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Comprehensive Cloud Incremental Data-Application Migration – A Proposed Model for Cloud Migration

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***Abstract* - The cloud is still in its early days as a computing environment, with new technologies and vendors evolving rapidly to address the many issues being faced in the migration and connectivity between traditional computing environments and cloud services. Migrating enterprise InfoTech systems and infrastructure to a private or public Cloud accelerates service delivery with substantial cost cutting. Consumers and small businesses are diverting to the public cloud driven by the compelling and competitive prices for better InfoTech services. On the other hand, the enterprise has been a bit more cautious. While moving to cloud architecture is clearly advantageous, but the process of migration is not simple because many challenges need to be overcome to make Cloud suitable for the enterprise applications, such as cost, performance, security, and interface mismatch. Enterprises which are planning a cloud migration must keep in mind the complexities of the emerging cloud technologies and architectures and should also understand how the process will affect business operations. Companies frequently trumpet there. Cloud enabled services but rarely give any details on precisely how they achieved this or how much of their infrastructure has been fully migrated. Security and reliability of cloud services are often raised as concerns. Without having a quantifiable impact assessment of migrating enterprise resources to a Cloud, generally enterprises are faced with ad-hoc decisions during their cloud migration process. This paper outlines a comprehensive approach for moving data and application migration to Cloud. Proposed model is a hybrid of prototype and a structured phase wise approach. Our Model suggests migrating data and applications into parts. First a little amount of data will be migrated along with the applications. It is then tested and if satisfactory results were found more data will be migrated. This continues till the whole data is migrated.**

***Keywords:* Cloud, Cloud Migration, Legacy systems, Migration Challenges, Migration process.**

I. INTRODUCTION

The advances of the cloud computing phenomenon has changed the way information technology(IT) Services are invented ,developed , deployed, scaled and maintained. Over the last few years startup companies such as Twitter (www.twitter.com) and Animoto (www.animoto.com) have used clouds to build highly scalable systems. However, cloud computing is not just for startups; enterprises are attracted to cloud-based services as cloud providers market their services as being superior to in house data centers in terms of financial and technical dimensions e.g. more cost effective, equally or perhaps more reliable, and highly scalable. Though migration to cloud offer several technological and financial benefits, it is important that we should consider other dimensions also. Little has been available about the various implications of migration to cloud from an organizational perspective. Moreover the organizations are not clear about the migration process and outcomes, hence our model focus on incremental migration in small amount. The growing popularity of cloud migration has accelerated the cloud migration. It has also given rise to several cloud service providers to offer competitive and alluring solutions for organizations.

A. Motivation for Considering Cloud Computing

A number of drawbacks exist with the traditional client server architecture.

Limited System Scalability: The single server has limited capability to scale to meet potential traffic. Meeting potential scalability requirements would require purchase of additional servers that increases cost. Moreover, since user load volumes are variable, purchasing enough hardware to meet peak demand would result in excess hardware during low-demand periods, thereby tying up capital in unneeded capacity.

Limited Storage Scalability: Traditional architecture offers the ability for users to upload large documents and digital media like audio and video, which require large amounts of storage. Since individual servers are typically limited to two drives, it is likely that users will eventually require more storage than is possible on a single server. One option to address this is to move system data to a specialized storage device, which can contain more drives. However, this would require

additional hardware purchase and poses the same issue of over-provisioning capacity.

Vulnerability to Hardware Failure: Users essential data is stored on servers. System outages due to failures could hinder users in their work. Usually data is stored on a single server. This poses a risk, since hardware failure could result in system unavailability until repairs were made. If a component like a network card or a motherboard were to fail, a day or more could pass before system availability was restored. If a disk drive were to fail, not only would the device need to be replaced, but the system would need to be restored from backup, taking even longer.

B. Migration To Cloud Computing

We know that implementing a Cloud intended at replacing an on premise major business application. Before migrating to cloud let's have a look at the major cloud vendors and their offering.

1.2.1 THE MAJOR CLOUD VENDORS

Company	Product & Services
Amazon	S3 (Data storage/file system), SimpleDB (non-relational database) and EC2 (computing servers)
Rack space	Cloud Drive (Data storage/file system), Cloud Sites (web site hosting on cloud) and Cloud Servers(computing servers
Go Grid's	Cloud Hosting (web site hosting on cloud) and Cloud Storage (Data storage/file system)
IBM	Smart Business Storage Cloud and Computing on Demand (CoD), Lotus Live iNotes, a web based email service that provides messaging and calendaring
AT&T	Synaptic Storage as a service and Synaptic Compute as a service.
Google	GoogleAPPEngine Development platform based upon Python and Java. SaaS space include Google Docs,
Force.Com	A development platform based upon a proprietary programming language called Apex
Microsoft	Microsoft Azure A development platform based upon .Net
Zoho	Vast suite of online products similar to Microsoft office suite.

TABLE 1: CLOUD COMPUTING VENDORS AND OFFERINGS

Though cloud migration may seem a simple straight forward process, it is burdened with loose ends which may undermine the true value of the investment and in fact put enterprises in worst situation than before.

1. 1.2.2 Challenges for migration [8] [12]

All applications as well as the supporting network infrastructure may not be suitable for migration onto the Cloud. There are both business and technical factors to consider while evaluating the suitability of an application and infrastructure for Cloud migration. The various Cloud migration challenges are depicted below.

Existing investments in IT: For migrating into the cloud, Small and Medium Enterprises (SMEs) are at an advantage over large organizations because they have a limited installed IT base. They may be able to directly move into the Cloud. In comparison large organizations huge investments and complexity of hardware, network, application support, administration, customization and integration make it difficult for them to migrate to cloud easily.

Costs: The existing cost model for IT is a combination of capital expenditure and operational expenditure. It is important for organizations to estimate application usage and operational costs before moving to the Cloud. Migration costs should also be factored in before making the decision to move into the Cloud. Failure to do this could negate the cost savings.

Data security [11]: One of the crucial issues while migrating to cloud is security of data. Organizations resist sending sensitive applications and confidential information behind the corporate firewall. Data with greater security tolerance however could be ported onto the Cloud. Security of data is still the top most inhibiter of Cloud adoption.

Regulations: Geopolitical issues especially for Governments and financial institutions should be carefully evaluated before making the transition to the Cloud. In the Indian context this is especially relevant as most Cloud data centers are not located within the country. It is also important to ensure that local regulations relevant to each organization should be adhered to before deciding to move to the Cloud

Existing infrastructure: Cloud migration makes change in the IT architecture necessary which further changes the way IT is delivered to end users. Hence, organizations would have to concentrate on building vendor management competencies.

Complexity: Simple applications can be easily migrated to the Cloud and the amount of effort required moving such applications may not be not too significant. Migration of complex applications however, needs elaborate planning and testing prior to implementation. Legacy applications and existing enterprise applications could require code changes to work on the Cloud.

Network and support: Moving to cloud makes you totally dependent on network. A large number of connections are required and hence the bandwidth and reliable network connection.

IT skills: Migration to Cloud requires IT team with updated skills like virtualization, Web 2.0 etc. These types of challenges need to be addressed prior to deciding the migration to the Cloud.

Service Level Agreements (SLAs): Another key aspect to consider before migrating to the Cloud is whether Cloud service providers are able to provide SLAs that the business needs. It should clearly outline service provider responsibilities and penalties for failure to meet agreed service levels

2. 1.2.3 Existing Cloud Migration Models and their limitations

3. 1.2.3.1 Existing Model 1 -The seven-step model of migration into a cloud[13]

The Seven-Step Model of Migration into the Cloud is an effort in understanding and leveraging the cloud computing service offerings in the enterprise context. The model is as follows

1. Conduct Cloud Migration Assessments
2. Isolate the Dependencies
3. Map the Messaging & Environment
4. Re-architect & Implement the lost Functionalities
5. Leverage Cloud Functionalities & Features
6. Test the Migration
7. Iterate and Optimize

Cloud migration assessments comprise assessments to understand the issues involved in the specific case of migration at the application level or the code, the design, the architecture, or usage levels. In addition, migration assessments are done for the tools being used, the test cases as well as configurations, functionalities, and NFRs of the enterprise application. Proof of concepts or prototypes for various approaches to the migration along with the leveraging of pricing parameters enables one to make appropriate assessments. These assessments are about the cost of migration as well as about the ROI that can be achieved in the case of production

Fig 1. The Seven Step Model of Migration into the Cloud (Source: Infosys Research) [13].

version. The next process step is in isolating all systemic and environmental dependencies of the enterprise application components within the captive data center. This, in turn, yields a picture of the level of complexity of the migration. After isolation is complete, one then goes about generating the mapping constructs between what shall possibly remain in the local captive data center and what goes onto the cloud. Perhaps a substantial part of the enterprise application needs to be rearchitected, redesigned, and reimplemented on the cloud. This gets in just about the functionality of the original enterprise application. Due to this migration, it is possible perhaps that some functionality is lost. The next process step leverages the intrinsic features of the cloud computing service to augment enterprise application in its own small ways. Having done the augmentation, validation and test of the new form of the enterprise application is done with an extensive test suite that comprises testing the components of the enterprise application on the cloud as well. These test results could be positive or mixed. After several such optimizing iterations, the migration is deemed successful. Best practices indicate that it is best to iterate through this Seven-Step Model process for optimizing and ensuring that the migration into the cloud is both robust and comprehensive. Though not comprehensive in enumeration, it is representative

4. Challenges in Seven Step Model

The biggest challenge to any cloud migration project is how effectively the migration risks are identified and mitigated. In the Seven-Step Model of Migration into the Cloud, the process step of testing and validating includes efforts to identify the key migration risks. In the optimization step, we address various approaches to mitigate the identified migration risks.

5. 1.2.3.2 Existing Model 2: Factory Model to Bulk Cloud Migration [9]

Cloud assessment and migration of multiple applications can be handled well using a factory approach. The majority of personnel are allocated to migration teams that make up the factory. QA teams validate the correctness of what the factory produces. An Advance Team analyzes applications first and keeps the factory equipped for the types of work it needs to do. An Exceptions Team supports factory members, helping with problems and sometimes taking over difficult migrations directly. The "factory" is one or more technical teams who are able to rapidly perform migration tasks. This type of work favors a heavy offshore component to keep costs down. Migration tasks could be complete migrations or assembly-line style partial tasks. Like a physical factory, one or more supervisors are needed to oversee how things are going and ensure the factory is humming along as it should be. Problems that stop the assembly line need to be dealt with swiftly.

The Factory: Migration Teams Performing Repeatable Technical Work

The Advance Team: Equips the Factory for New Kinds of Work

The factory only knows how to manufacture what is has been configured to make. The Advance Team consists of architects and technology subject matter experts who

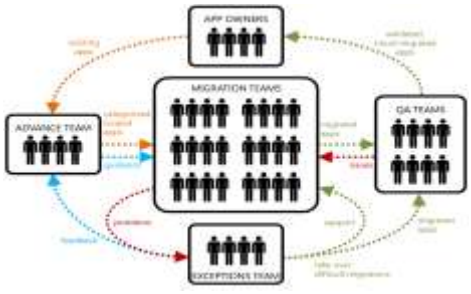

Figure 2. Factory Model to Bulk Cloud Migration [9]

analyze applications before they are handed off to the factory, categorizing them as previously-encountered types or something new. New kinds of applications are studied, and updated migration guidance for the factory is created. The advance team also sizes the migration effort required. The Advance Team receives feedback from the Exceptions Team on how migration work is going.

The Exceptions Team: Supports the Factory and Takes over Difficult Migrations

The factory model is all well and good, but occasional surprises and difficulties are inevitable. The Exceptions Team supports the migration teams and helps them through problems with support. If necessary, the Exceptions Team will take over a difficult migration directly. Unusual, one-of-a-kind, or highly complex migrations will be handled by the Exceptions Team.

The QA Teams: Validation of Completed Migrations

The quality assurance teams test migrations produced by the factory to confirm quality requirements are met and the migrated apps have fidelity to the original apps. Often this will consist of a cursory check (performed by the integration partner) followed by user acceptance testing (per-formed by the owner organization).

1.2.3.2.1Challenges in Bulk Migrations

A bulk migration is a serious commitment. Whereas an individual application migration might be sponsored by a single department, a bulk migration implies broad buy-in by departments across the organization on a cloud strategy and supporting operational changes. A bulk migration isn't likely to happen until there is a strong degree of confidence and consensus by stake-holder departments on cloud vision, platform/provider, and integration partner.

A bulk migration is challenging to estimate properly. In a single-application migration the candidate application can be deeply studied. In a bulk migration you rarely have that luxury and need to make high-level estimates based more on tribal knowledge about applications and less on direct examination of code.

A bulk migration represents a sizeable effort, one that needs to be carefully managed. Surprises can surface in the midst of any application migration; when performing a large number of migrations in parallel a mounting number of surprises could quickly put the budget and timeline at risk if not managed well.

A bulk migration may encounter product obstacles. Products your software is dependent on may or may not be compatible with the cloud. Even without technical hurdles, you may be unable to use some products in the cloud for licensing and support reasons.

1.2.4 A Comprehensive Cloud incremental Data Application Model – A Proposed Model for Cloud Migration

6. 1.2.4.1 Introduction

We suggest a comprehensive approach for moving data and application migration to Cloud. Proposed model is a hybrid of prototype and a structured phase wise approach. Our Model suggests migrating data into parts. First a little amount of data will be migrated along with the applications. It is then tested and if satisfactory results were found more data will be migrated. This continues till the whole data is migrated.

Phase 1: Cloud Assessment Phase

Phase 1 assess the cloud as per its cost, architecture, Risks and security. The assessment will be a pure comparative study of traditional onsite infrastructure management and cloud computing. Weighing the financial considerations of owning and operating a data center or co-located facilities versus employing a cloud-based infrastructure requires detailed and careful analysis. In practice, it is not as simple as measuring potential hardware expense alongside utility pricing for compute and storage resources. Indeed, businesses must take a multitude of options into consideration in order to affect a valid comparison between the two alternatives.

Phase 2: Data Migration Phase

In this phase the basic requirements for data migration were analyzed. Various storage options, different RDBMS (commercial and open source) options, need to be explored. Data are segmented. And the efforts required to migrate data to the cloud is calculated. Our Model suggests migrating data into small increments.

Phase 3: Application Migration Phase

In this phase we suggest moving the application in parts rather than moving all applications at once. This reduces the risk of unexpected behavior after migration and is ideal for large systems that involve several applications. This strategy can be used to integrate cloud applications with other cloud-incompatible legacy applications (Mainframe applications or applications that require specialized hardware to function). In this strategy, you might have to design,

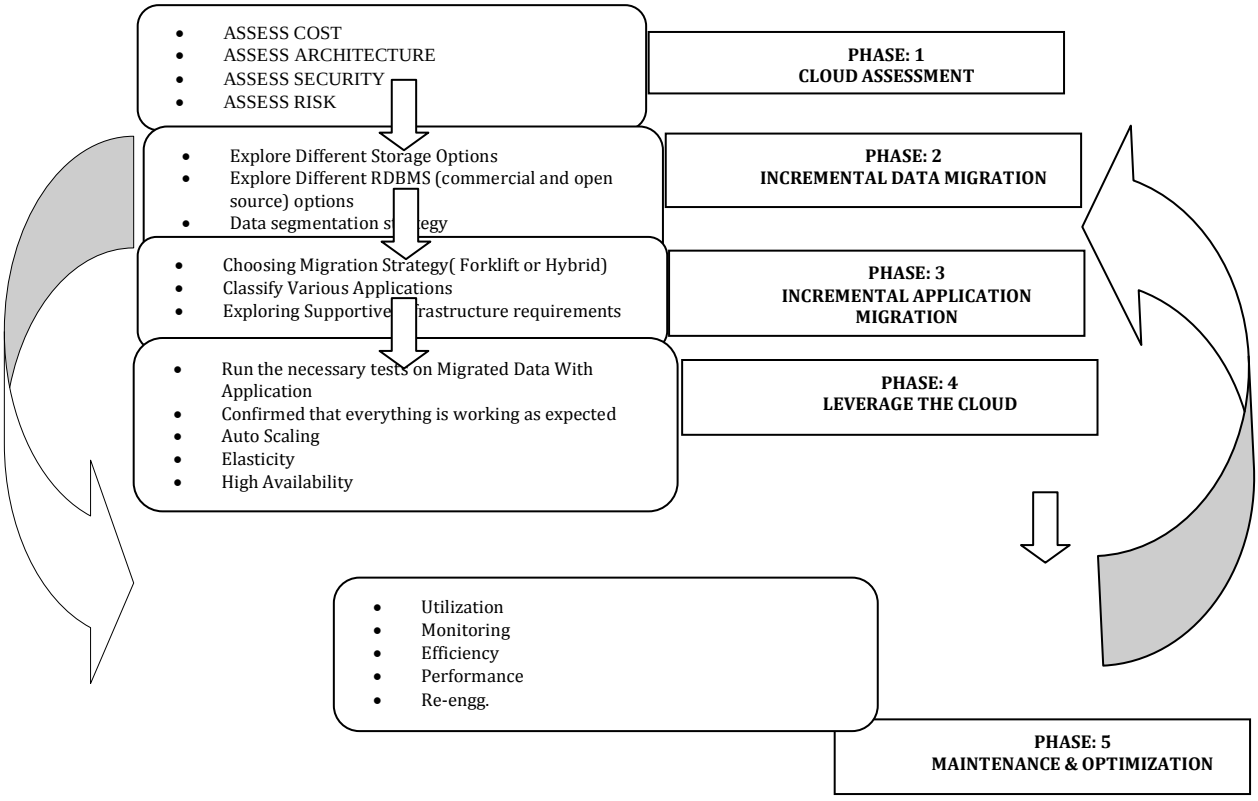

Figure 3: A Comprehensive Cloud incremental Data-Application Model Cloud Migration

architect and build temporary "wrappers" to enable communication between parts residing in your traditional datacenter and those that will reside in the cloud.

Phase 4: Leverage the Cloud Phase

After you have migrated your data and application to the cloud, run the necessary tests, and confirmed that everything is working as expected. First Small data migrated will be tested with the migrated application and if everything goes as expected some more data and its supportive applications will be migrated and tested. Our model follows an incremental approach for data–application combinational migration. This phase also includes providing additional benefits of the cloud like auto scaling, edge caching your static content, auto-recovery and most importantly, elasticity. Elasticity is a fundamental property of the cloud and can be implemented at different levels of the application architecture. Implementing elasticity might require refactoring and decomposing your application into components so that it is more scalable. In this phase, you should try to automate elasticity which enables you to quickly start any number of application instances when you need them and terminate them when you don't, while maintaining the application upgrade process.

Phase 5: Optimization Phase

In this phase, you should focus on how you can optimize your cloud-based application in order to increase cost savings. Since you only pay for the resources you consume, you should strive to optimize your system whenever possible. In most cases, you will see immediate value in the optimizations. A small optimization might result in thousands of dollars of savings in your next monthly bill. Terminate your under-utilized virtual instances, understand your usage patterns, and improve efficiency of your application architecture by implementing caching wherever you can. Invest in advanced monitoring and telemetry of your applications so you get better visibility into your applications remotely.

II. CONCLUSIONS

Though migrating to a cloud include lot of challenges, there are significant opportunities and success factors for a well designed cloud migration strategy using the iterative migration into the Cloud. It is challenging given the complexity of comprehending the various factors involved for a successful migration. The proposed iterative Model of Migration into the cloud helps structure and organize one's efforts in putting together a plan of action and process to successful complete the migration without problems.

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REFERENCES

[1] Michael Armbrust, Armando Fox, Rean Griffith, Anthony D. Joseph, Randy Katz, Andy Konwinski, Gunho Lee, David Patterson, Ariel Rabkin, Ion Stoica, and Matei Zaharia. A view of cloud computing. Communications of the ACM, 53:50–58, April 2010.

[2] Boto: Python interface to Amazon Web Services. http://code.google.com/p/boto/.

[3] Yao Chen and Radu Sion. To Cloud or Not To Cloud? Musings on Costs and Viability. http://www.cs.sunysb.edu/~sion/research/cloudc2010-draft.pdf.

[4] IDC. Global market pulse. http://i.dell.com/sites/content/business/smb/sb360/en/Documents/0910-us-catalyst-2.pdf.

[5] Prince Mahajan, Srinath Setty, Sangmin Lee, Allen Clement, Lorenzo Alvisi, Mike Dahlin, and Michael Walfish. Depot: Cloud storage with minimal trust. In Proceedings of the 9th USENIX conference on Operating systems design and implementation (OSDI), 2010.

[6] Nasuni. Nasuni: The gateway to cloud storage. http://www.nasuni.com/.

[7] Richard Holland: Ten Steps to Successful Cloud Migration.2010 http://www.eaglegenomics.com/download-files/whitepaper/CloudWhitePaper.pdf.

[8] C. Ward, N. Aravamudan, K. Bhattacharya, K. Cheng, R. Filepp, R. Kearney, B. Peterson, L. Shwartz, C. C. Young ,IBM , Workload Migration into Clouds – Challenges, Experiences, Opportunities, 2010 IEEE 3rd International Conference on Cloud Computing.

[9] David Pallmann: Applying the Factory Model to Bulk Cloud Migration, 2010 http://neudesic.blob.core.windows.net/docs/Applying the Factory Model to Bulk Cloud Migrations.pdf.

A. Khajeh-Hosseini, I. Sommerville, and D.Greenwood, Cloud Migration: A Case Study of Migrating an Enterprise IT System to IaaS Submitted to 1st ACM Symposium on Cloud Computing (SOCC 2010), 2010.

[10] Seccombe A, Hutton A, Meisel A, Windel A, Mohammed A, icciardi A, et al. Security guidance for critical areas of focus in cloud computing, v3.0. Cloud Security Alliance, 2011, 176 p.

[11] P. Mohagheghi, T. Saether, Software Engineering Challenges for Migration to the Service Cloud Paradigm Ongoing Work in the REMICS Project, 2011 IEEE World Congress on Services.

[12] Cloud Computing: Principles and Paradigms edited by Rajkumar Buyya, James Broberg, Andrzej M. Goscinski