Cloud Migration Techniques, Migration Phases and Cloud Storage Gateway

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Abstract: **Several organizations are moving their applications to the private or public cloud. The driving motivation is to use scalable infrastructure, state-of - the-art, get rid of internal IT baggage and find time to focus on core business development. The companies are shaping their path ahead, starting with a few acute applications to move to the cloud. The degree of success and smoothness during migration depends on three factors such as efforts and inducement of the migration team, Easiness of the application architecture and how loosely the application is linked with other internal services. There are various other factors which would cause you to fail or succeed in migration. Those include socio-political aspects within the company and whether you have unanimous support executive management and all stakeholders. The non-technical factors are also vibrant for the success of migration. This paper deals with various techniques of Cloud Migration, Phases during the Migration of an Application to the cloud and the benefits of Cloud Storage Gateway (CSG). A data migration technique has been adapted by users to have improved security services and to guarantee that their data is safe on the cloud. So there is necessity of additional secure mechanism to migrate the data over the cloud and henceforth numerous mechanisms have been proposed.**

Keywords: Cloud Migration techniques, Migration Phases, Data Migration Challenges, VM Migration, Cloud Storage Gateway.

I. INTRODUCTION

Cloud computing has inclined many business organizations due to its economic, business, and technical benefits. IT giants like, Google, Microsoft, Amazon and IBM were some of the first to offer cloud computing services. However, cloud executions are often isolated from each other. Virtualization is the main concept for managing the data centers and IT infrastructure in cloud computing. Migration specifies the process of moving data between different physical machines. Proficient resource management can be accomplished by applying suitable migration technology. Migration techniques can be used in various areas such as power reduction, load balancing and fault tolerance. The cloud computing enterprises have established significant attention towards addressing scalability, high computing capability and resource consumption, and also offering services in various forms. Virtual machine (VM) migration schemes have been implemented to exploit migration efficiency by considering enhanced metrics in several Cloud Data Center (CDC) environments [4]. The performance could be enhanced by Server consolidation and Load balancing. Uniting servers and moving VMs away from lightly loaded computing nodes could achieve energy management [2].The unevenness of resource usage over all the Physical Machines (PMs) in the same node could be decreased by load balancing. The VM real-time migration technology could transfer the VM from one physical computer to another physical computer and incorporate service faultlessly while keeping the virtual machine operating. The VM real-time migration technology could transfer the VM from one physical computer to another physical computer and incorporate service faultlessly while keeping the virtual machine operating. Because of the little downtime of the virtual machine real-time migration, service interruption shall be minimized to understand dynamic load balancing and maintenance of the Server. A possible fault-tolerant scheme is delivered, which is the finest and cherished application of virtual machine .But because real-time migration has certain negative effect on the system's real-time service, how to decrease the downtime is quiet challenging. Live VM Migration migrates the whole OS and its related application from one physical machine to another [3].The VM are migrated dynamically without disturbing the apps running on it. The benefits of VM migration comprises, load balancing among the physical

servers, conservation of physical server energy and failure tolerance in case of unexpected failure. The virtual machine migration techniques are Fault Tolerant Migration Techniques, Energy Efficient Migration Techniques and Load Balancing Migration Techniques [8]. Fault tolerance permits the VMs to continue its job even if any part of system fails. It increases the availability of physical server and evades performance deprivation of applications. The objective of Load balancing migration technique is to assign load across the physical servers to upsurge the scalability of physical servers. The Load balancing aids in avoiding bottlenecks, minimizing the resource consumption, and avoiding over provisioning of resources. The power consumption of Data centers are primarily based on the exploitation of the servers and its cooling systems. The servers normally need up to 70% of their extreme power consumption even at their little utilization level. Therefore, there is a necessity for migration techniques which preserves the energy of servers by optimal resource utilization [6].

II. CHALLENGES WITH DATA MIGRATION

After creation of Cloud services within your organization, you need to migrate some user data, user login, profile details and corporate information to the cloud. Cloud providers must have procedures and templates to appropriately migrate in-house data to public clouds [5]. However, we must be conscious of intrinsic challenges during and after migration, which are as follows:

- Liability Concerns-Cloud providers have maximum data value for damage claims in the Service Level Agreement(SLA).This value might be much lesser than the data or the efforts needed to fix integrity problems or data loss
- Compliance Concerns-The cloud providers must comply with various legal and regulatory requirements such as the Health Insurance Portability and Accountability Act (HIPAA), the Federal Information Security Management Act (FISMA) AND THE International Organization for Standardization (ISO), mandated by your business vertical for data protection and privacy
- Connectivity Concerns-There can be numerous faults in the Wide Area Network links between the consumer and the provider. It is supported by various connectivity providers and is outside the control of the provider or the consumer

Despite these challenges, cloud data and traffic are rising rapidly and are estimated to grow at a Compound Annual Growth Rate (CAGR) of 31% between 2011 and 2016.

III. MIGRATION TECHNIQUES OF CLOUD [12]

There are several ways by which traditionally hosted application or in-house application could be moved to a public or private cloud. The decision requires evaluating requirements related to application architecture, user community, and cost of hosting in the cloud, compliance, IT staff skills and the value of existing infrastructure to support the migration. While migrating to the cloud, there are some key aspects which would hasten the migration of applications to the cloud environment. The key aspects for migrating users to cloud Applications are:

- Technical and business advantages in the cloud
- Criticality of applications that is being moved to the cloud
- Support offered by the Cloud provider
- Elasticity in terms of resource scheduling
- Technical factors such as Cloud infrastructure
- Governance in terms of legal, security and compliance requirements

Various techniques of Cloud Migration are:

A. Application Rehosting

The target platform is Infrastructure as a Service (IaaS). It moves the application and the code to a cloud infrastructure. The advantages of application rehosting are:

- Use of a virtualized resource pool
- Reduced capital expenses
- Use of a shared IT administration team
- No need to re-design or re-write code
- Faster migration timeline

The disadvantages are:

- Application is not natively written for use on a cloud and hence, could miss on cloud benefits such as scalability, dynamic resource use, etc

B. Application Refactoring [7]

The target platform is Platform as a Service (PaaS). It's main function is to migrate to and host the old application on a PaaS provider's infrastructure (Paas must be well-matched with and meet the application needs).

The advantage is:

- Uses a familiar application design, language and development environment

The disadvantages are:

- PaaS might lack useful features
- Lock-in to PaaS vendor
- Risks during or after migration process

C. Application revision and optimization

The target platform is Infrastructure as a Service (IaaS) or Platform as a Service (PaaS).Its main function is to modify existing application code to make it suitable for a private or public cloud; then, rehost/re-factor it for a new deployment.

The advantage is:

- Better performance

The disadvantage is:

- Lots of manpower and development time

D. Application re-architecture and re-building

The target platform is Platform as a Service (PaaS). Its main functions are,

- Discard old code and application
- Design a new architecture
- Develop a new application
- Migrate data to new application
- Test and go live

The advantages are:

- Improved scalability by using service-oriented architecture
- Improved agility and modularity for easier module-based management and upgrades
- Use of new, efficient tools and templates

The disadvantages are:

- Requires lots of investment in time and manpower
- Lock-in
- Loss of familiarity of old code and framework

E. Replacement of the application

The target platform is Software as a Service (SaaS). Its main functions are,

- Discard the old application
- Select a SaaS service that meets the requirement, and copy the old data for use from within the new SaaS service.

The advantage is:

- Reduced IT investment

The disadvantages are:

- Vendor lock-in
- New use for old IT infrastructure needs to be found
- Users may look at it just as a learning curve only

IV. PHASES DURING THE MIGRATION OF AN APPLICATION TO THE PRIVATE OR PUBLIC CLOUD

Migrating a service to the cloud should be careful, with checks at each phase to perceive the acceptance level within the organization. Like, any IT project, it must have a robust management support to help resolve socio-political or technical concerns. The various Migrating Phases are [10]:

1. EVALUATION PHASE

The activities of the evaluation phase are:

- Identify the application, usage pattern over a month or a week, utilization of memory, CPU, storage and bandwidth
- Evaluate cloud options, long-term and short-term expenses, SLA with the provider, security, compliance, technical support, etc
- Identify the tools that you would use and those tools that you needed to develop when hosting in the cloud
- Establish a set of principles for success measurement

Benefits of evaluation phase:

- Identify and document differences in your traditional architecture and proposed cloud environment

- Opportunity to build a case for cloud, such as faster deployment, flexibility, quicker time to market, scalability and agility

2. PROOF OF CONCEPT

The activities of this phase are:

- Select a public cloud service provider/vendor if implementing a private cloud
- Understand the technical environment in the different cloud platforms
- Test existing cloud features or build a private cloud for initial tests
- Build a pilot to validate the cloud features

Benefits of proof of concept phase:

- Helps validate critical parts of the proposed cloud
- Helps establish confidence on proposed solutions
- Helps build an opportunity to identify and overcome shortcomings

3. APPLICATION INSTALLATION AND SETUP

The activities of this phase are:

- Configure database in the cloud.
- Install application in the cloud.
- Configure application.
- Create accounts for user authentication.

Benefits of application installation and setup phase:

- Configure an elastic and scalable infrastructure
- Configure security for data and user access

4. MOVE YOUR DATA

The activities of this phase are:

- Move some user data to the cloud and test it
- Understand data storage options
- Understand database options

Benefit of this phase:

- Use fault-tolerant and highly available storage

5. LEVERAGE THE CLOUD

The activities of this phase:

- Automate elasticity and scalability
- Harden the OS and applications
- Setup backups
- Configure system and user activity logs
- Automatic monitoring and alerts

Benefits of this phase:

- Automated failovers
- Resilient backups
- Improved resource utilization

6. AUDIT AND OPTIMIZE

The activities of Audit and Optimize phase:

- Improved efficiency
- Identify vulnerabilities and tighten security
- Optimize resource utilization
- Improved performance by data caching

Benefits of audit and optimize:

- Easy to meet greater user loads
- Proactive and better monitoring

The proof of concept phase must be used to satisfy key stakeholders who are uncertain or skeptical about supporting the migration. Most of the services such as those based on a 3-tier architecture with web front-ends, back-end information processing, can be efficaciously moved to the cloud to get the advantage of convenience and lower the long-term cost. There are several ways in which traditionally hosted or in-house application can be moved to a public or private cloud.

V. CLOUD EMULATORS FOR APPLICATION TESTING AND MIGRATION

Developing and testing an application in the cloud requires to be connected online and use cloud resources and network bandwidth. This adds the cost of using the cloud. A common alternative is to use Cloud Emulators. Cloud Emulators are the software module that creates an environment on a local Server that resembles a desired cloud platform, in terms of features and interface. Instead of a local server, it could be setup on a remote cloud. The module could be used to develop and test applications before it could be moved to the desired cloud. The advantage of Emulators is that the application development and user testing could be in an emulated, local environment. Later, there is no need to re-develop or test it, when it has been moved to the cloud [9].

VI. CLOUD STORAGE GATEWAYS [1]

To address the security issues and performance in public clouds, consumer organizations can use CSG. The Cloud Storage Gateway is an appliance residing in the customer's premises and provides data protection by encrypting, compressing and archiving data sets before moving the data to the cloud. A CSG at the corporate office captures and manages all the I/O between the cloud storage providers and the users. A CSG is a downloadable software program that could be installed on a server at the customer location. CSGs have local cache to store the data temporarily. Users could download a CSG software and configure a local storage device as the cache. CSGs eliminate the issues of vendor lock-in, as they support different formats and facilitate data backup. In Figure 1, the CSG is located in the customer premises. It could contact the CSG vendor to get credentials for each cloud provider, which the user makes use of and for the call-home features (if enabled).The call-home features allow the CSG to automatically report issues, problems, status and diagnostic reports to the CSG vendor to enable preventive maintenance or accelerate problem resolution. It should able to send data via SMS, e-mail or posting them on the user interface of the monitoring application. To performance, the CSG caches data as well as metadata.

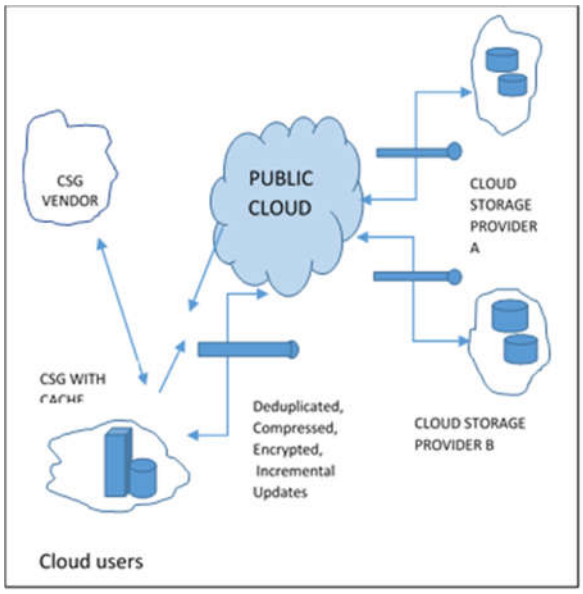

Figure 1: The CSG

The CSG provides data protection in four steps:

a. The CSG cache accelerates I/O rates and enables a convenient replication procedure.
b. Files that are to be copied to the cloud are first stored in the CSG cache.
c. After a certain pre-set time interval, the cache data is pushed to the cloud.
d. Data that is read from the cloud is copied to the cache.

The CSG which you select must deliver the following features:

1. CACHING ALGORITHM

The cache in a CSG provides a buffer of vital data to speed access and reads, instead of having to reach out to the original servers to data each time it is required. The CSG uses certain algorithms such as Least-Recently Used (LRU) algorithm, to enhance the cache hit rate. Using LRU, the CSG keeps a list of all recently-used data in its cache. The advantage is that the user could access parts of the file in less time and does not need to wait longer time to pull the entire file.

2. INTELLIGENT PRE-FETCHING ALGORITHMS

The CSG must monitor the read patterns and intelligently pre-fetch data from the cloud to the cache before the user requests the data. It must use the read history to establish a pattern to predict what the user might request next and proactively fetch the data into the cache. The CSG must measure its success rate and regulate its algorithm in real-time to improve cache hit rate.

3. CACHING TIME PERIODS

Some CSGs allow users to setup a caching time duration. In other cases, it must be aggressive in removing old-cached data in preference to newly-cached data. Smaller cache-time-period provides enough space to store all the newly-written data.

4. SYNCHRONOUS SNAPSHOTS

The CSG must take synchronous snapshot of the user file tree and data. It allows the CSG to identify new and modified data, which are tagged as dirty and moved to the cloud.

5. DATA REPLICATION PROCESS

The CSG must have an efficient data transfer mechanism. Ideally, it must split files into chunks. The data must be de-duplicated, Compressed and encrypted before sending to the cloud.DE-duplication

reduces the amount of data that must be copied to the cloud. Compression reduces storage and bandwidth utilization, and also reduces the fees to the cloud provider.

6. END-TO-END ENCRYPTION

This protects data from being read by unauthorized users and hackers. The CSG must use strong data encryption for the content as well as the metadata. The encryption algorithm must use random keys to avoid anyone from intercepting a series of encrypted data and reverse-engineering the keys. Someone intercepting any data should not be able to decipher any content or metadata.

7. SECURE CHANNELS

Ideally, the data in-transit between the CSG and the Cloud is double encrypted. It is encrypted before it is transmitted and also when it is sent over a Virtual Private Network (VPN) tunnel to the cloud. At the other end of the VPN tunnel, the cloud provider's employees cannot decipher the data, because it is encrypted.

8. DATA COMPRESSION

It helps reduce bandwidth and storage space utilization.

9. CSG TUNING PARAMETERS

The CSG must allow its administrator to tune certain parameters such as maximum bandwidth utilization during certain time periods and cache push intervals.

VII. CONCLUSION

There are several aspects to be considered when migrating users from traditional service to a cloud-hosted service. Some of the aspects are Technical and business advantages in the clouds, Criticality of application to the consumer organization, Cloud environment, such as its infrastructure, elasticity, etc., Support offered by the cloud provider. The migration to the cloud must be in a phased manner and follow a set of steps. The phases are Cloud evaluation, Proof of concept and provider selection, Application setup, Migration of application data to the cloud, Leveraging the benefits of the cloud, Auditing your use of the cloud and optimization. Cloud emulators can prove useful in testing applications before they are moved to a cloud. CSGs are appliances that intercept data travelling between your internal corporate network and public clouds. CSGs protect and encrypt internal corporate data. They perform caching and compression to improve performance. They archive and backup data to improve availability and redundancy.

REFERENCES

[1] https://www.techopedia.com/definition/26537/cloud-storage-gateway

[2] YANG Jing, "Key Technologies and Optimization for dynamic migration of Virtual Machines in Cloud Computing", IEEE 2012

[3] Maya Mohandas,K R Remesh Babu, "Live Migration of Virtual Machines in theHomogeneous Cloud",2016 International Conference on Emerging Technological Trends [ICETT], IEEE 2016

[4] A-young Son, Eui-Nam Huh, "Migration Method for Seamless Service in Cloud Computing: Survey andResearch Challenges", IEEE 2016

[5] Chetan Gudisagar, Bibhu Ranjan sahoo, Sushma M, Jaidhar CD, "Secure Data Migration between Cloud Storage Systems",IEEE 2017

[6] Anandi J.Mungole, M.P. Dhore, "Techniques of Data Migration in Cloud Computing", IOSR Journal of Computer Engineering, 2016

[7] Muhammad Aufeef Chauhan, Muhammad Ali Babar, "Migrating Service-Oriented System to Cloud Computing: An Experience Report", 2011 IEEE 4th International Conference on Cloud Computing.

[8] Sushil Kumar Soni, Ravi Kant Kapoor, "Enhanced Live Migration of Virtual Machine Using Comparison of Modified and Unmodified Pages", International Journal of Computer Science and Mobile Computing, IJCSMC, Vol. 3, Issue. 2, February 2014, pg.779 – 787

[9] Cloud Emulators and its Use for Application Testing and Migration-Wikipedia

[10] https://d1.awsstatic.com/whitepapers/cloud-migration-main.pdf

[12] Jun-Feng Zhao, Jian-Tao Zhou, "Strategies and Methods for Cloud Migration", International Journal of Automation and Computing, April 2014