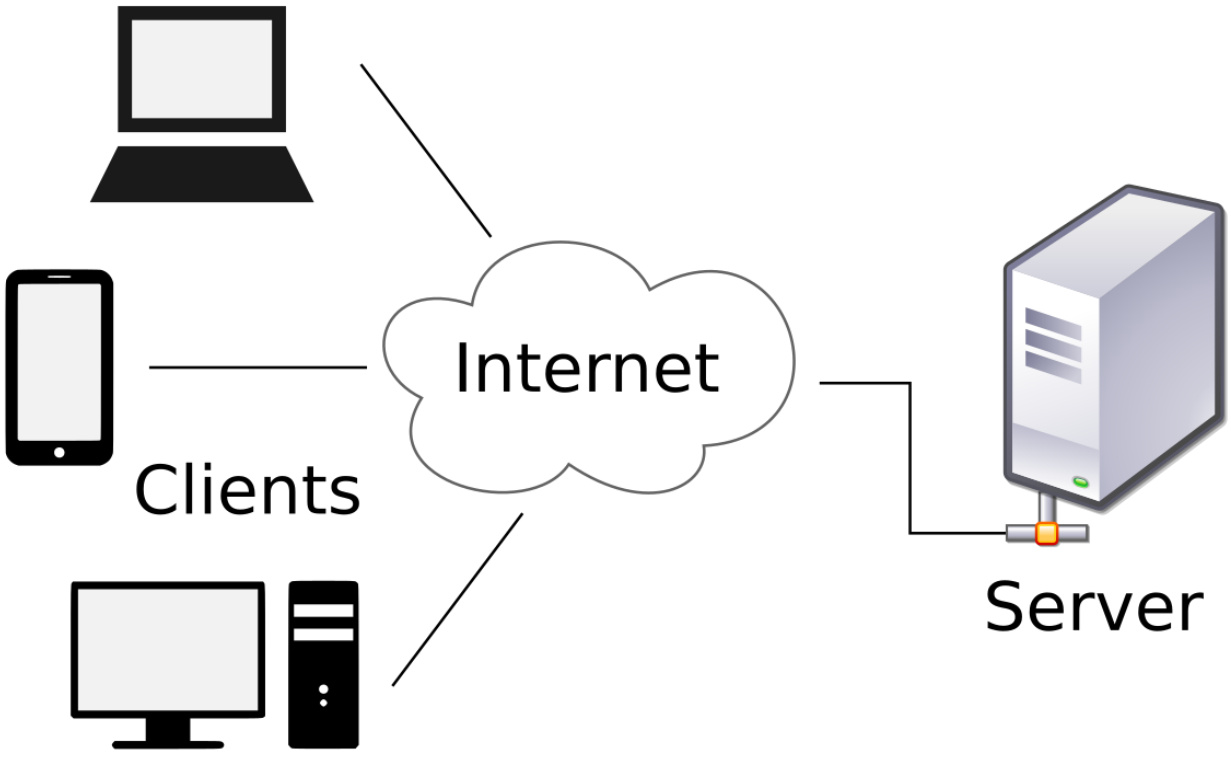


**Figure 1: A computer network diagram of clients communicating with a server via the Internet**

**2. How does the Client-Server Model work?**

- In this article, we are going to take a dive into the Client-Server model and have a look at how the Internet works via, web browsers. This article will help us in having a solid foundation of the WEB and help in working with WEB technologies with ease.

+ Client: When we talk about the word Client, it means to talk of a person or an organization using a particular service. Similarly in the digital world, a Client is a computer (Host) i.e. capable of receiving information or using a particular service from the service providers (Servers).

+ Servers: Similarly, when we talk about the word Servers, It means a person or medium that serves something. Similarly in this digital world, a Server is a remote computer that provides information (data) or access to particular services.

- So, its basically the Client requesting something and the Server serving it as long as its present in the database.

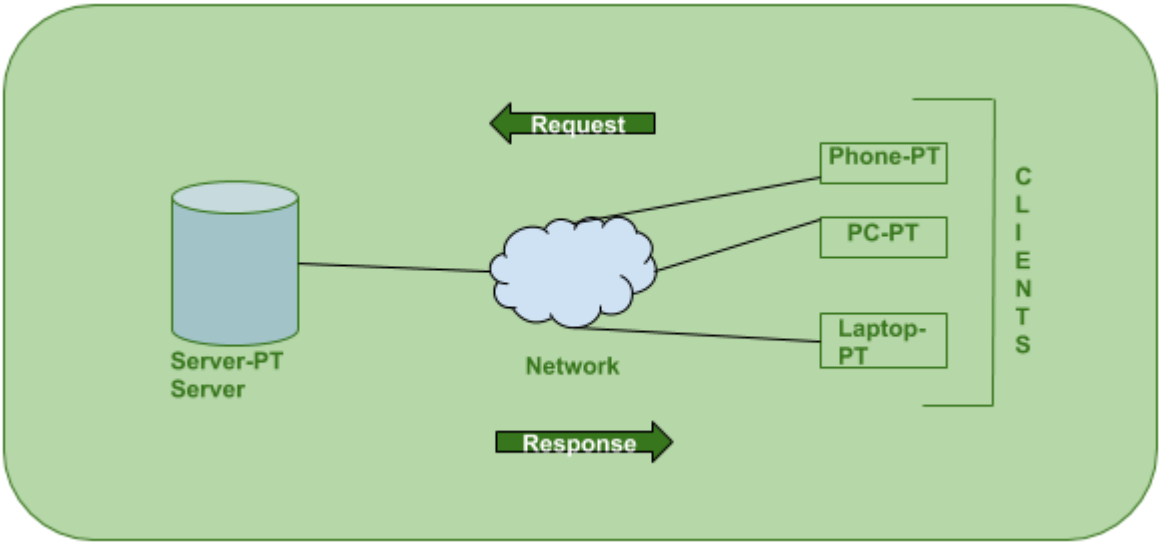


**Figure 2: How does the Client-Server Model work?**

**3. How the browser interacts with the servers?**

- There are few steps to follow to interacts with the servers of a client.

+ The user enters the **URL(Uniform Resource Locator)** of the website or file. The Browser then requests the **DNS(DOMAIN NAME SYSTEM)** Server.

+ **DNS Server** lookup for the address of the **Web Server**.

+ **DNS Server** responds with the **IP address** of the **WEB Server**.

+ The browser sends over an **HTTP/HTTPS** request to **WEB Server's IP** (provided by the **DNS server**).

+ The server sends over the necessary files of the website.

+ The browser then renders the files and the website is displayed. This rendering is done with the help of **DOM (Document Object Model)** interpreter, **CSS** interpreter, and **JS Engine** is collectively known as the **JIT or (Just in Time)** Compilers.

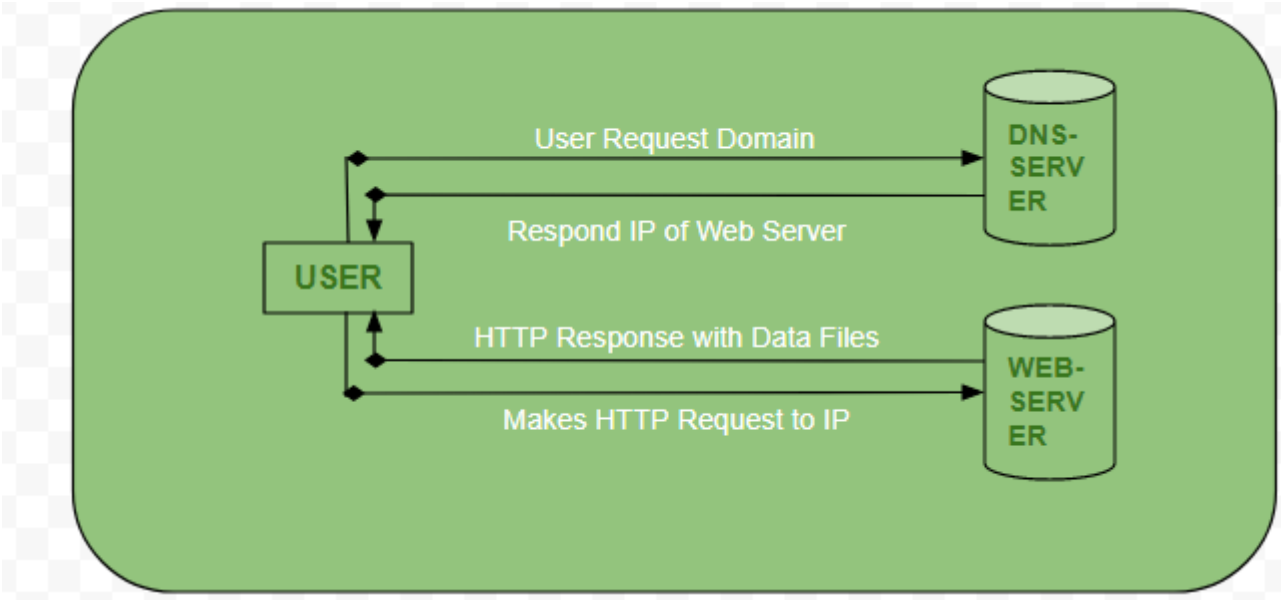


**Figure 3: How the browser interacts with the servers?**

**4. Advantages of Client-Server model:**

- Centralized system with all data in a single place.

- Cost-efficient requires less maintenance cost and Data recovery is possible.

- The capacity of the Client and Servers can be changed separately.

**5. Disadvantages of Client-Server model:**

- Clients are prone to viruses, Trojans and worms if present in the Server or uploaded into the Server.

- The server is prone to Denial of Service (DOS) attacks.

- Data packets may be spoofed or modified during transmission.

- Phishing or capturing login credentials or other useful information of the user is common and MITM(Man in the Middle) attacks are common.

## II. Peer-to-peer Model (P2P Model)

### 1. Definition

- Peer-to-peer (P2P) computing or networking is a distributed application architecture that partitions tasks or workloads between peers. Peers are equally privileged, equipotent participants in the application. They are said to form a peer-to-peer network of nodes.

- Peers make a portion of their resources, such as processing power, disk storage, or network bandwidth, directly available to other network participants, without the need for central coordination by servers or stable hosts. Peers are both suppliers and consumers of resources, in contrast to the traditional client–server model in which the consumption and supply of resources are divided.

- While P2P systems had previously been used in many application domains, the architecture was popularized by the file-sharing system Napster, originally released in 1999. The concept has inspired new structures and philosophies in many areas of human interaction. In such social contexts, peer-to-peer as a meme refers to the egalitarian social networking that has emerged throughout society, enabled by Internet technologies in general.

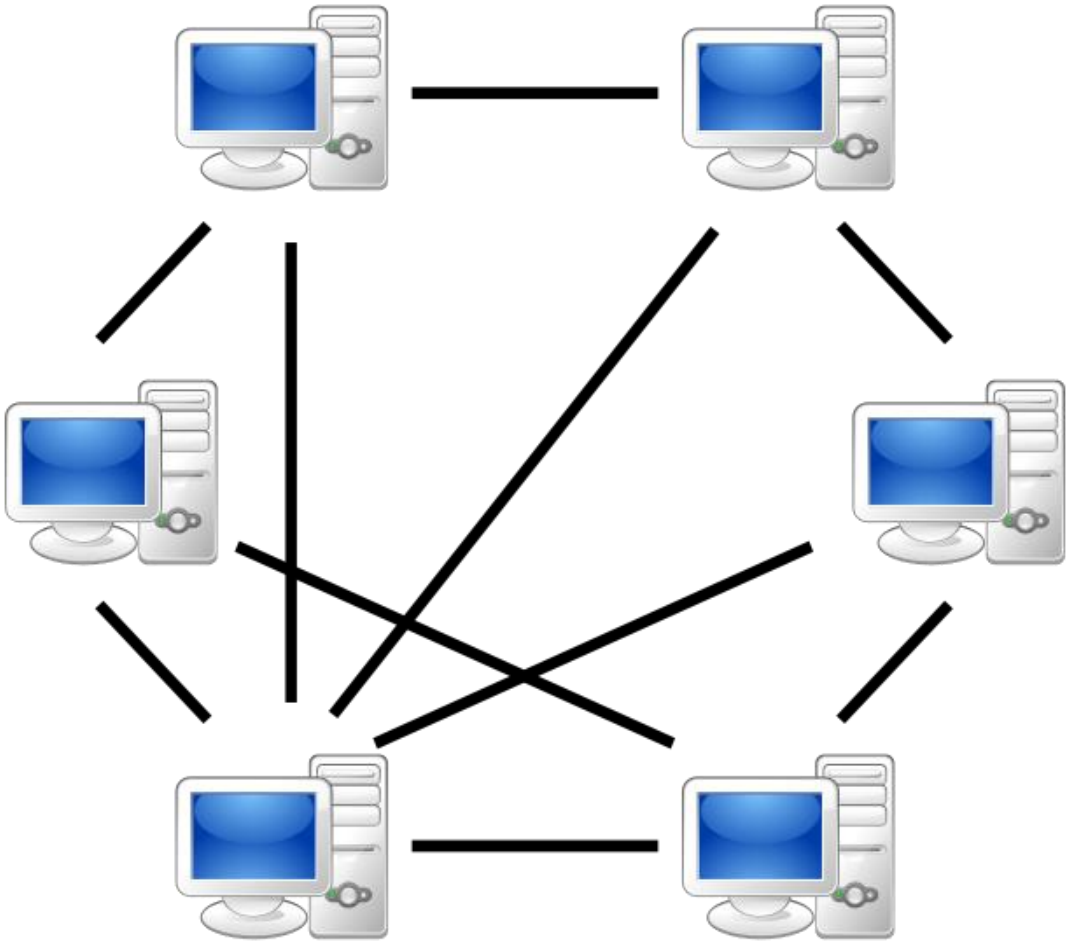

Figure 4: Peer-to-peer Model (P2P Model)

**2. Types of P2P networks:**

**- Unstructured P2P networks**

+ In this type of P2P network, each device can make an equal contribution. This network is easy to build as devices can be connected randomly in the network. But being unstructured, it becomes difficult to find content.

**- Structured P2P networks**

+ It is designed using the software which creates a virtual layer to put the nodes in a specific structure. These are not easy to set up but can give easy access to users to the content.

**- Hybrid P2P networks**

+ It combines the features of both P2P network and client-server architecture. An example of such a network is to find a node using the central server.

**3. Features of P2P network:**

- These networks do not involve a large number of nodes, usually less than 12. All the computers in the network store their own data but this data is accessible by the group. Unlike client-server networks, P2P uses resources and also provides them. This results in additional resources if the number of nodes increases. It requires specialized software. It allows resource sharing among the network. Since the nodes act as servers also, there is a constant threat of attack. Almost all the OS today support P2P networks.

**4. How to use a P2P network efficiently:**

- Firstly secure your network via privacy solutions. Design a strategy that suits the underlying architecture to manage applications and underlying data. Keep a check on the cyber security threats which might prevail in the network. Invest in good quality software that can sustain attacks and prevent the network from being exploited. Update your software regularly.

**5. Advantages of P2P Network:**

- The network is easy to maintain because each node is independent of the other.

- Since each node acts as a server, therefore the cost of the central server is saved.

- Adding, deleting, and repairing nodes in this network is easy.

**6. Disadvantages of P2P Network:**

- Because of no central server, data is always vulnerable to get lost because of no backup.

- It becomes difficult to secure the complete network because each node is independent.

### 7. Examples of P2P networks:

- P2P networks can be basically categorized into three levels. The first level is the basic level which uses a USB to create a P2P network between two systems. The second is the intermediate level which involves the usage of copper wires in order to connect more than two systems. The third is the advanced level which uses software to establish protocols in order to manage numerous devices across the internet.

## III. Grid Computing Model

### 1. Definition

- Grid Computing can be defined as a network of computers working together to perform a task that would rather be difficult for a single machine. All machines on that network work under the same protocol to act as a virtual supercomputer. The task that they work on may include analyzing huge datasets or simulating situations that require high computing power. Computers on the network contribute resources like processing power and storage capacity to the network.

- Grid Computing is a subset of distributed computing, where a virtual supercomputer comprises machines on a network connected by some bus, mostly Ethernet or sometimes the Internet. It can also be seen as a form of Parallel Computing where instead of many CPU cores on a single machine, it contains multiple cores spread across various locations. The concept of grid computing isn't new, but it is not yet perfected as there are no standard rules and protocols established and accepted by people.

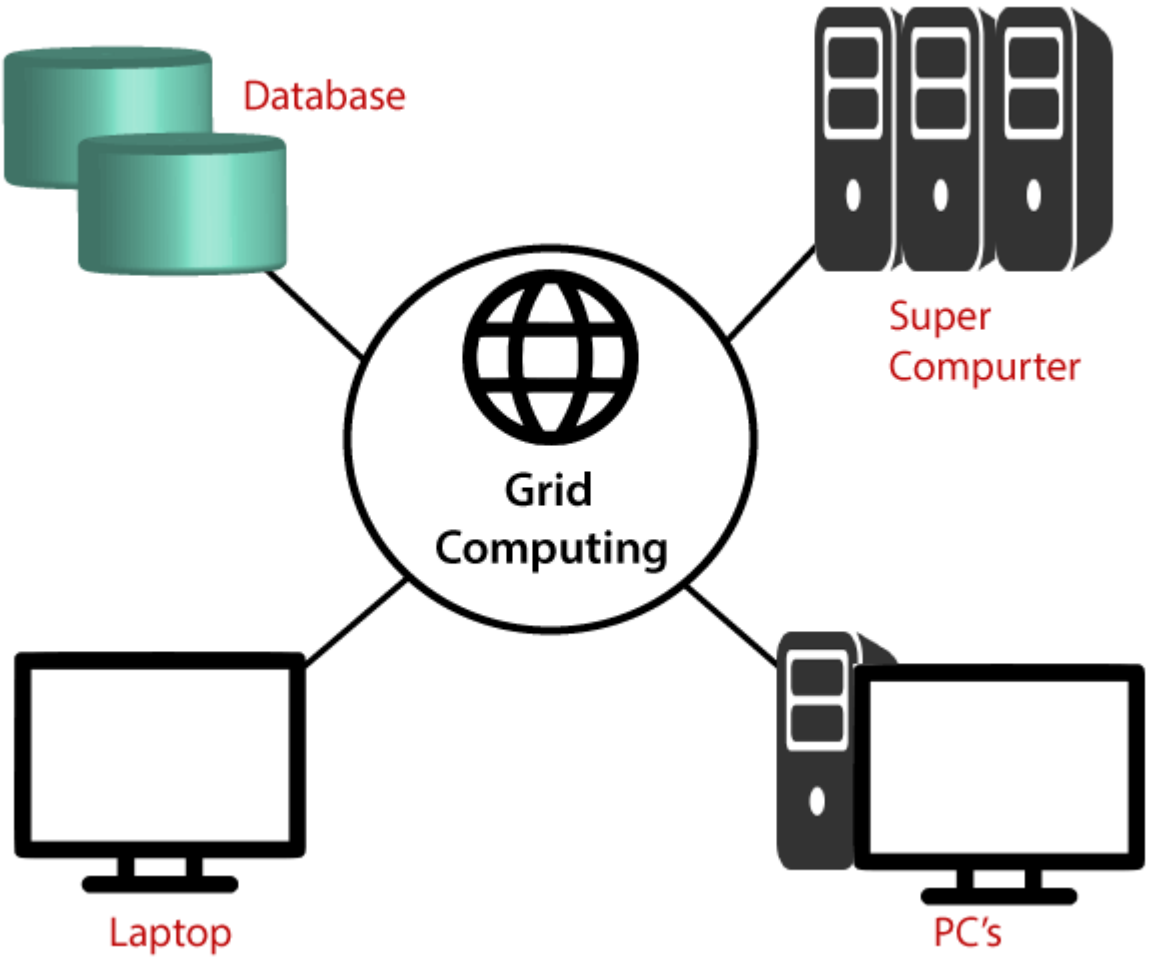


Figure 5: Grid Computing Model

**2. Topology of Grid Computing Model**

- A Grid computing network mainly consists of these three types of machines

**- Control Node:**

+ A computer, usually a server or a group of servers which administrates the whole network and keeps the account of the resources in the network pool.

**- Provider:**

+ The computer contributes its resources to the network resource pool.

**- User:**

+ The computer that uses the resources on the network.

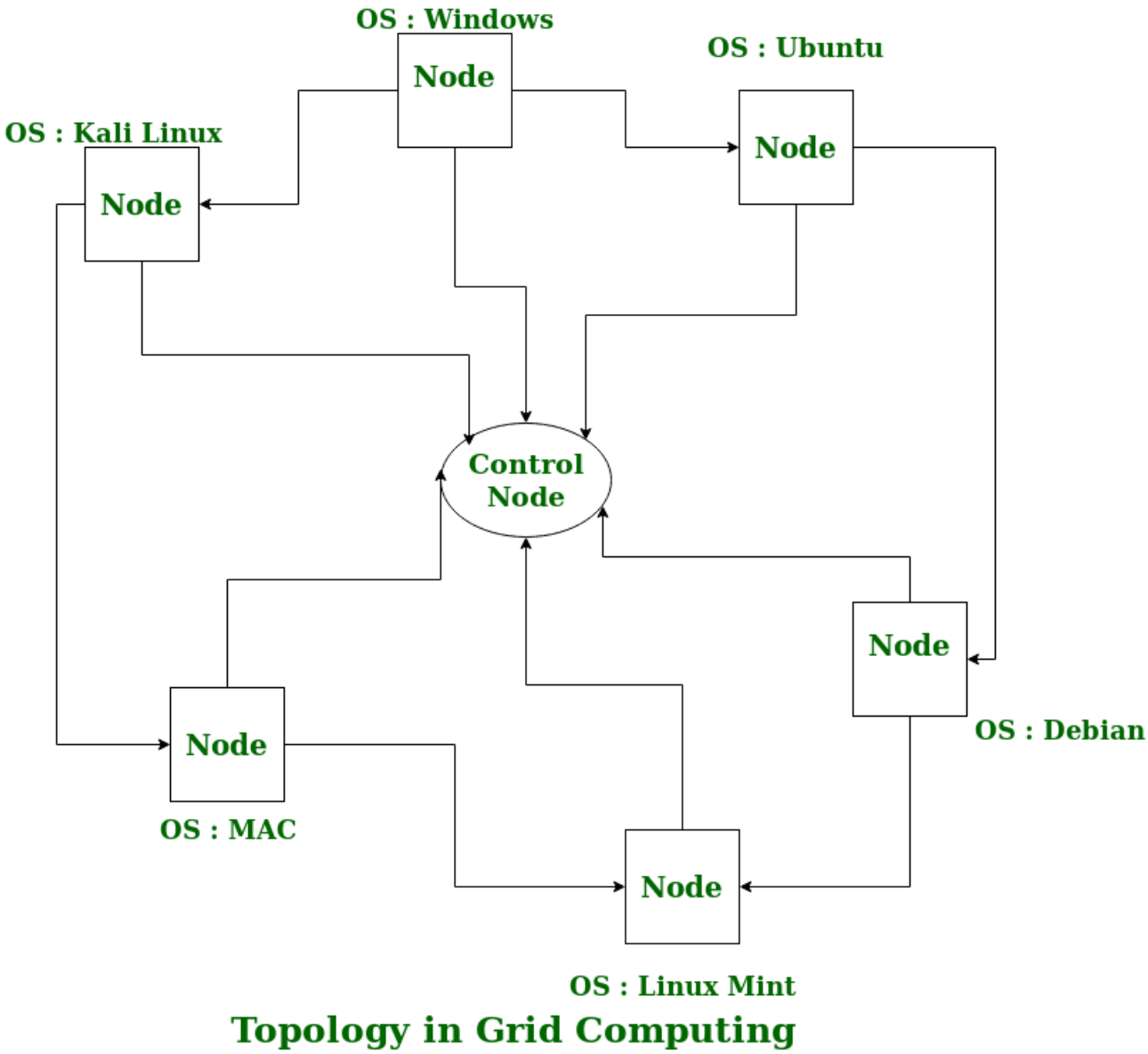


Figure 6: Topology in Grid Computing

### 3. How does Grid Computing Model work?

- When a computer requests resources to the control node, the control node gives the user access to the resources available on the network. When it is not in use it should ideally contribute its resources to the network. Hence a normal computer on the node can swing in between being a user or a provider based on its needs. The nodes may consist of machines with similar platforms using the same OS called homogenous networks, else machines with different platforms running on a various OS called heterogeneous networks. This is the distinguishing part of grid computing from other distributed computing architectures.

- For controlling the network and its resources a software/networking protocol is used generally known as Middleware. This is responsible for administrating the network and the control nodes are merely its executors. As a grid computing system should use only unused resources of a computer, it is the job of the control node that any provider is not overloaded with tasks.

- Another job of the middleware is to authorize any process that is being executed on the network. In a grid computing system, a provider permits the user to run anything on its computer, hence it is a huge security threat for the network. Hence a middleware should ensure that there is no unwanted task being executed on the network.

**4. The meaning of the term Grid Computing**

- The meaning of the term Grid Computing has changed over the years, according to "The Grid: Blueprint for a new computing infrastructure" by Ian Foster and Carl Kesselman published in 1999, the idea was to consume computing power like electricity is consumed from a power grid. This idea is similar to the current concept of cloud computing, whereas now grid computing is viewed as a distributed collaborative network. Currently, grid computing is being used in various institutions to solve a lot of mathematical, analytical, and physics problems.

**5. Advantages of Grid Computing Model**

- It is not centralized, as there are no servers required, except the control node which is just used for controlling and not for processing.

- Multiple heterogeneous machines i.e. machines with different Operating Systems can use a single grid computing network.

- Tasks can be performed parallelly across various physical locations and the users don't have to pay for them (with money).

## IV. Cloud Computing Model

### 1. Definition

- Cloud computing is the on-demand availability of computer system resources, especially data storage (cloud storage) and computing power, without direct active management by the user. The term is generally used to describe data centers available to many users over the Internet. Large clouds, predominant today, often have functions distributed over multiple locations from central servers. If the connection to the user is relatively close, it may be designated an edge server.

- Clouds may be limited to a single organization (enterprise clouds), or be available to multiple organizations (public cloud).

- Cloud computing relies on sharing of resources to achieve coherence and economies of scale.

- Advocates of public and hybrid clouds note that cloud computing allows companies to avoid or minimize up-front IT infrastructure costs. Proponents also claim that cloud computing allows enterprises to get their applications up and running faster, with improved manageability and less maintenance, and that it enables IT, teams, to more rapidly adjust resources to meet fluctuating and unpredictable demand, providing the burst computing capability: high computing power at certain periods of peak demand.

- Cloud providers typically use a "pay-as-you-go" model, which can lead to unexpected operating expenses if administrators are not familiarized with cloud-pricing models.

- The availability of high-capacity networks, low-cost computers, and storage devices as well as the widespread adoption of hardware virtualization, service-oriented architecture, and autonomic and utility computing has led to growth in cloud computing. As of 2017, most cloud computers run a Linux-based operating system.

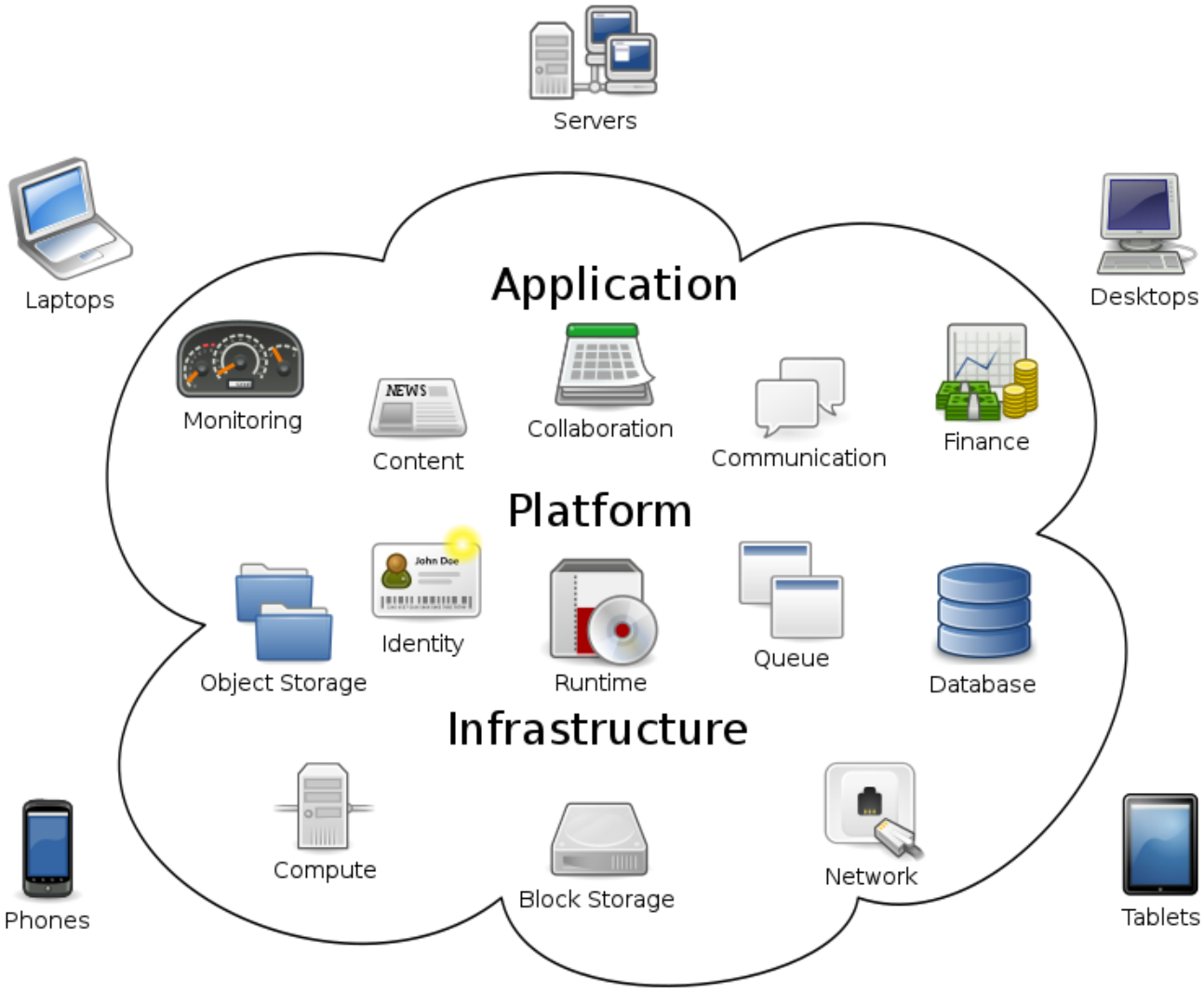


**Figure 7: Cloud Computing Model**

**2. Cloud Computing Architecture:**

- Cloud computing architecture refers to the components and sub components required for cloud computing. These components typically refer to:

+ Front end(fat client, thin client)

+ Back end platforms(servers,storage)

+ Cloud-based delivery and a network(Internet, Intranet, Intercloud).

### 3. Hosting a Cloud

- There are three layers in cloud computing. Companies use these layers based on the service they provide.

+ Infrastructure

+ Platform

+ Application

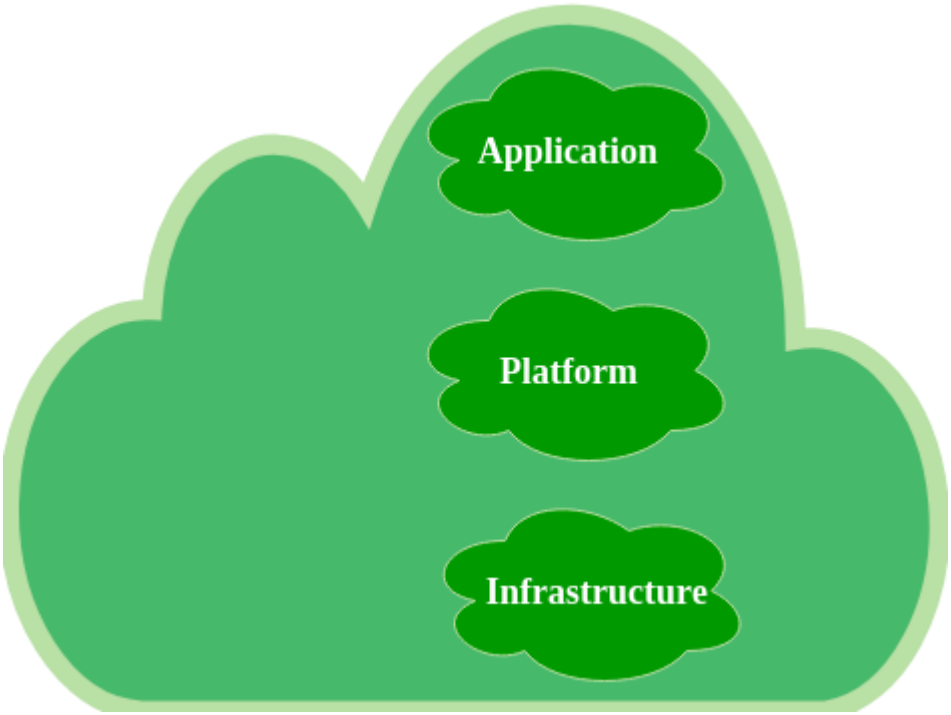


**Figure 8: Three layers of Cloud Computing**

- At the bottom is the foundation, the Infrastructure where the people start and begin to build. This is the layer where cloud hosting lives.

- **Now, let's have a look at hosting:**

- Let's say you have a company and a website and the website has a lot of communications that are exchanged between members. You start with a few members talking with each other and then gradually the numbers of members increases.

- As time passes, as the number of members increases, there would be more traffic on the network and your server will get slow down. This would cause a problem.

- A few years ago, the websites are put on the server somewhere, in this way you have to run around or buy and set several servers. It costs a lot of money and takes a lot of time. You pay for these servers when you are using and as well as when you are not using them. This is called hosting.

- This problem is overcome by cloud hosting. With Cloud Computing, you have access to computing power when you needed. Now, your website is put in the cloud server as you put it on the dedicated server. People start visiting your website and if you suddenly need more computing power, you would scale up according to the need.

**4. Benefits of Cloud Computing**

- **Scalability**:

+ With cloud hosting, it is easy to grow and shrink the number and size of servers based on the need.

+ This is done by either increasing or decreasing the resources in the cloud. This ability to alter plans due to fluctuation in business size and needs is a superb benefit of cloud computing, especially when experiencing a sudden growth in demand.

- **Instant:** Whatever you want is instantly available in the cloud.

- **Save Money**:

+ An advantage of cloud computing is the reduction in hardware cost. Instead of purchasing in-house equipment, hardware needs are left to the vendor. For companies that are growing rapidly, new hardware can be large, expensive, and inconvenient. Cloud computing alleviates these issues because resources can be acquired quickly and easily. Even better, the cost of repairing or replacing equipment is passed to the vendors.

+ Along with purchase cost, off-site hardware cuts internal power costs and saves space. Large data centers can take up precious office space and produce a large amount of heat. Moving to cloud applications or storage can help maximize space and significantly cut energy expenditures.

- **Reliability**: Rather than being hosted on one single instance of a physical server, hosting is delivered on a virtual partition that draws its resource, such as disk space, from an extensive network of underlying physical servers. If one server goes offline it will not affect availability, as the virtual servers will continue to pull resources from the remaining network of servers.

- **Physical Security:** The underlying physical servers are still housed within data centers and so benefit from the security measures that those facilities implement to prevent people from accessing or disrupting them on-site

### V. On-demand self service

- Cloud computing resources can be provisioned without human interaction from the service provider. In other words, a manufacturing organization can provide additional computing resources as needed without going through the cloud service provider. This can be a storage space, virtual machine instances, database instances, and so on. Manufacturing organizations can use a web self-service portal as an interface to access their cloud accounts to see their cloud services, their usage, and also to provision and de-provision services as they need to.

### VI. Broad network access

- Cloud computing resources are available over the network and can be accessed by diverse customer platforms. In other words, cloud services are available over a network—ideally high broadband communication link—such as the internet, or in the case of private clouds it could be a local area network (LAN). Network bandwidth and latency are very important aspects of cloud computing and broad network access because they relate to the quality of service (QoS) on the network. This is particularly important for serving time-sensitive manufacturing applications.

### VII. Elastic resource pooling

- A multi-tenant design is supported by cloud computing tools. Multi-tenancy allows multiple customers to use the same software or the same physical infrastructure while protecting their information's privacy and security. It's similar to people living in an apartment building, sharing the same building infrastructure, but within that infrastructure they also have their own apartments and privacy. This is how multi-tenancy in the cloud operates.

- Resource pooling means that the same physical resources will serve multiple customers. The asset pool of suppliers should be very broad and versatile enough to serve multiple customer needs and provide economies of scale. Resource allocation must not affect the performance of critical manufacturing applications when it comes to resource pooling.

**VIII. Rapid elasticity**

- One of the great things about cloud computing is the ability to deliver services efficiently in the cloud as they are required by manufacturing organizations. And then if they don't need them to remove them. Cloud computing resources may rapidly increase or decrease and, in some cases, automatically respond to business demands. It's a key cloud computing feature. Usage, efficiency, and thus cost, can be scaled up or down without any additional contract or penalties.

**IX. Measured service**

- Cloud computing resource usage is metered and manufacturing organizations pay accordingly for what they have used. Resource utilization can be optimized by leveraging charge-per-use capabilities. This means that cloud resource usage—whether virtual server instances that are running or storage in the cloud—get monitored, measured, and reported by the cloud service provider. The cost model is based on "pay for what you use"—the payment is variable based on the actual consumption by the manufacturing organization.

**Question 2:** Persuade the board director to use Cloud Computing in ATN

**I. What cloud services can be used for ATN?**

**1. Infrastructure-as-a-Service (IaaS) and Platform-as-a-Service (PaaS)**

- Infrastructure-as-a-Service (IaaS) delivers fundamental compute, network, and storage resources to consumers on-demand, over the internet, and on a pay-as-you-go basis. Using an existing infrastructure on a pay-per-use scheme seems to be an obvious choice for companies saving on the cost of investing to acquire, manage, and maintain an IT infrastructure.

- Platform-as-a-Service (PaaS) provides customers a complete platform—hardware, software, and infrastructure—for developing, running, and managing applications without the cost, complexity, and inflexibility of building and maintaining that platform on-premises. Organizations may turn to PaaS for the same reasons they look to IaaS, while also seeking to increase the speed of development on a ready-to-use platform to deploy applications.

**2. Hybrid cloud and multicloud**

- A hybrid cloud is a computing environment that connects a company's on-premises private cloud services and third-party public cloud into a single, flexible infrastructure for running the organization's

applications and workloads. This unique mix of public and private cloud resources provides an organization the luxury of selecting optimal cloud for each application or workload and moving workloads freely between the two clouds as circumstances change. Technical and business objectives are fulfilled more effectively and cost-efficiently than could be with public or private cloud alone.

- Multicloud takes things a step further and allows you to use two or more clouds from different cloud providers. This can be any mix of Infrastructure, Platform, or Software as a Service (IaaS, PaaS, or SaaS). With multi-cloud, you can decide which workload is best suited to which cloud-based on your unique requirements, and you are also able to avoid vendor lock-in.

**3. Test and Development**

- One of the best scenarios for the use of a cloud is a test and development environment. This entails securing a budget and setting up your environment through physical assets, significant manpower, and time. Then comes the installation and configuration of your platform. All this can often extend the time it takes for a project to be completed and stretch your milestones.

- With cloud computing, there are now readily available environments tailored for your needs at your fingertips. This often combines but is not limited to, automated provisioning of physical and virtualized resources.

**4. Big Data Analytics**

- One of the aspects offered by leveraging cloud computing is the ability to use big data analytics to tap into vast quantities of both structured and unstructured data to harness the benefit of extracting business value.

- Retailers and suppliers are now extracting information derived from consumers' buying patterns to target their advertising and marketing campaigns to a particular segment of the population. Social networking platforms are now providing the basis for analytics on behavioral patterns that organizations are using to derive meaningful information.

**5. Cloud Storage**

- Cloud can offer you the possibility of storing your files and accessing, storing and retrieving them from any web-enabled interface. The web services interfaces are usually simple. At any time and place, you have high availability, speed, scalability, and security for your environment. In this scenario, organizations

are only paying for the amount of cloud storage they are actually consuming, and do so without the worries of overseeing the daily maintenance of the storage infrastructure.

- There is also the possibility to store the data either on- or off-premises depending on the regulatory compliance requirements. Data is stored in virtualized pools of storage hosted by a third party based on the customer specification requirements.

**6. Disaster Recovery**

- Yet another benefit derived from using the cloud is the cost-effectiveness of a disaster recovery (DR) solution that provides for faster recovery from a mesh of different physical locations at a much lower cost than the traditional DR site with fixed assets, rigid procedures, and a much higher cost.

**7. Data Backup**

- Backing up data has always been a complex and time-consuming operation. This included maintaining a set of tapes or drives, manually collecting them, and dispatching them to a backup facility with all the inherent problems that might happen in between the originating and the backup site. This way of ensuring a backup is performed is not immune to problems (such as running out of backup media), and there is also the time it takes to load the backup devices for a restore operation, which takes time and is prone to malfunctions and human errors.

- Cloud-based backup, while not being the panacea, is certainly a far cry from what it used to be. You can now automatically dispatch data to any location across the wire with the assurance that neither security, availability nor capacity issues.

- While the list of the above uses of cloud computing is not exhaustive, it certainly gives an incentive to use the cloud when comparing to more traditional alternatives to increase IT infrastructure flexibility, as well as leverage on big data analytics and mobile computing.

## II. The benefits (advantages) of using cloud for ATN

- Cloud computing works on a similar principle to web-based email clients, enabling users to access all of the system's features and data while maintaining the bulk of the system on their own machines. It would seem, most people are already using a variety of cloud computing services without realizing it. These cloud-based applications are Gmail, Google Drive, TurboTax, and even Facebook and Instagram. Users send their personal data to a cloud-hosted server for all of these services, which stores the information for later

access. And as useful as these apps are for personal use, they are even more important for businesses that need to be able to access large amounts of data through a secure online network connection.

- Employees, for instance, can access customer information from their smartphone or tablet at home or while traveling via cloud-based CRM technology such as Salesforce, and can easily share this information with other approved parties anywhere in the world. Now, there are those leaders who remain skeptical about their companies committing to cloud-computing solutions. Like these 3 cloud computing market advantages.

+ Security: For one thing, the full-time job of a cloud host is to track security carefully, which is significantly more efficient than a traditional in-house system, where an organization needs to divide its efforts among a multitude of IT issues, with security being just one of them. And while most businesses do not like to openly consider internal data theft possibilities, the truth is that a staggeringly high percentage of data thefts occur internally and are perpetrated by employees. In fact, if this is the case, keeping sensitive information off-site can be much safer.

+ Cost saving: The organization will save time and money in project start-ups once the information is on the cloud. However, most cloud computing services are paid as you go for those who are concerned that they will end up paying for functionality they don't need or want. This means that if you don't take advantage of what the cloud has to offer, you're not going to have to drop money on it at least.

+ Flexibility: The cloud provides businesses with greater overall flexibility compared to hosting on a local server. However, if you need extra bandwidth, cloud-based service will immediately satisfy the requirement, rather than undertaking a complicated (however expensive) IT infrastructure upgrade. Such increased independence and flexibility will make a substantial difference to the organization's overall effectiveness.

### III. The drawbacks of cloud for ATN

- There are benefits from cloud computing usage but it is undeniable that this system also has some disadvantages. The risks of cloud computing you should know such as:

#### 1. Risk of data confidentiality

- There is always a risk that user data can be accessed by other people. So data and cloud protection must be good because if it won’t be dangerous for data confidentiality.

**2. Depends on the internet connection**

- The internet is the only way to cloud computing. When there is no internet connection in your place or the internet path to the cloud provider is in trouble, automatically access to your cloud computing machine will be disconnected. Now, this is where the biggest obstacle is happening in developing countries and remote areas that do not have good internet access. And the weakness of the public cloud is where everyone accesses the same server and server and will increase the risk of attack, and down the server.

**3. The Level of security**

- Secrecy and security are among the most doubtful things in cloud computing. By using a cloud computing system means we are fully entrusted with the security and confidentiality of data to companies that provide cloud computing servers. When you experience a problem, you cannot sue the server for errors in the data. When you experience a problem, you cannot sue the server for errors in the data.

**4. Compliance**

- Which refers to the risk of a level compliance deviation from the provider against the regulations applied by the user.

**5. Vulnerable in the event of an attack**

- There are lots of arguments against cloud computing one of which is computing because the Cloud Computing work system is online, each component that is on Cloud Computing can be exposed to a wide range, this is a wide-open opportunity for attacks on data or activities stored on the server. When an attack is carried out by hackers, the problems that occur are data security and data privacy.

**6. Data Mobility**

- which refers to the possibility of sharing data between cloud services and how to retrieve data if one day the user makes a process of terminating cloud computing services. And there is local storage where the data can be used at any time as needed.

**7. Technical Problem**

- Besides that the use of Cloud Computing makes you unable to manage it yourself when there is a problem or a problem, you must contact customer support who is not necessarily ready 24/7. This is a problem because for some support you also have to pay more money.

### 8. Low Connection

- Does not work well if the connection is slow. The quality of cloud computing servers is one of the most important considerations before we decide to provide cloud computing server service, providers. When the server is down or the performer is not good, we will be harmed because of poor server quality.

- Well, that's the advantages and disadvantages of using Cloud Computing services. Not only the use of Cloud is just good, but there is also a shortage of Cloud. However, never be afraid to use what is called Cloud Computing. What readers need to note is that there is no single safe and good system. If there is a safe and good system, there is no need for a system update and bug fixes.

**Question 3.** Proposed solution

### I. Diagram

- The Cloud Computing Architecture is the device configuration that includes local and cloud resources, infrastructure, middleware and applications, cloud users, cloud storage, networks, and geo-location. Notice that the Cloud Computing Architecture is based on end-user needs-the cloud client and explains how all these elements are organized and connected. This approach helps one to objectively portray how cloud computing operates.

- The architecture for cloud computing is the system configuration which includes local and cloud resources, infrastructure, middleware and applications, cloud users, cloud storage, networks, and geo-location. Notice that the Cloud Computing Architecture is based on the cloud client's end-user needs and discusses how all of these components are structured and linked.

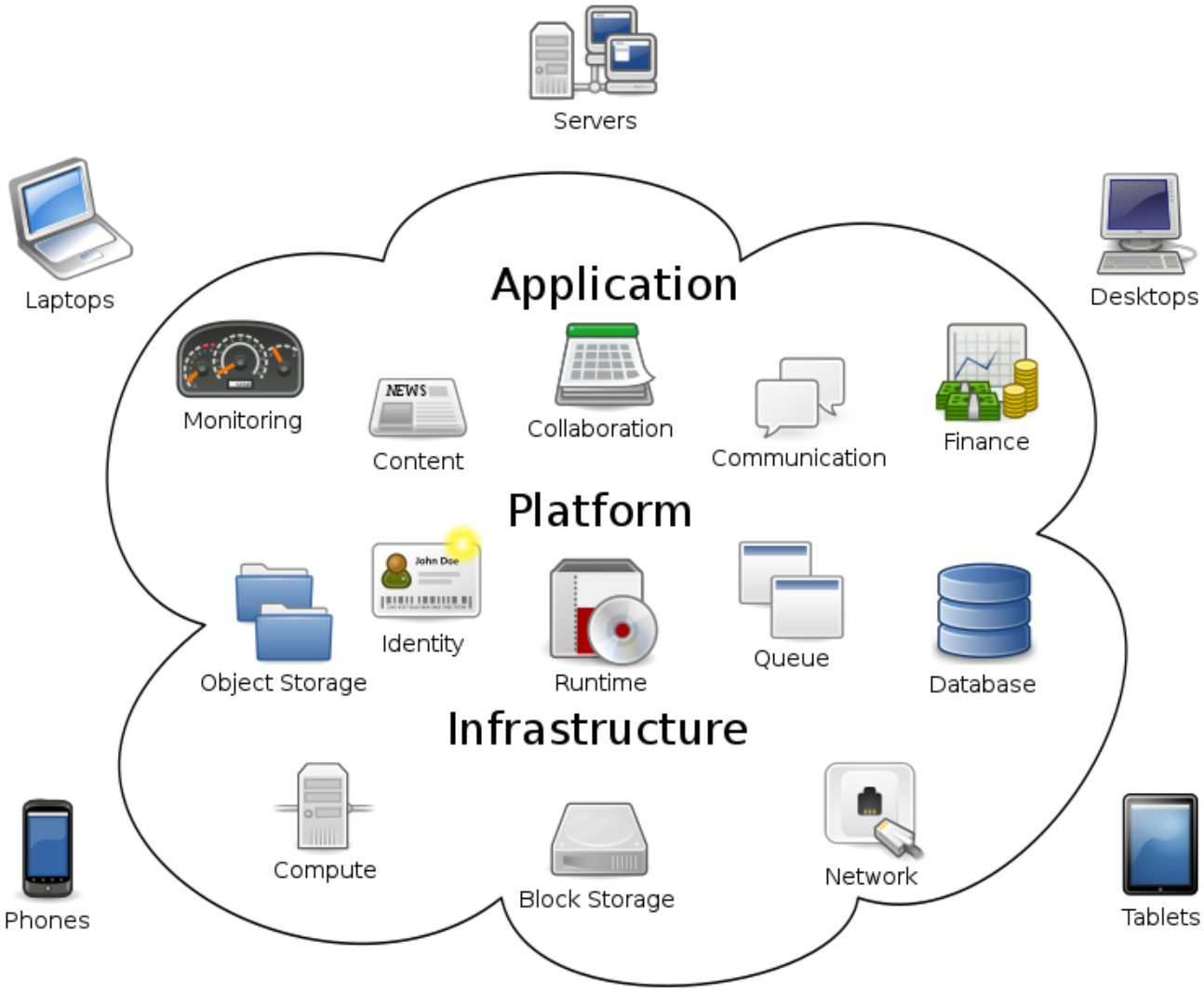


**Figure 9: Cloud Computing**

### II. Infrastructure.

- Cloud computing infrastructure is the collection of hardware and software elements needed to enable cloud computing. It includes computing power, networking, and storage, as well as an interface for users to access their virtualized resources. The virtual resources mirror a physical infrastructure, with components like servers, network switches, memory, and storage clusters.

- Cloud infrastructure offers the same capabilities as physical infrastructure but can provide additional benefits like a lower cost of ownership, greater flexibility, and scalability. Cloud computing infrastructure is available for private cloud, public cloud, and hybrid cloud systems. It's also possible to rent cloud infrastructure components from a cloud provider, through cloud infrastructure as a service (Iaas). Cloud infrastructure systems allow for integrated hardware and software and can provide a single management platform for multiple clouds.

### III. Platform

- Anyone using the internet will experience flexible computing power on a plug-in and play basis with cloud computing. This has become a very popular solution since it saves companies from the need to spend and maintain expensive infrastructure. Most companies offer cloud services for application development, management and delivery. The cloud services bellow that you can use to handle the organization's which need to be effectively.

#### 1. Heroku

- Heroku is a cloud platform as a service (PaaS) supporting several programming languages. One of the first cloud platforms, Heroku has been in development since June 2007, when it supported only the Ruby programming language, but now supports Java, Node.js, Scala, Clojure, Python, PHP, and Go. For this reason, Heroku is said to be a polyglot platform as it has features for a developer to build, run and similarly scale applications across most languages.


**Figure 10: Heroku**

### 2. Amazon Web Service

- Among all the cloud service providers Amazon is considered is the most powerful and flexible solution. AWS's virtual cloud platform comes with most of the attributes of an actual computer including hardware (CPU(s) & GPU(s) for processing, hard-disk/SSD for storage & local/RAM for memory); an operating system to choose from and pre-loaded apps like web servers, databases, CRM, etc.


**Figure 11: Amazon Web Service**

### 3. Microsoft Azure

- Windows Azure is used to installing software on servers running Microsoft. This software provides access to resources for local storage (blobs, queues, and tables). It may be combined with SQL Server while the SQL Azure is not a complete SQL Server example. Azure AppFabric supports security features such as encryption, security, etc. that allow applications inside your LAN to communicate with Azure cloud. Ultimately, it is a comprehensive package that supports application development, management, and security.


**Figure 12: Microsoft Azure**

## IV. Application

- Cloud computing applications are virtually limitless. A cloud computing platform could run all the programs that a regular machine might run with the right middleware. Potentially, anything could work on a cloud computing system from generic word processing software to customized computer programs designed for a particular company such as Online File Storage, Online Maps, Online Presentation.

- Cloud computing applications are virtually limitless. A cloud computing platform could run all the programs that a regular machine might run with the right middleware. Potentially, anything could work on

a cloud computing system from generic word processing software to customized computer programs designed for a particular company such as Online File Storage, Online Maps, Online Presentation.

1. **Online File Storage**

- The number of online cloud storage providers continues to increase daily. All competing over how much space they can provide for customers. MediaFire, Megaupload, Hotfile, 4Shared, Rapidshare, and Yourfilehost are examples used to host files, including papers, photos, presentations, clips, and so on. The software is simple to use and from these pages, users can upload and download files. Here users can use storage space of 200 GB and a 2 GB file size. The price for this cloud storage application's premium version is an average of $9.

2. **Online Maps**

- Finding directions and locations on the internet was another field where cloud applications became popular. Mapping apps like Google Maps are the leading ones. We are the most popular free online software that has supported millions of users by providing directions and routes in different ways and helped people get to their destinations over the past decade.

3. **Online Presentation**

- Sliderocket is free online presentation software. This enables the import of PowerPoint presentations from Microsoft. Because it is a web-based software program, it is possible to access the presentations from anywhere in the world. But the free version does not allow users of the cloud to edit offline presentations.

**Question 4.** Explain the appropriateness of the solution for the scenario

- As I was told, the ATN company currently markets toys to adolescents in many provinces across Vietnam is an affiliate. The company's revenue reaches $500,000/year. Every shop currently has its own database to store only transactions for that shop. Each shop has to give the sales data to the board manager monthly and the board director needs a lot of time to compile the data from all the shops collected. Nevertheless, the director of the board cannot see the actual update of the stock data.

- The IT team members are planning to put the application on the cloud to help make the work of the company easier This will allow retailers to have a centralized database that can verify whether products are available in the warehouse. It can also enable the board manager to make this easier to check monthly revenue. That's why the team drew up a graph that showed how the new system works.

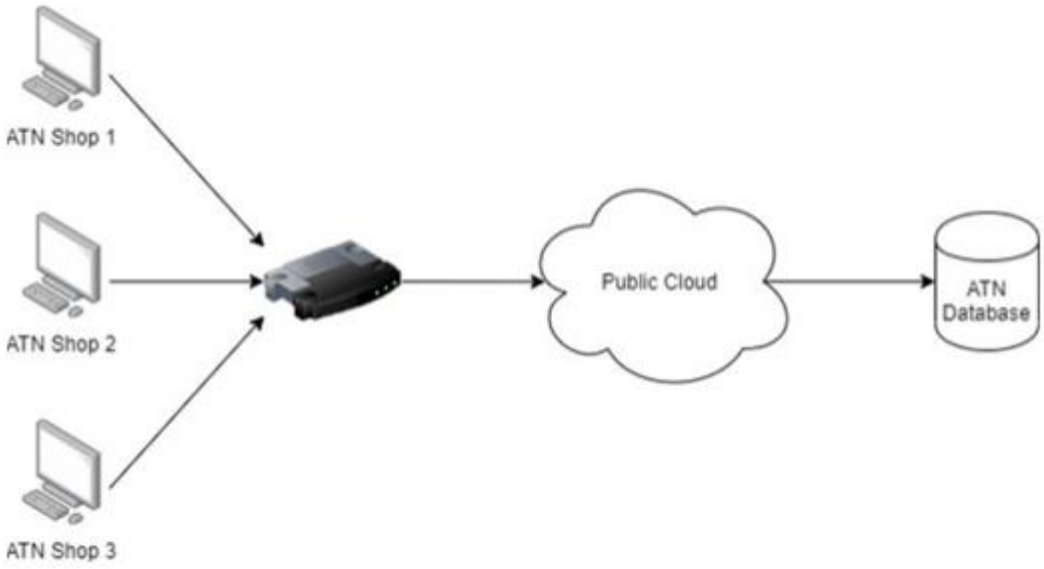


**Figure 13: ATN Solution Diagram**

- As shown in Figure 13, retailers of ATN will use their computers to insert data or report goods sold via an internet router. From there, the router connects to the company's public cloud and then communicates to the database system of ATN. For instance, the seller enters the number of goods sold, the data will then be sent to the public cloud and forwarded to the database. To be able to upload to the cloud, IT team members agreed to change the on-site database based on the company's initial application to store and transfer it to the cloud. Retailers were able to use only one web app through these common practices and could synchronize the database and reduce the cost and time the store spent notifying the board manager of sales.

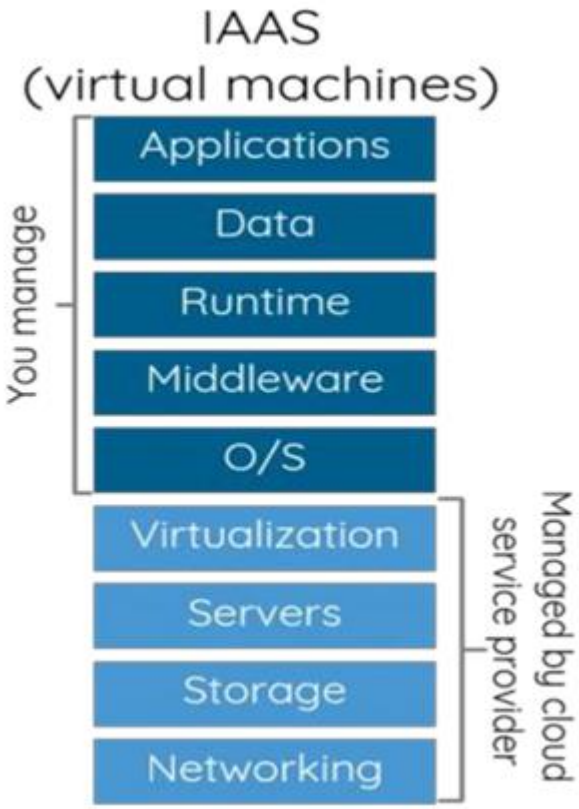


**Figure 14: IAAS**

- IT team members need to take steps such as selecting deployment models and deployment services to be able to upload to the cloud. For the Infrastructure as a Service (IaaS). To demonstrate this, on Figure shows that IaaS will provide users with Virtualization, Servers, Storage, and Networking. From there, IT team members need to create and manage programs, data, runtime, middleware, and operating systems. Members, therefore, had to pick then hiring and uploading applications and data to the cloud.

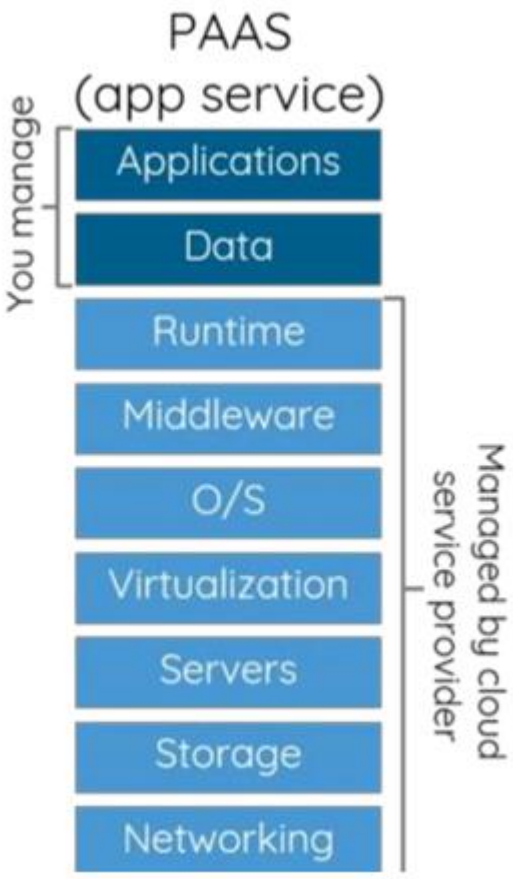


**Figure 15: PAAS**

On the other hand, IT team members only perform fewer stages than IaaS for Platform as a Service (PaaS). As can be seen in Figure, the cloud service provider will provide runtime, middleware, O / S, virtualization, servers, storage, and networking for users. We only need to program and design the web app, then upload it to the cloud.

- For the application side, the developer team only needs to re-create the original application which being use by the retailers. After re-creating the app, the developer will use it then push it to GitHub and host it for the cashier to use.

- The reason ATN company should use Computing Can is that it uses the internet so that time-wasting and accessing information in real-time are not an issue, it relies on the internet connection, the data transfers fast and instantly to the ATN cloud and the director can simply check and operate it. Moreover, by using the cloud, the company doesn't have to compile all the data in the shop then send it to the board manager, which can make things easier and less complicated for the shop. Furthermore, it can help the board manager see real-time selling stock.

**P2** Design an appropriate architectural Cloud Computing framework for a given scenario.

**Question 5.** Architectural design (architectural diagram and description) for ATN

- The architecture of cloud computing basically consists of two parts. They're both the front end and the back end. The front end is the end that the client uses, and the host controls the back end. All the end connects with the internet to each other.

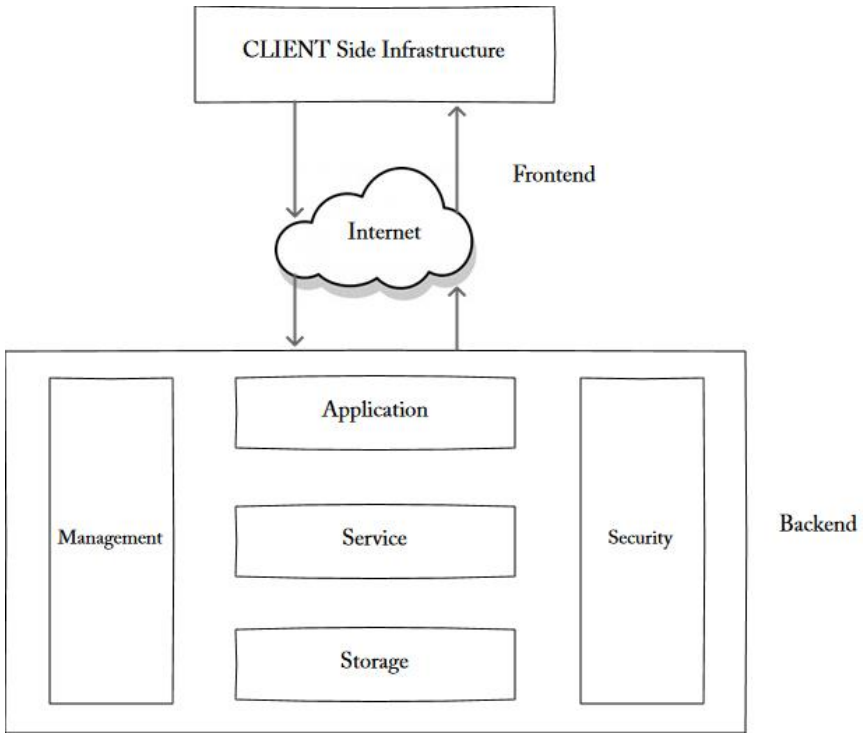


**Figure 16: Architectural Design**

- The front end is the Cloud Computing application component which uses the user's specification. The front end contains the software and frameworks that help you access cloud computing. Example- Browser or the company's own device. On the other hand, the back end is a component that is handled by the company's allocated authorities and has large data storage facilities, virtual machines, security systems, and servers in their back end. Together with security management, they also participate in traffic management.

### I. Client

- A Cloud Client consists of computer hardware and/or software that relies on cloud computing for application delivery. A Cloud Client could also be specifically designed for the delivery of cloud services. In either case, the Cloud Client is essentially useless without Cloud Services. Examples of Cloud Clients include some computers, phones and other devices, operating systems, and browsers.

## II. Application

- A cloud application, or cloud app, is a software program where cloud-based and local components work together. This model relies on remote servers for processing logic that is accessed through a web browser with a continual internet connection.

- Cloud application servers typically are located in a remote data center operated by a third-party cloud services infrastructure provider. Cloud-based application tasks may encompass email, file storage, and

sharing, order entry, inventory management, word processing, customer relationship management (CRM), data collection, or financial accounting features.

- Data is stored and compute cycles occur in a remote data center typically operated by a third-party company. A back end ensures uptime, security, and integration and supports multiple access methods. While under constant control, cloud applications don't always consume storage space on a computer or communications device. Assuming a reasonably fast internet connection, a well-written cloud application offers all the interactivity of a desktop application, along with the portability of a web application.

- A key difference between cloud and web applications is architecture. A web application or web-based application must have a continuous internet connection to function. Conversely, a cloud application or cloud-based application performs processing tasks on a local computer or workstation. An internet connection is required primarily for downloading or uploading data.

## III. Service

- Corporate and government entities utilize cloud computing services to address a variety of application and infrastructure needs such as CRM, database, compute, and data storage. Unlike a traditional IT environment, where software and hardware are funded upfront by the department and implemented over a period of months, cloud computing services deliver IT resources in minutes to hours and align costs to actual usage. As a result, organizations have greater agility and can manage expenses more efficiently. Similarly, consumers utilize cloud computing services to simplify application utilization, store, share, and protect content, and enable access from any web-connected device.

- Software as a Service (SaaS) – software runs on computers owned and managed by the SaaS provider, versus installed and managed on user computers. The software is accessed over the public Internet and generally offered on a monthly or yearly subscription.

- Infrastructure as a Service (IaaS) – compute, storage, networking, and other elements (security, tools) are provided by the IaaS provider via the public Internet, VPN, or dedicated network connection. Users own and manage operating systems, applications, and information running on the infrastructure and pay by usage.

- Platform as a Service (PaaS) – All software and hardware required to build and operate cloud-based applications are provided by the PaaS provider via the public Internet, VPN, or dedicated network connection. Users pay by use of the platform and control how applications are utilized throughout their lifecycle.

### IV. Storage

- Cloud storage allows you to save data and files in an off-site location that you access either through the public internet or a dedicated private network connection. Data that you transfer off-site for storage becomes the responsibility of a third-party cloud provider. The provider hosts, secures, manages, and maintains the servers and associated infrastructure and ensures you have access to the data whenever you need it.

- Managed storage can reduce the cost of capital associated with buying and managing storage systems. This is considered an advantage to managed storage, as organizations may simply order more storage or facilities as required, rather than buying new hardware and software.

### V. Management of Cloud

- Cloud management means the software and technologies designed for operating and monitoring applications, data, and services residing in the cloud. Cloud management tools help ensure cloud computing-based resources are working optimally and properly interacting with users and other services.

- Cloud management strategies typically involve numerous tasks including performance monitoring (response times, latency, uptime, etc.), security and compliance auditing and management, and initiating and overseeing disaster recovery and contingency plans.

### VI. Security for Cloud

- Cloud security is a collection of control-based protections and protection of technology designed to protect online stored information from leakage, theft, or loss of data. Protection involves threat-related cloud infrastructure, software, and data. Security systems use a Software as a Service (SaaS) model as cloud software.

- To protect your data, cloud service providers use a variety of methods. Firewalls are a major infrastructure of the cloud. Firewalls secure the network security and end-users ' perimeter. Firewalls also secure traffic between various cloud-based apps. By allowing you to set access lists for different assets, access controls protect data.

**LO2 Evaluate the deployment models, service models and technological drivers of Cloud Computing and validate their use**

**P3 Define an appropriate deployment model for a given scenario.**

**Question 6. Detailed design**

**I. Deployment Model**

- NIST describes four types of cloud deployment: public cloud, private cloud, community cloud, and hybrid cloud. A cloud deployment model is characterized by the position of the deployment infrastructure and who is in charge of that infrastructure. Every cloud delivery model meets growing organizational requirements.

**1. Private Cloud**

- Private cloud is a type of cloud computing that delivers similar advantages to the public cloud, including scalability and self-service, but through a proprietary architecture. Unlike public clouds, which deliver services to multiple organizations, a private cloud is dedicated to the needs and goals of a single organization.

- A private cloud is a single-tenant environment, meaning the organization using it (the tenant) does not share resources with other users. Those resources can be hosted and managed in a variety of ways. The private cloud might be based on resources and infrastructure already present in an organization's on-premises data center or on a new, separate infrastructure, which is provided by a third-party organization. In some cases, the single-tenant environment is enabled solely using virtualization software. In any case, the private cloud and its resources are dedicated to a single user or tenant.

- A private cloud's main advantage is that users don't share resources. Because of its proprietary nature, a private cloud computing model is best suited for companies with complex or unpredictable computing needs that require direct control over their environment, usually to meet requirements for security, corporate governance, or regulatory compliance.

- When an organization properly architects and implements a private cloud, it can provide most of the same benefits found in public clouds, such as user self-service and scalability, as well as the ability to provision and configure virtual machines (VMs) and change or optimize computing resources on demand. An organization can also implement chargeback tools to track computing usage and ensure business units pay only for the resources or services they use.

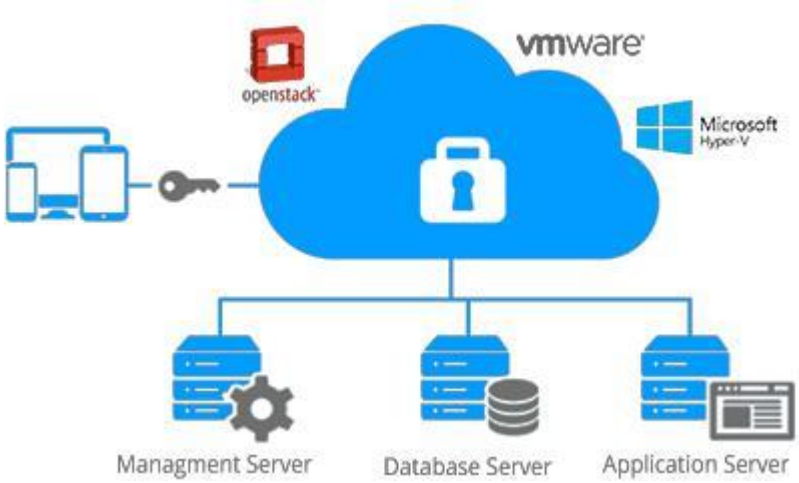


**Figure 17: Private Cloud**

### 2. Public Cloud

- A public cloud is a type of computing in which a service provider makes resources available to the public via the internet. Resources vary by provider but may include storage capabilities, applications, or virtual machines. Public cloud allows for scalability and resource sharing that would not otherwise be possible for a single organization to achieve.

- Some public cloud providers offer resources for free, while clients pay for other resources by subscription or a pay-per-usage model. Cloud services are available to individual users, as well, and prices scale depending on the user's resource needs. Organizations with huge amounts of data need to develop a cloud migration strategy before choosing a cloud vendor.

- The public cloud allows users to share resources while maintaining the privacy of each user's data. Public cloud architecture is completely virtualized, providing an environment where shared resources are leveraged as needed.

- A key advantage of public cloud architecture is the ability to access a service or application on any internet-connected device. Because the device itself performs little to no computation, individuals can use highly complex applications almost anywhere.

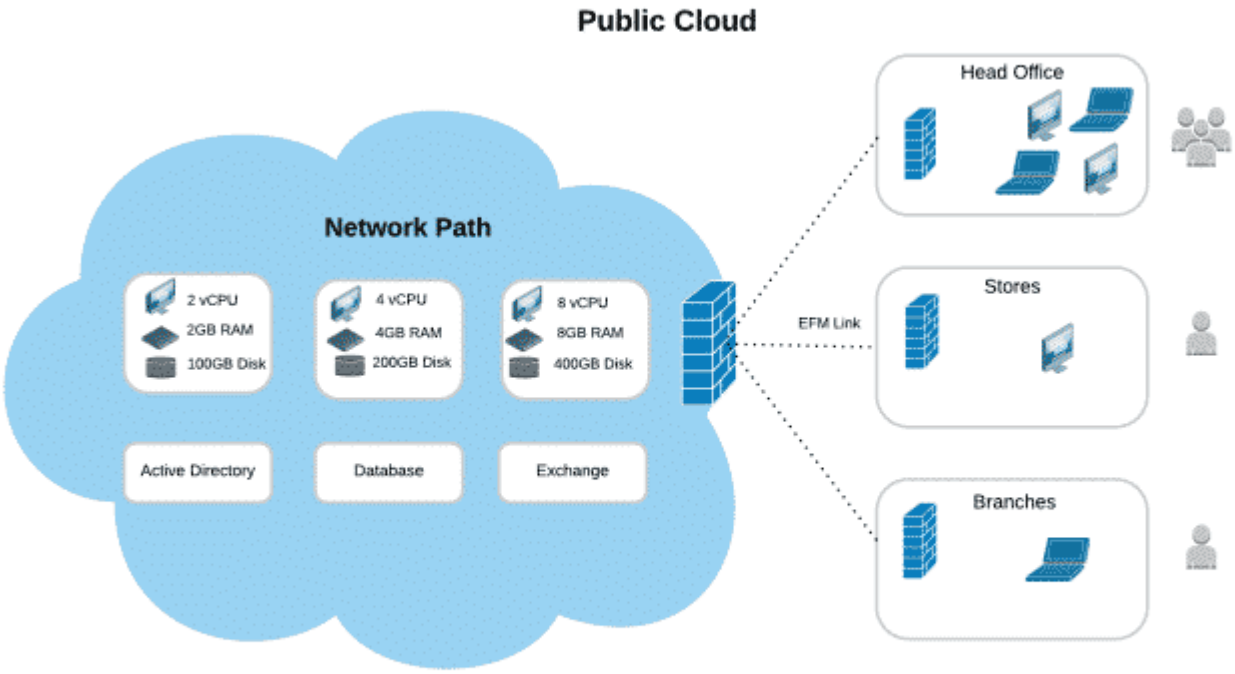


**Figure 18: Public Cloud**

### 3. Community Cloud

- Cloud computing keeps steamrolling forward as more companies adopt the technology, but to be clear, what we're seeing is a change in how businesses use the Internet. Apart from marketing terms, there are more tools out there, more technical support systems, and a stronger need for data dissemination. Many organizations share the infrastructure and support a specific community with shared concerns (e.g., mission, security requirements, policy considerations, and compliance considerations).

- Users of a particular community cloud fall into a well-identified category, having the same interests or needs; they can be government bodies, businesses, or even basic users, but for their contact with the cloud they all concentrate on the same issues. This is a situation that is different from public clouds, representing a multitude of users with different needs. Public clouds are also distinct from private clouds, where services are usually delivered within the cloud-owned entity.

- The community cloud is highly scalable and versatile as it is mostly compatible with any user and can be changed according to their use. The cloud will help forms such as acquisitions, branch or staff cuts, or fast climbing. It also allows credit unions to help remote customers, enabling workers to work out wherever they are. The cloud also supports smartphones, laptops, and various devices. The cloud helps credit unions to protect these devices and their data.

- Customer data should be safe and properly managed. If apps and expertise are available from any computer at any time and anywhere, the software should not be transferred. In reality, you can prevent users from downloading with the cloud. Sensitive data should be maintained on the servers and safely. Such data should not be stored anywhere else an extensive security audit exposed the presence of sensitive data on desktops, printers, backup systems, USB drives, smartphones, tablets, and even personal computers of employees. As a result of staff copy files, data is unfolded all over to shape them provided once and wherever they are.

- One example of using a group cloud would be to test-drive some high-end security products or even check some of a public cloud environment's features This is perfect for compliance-driven companies and regulatory decisions. Government, healthcare, and other regulated private industries use the added security features in a group cloud environment. Instead of just having space in a public cloud, organizations can test and operate on a stable, "dedicated" and even regulatory-compliant cloud platform. The really interesting part is that the operation can be on-site or offsite with a group cloud.

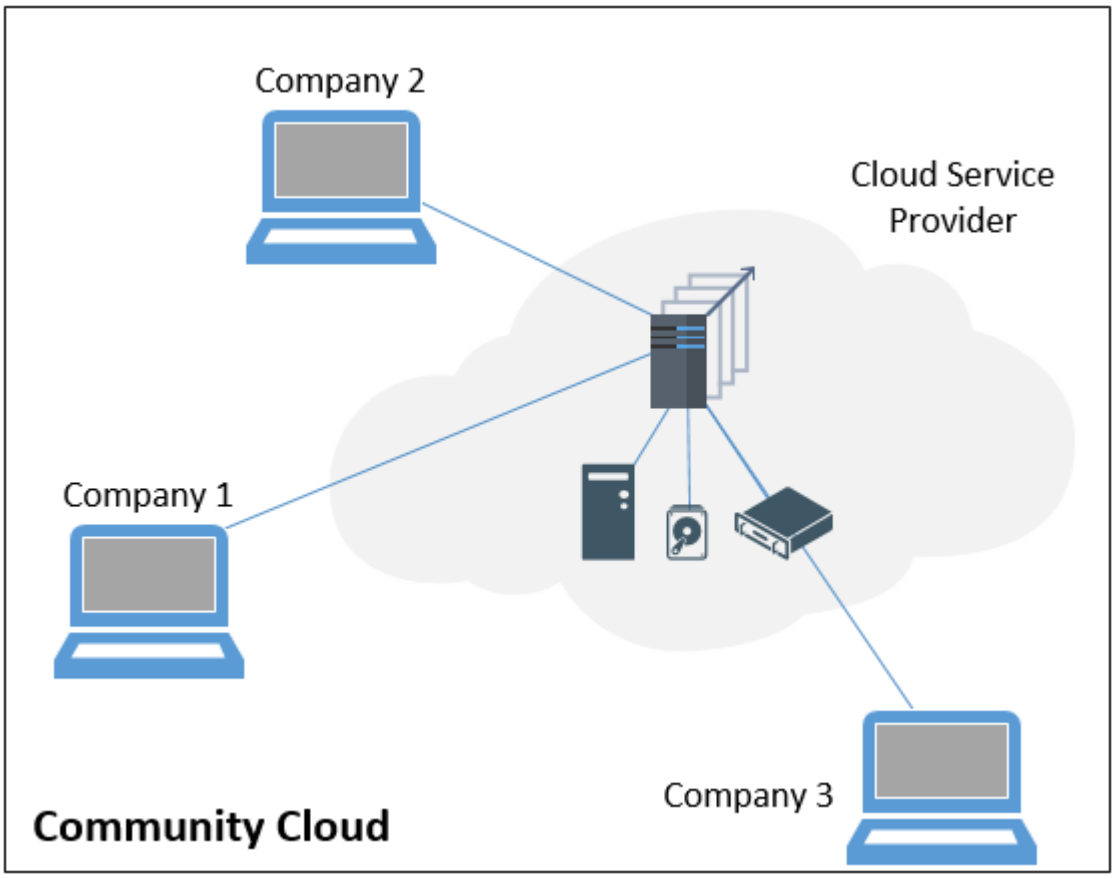


**Figure 19: Community Cloud**

**4. Hybrid Cloud**

- A hybrid cloud is a cloud computing environment that uses a mixture of on-premises, private cloud, and third-party orchestrated public cloud services between the two platforms. Hybrid cloud provides companies with greater flexibility and more technology storage options by allowing workloads to switch between private and public clouds as computing needs and cost changes.

- Hybrid cloud refers to mixed computing, storage, and services environment made up of on-premises infrastructure, private cloud services, and a public cloud—such as Amazon Web Services (AWS) or Microsoft Azure—with orchestration among the various platforms. Using a combination of public clouds, on-premises computing, and private clouds in your data center means that you have a hybrid cloud infrastructure.

- Although cloud services can drive cost savings, their main value lies in supporting a fast-moving digital business transformation. Every technology management organization runs under two agendas: the IT agenda and the business transformation agenda. Typically, the IT agenda has been focused on saving money. However, digital business transformation agendas are focused on investments to make money.

- The primary benefit of a hybrid cloud is agility. The need to adapt and change direction quickly is a core principle of a digital business. Your enterprise might want (or need) to combine public clouds, private clouds, and on-premises resources to gain the agility it needs for a competitive advantage.

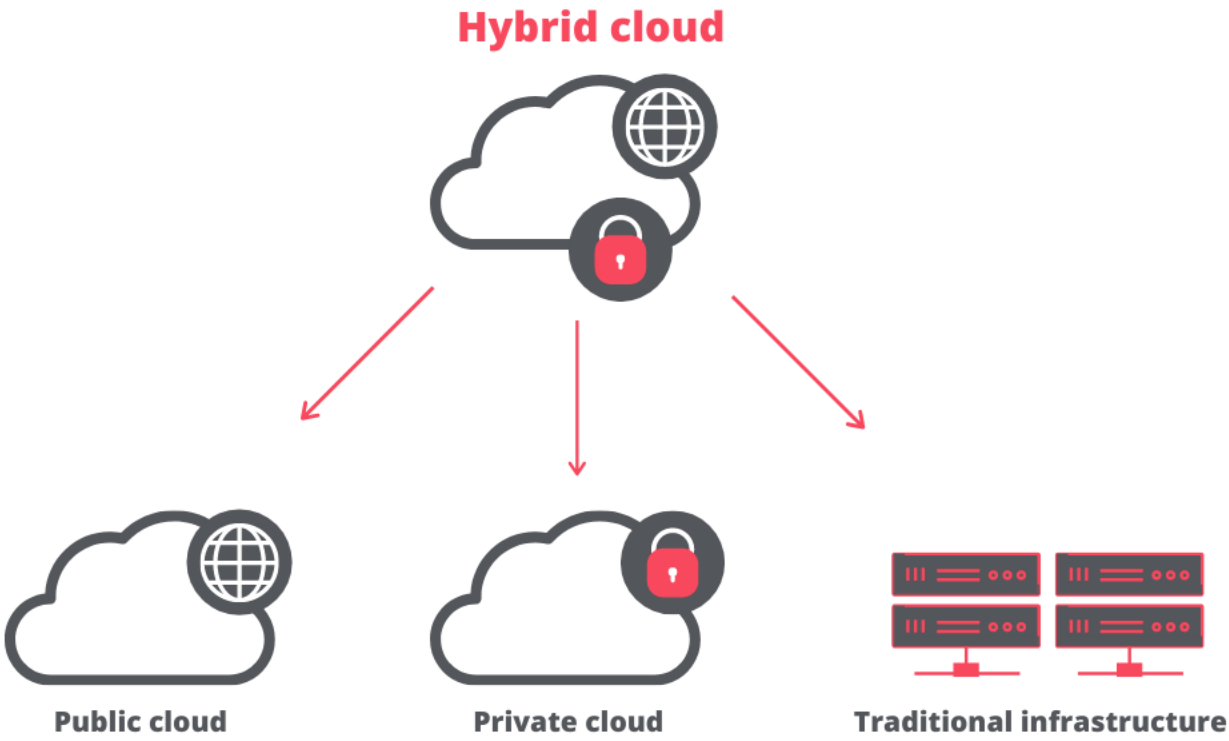


Figure 20: Hybrid Cloud

**5. The deployment model for the scenario.**

- After understanding all the deployment models, the first thing to do is to choose a model that fits the ATN company's project. As can be seen, the business should be best suited to the public cloud among all the above models. Because its setup and use are not sophisticated. Not only that, the public cloud, cost-effective. The company can also adjust the virtual server configuration to suit the needs of the company ATN.

**P4** Compare the service models for choosing an adequate model for a given scenario.

## II. Service Model

### 1. IaaS Service Model

- Infrastructure as a service (IaaS) is a form of cloud computing that provides virtualized computing resources over the internet. IaaS is one of the three main categories of cloud computing services, alongside software as a service (SaaS) and platform as a service (PaaS). In an IaaS model, a cloud provider hosts the infrastructure components traditionally present in an on-premises data center, including servers, storage, and networking hardware, as well as the virtualization or hypervisor layer.

- The IaaS provider also supplies a range of services to accompany those infrastructure components. These can include detailed billing, monitoring, log access, security, load balancing, and clustering, as well as storage resiliency, such as backup, replication, and recovery. These services are increasingly policy-driven, enabling IaaS users to implement greater levels of automation and orchestration for important infrastructure tasks. For example, a user can implement policies to drive load balancing to maintain application availability and performance.

- IaaS customers access resources and services through a wide area network (WAN), such as the internet, and can use the cloud provider's services to install the remaining elements of an application stack. For example, the user can log in to the IaaS platform to create virtual machines (VMs); install operating systems in each VM; deploy middleware, such as databases; create storage buckets for workloads and backups, and install the enterprise workload into that VM. Customers can then use the provider's services to track costs, monitor performance, balance network traffic, troubleshoot application issues, manage disaster recovery, and more.

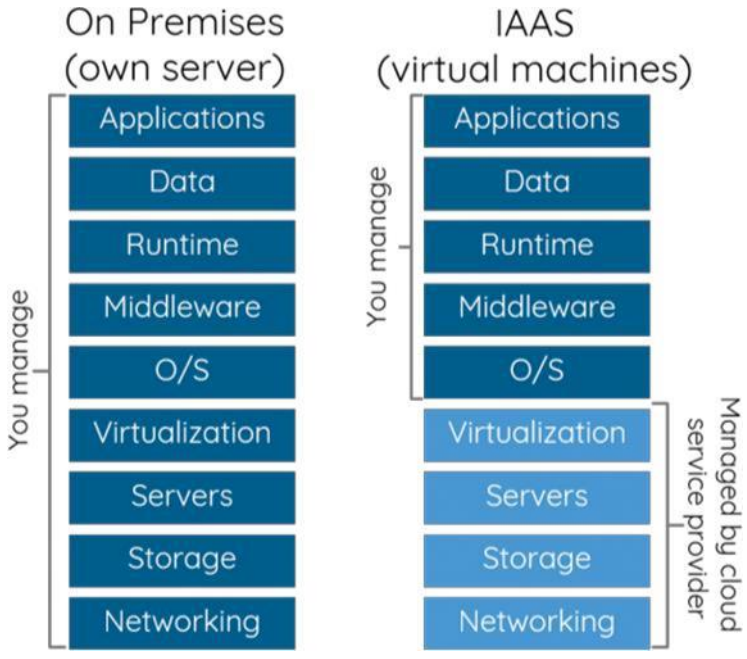


**Figure 21: IaaS Service Model**

### 2. PaaS Service Model

- Platform as a service (PaaS) is a cloud computing model in which a third-party provider delivers hardware and software tools -- usually those needed for application development -- to users over the internet. A PaaS provider hosts the hardware and software on its own infrastructure. As a result, PaaS frees developers from having to install in-house hardware and software to develop or run a new application.

- PaaS does not typically replace a business's entire IT infrastructure. Instead, it tends to incorporate various underlying cloud infrastructure components, such as operating systems, servers, databases, middleware, networking equipment, and storage services. Each of these functions is owned, operated, configured, and maintained by the service provider. PaaS also provides additional resources, including database management systems, programming languages, libraries, and various development tools.

- Many PaaS products are geared toward software development. These platforms offer to compute and storage infrastructures, as well as text editing, version management, compiling, and testing services that help developers create new software more quickly and efficiently. A PaaS product can also enable development teams to collaborate and work together, regardless of their physical location.

PaaS architectures keep their underlying infrastructure hidden from developers and other users. As a result, the model is similar to serverless computing and function-as-a-service architectures where the cloud service provider manages and runs the server and controls the distribution of resources.

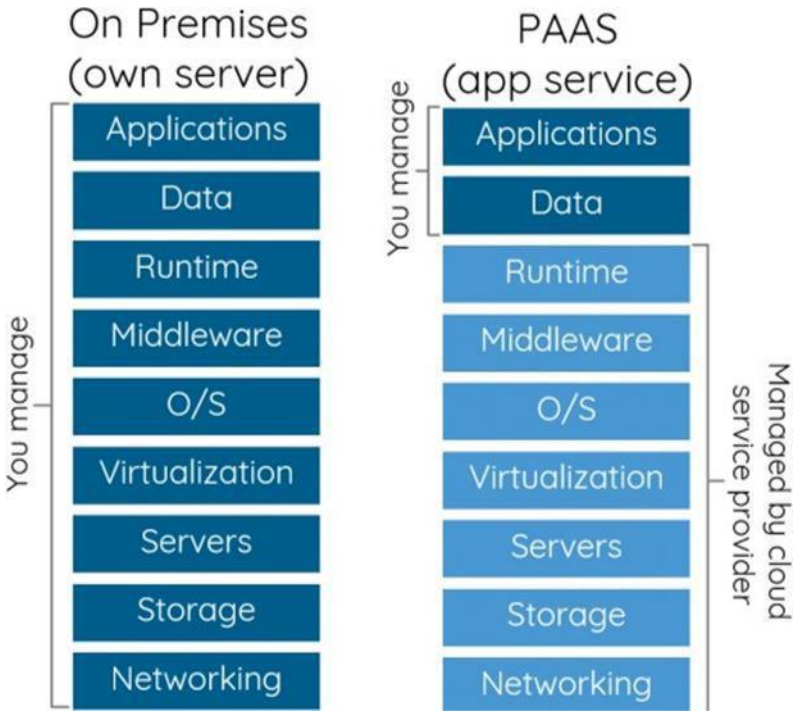


**Figure 22: PaaS Service Model**

- The principal benefit of PaaS is simplicity and convenience for users -- the PaaS provider supplies much of the infrastructure and other IT services, which users can access anywhere via a web browser. The ability to pay on a per-use basis allows enterprises to eliminate the capital expenses they traditionally have for on-premises hardware and software.

### 3. SaaS Service Model

- Software as a service (SaaS) is a software distribution model in which a third-party provider hosts applications and makes them available to customers over the Internet. SaaS is one of three main categories of cloud computing, alongside infrastructure as a service (IaaS) and platform as a service (PaaS).

- SaaS is closely related to the application service provider (ASP) and on-demand computing software delivery models. The hosted application management model of SaaS is similar to ASP, where the provider hosts the customer's software and delivers it to approved end-users over the internet. In the software on-demand SaaS model, the provider gives customers network-based access to a single copy of an application that the provider created specifically for SaaS distribution. The application's source code is the same for all customers and when new features or functionalities are rolled out, they are rolled out to all customers. Depending upon the service level agreement (SLA), the customer's data for each model may be stored locally, in the cloud, or both locally and in the cloud. Organizations can integrate SaaS applications with other software using application programming interfaces (APIs). For example, a business can write their own software tools and use the SaaS provider's APIs to integrate those tools with the SaaS offering.

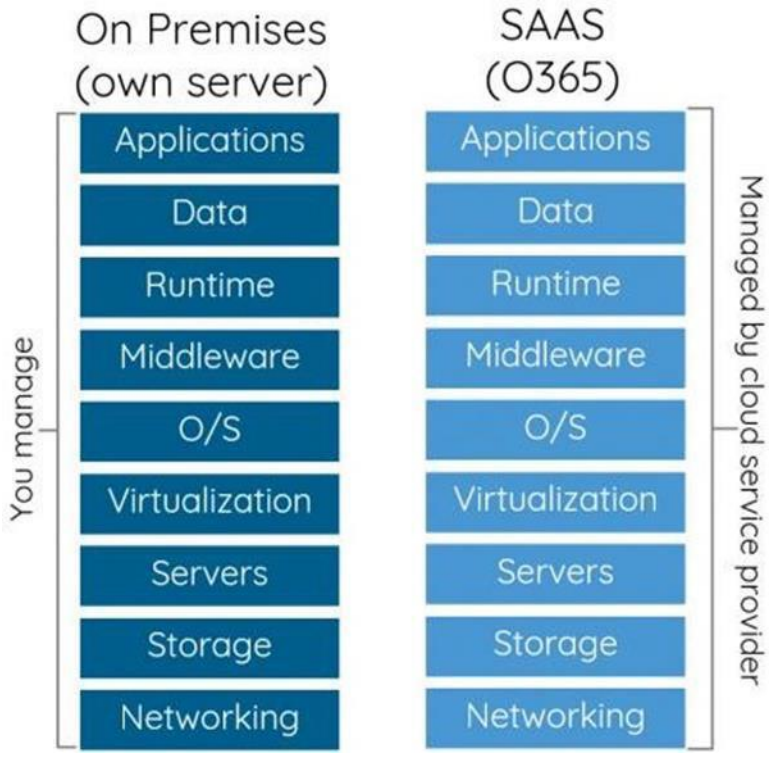


**Figure 23: SaaS Service Model**

- SaaS removes the need for organizations to install and run applications on their own computers or in their own data centers. This eliminates the expense of hardware acquisition, provisioning, and maintenance, as well as software licensing, installation, and support.

**4. Scenario service model.**

- The service model is Platform as a Service (PaaS): PaaS is a cloud-based service that eliminates the application development cost and complexity. Platform as a Service is part of a cloud platform family including Software as a Service (SaaS) and Infrastructure as a Service (IaaS). To help streamline application development, it offers software development tools, application programming interfaces (APIs), and code.

- Rapid Time-to-Market PaaS is used to build applications faster than it would be possible for developers to build, configure and supply their own platforms and backend infrastructure. Developers gain instant access to a full software development environment with PaaS, including sample code and pre-constructed components. Minimal Development From the above stage, PaaS services allow rapid prototyping and development by providing pre-constructed backend infrastructure and other resources. A platform provides access to tools, templates, and code libraries that reduce development time and make the process easier.

## III. Programming language/ webserver/database server chosen.

- The choice and use of the appropriate programming languages, web servers, and database servers for the project is essential to execute the project for ATN. The IT representatives of the company chose HTML and Php to construct the web form for programming languages. Therefore, selecting a programming tool for the web app is also one of the important things so that Atom is the IDE that IT team members use in HTML and Php languages for web programming.

- The IT team members have selected Heroku and GitHub to host the web app. With Heroku instead of infrastructure, it will help the developer to concentrate on technology. Boost the cloud app development team's productivity. Offers one-time billing for all team-based projects. Track and improve performance by thorough monitoring of applications. On the other hand, to save all the information of the product all the stores had sold, the team has chosen to use the PostgreSQL Database. This supports the mechanism for locking. It is software that is free and open source. It has the ability to tolerate fault. It takes very little maintenance.

## IV. Summary

- With a large amount of data as an ATN Company and the problems they were, Public Cloud and PaaS deployment service is the best alternative. It can monitor and resolve all of the company's problems and make them successful in the future as well.

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