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Optimizing the Transition: Strategies for Migrating On-Premise Storage to the Cloud

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Abstract. In recent years, Cloud Computing has had great relevance and has aroused interest in the Telecommunications industry, due to the reduction of costs in hardware acquisition, maintenance and operation personnel. One of the great advantages of cloud computing is the automation of processes that makes systems more robust and secure by limiting the margin of human and operational errors. It is of utmost importance to consider the large storage capacity management of video files that can provide solutions to media companies or related industries, this is key to think about a cost benefit analysis that can generate the migration and rental of these services in the cloud, with more reliable and accessible systems, this will help us to study hybrid technologies that offer on premise solutions. In addition to the above, when talking about companies that seek to digitally transform themselves to achieve agility and resilience, as well as to support future applications, it is necessary to mention their current infrastructures that have the capacity to host new technologies that require high performance, security and an adequate digital interconnection that allows the correct access to the acquired applications. In this research, an analysis of the existing process models for migration from on-premise storage to the cloud has been made with the objective of identifying the most important challenges, from planning, execution, factors to consider when assessing the complexity of applications and data before migrating to the cloud.

Keywords: Cloud computing, on-premise, process automation, process models, migration strategies.

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1 Introduction

In a short time, the cloud was considered a means to improve the investment and flexibility of the IT area, it has also evolved exponentially meeting the expected expectations.

Cloud Computing by offering services through an internet connection makes it multi-location, a main feature that makes the difference in on premise technology models.

It offers secure software and servers, easy access, and practical and applicable solutions, being models based on sharing computing resources and information, they are considered on-demand over the Internet.

Paying only for the resources consumed allows companies or users to scale in a considerable and efficient way, eliminating the need to worry about buying, designing and maintaining their own physical data centers and servers. This is another of the great advantages that makes this technology attractive, adding the reduction of energy consumption and technical personnel.

Having the data hosted in the cloud guarantees that the information is secure and reliable because it is automatically and periodically backed up with encrypted padlocks to prevent any kind of hacking of the information.

Advantages such as the above note the favorable results that can be obtained by using the services offered by the cloud, however, for digital content companies, it is necessary to address issues such as hybrid models for cataloging information in non-sensitive loads, sensitive and secure data, and the use of cloud services.

When mentioning the advantages that cloud storage can have, the following questions arise: What are the challenges in the process of migrating from on-premise storage to the cloud, how can an on-premise to cloud migration be planned and executed effectively and efficiently, what factors should be considered when assessing the complexity of applications and data before migrating to the cloud, and what factors should be considered when assessing the complexity of applications and data before migrating to the cloud?

2. CLOUD COMPUTING

Cloud Computing is a model that allows remote access, as needed and on demand, and through a communications network, to a shared set of configurable administrator resources (networks, servers, storage, applications and services) that can be reserved and used immediately with simple modes and provider intervention (Beltran & Sevillano, 2013).

Business model: Cloud computing employs a service-based business model. In other words, hardware and platform resources are provided as on-demand services.

However, in practice, clouds offer services that can be grouped into three categories: software as a service (SaaS), platform as a service (PaaS) and infrastructure as a service (IaaS) (Perez, 2020).

According to Cierco (2011) the three service models are defined as follows:

- Software as a Service (SaaS): The user is offered the ability to have the applications supplied by his provider run on a cloud infrastructure, the applications being accessible through, for example, a simple web browser as in the case of webmail, which is possibly the most representative example of this service model, due to its widespread use. The user has no control over the infrastructure or the applications themselves, with the exception of the possible user configurations or customizations allowed (Cierco, 2011).
- The user who opts for this service will be able to make use of the applications through the Internet that he/she contracts with the corresponding provider.
- An example might be an SME that contracts an e-mail application for its 30 employees. The application cannot be modified by the SME or its users, except for possible user configurations or customizations allowed by the provider. The application will be hosted in the provider's cloud infrastructure and the user will have no control over it (Andrade, 2014).
- Platform as a Service (PaaS): The user is allowed to deploy his own applications (either acquired or developed by the user himself) in the cloud infrastructure of his provider, who is the administrator of the development resources and who provides the programming resources. In this case, it is the user who maintains control of the application, although not of the entire underlying infrastructure (Cierco, 2011). The user will contract a service that allows him to host and develop his own applications on a platform that has development tools so that the user can develop a solution. The user is offered the use of your platform, which in turn is hosted on your infrastructure. The user has no control over the platform or infrastructure, but has control over their applications. They are provided by companies such as: Microsoft Azure, Google App Engine (Andrade, (2014).
- Infrastructure as a service (laaS): The provider offers the user resources such as processing, storage or communications capacity, which the user can use to run any type of software, from operating systems to applications (Cierco, 2011). In this model, the user is only contracting the technological infrastructure (processing, storage and/or communications capacity). This refers to hardware-related services. On this laaS he will host his applications and platforms; he will have

control over the latter, but not over the infrastructures. They are, for example, provided by Amazon, VMWare, Rackspace, Level 3, Telconet, among others (Andrade, 2014).

According to Joyanes (2022), Cloud Computing is a pay-per-use model that facilitates on-demand, available and direct network access to a set of configurable computing resources such as networks, servers, storage, applications and services, which can be rapidly provisioned and launched (reviewed) with minimal management effort or service provider interaction. This model promotes availability and comprises five key characteristics, according to the National Institute of Standards and Technology (NIST):

- On-demand self-service. The user is provided only with features such as server time and network storage as needed without requiring support from the service provider.
- Ubiquitous Network Access. Features or competencies are available on the Web and accessed through standard modes that promote use by client platforms such as cell phones, laptops, PDAs, tablets (Apple iPad, Samsung Galaxy...), ultrabooks.
- Position-independent resource pooling. The provider's resources are pooled to serve multiple consumers using a multi-tenant model with different physical and virtual resources dynamically allocated and reallocated according to consumer demand. There is a sense of position independence, such that the customer typically has no control or knowledge over the exact position of the resources provided, but may be able to specify the position at a higher level of abstraction (e.g., country, geographic region or data center). Examples of resources are storage, processing, memory, network bandwidth and virtual machines.
- Rapid elasticity. Capabilities can be provided quickly and elastically, in an automatic way that makes it easy to scale quickly and easily. Typically its available provisioning features give the consumer the impression of being abundant and unlimited with the possibility of obtaining them in any quantity and at any time.
- Measured service. Cloud computing systems control and optimize resource usage automatically, leveraging metering capabilities at a level of abstraction appropriate to the type of service (storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled and reported, providing transparency to both the provider and consumer of services.

The architecture of cloud computing can be divided into 4 layers: the hardware/data center layer, the infrastructure layer, the platform layer and the application layer; presented in Figure 1 (Perez, 2020).

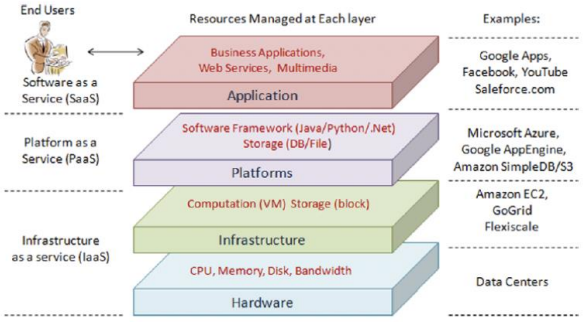

Fig. 1. *Cloud computing architecture. Source:* Perez (2020).

The hardware layer: This layer is responsible for managing the cloud's physical resources, including physical servers, routers, switches, and power and cooling systems.

The infrastructure layer: Also known as the virtualization layer, it creates a pool of storage and compute resources by partitioning physical resources using virtualization technologies such as Xen, KVM, and VMware.

The platform layer: This layer consists of the operating systems and application frameworks. The purpose of this layer is to minimize the burden of deploying applications directly on top of the virtual machine containers.

The application layer: At the highest level of the hierarchy, the application layer consists of the Cloud applications. Unlike traditional applications, Cloud applications can leverage the automatic scaling feature to achieve better performance, availability and lower operational cost (Perez, 2020).

3. KINDS OF CLOUD

Each user has specific needs so the management of this service is according to the level of the solution that meets the requirements of each one. Currently there are 3 types of clouds, public cloud, private cloud and hybrid cloud. Acosta (2020) describes each as follows:

- Public cloud: In this type of cloud, service providers offer their resources as services to the general public.
- Public clouds offer several key benefits for service providers, including the absence of upfront capital investment in infrastructure and the transfer of risk to infrastructure providers.
- However, public clouds lack fine-grained control over data, network and security settings, which hinders their effectiveness in many business scenarios.
- Private cloud: Also known as internal clouds, private clouds are designed for the exclusive use of a single organization. A private cloud can be built and managed by the organization or by external providers.
- This type of cloud offers the greatest degree of control over performance, reliability and security; however, they are often criticized for being similar to traditional proprietary server farms.
- Hybrid cloud: A combination of public cloud and private cloud models that attempts to address the limitations of each approach.
- In a hybrid cloud, part of the service infrastructure runs on private clouds, while the remaining part runs on public clouds.
- Hybrid clouds offer more flexibility than public and private clouds.

Specifically, they provide tighter control and security over application data compared to public clouds, while facilitating on-demand service expansion and contraction. On the downside, designing a hybrid cloud requires carefully determining the best split between public and private cloud components (Pérez, 2020).

4. ADVANTAGES AND DISADVANTAGES OF CLOUD COMPUTING

The use of cloud computing technologies to support logistics operations presents a number of advantages and disadvantages to users who contract cloud services due to the importance of the software. Before choosing a cloud solution, the business factors and cost factors involved should be known in order to choose the best possible option. Gutierrez and Martinez (2017) list some advantages and disadvantages as follows:

Advantages

1. Cost. This could be the most attractive advantage, or at least the most obvious of all the advantages offered by this technology.
2. By giving the responsibility for the implementation of the infrastructure to the provider, the client does not have to worry about buying computer equipment, training personnel for its configuration and maintenance.
3. The user of these services only pays for the resources he uses, allowing him to design a payment plan based on the time he uses them (memory, processing, storage).
4. Competitiveness. By not having to invest a large amount of money, small users can have access to the newest technologies at affordable prices, paying only for what they use. The competitiveness of the system does not lie in the one who has the most resources, but in the one who uses them best.
5. Availability. The provider is obliged to guarantee that the service is always available to the user. In this sense, virtualization plays a fundamental role in designing a redundant infrastructure that allows it to offer an uninterrupted service according to the needs of the users who contract the service..
6. Abstraction of the technical part. Cloud computing allows the user to forget about the implementation, configuration and maintenance of equipment and applications, transferring this responsibility to the service provider.
7. Access from any geographical location. The use of this system has the great advantage that it can be used and consulted from any device with Internet access, which makes it possible to use the application even from mobile devices such as smartphones.

8. Scalability. Updates to both the computer equipment and the operating system are automatic and transparent to the user, and are always available.

Concentration of efforts on business processes. All of the above allows the user to concentrate more resources and efforts towards a strategic and transcendent aspect, which has a direct impact on the business processes of the organization, transferring to the supplier the responsibility of the implementation, configuration and maintenance of the infrastructure necessary for the application to run.

Disadvantages

1. Privacy. It is understandable the concern of insecurity generated by a technology that puts the information (sensitive in many cases), on servers outside an environment controlled by the user, leaving the contracted provider responsible for the information. Privacy, many consider that what cloud computing proposes puts at risk vital information for business processes.
2. Availability. Although it is true that availability was previously included as an advantage, it remains as a responsibility that falls solely on the service provider, so that if its redundancy system fails and fails to keep the service available to the user, the latter cannot take any corrective action to restore the service and runs the risk of losing information.
3. Lack of control over resources. By having the entire infrastructure and even the application running on servers that are in the cloud, i.e. on the system administrator's side, the client lacks control over the resources and even over its own information, once it is uploaded to the cloud.
4. Dependency. In a solution based on cloud computing, the client is dependent on the provider's service and its connection to the network, leaving it vulnerable, since the user must be permanently connected to be able to reach the system in the cloud.
5. Integration. Not in all environments where the system is used, the interaction with the resources given to the user through cloud computing infrastructures with conventionally developed systems is practical. This aspect must be taken into account by the user to see the feasibility of implementing a cloud-based solution within their organization (Gutierrez & Martinez, 2017).

It is important to consider the points mentioned above as factors to evaluate the complexity of applications and data before thinking about migrating to the cloud. Figure 2 shows the difference between the On-Premise model and the Cloud model.

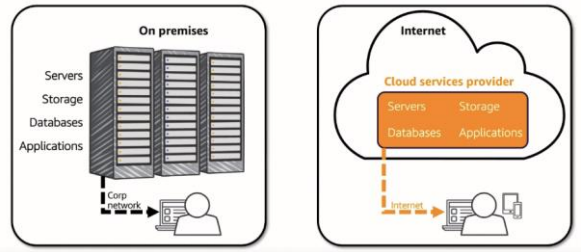

Fig. 2. *Representation of On premise Model - Cloud Model. Source:* Acosta (2020).

5. VIDEO FILE ANALYSIS

Video is defined as the capture, recording, processing, storage, transmission and reconstruction by digital or analog electronic means of a sequence of images representing moving scenes. The concepts necessary to understand each part of a video file are defined below.

- Códec: The main function of a codec is to transform a digital file with specific characteristics (Montaña, 2016).
- Format: Container formats are what we know as extensions of our digital files, i.e. .mov, mp4, .avi, etc. Container formats encapsulate both audio and video codecs for later playback on different devices and multimedia platforms.

- A video is a succession of images played at a rate (24/25/30 frames) per second (Montaña, 2016).
- Bitrate: The bitrate of a video, is the traffic or data rate, or the amount of information a computer plays per second. Consequently, as the data transfer rate increases, the quality of the content improves. This measure is expressed in kilobytes per second (kbps), so the higher this value, the higher the quality of the resulting video (Lillo, 2023).

Figure 3 shows an example of the bit rate handled in different 4096 x 2160 24p video files.

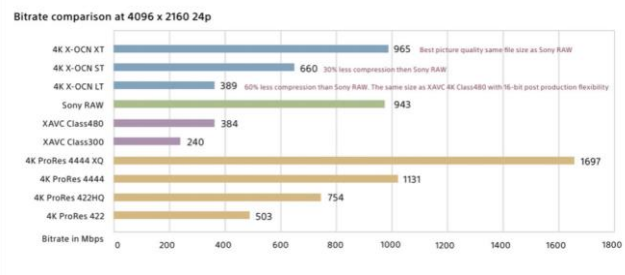

Fig. 3. *Bit rate for different 4K files. source:* Lillo (2023).

Resolution: Determines the amount of detail in a video, i.e. its degree of sharpness and realism. It is measured by the number of pixels it can display and is obtained by multiplying the number of pixels in width and height (Lillo, 2023).

Fig. 4. *Video resolution. Source:* Lillo (2023).

Generally, the higher the number of pixels, the higher the resolution. The most common are: HD, 1280 x 720 pixels, Full HD, high definition resolution, consists of 1920 horizontal pixels by 1080 vertical pixels, 2k or QHD 2560 x1440 pixels, Ultra HD or UHD, 3840 x 2160 pixels. Frame rate: The rate at which frames are displayed per second. Generally measured in fps (Frames per Second). A greater fluidity and smoothness in the movement can be appreciated when the rate of frames per second is increased (Lillo, 2023).

The most common framerates are:

- 24 fps: standardized for the television industry and cinema.
- 30 fps: most frequently used for sporting events on television.
- 60 fps: used for slow motion videos, because by setting the effect in video editors, having extra frames will still look fluid, although slow.

Each of these elements will determine the weight of the files, but it is important to think about weight reduction for later storage on physical devices, but mainly in the cloud.

6. ON-PREMISE TO CLOUD MIGRATION PROCESS

The following are aspects that must be taken into account to plan and execute an on-premise migration to the cloud in an effective and efficient way. Developing a cloud migration plan provides the team with a structured approach to the migration process to ensure that all technical aspects and work processes are discussed in advance. Taking the time to map out a plan also helps to allocate resources, establish realistic timelines and mitigate potential risks. Sarmiento and Cuenca, (2019) point out that for the migration of a technological product these are the main aspects:

- Strategy: Standard of action that supports the decisions to be made from beginning to end during a migration process. Taking into account the analysis of the reasons that originate the process and the utilities to be obtained, defining the decision of immediate or phased replacement of the analyzed system.
- Methods: Particularly in service orientation, it is about defining a functional abstraction level, converting conceptual aspects into service support elements. Determining a set of existing services in the system to be migrated and specifying new services.
- Tools: A system migration process can be a particularly laborious task, so it is advisable to have a set of tools that facilitate activities such as code generation, model editing, version control or even data transformation. Of course, communication tools are essential in a process of this nature.
- Standards: Consideration of standards is vital in a system migration or evolution process, since existing solutions are very particular to the technology providers that offer them.
- Business: Indicators associated with the business domain are fundamental in a migration effort. These are identified as not necessary requirements and will drive technical definitions in order to be covered. (Sarmiento & Cuenca, 2019).

Sebastián de Benito (2023) as part of the cloud migration process, 3 important phases are mentioned:

1. EVALUATION PHASE: As a first step, the attributes corresponding to each application are evaluated and studied, since these different values will be the variables that guide the operation of a simulation (criticality, stability, number of virtual machines...). Instead of introducing real starting data, as this would be very complex in this situation, synthetic data based on probability will be used. In other words, applications with artificial characteristics will be created, which will provide privacy and security, control over the results and reduce the time spent on this activity.
2. PLANNING PHASE: Once the migration has been decided, the migration of the applications is planned. Additionally, the transfer time of each wave will be calculated, which corresponds to the time required to move all the application data from the on-premises data center to the Cloud. Next, we proceed to estimate the efforts, times and costs of the migration. The Effort Estimation follows the principles established by the Cloud Suitability Assessment, with the difference that the first one focuses on the ease or complexity of each application to be migrated (and not operated). The effort obtained is used as input in the Time Estimation, which is used to estimate the duration of each of the migration phases of each wave. Finally, and using the times obtained, the migration cost estimation must be performed. Additionally, the operating costs of the applications in the Cloud must be estimated, which is essential for the Financial Analysis.
3. FINANCIAL ANALYSIS: The Financial Analysis is a documented study about the economic viability of a project. Contrary to the two previous sections, this does not correspond to a migration phase. The Financial Analysis has been conceived as an economic feasibility analysis, which is mainly based on the results obtained from the Cost Estimation. Based on these values, the cash flows of the entire migration project are estimated, including Transformation Costs and Operating Costs.

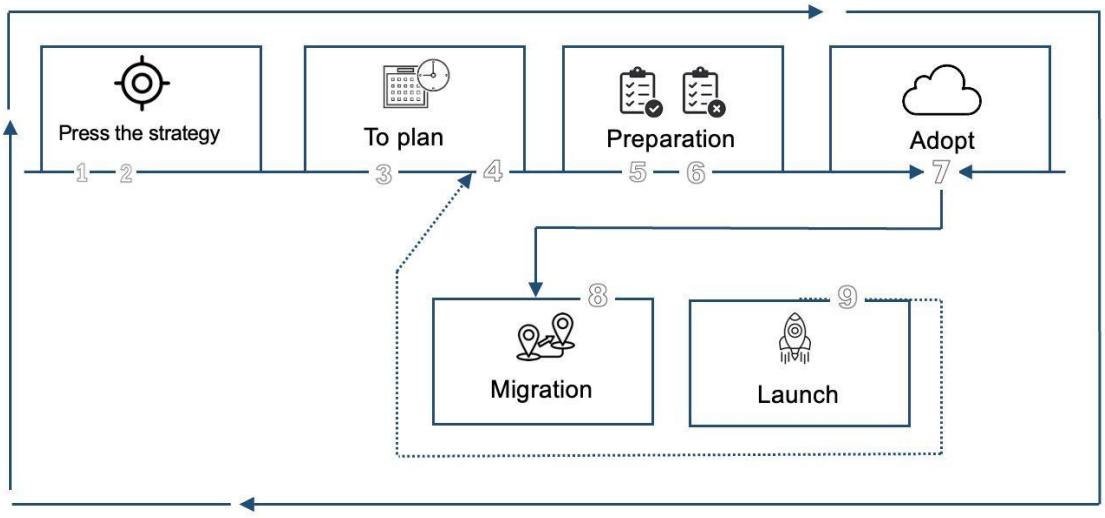

Fig. 5. *General map of processes for migrating services to the cloud. Source: Own elaboration.*

Figure 5 mentions each of the phases with stages that are considered to innovate in the cloud as follows:

1. Clarify the strategy, Documenting the strategy: Documenting the changes to be made for innovation and documenting the current work processes to be migrated. Promote the support of stakeholders: It is necessary to establish the business objectives and desired results by operation and IT.
2. Plan, Migration approach: Development of modernization plan to migrate applications in operation, defining and prioritizing key workloads. Cloud planning: Choice of a strategy for each application. Validation of the infrastructure to redesign or renew it. Creation of migration plans for the apps and their data.
3. Preparation, Equipment preparation: Performing analysis of existing hardware to check compatibility with new technologies. User preparation: Notification of the new business model to work teams, to offer complementary training and encourage them to be an active part of the digital transformation.
4. Adopt, Test migration and user acceptance testing: Design a test strategy before starting the migration to test and validate data synchronization.
5. Migration, assess environment migration readiness: Migrate according to the plan for each app in stages for execution as a whole and validate performance.
6. Launch, Drive consistency and standardization of processes - Monitoring of applications and cloud for necessary adjustments in processes and costs.

7 Conclusions

With this analysis of CLOUD vs. ON-PREMISE, considerable advantages can be highlighted that help companies obtain cost savings, scale quickly, manage resources and storage in a different way, satisfying business demands without having to invest in a physical infrastructure.

The cloud provides connection flexibility by allowing users to access data from wherever they are and at any time without having to be connected to a specific computer or location.

However, the telecommunications environment handles an overwhelming amount of information that makes it very expensive to rent external spaces and requires internal infrastructure to route this technology, because of this it is essential to conduct a thorough analysis of the needs to choose the right technology that provides productivity, scalability, and above all digital transformation.

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