CLOUD COMPUTING

Assignment 1

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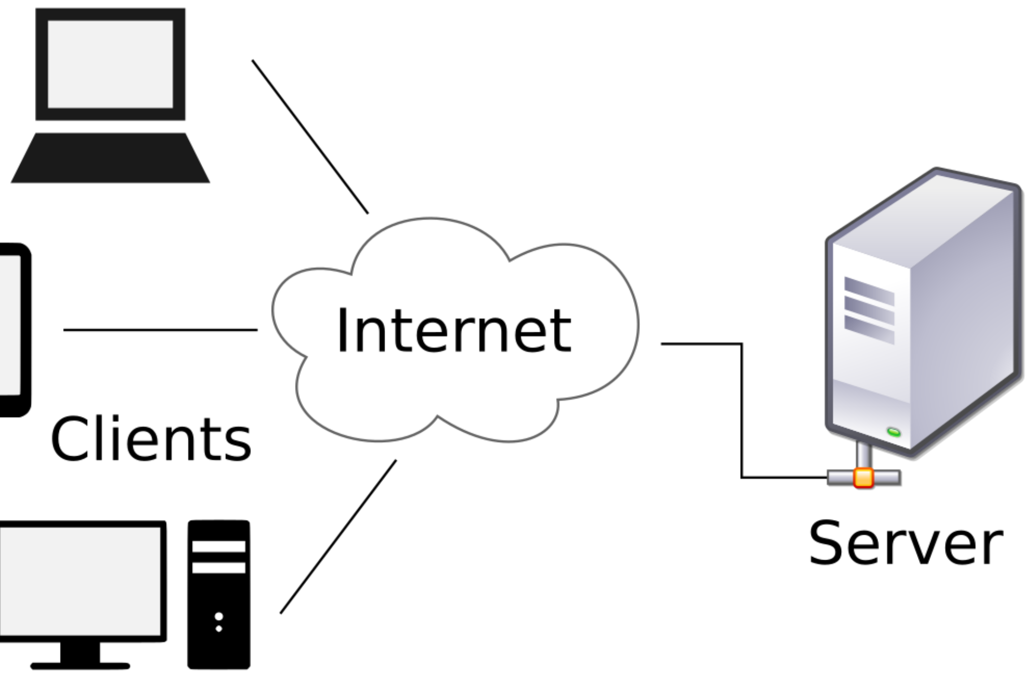
Introduction

Over the past decade, cloud computing adoption has seen explosive growth – at both consumer and enterprise levels. Legacy software providers such as Microsoft, Oracle and Adobe have all made huge, concerted efforts to encourage users of their on-premises software offerings to upgrade to their cloud equivalents, which are usually offered on a subscription pay-as-you-go basis. In this report, I will be discussing several factors that contribute to the fundamentals of cloud computing as well as how those factors provide a solution for the given scenario.

Fundamentals of cloud computing

Computing model

1.Client-Server model:



The Client-server model is a distributed application structure that partitions task or workload between the providers of a resource or service, called servers, and service requesters called clients. In the client-server architecture, when the client computer sends a request for data to the server through the internet, the server accepts the requested process and deliver the data packets requested back to the client. Clients do not share any of their resources. Examples of Client-Server Model are Email, World Wide Web, etc. (Singh, 2017)

The different advantages of client server computing are:

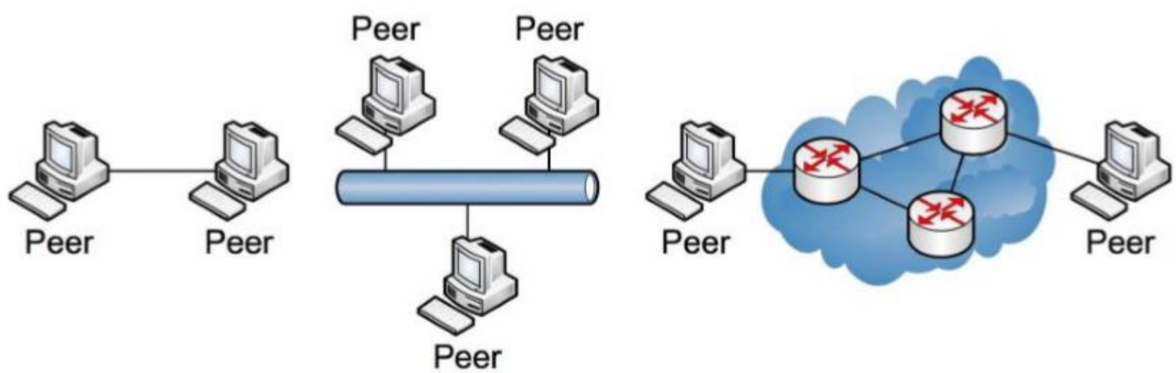
- All the required data is concentrated in a single place i.e. the server. So it is easy to protect the data and provide authorization and authentication.
- The server need not be located physically close to the clients. Yet the data can be accessed efficiently.
- It is easy to replace, upgrade or relocate the nodes in the client server model because all the nodes are independent and request data only from the server.

- All the nodes i.e. clients and server may not be built on similar platforms yet they can easily facilitate the transfer of data.

The different disadvantages of client server computing are:

- If all the clients simultaneously request data from the server, it may get overloaded. This may lead to congestion in the network.
- If the server fails for any reason, then none of the requests of the clients can be fulfilled. This leads of failure of the client server network.
- The cost of setting and maintaining a client server model are quite high.

2. Peer to peer model



According to (Binh, 2019), Peer to Peer is the model where every single computer join has the same function, responsibility, every computer can share and access data freely, there's no centralization system to control them. "The participants are both resource providers and resource requestors and use similar networking programs to connect with each other"

Advantages:

- Easy and simple to set up only requiring a hub or a switch to connect all computers together.

- You can access any file on the computer as-long as it is set to a shared folder.

- If one computer fails to work all the other computers connected to it still continue to work.

Disadvantages

- Security is not good other than setting passwords for files that you don't want people to access.

- If the connections are not connected to the computers properly then there can be problems accessing certain files.

- It does not run efficient if you have many computers, it is best to used two to eight computers.

High Performance Computer (HPC)

High-performance computing (HPC) is the use of super computers and parallel processing techniques for solving complex computational problems. HPC technology focuses on developing parallel processing algorithms and systems by incorporating both administration and parallel computational techniques.

High-performance computing is typically used for solving advanced problems and performing research activities through computer modeling, simulation and analysis. HPC systems have the ability to deliver sustained performance through the concurrent use of computing resources.

The terms high-performance computing and supercomputing are sometimes used interchangeably.

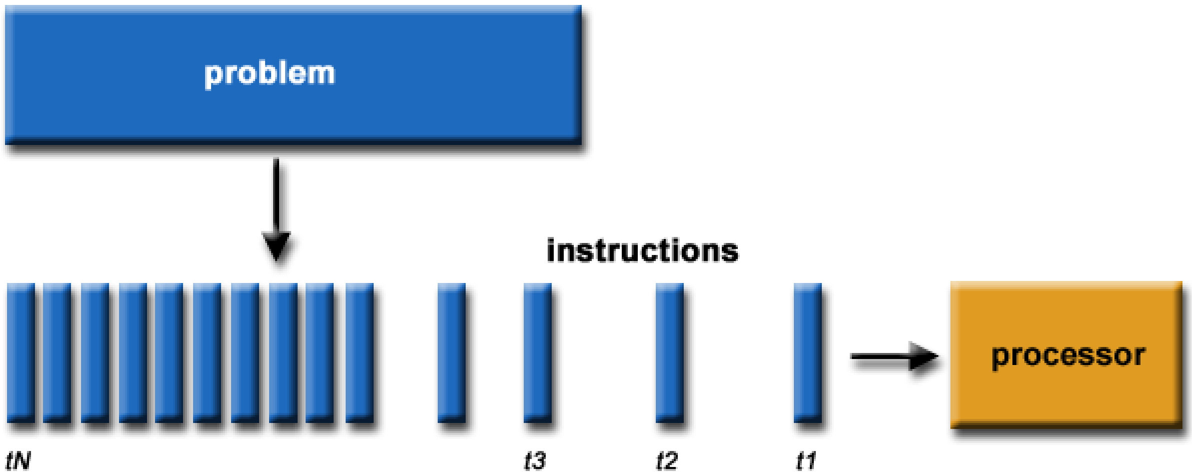
High-performance computing (HPC) evolved due to meet increasing demands for processing speed. HPC brings together several technologies such as computer architecture, algorithms, programs and electronics, and system software under a single canopy to solve advanced problems effectively and quickly. A highly efficient HPC system requires a high-bandwidth, low-latency network to connect multiple nodes and clusters.

HPC technology is implemented in multidisciplinary areas including:

- Biosciences
- Geographical data
- Oil and gas industry modeling
- Electronic design automation
- Climate modeling
- Media and entertainment

(technopedia, 2017)

1.Parallel Computing

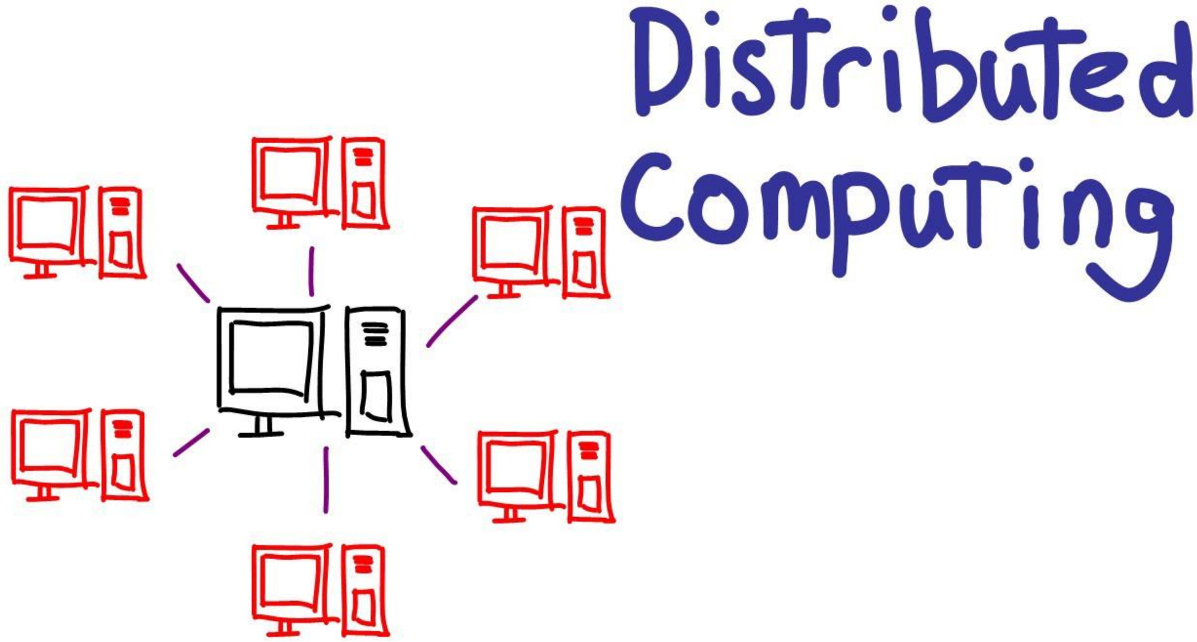


“Parallel computing” stands for the ability of computer systems to perform multiple operations simultaneously. The main driver behind parallel computing is the fact that large problems can be divided to smaller ones which can be then solved in parallel — i.e. executed concurrently on the available computing resources.

(Kyrkou, 2017)

Parallel processing is generally implemented in operational environments/scenarios that require massive computation or processing power. The primary objective of parallel computing is to increase the available computation power for faster application processing or task resolution. Typically, parallel computing infrastructure is housed within a single facility where many processors are installed in a server rack or separate servers are connected together. The application server sends a computation or processing request that is distributed in small chunks or components, which are concurrently executed on each processor/server. Parallel computation can be classified as bit-level, instructional level, data and task parallelism.

2. Distributed Computing



A distributed computer system consists of multiple software components that are on multiple computers, but run as a single system. The computers that are in a distributed system can be physically close together and connected by a local network, or they can be geographically distant and connected by a wide area network. A distributed system can consist of any number of possible configurations, such as mainframes, personal computers, workstations, minicomputers, and so on. The goal of distributed computing is to make such a network work as a single computer.

(IBM, n.d.)

Distributed systems offer many benefits over centralized systems, including the following:

Scalability: The system can easily be expanded by adding more machines as needed.

Redundancy: Several machines can provide the same services, so if one is unavailable, work does not stop. Additionally, because many smaller machines can be used, this redundancy does not need to be prohibitively expensive.

3. Cluster Computing

Cluster computing refers that many of the computers connected on a network and they perform like a single entity. Each computer that is connected to the network is called a node. Cluster computing offers solutions to solve complicated problems by providing faster computational speed, and enhanced data integrity. The connected computers execute operations all together thus creating the impression like a single system (virtual machine). This process is termed as transparency of the system. Based on the principle of distributed systems, this networking technology performs its operations. And here, LAN is the connection unit. This process is defined as the transparency of the system. Cluster computing goes with the features of:

- All the connected computers are the same kind of machines
- They are tightly connected through dedicated network connections
- All the computers share a common home directory.

(watelectronics, 2020)

4. Grid Computing

Grid computing is a processor architecture that combines computer resources from various domains to reach a main objective. In grid computing, the computers on the network can work on a task together, thus functioning as a supercomputer.

Typically, a grid works on various tasks within a network, but it is also capable of working on specialized applications. It is designed to solve problems that are too big for a supercomputer while maintaining the flexibility to process numerous smaller problems. Computing grids deliver a multiuser infrastructure that accommodates the discontinuous demands of large information processing.

A grid is connected by parallel nodes that form a computer cluster, which runs on an operating system, Linux or free software. The cluster can vary in size from a small work station to several networks. The technology is applied to a wide range of applications, such as mathematical, scientific or educational tasks through several computing resources. It is often used in structural analysis, Web services such as ATM banking, back-office infrastructures, and scientific or marketing research.

(techopedia, 2017)

Cloud Computing

Cloud computing is the distribution of on-demand IT resources over the Internet with a pay-per-use policy. Instead of buying, owning and maintaining data centers and physical servers, you can access technology services, such as computing power, storage and databases, as needed, from cloud service providers.

Organizations of all types, sizes, and industries are using cloud services for a variety of use cases, such as data backup, disaster recovery, email, virtual desktops, development, and Software testing, big data analytics, and interactive web applications with customers. For example, healthcare companies are using cloud services to develop more appropriate treatments for patients. Financial services companies are using cloud services to enhance detection and prevent fraud in real time. And video game makers are using cloud services to deliver online games to millions of players around the world.

1.Characteristics of cloud computing

The special publication includes the five essential characteristics of cloud computing:

1. **On-demand self-service:** A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.

2. **Broad network access:** Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops and workstations).

3. **Resource pooling:** The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state or datacenter). Examples of resources include storage, processing, memory and network bandwidth.

4. **Rapid elasticity:** Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.

5. **Measured service:** Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth and active user accounts). Resource usage can be monitored, controlled and reported, providing transparency for the provider and consumer.

2.Cloud Deployment Model

According to (Tom Laszewski, 2012) Cloud deployment models indicate how the cloud services are made available to users. The four deployment models associated with cloud computing are as follows:

Public cloud: as the name suggests, this type of cloud deployment model supports all users who want to make use of a computing resource, such as hardware (OS, CPU, memory, storage) or software (application server, database) on a subscription basis. Most common uses of public clouds are for application development and testing, non-mission-critical tasks such as file-sharing, and e-mail service.

Private cloud: True to its name, a private cloud is typically infrastructure used by a single organization. Such infrastructure may be managed by the organization itself to support various user groups, or it could be managed by a service provider that takes care of it either on-site or off-site. Private clouds are more expensive than public clouds due to the capital expenditure involved in acquiring and maintaining them. However, private clouds are better able to address the security and privacy concerns of organizations today.

Hybrid cloud: in a hybrid cloud, an organization makes use of interconnected private and public cloud infrastructure. Many organizations make use of this model when they need to scale up their IT infrastructure rapidly, such as when leveraging public clouds to supplement the capacity available within a private cloud. For example, if an online retailer needs more computing resources to run its Web applications during the holiday season it may attain those resources via public clouds.

Community cloud: This deployment model supports multiple organizations sharing computing resources that are part of a community; examples include universities cooperating in certain areas of research, or police departments within a county or state sharing computing resources. Access to a community cloud environment is typically restricted to the members of the community.

With public clouds, the cost is typically low for the end user and there is no capital expenditure involved. Use of private clouds involves capital expenditure, but the expenditure is still lower than the cost of owning and operating the infrastructure due to private clouds' greater level of consolidation and resource pooling. Private clouds also offer more security and compliance support than public clouds. As such, some organizations may choose to use private clouds for their more mission-critical, secure applications and public clouds for basic tasks such as application development and testing environments, and e-mail services.

3.Cloud service model

IaaS

Infrastructure-as-a-Service (IaaS) is a cloud-computing offering in which a vendor provides users access to computing resources such as servers, storage and networking. Organizations use their own platforms and applications within a service provider's infrastructure.

Key features

- Instead of purchasing hardware outright, users pay for IaaS on demand.
- Infrastructure is scalable depending on processing and storage needs.
- Saves enterprises the costs of buying and maintaining their own hardware.
- Because data is on the cloud, there can be no single point of failure.
- Enables the virtualization of administrative tasks, freeing up time for other work.

PaaS

Platform as a service (PaaS) is a cloud computing offering that provides users with a cloud environment in which they can develop, manage and deliver applications. In addition to storage and other computing resources, users are able to use a suite of prebuilt tools to develop, customize and test their own applications.

Key features

- PaaS provides a platform with tools to test, develop and host applications in the same environment.

- Enables organizations to focus on development without having to worry about underlying infrastructure.
- Providers manage security, operating systems, server software and backups.
- Facilitates collaborative work even if teams work remotely.

SaaS

Software as a service (SaaS) is a cloud computing offering that provides users with access to a vendor's cloud-based software. Users do not install applications on their local devices. Instead, the applications reside on a remote cloud network accessed through the web or an API. Through the application, users can store and analyze data and collaborate on projects.

Key features

- SaaS vendors provide users with software and applications via a subscription model.
- Users do not have to manage, install or upgrade software; SaaS providers manage this.
- Data is secure in the cloud; equipment failure does not result in loss of data.
- Use of resources can be scaled depending on service needs.
- Applications are accessible from almost any internet-connected device, from virtually anywhere in the world.

(IBM, n.d.)

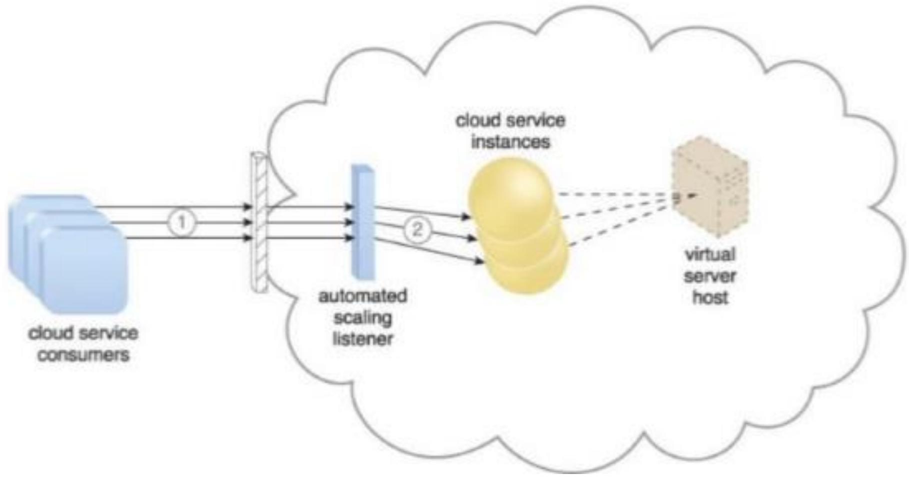
Some of cloud service models' advantages include:

Scalable: A cloud service allows quick scaling up and down of computing resources to accommodate your changing needs.

Affordable: You pay less for a cloud service, as it eliminates unnecessary costs involved in hardware upgrades and maintenance.

Secure: By signing up for a cloud service, you are essentially making your data more secure using their industry-grade security protocols.

4.Cloud Architecture



Architecture of cloud generally express the way cloud work. There's several architectures but in this report, I will choose the core automated scaling listener and resource replication mechanism.

The automated scaling listener mechanism is a service agent that monitors and tracks communications between cloud service consumers and cloud services for dynamic scaling purposes. Automated scaling listeners are deployed within the cloud, typically near the firewall, from where they automatically track workload status information.

Workloads can be determined by the volume of cloud consumer-generated requests or via back-end processing demands triggered by certain types of requests. For example, a small amount of incoming data can result in a large amount of processing.

Automated scaling listeners can provide different types of responses to workload fluctuation conditions, such as:

- Automatically scaling IT resources out or in based on parameters previously defined by the cloud consumer (commonly referred to as auto-scaling).
- Automatic notification of the cloud consumer when workloads exceed current thresholds or fall below allocated resources. This way, the cloud consumer can choose to adjust its current IT resource allocation.

Apply Cloud Computing for ATN

ATN problems

First and foremost, let us discuss the facts that we know, ATN, in the scenario, is known as a company that sells toys for teenagers in Viet Nam, the revenue per year is about 700.000$, for something as popular as toys, considering that most of Vietnamese population are range from 15 to 25, which is mostly teenagers, and the scale of ATN, this revenue in one year is quite low, and so, in my opinion, ATN is a small company.

The problem which ATN is currently facing is that they don't have the database for every stores, it's just the database for each shop and then the time needed to summarize the statistics is too long.

Furthermore, the company's board can't see the stock status in real time to have the stock transportation timely. The revenue decrease to the low level mainly because of these two reason. So applying the cloud technology can partly solve these problem

- Firstly, every store in the company can easily use a server to store sale data, which makes it easier to summarize the statistics, this can not only save a lot of time but also human resources which can be used for other important matters

- Secondly, whenever a branch updates any information, the board can also see this and have the corresponding reviews and adjustments.

appropriately.

- As mentioned above, ATN is not a big company, which means their resources are limited, so they can deploy the public model, which is not pricey.

- With a database, the websites of the company can inform the customers almost immediately when there's any changes of the status of the products. Without cloud, the process becomes more complicated as each branch would have to create and operate their own website, which makes it difficult for the customers to find the right branch and the board to manage and receive data, this makes updating the status even harder.

Solution

With all the facts out of the way, let us discuss the solutions:

- For the deploy model, the recommendation is public model, as mentioned above, for the economy problem of the company, moreover, ATN is not yet a big company, which makes the data not too sensitive so that they won't really need a private server, where the price is expensive.

- For the service models, SaaS and PaaS, and two applications along with them, GitHub and Heroku. GitHub is well-known in the IT department and could help the development team immensely in this project, and it's free. Heroku is also free, its functions allow the development team to build, run and operate the website entirely on cloud, writing source code and deploy it. Using these applications for developing is not complicated so it's good for a small company such as ATN to use them.

- For the database sever, my recommendations are Apache and PostgreSQL because they work together very well along with heroku. PostgrSQL is known for its open source database and easy to use friendly interface, easy to configure and develop a database.

- For programming language, my recommendation is PHP, as I have experience in developing websites with this language before, it works well with many frameworks such as Boostrap or jquery

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