



## Migration of Existing Applications to Cloud and Among Clouds

**J. Priya Shanthi \***

Student, MCA III-II

*Department of Computer Applications  
Sreenidhi Institute of Science and Technology,  
Hyderabad, India*

**Parsi Kalpana**

Assistant Prof.

*Department of Computer Applications  
Sreenidhi Institute of Science and Technology,  
Hyderabad, India*

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**Abstract—** *Cloud computing is a form of parallel and distributed system where the resources are shared dynamically and services are provided to customers on demand. It is a new, rapidly growing technology. Hosting applications on a cloud saves a lot of time and effort for the organization as well as their clients. This paper addresses the security issues in cloud computing and computing paradigm called DPaaS which is used as a suite for security and how migration is possible for existing applications to the cloud and among clouds.*

**Keywords—** *Cloud Computing, DPaaS, OpenVirtualFormat, Cloud migration, Portability*

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### I. INTRODUCTION

Technology is constantly evolving and continually changing-there's always more to learn! To survive in this competitive world we must always upgrade ourselves with the current technology. Cloud Computing is one of the burning issues in the present scenario wherein many organizations are still in a dilemma whether to adopt cloud computing or not? If yes, then how do they migrate their existing applications to cloud?

Any applications if they are developed by following certain standards then we can ensure its migration with minor changes. First let us understand the basic cloud terminology. A cloud is a combination of hardware, networks, storage, services and interfaces that helps in delivering computing as a service. Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. In this computing environment the users have to pay only for the duration for which they utilize the resources and this model is popularly called as "pay-per-usage" model. It can be compared to that of utility computing such as electricity. Cloud computing helps in the utilization of investment in the corporate sector; therefore it is cost saving. It helps in developing scalable and robust applications within a short duration. It also helps in saving time in terms of deployment and maintenance. Cloud service is a service that is used to build cloud applications. It provides the facility of using the cloud application without installing any software on the computer. It reduces the effort in maintaining and supporting the application as compared to the effort in maintaining and supporting those applications that are not developed using the cloud service.

#### A. Models of Cloud Services

1) *Infrastructure as a Service (IaaS)*: IaaS provides storage and computer resources that developers and IT organizations can use to offer customized business solutions.

2) *Platform as a Service (PaaS)*: PaaS enables the provider to deliver the additional amount of infrastructure. It offers a solution stack, which is a mutually inclusive set of software to help developers at the time of development of an application and its execution.

3) *Software as a Service (SaaS)*: SaaS delivers the software as a service over the internet. SaaS also provides security and reliability by incorporating virtual private networks (VPN's). This enables the user to transfer the data securely over the network, such as internet.

#### B. Deployment Models used in Cloud

1) *Public Cloud or external cloud*: It is freely available for access. You can use a public cloud to collect data pertaining to the purchase of items from a web site on the internet.

2) *Private Cloud*: Allows the usage of services by a single client on a private network.

3) *Hybrid Cloud*: Consists of multiple service providers. This model integrates various cloud services for hybrid web hosting. It is basically a combination of private and public cloud feature.

### II. SECURITY ISSUES

There are significant concerns that need to be addressed when considering moving critical applications and sensitive data to public and shared cloud environments. Some of the threats are:

- A. *Data Breaches*: It is the topmost threat in the present scenario. As a result of this threat many service providers like Yahoo, eHarmony, LinkedIn and others have suffered a lot.
- B. *Data Loss*: This threat is not from cybercriminals, but from cloud service providers themselves. Accidental deletion happens more often than a lot of people may think and this may cause damage to the reputation of both the customer and the service provider.
- C. *Account Hijacking (or Service Hijacking)*: It is not a new threat. It includes attack methods such as phishing, fraud and exploitation of software vulnerabilities.
- D. *Insecure APIs*: Cloud computing providers provide a set of interfaces or APIs to customers in order to interact and manage the cloud services. Furthermore, organizations and third parties often build upon these interfaces to offer value-added services to their customers, increasing the risk to an organization if the APIs are insecure.
- E. *Malicious Insiders*: There is often little or no visibility into the hiring standards and practices for cloud employees. This kind of situation clearly creates an attractive opportunity for an adversary—ranging from hobbyist hacker, to organized crime, to corporate espionage, or even nation-state sponsored intrusion. Other threats include Denial of Service, Abuse of Cloud Services, Insufficient Due Diligence, and Shared Technology Issue [1]. Cloud computing promises rapid scaling, lower costs, service availability and easier maintenance anywhere, anytime but the major challenge is how to ensure and build confidence that the cloud can handle user data securely. A recent Microsoft survey revealed that “58 percent of the public and 86 percent of business leaders are excited about the possibilities of cloud computing. But more than 90 percent of them are worried about availability, security, and privacy of their data as it rests in the cloud.” [2]

The final decision is left to the clients to decide the vendors, based on their willingness to implement secure policies and be subject to 3rd party verifications. Dawn Song, Elaine Shi, and Ian Fischer, University of California, Berkeley described a computing paradigm called Data protection as a Service (DPaaS)[3]. In this approach key management and access control is moved to a middle tier (the computing platform) to balance the rapid development and easy maintenance with user-side verifiability. But now the question arises, how to make it easy for existing applications to migrate to DPaaS cloud or to a cloud environment? How migrations are possible to and among clouds?

Migration of an application is not an easy task because there may be many differences between the original and target environments. Even cloud applications are not typically designed to be portable. Applications created on various cloud development platforms, such as Google App Engine, Windows Azure and Force.com, are usually designed to run on the platform they were developed on, other elements such as operating systems, networking architecture and virtual machine (VM) configuration and other factors can differ from those in the environment where the application was developed or deployed. To understand the concept of migration to cloud and among clouds lets we first understand the following terminology:

Application migration is the process of moving an application program from one environment to another i.e., migration from an on-premises enterprise server to a cloud provider’s environment or from one cloud environment to another. Interoperability is the ability of software and hardware on different machines from different vendors to interact with each other effortlessly. Portability is the ability to move applications and data from one computing environment to another.

### **III. MIGRATION BASICS**

There are several aspects of the application architecture that need to be considered when we want to migrate an application from on-premises to the cloud or to create a new application on a cloud service.

#### *A. Application management*

Irrespective of whether your application is running on-premises or in the cloud, the operations management team needs data that will enable them to make effective decisions. Issues like service-level agreements, customer billing, application monitoring, traffic analysis, capacity planning and managing costs etc. need to be resolved before the application is deployed to production or before it is created.

#### *B. Application security*

The major concern of any organization migrating to the cloud is security. Most of the companies have invested a substantial amount of time, money and engineering into designing and developing a security model. To address these concerns, the cloud provider must develop sufficient controls to provide the same or greater level of security than the organization would have if the cloud were not used.

#### *C. Application compatibility*

It is important to evaluate your application to see if it’s a good fit, with the ability to run native code and run the applications with full trust i.e., verify whether the application is running correctly in the development environment.

#### *D. Database compatibility*

It is very important to check the size of your database and how it fits within the database allowances of the cloud provider. Consumers of cloud services may seek cloud portability so that, they can migrate services to a new provider in response to price increase or a breached service-level agreement. Other consumers may seek cloud portability capabilities

to fulfil a business need, such as moving cloud-based resources to another provider that is geographically closer to the consumers of the cloud service.

#### IV. PORTABILITY

The goal around migrating among cloud is to somehow make applications more cloud portable. Some of the ways to achieve it are [4]:

- Architect the applications to increase portability.
- Develop open standards for clouds.
- Find tools that move applications around clouds without requiring changes.

##### A. Architect the applications to increase portability

Most of the present large, old monolithic applications are not portable and they must be rebuilt in order to fit in the target environment. Many newer applications being built today are not very portable, certainly not cloud portable. And there are some applications that require special hardware to facilitate their portability. So, some of the cloud experts have indicated how important an application's architecture reflects on the ability to move it from one cloud to another. Some of the architectures include Traditional application architecture, Synchronous application architecture, and Asynchronous application architecture.

Appropriate cloud application architectures are needed as a solution for cloud interoperability, and for existing applications to facilitate migration, they need to be re-architected. The main factors to be considered for application architecture are "where the application is developed and where it is to be run?"

One suggestion is to design the application and its supporting stack components not to rely on the operating system and the infrastructure. The more you do this; the better off you will be with respect to interoperability and application migration. Also consider using fourth-generation languages or interpretive systems to build applications which will enhance the chances of interoperability.

The problem you might run into is, not getting the performance and/or the functionality you need. In addition, you may have to avoid certain performance and capability benefits that could be available with hypervisor tools or from the specifics of an operating system. You also might have to go for a generic operation of your application with min-set functionality to make it portable from cloud to cloud. The more generic and higher level the application is, the greater your chances of moving it to cloud and among clouds.

##### B. Develop open standards for clouds

Standards are the key to achieve portability. Open cloud standards are considered the eventual solution to issues around application migration and cloud interoperability. Cloud portability requires interoperability among cloud providers, which means one cloud provider, must be able to replicate the application environment that the previous cloud provider had established for service.

Open Virtualization Format (OVF) from the Distributed Management Task Force [5], for example, was developed to address portability concerns between various virtualization platforms. IEEE has formed a working group [6] to develop a set of interoperability. It has originated in two groups, as shown in Fig. 1:

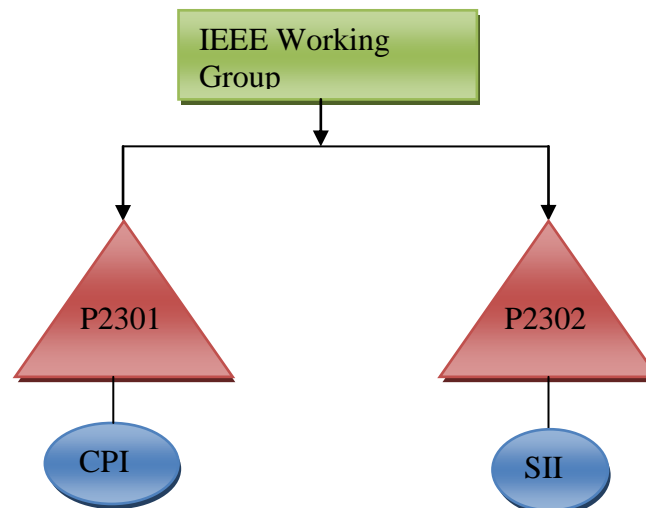


Fig. 1 Figure depicting IEEE working group that develops sets of interoperability

1) *P2301*: This group develops the guide for Cloud portability and Interoperability Profiles (CPIP). It assists the cloud computing vendors and users in developing, building, and using standards-based cloud computing products and services, which lead to increased portability, commonality, and interoperability.

2) *P2302*: This group is responsible for developing the Standard for Intercloud Interoperability and Federation (SIIF). It defines topology, functions, and governance for cloud-to-cloud interoperability and federation. It also creates an economy amongst cloud providers that are transparent to users and applications, which provides for a dynamic infrastructure that can support evolving business models.

Application and data portability is a key requirement, whether moving to the cloud for the first time or moving from one cloud to another. Data portability is more complex and more fundamental to the notion of portability because the control over data is handed over to the owner of the data, not the web application that uses it or the service provider that hosts the application. Cloud consumers need to maintain control of their data. Moving data from one cloud provider to another includes the need to securely delete the old storage space. The data porting process is not complete, however, until the data is removed or erased from the old cloud provider's storage. The key to data portability is that the user's data and Meta data are available in a well documented and well-tested format available to all, for use on other platforms.

### C. Finding tools that move applications around clouds without requiring changes

In order to migrate applications to cloud, you may decide to start working with a cloud provider template where the provider gives you an operating system. You will then try to put your application on it, fixing up the things that are mismatched between the source environment and the target environment. Doing so, you are really rewriting your application. Hopefully you won't have to rewrite it all, but you will surely change configuration and other things. Finally you will end up with a different application which results in two different versions of the application. This could be good or bad, but either way you will have at least two versions of your application—the data centre version and the cloud version.

The best solution is to use the existing software tools for cloud migrations. Using these tools we can migrate our application from a non-cloud environment to a cloud environment as shown in Fig. 2(a) and cloud applications migration from one vendor to another vendor. In Fig. 2(b) shows how a cloud application under vendor A's environment is migrated to the cloud environment of another vendor B with the help of a software migration tool. Some of the examples of such tools are CloudSwitch [7] and Racemi[8] etc. that will ease the difficulty and make hybrid clouds more of a reality.

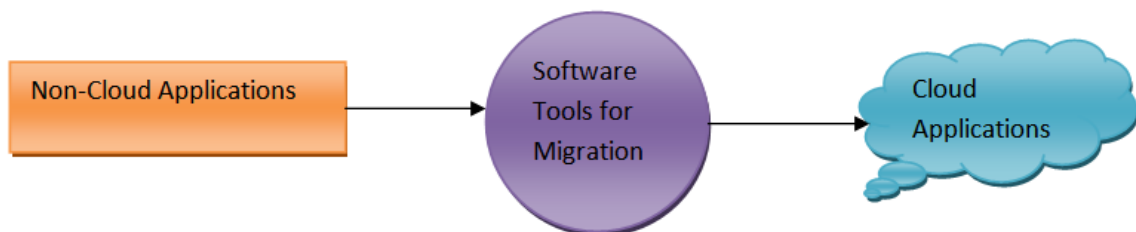


Fig. 2(a) Application migration from non-cloud environment to cloud environment

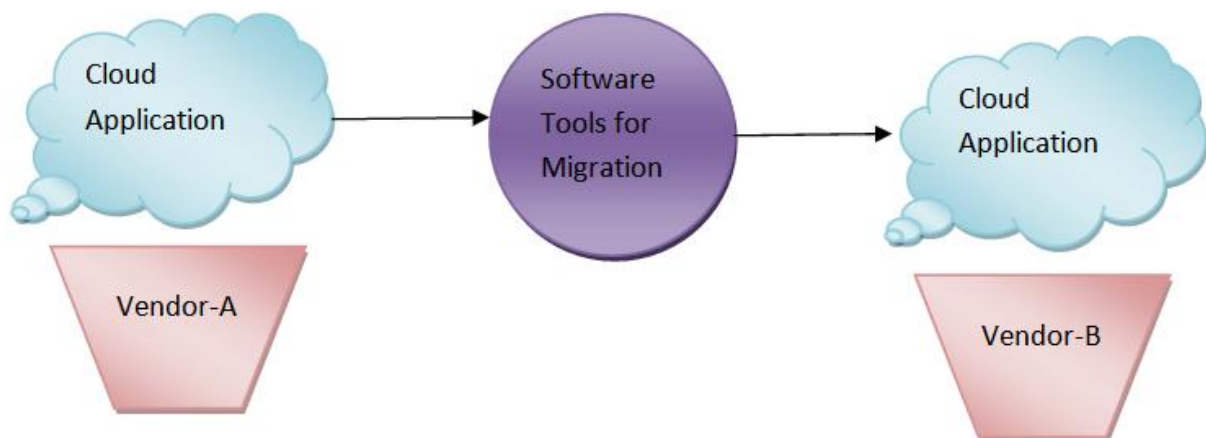


Fig. 2(b) Cloud application migration from one vendor to another

CloudSwitch is a company that makes cloud migration software. This company's product makes it easier for users to move applications and workload securely between their business premises and the cloud.

## V. CONCLUSIONS

In this paper we have discussed the basic cloud terminology, security concerns, DPaaS security suite and issues regarding migration. Migration cost can be lowered by using certain best practices such as choosing cloud providers who support a wide range of programming languages and application runtime and middleware, as well as variety of cloud development models independent of other choices that the user may have made. As the technology moves forward in the years to come security, migration will not be a concern surrounding the adaptation of cloud technology, these hurdles would have been overcome and something new will be the concern.

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