

## UNIT - 2

### MIGRATING INTO A CLOUD: INTRODUCTION

Cloud computing has been a hotly debated and discussed topic amongst IT professionals and researchers both in the industry and in academia. There are intense discussions on several blogs, in Web sites, and in several research efforts. This also resulted in several entrepreneurial efforts to help leverage and migrate into the cloud given the myriad issues, challenges, benefits, and limitations and lack of comprehensive understanding of what cloud computing can do.

On the one hand, there were these large cloud computing IT vendors like Google, Amazon, and Microsoft, who had started offering cloud computing services on what seemed like a demonstration and trial basis though not explicitly mentioned. They were charging users fees that in certain contexts demonstrated very attractive pricing models.

Most enterprises today are powered by captive data centers. In most large or small enterprises today, IT is the backbone of their operations. Invariably for these large enterprises, their data centers are distributed across various geographies.

They comprise systems and software that span several generations of products sold by a variety of IT vendors. In order to meet varying loads, most of these data centers are provisioned with capacity beyond the peak loads experienced.

Many data center management teams have been continuously innovating their management practices and technologies.

Cloud computing turned attractive to them because they could pass on the additional demand from their IT setups onto the cloud while paying only for the usage and being unencumbered by the load of operations and management.

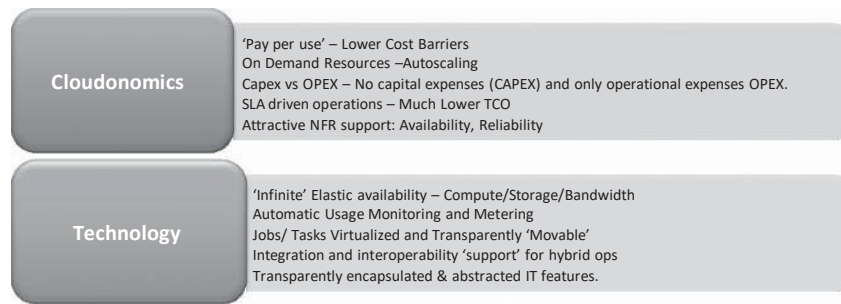
#### The Promise of the Cloud

1. The promise of the cloud both on the business front (the attractive cloudonomics) and the technology front widely aided the CxOs to spawn out several non-mission critical IT needs from the ambit of their captive traditional data centers to the appropriate cloud service.
2. Invariably, these IT needs had some common features: They were typically Web-oriented; they represented seasonal IT demands; they were amenable to parallel batch processing; they were non-mission critical and therefore did not have high security demands. They included scientific applications too [7]. Several small and medium business enterprises, however, leveraged the cloud much beyond the cautious user.
3. Many startups opened their IT departments exclusively using cloud services—very successfully and with high ROI. Having observed these successes, several large enterprises have started successfully running pilots for leveraging the cloud.
4. Many large enterprises run SAP to manage their operations. SAP itself is experimenting with running its suite of products: SAP Business One as well as

SAP NetWeaver on Amazon cloud offerings.

5. Gartner, Forrester, and other industry research analysts predict that a substantially

significant percentage of the top enterprises in the world would have migrated most of their IT needs to the cloud offerings by 2012, thereby demonstrating the widespread impact and benefits from cloud computing. Indeed, the promise of the cloud has been significant in its impact.



**The promise of the cloud computing services.**

## **BROAD APPROACHES TO MIGRATING INTO THE CLOUD**

### **Why Migrate:**

There are economic and business reasons why an enterprise application can be migrated into the cloud, and there are also several number of technological reasons.

Many of these efforts come up as initiatives in adoption of cloud technologies in the enterprise, resulting in integration of enterprise applications running off the captive data centers with the new ones that have been developed on the cloud.

At the core, migration of an application into the cloud can happen in one of several ways:

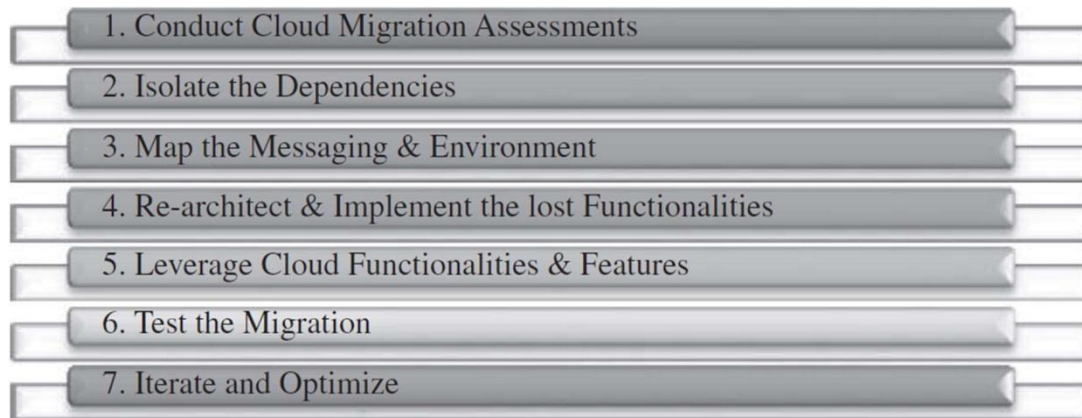
1. Either the application is clean and independent.
2. Perhaps some degree of code needs to be modified and adapted or the design (and therefore the code) needs to be first migrated into the cloud computing service environment
3. Perhaps the migration results in the core architecture being migrated for a cloud computing service setting, this resulting in a new architecture being developed, along with the accompanying design and code implementation.
4. Perhaps while the application is migrated as is, it is the usage of the application that needs to be migrated and therefore adapted and modified.
5. Migration can happen at five levels i.e.,
  1. Application
  2. Code
  3. Design
  4. Architecture
  5. Usage

With due simplification, the migration of an enterprise application is best captured by the following:

$$P \rightarrow P_C + P_I \rightarrow P_{OFC} + P_I$$

1. where  $P$  is the application before migration running in captive data center.
2.  $P_C^0$  is the application part after migration into a (hybrid) cloud.
3.  $P_l^0$  is the part of application being run in the captive local data center.

#### Seven-Step Model of Migration into a Cloud



Step-1: 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. These assessments are about the cost of migration as well as about the ROI that can be achieved in the case of production version.

Step-2: Isolating all systemic and environmental dependencies of the enterprise application components within the captive data center.

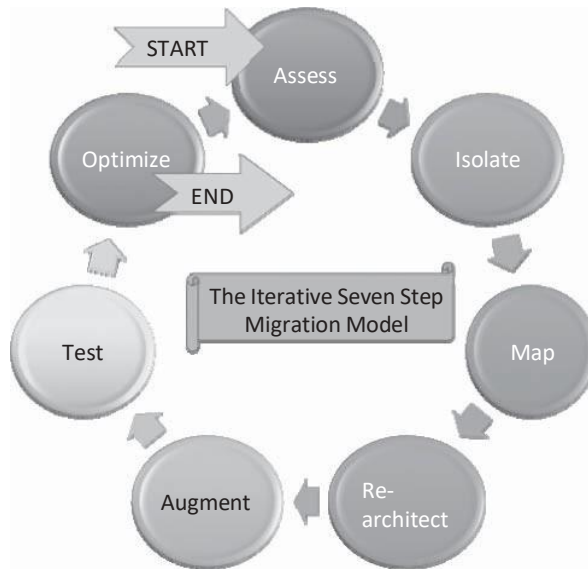
Step-3: Generating the mapping constructs between what shall possibly remain in the local captive data center and what goes onto the cloud.

Step-4: substantial part of the enterprise application needs to be rearchitected, redesigned, and reimplemented on the cloud

Step-5: We leverage the intrinsic features of the cloud computing service to augment our enterprise application in its own small ways.

Step-6: We validate and test the new form of the enterprise application with an extensive test suite that comprises testing the components of the enterprise application on the cloud as well

Step-7: Test results could be positive or mixed. In the latter case, we iterate and optimize as appropriate. After several such optimizing iterations, the migration is deemed successful



### Enriching the ‘Integration as a Service’ Paradigm for the Cloud Era

1. The trend-setting cloud paradigm represents the cool conglomeration of a number of proven and promising Web and enterprise technologies. Though the cloud idea is not conceptually new, practically it has brought in myriad tectonic shifts for the whole information and communication technology (ICT) industry.
2. The cloud concepts have progressively and perceptibly impacted the IT and business domains on several critical aspects. The cloud computing has brought in series of novelty-packed deployment, delivery, consumption and pricing models whereas the service orientation prescribes as much simpler application design mechanism.
3. The noteworthy contribution of the much-discoursed and deliberated cloud computing is the faster realization and proliferation of dynamic, converged, adaptive, on-demand, and online compute infrastructures, which are the key requirement for the future IT.
4. The delightful distinctions here are that clouds guarantee most of the nonfunction requirements (Quality of Service (QoS) attributes) such as availability, high performance, on-demand scalability/elasticity, affordability, global-scale accessibility and usability, energy efficiency etc.
5. Having understood the exceptional properties of cloud infrastructures (hereafter will be described as just clouds), most of the global enterprises (small, medium and even large) are steadily moving their IT offerings such as business services and applications to clouds. This transition will facilitate a higher and deeper reach and richness in application delivery and consumability.
6. Product vendors having found that the cloud style is a unique proposition are moving their platforms, databases, and middleware to clouds. Cloud Infrastructure providers

are establishing cloud centers to host a variety of ICT services and platforms of worldwide individuals, innovators, and institutions.

7. Cloud service providers (CSPs) are very aggressive in experimenting and embracing the cool cloud ideas and today every business and technical services are being hosted in clouds to be delivered to global customers, clients and consumers over the Internet communication infrastructure.

## **INTEGRATION AS A SERVICE (IAAS):**

### **Why Integration?**

- Increasingly business applications are deployed in clouds to reap the business and technical benefits.
- On the other hand, there are still innumerable applications and data sources locally stationed and sustained primarily due to the security reason.
- The question here is how to create a seamless connectivity between those hosted and on-premise applications to empower them to work together.

### **How Integration is done?**

- Integration as a service (IaaS) is the budding and distinctive capability of clouds in fulfilling the business integration requirements.
- IaaS overcomes these challenges by smartly utilizing the time-tested business- to-business (B2B) integration technology as the value added bridge between SaaS solutions and in-house business applications.

### **SaaS INTEGRATION**

- ◆ Cloud-centric integration solutions are being developed and demonstrated for showcasing their capabilities for integrating enterprise and cloud applications.
- ◆ Now with the arrival and adoption of the transformative and disruptive paradigm of cloud computing, every ICT products are being converted into a collection of services to be delivered via the open Internet
- ◆ In that line, the standards-compliant integration suites are being transitioned into services so that any integration need of any one from any part of the world, can be easily, cheaply and rapidly met.

### **Integration as a Service (IaaS):**

Migration of the functionality of a typical enterprise application integration (EAI) hub / enterprise service bus (ESB) into the cloud for providing for smooth data transport between any enterprise and SaaS applications.

- Users subscribe to IaaS as they would do for any other SaaS application.
- Cloud middleware will be made available as a service.
- For service integration, it is enterprise service bus (ESB) and for data integration, it is enterprise data bus (EDB).
- There are Message oriented middleware (MOM) and message brokers for integrating decoupled applications through message passing and pickup.
- Events are coming up fast and there are complex event processing (CEP) engines that receive a stream of diverse events from diverse sources, process them at real- time to

extract and figure out the encapsulated knowledge, and accordingly select and activate one or more target applications.

- Cloud infrastructure is not very useful without SaaS applications that run on top of them, and SaaS applications are not very valuable without access to the critical corporate data that is typically locked away in various corporate systems.
- Cloud applications to offer maximum value to their users, they need to provide a simple mechanism to import or load external data, export or replicate their data for reporting or analysis purposes, and finally keep their data synchronized with on- premise applications.

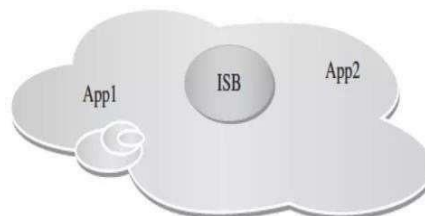
### Why SaaS Integration is hard? Reasons:

- **Limited Access:** Access to cloud resources (SaaS, PaaS, and the infrastructures) is more limited than local applications. Once applications move to the cloud, custom applications must be designed to support integration because there is no longer that low level of access. Enterprises putting their applications in the cloud or those subscribers of cloud-based business services are dependent on the vendor to provide the integration hooks and APIs.
- **Dynamic Resources:** Cloud resources are virtualized and service-oriented. That is, everything is expressed and exposed as a service. Due to the dynamism factor infrastructural changes are liable for dynamic changes. These would clearly impact the integration model.
- **Performance:** Clouds support application scalability and resource elasticity. However the network distances between elements in the cloud are no longer under our control. Because of the round trip latency, the cloud integration performance is bound to slow down

### NEW INTEGRATION SCENARIOS

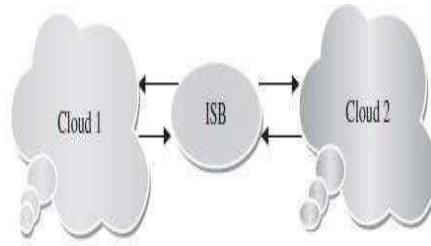
Three major integration scenarios

**Within a Public Cloud:** Two different applications are hosted in a cloud. The role of the cloud integration middleware (say cloud-based ESB or internet service bus (ISB)) is to seamlessly enable these applications to talk to each other. These applications can be owned by two different companies. They may live in a single physical server but run on different virtual machines.

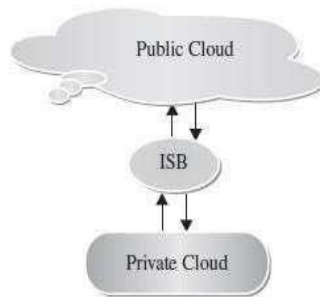


Homogeneous Clouds: The applications to be integrated are positioned in two geographically

separated cloud infrastructures. The integration middleware can be in cloud 1 or 2 or in a separate cloud. There is a need for data and protocol transformation and they get done by the ISB



Heterogeneous Clouds : One application is in public cloud and the other application is in private cloud



### The Integration Methodologies

There are three types for cloud integration

- **Traditional Enterprise Integration Tools can be empowered with special connectors to access Cloud-located Applications:** With a persistent rise in the necessity towards accessing and integrating cloud applications, special drivers, connectors and adapters are being built and incorporated on the existing integration platforms to enable bidirectional connectivity with the participating cloud services.
- **Traditional Enterprise Integration Tools are hosted in the Cloud:** This approach is similar to the first option except that the integration software suite is now hosted in any third-party cloud infrastructures so that the enterprise does not worry about procuring and managing the hardware or installing the integration software
- **Integration-as-a-Service (IaaS) or On-Demand Integration Offerings:** These are SaaS applications that are designed to deliver the integration service securely over the Internet and are able to integrate cloud applications with the on-premise systems, cloud-to-cloud applications.

### Characteristics of Integration Solutions and Products

- Connectivity refers to the ability of the integration engine to engage with both the source and target systems using available native interfaces
- Semantic Mediation refers to the ability to account for the differences between application semantics between two or more systems. Semantics means how information gets understood, interpreted and represented within information systems
- Data Mediation converts data from a source data format into destination data format. Coupled with semantic mediation, data mediation or data transformation is the process of converting data from one native format on the source system, to another data format for the target system
- Data Migration is the process of transferring data between storage types, formats, or systems. Data migration means that the data in the old system is mapped to the new systems
- Data Security means the ability to insure that information extracted from the source systems has to securely be placed into target systems
- Data Integrity means data is complete and consistent. Thus, integrity has to be guaranteed when data is getting mapped and maintained during integration operations, such as data synchronization between on-premise and SaaS-
- Based systems.
- Governance refers to the processes and technologies that surround a system or systems, which control how those systems are accessed and leveraged

### Products And Platforms

- Jitter bit is a fully graphical integration solution that provides users a versatile platform and a suite of productivity tools to reduce the Integration efforts sharply.
- It can be used standalone or with existing EAI infrastructures, enabling users to create new projects or consume and modify existing ones offered by the open source community or service provider.
- The Jitter bit solution enables the cool integration among confidential and corporate data, enterprise applications, web services, XML data sources, legacy systems, simple and complex flat files.

Jitter bit is comprised of two major components:

- **Jitter bit Integration Environment:** An intuitive point-and-click graphical UI that enables to quickly configure, test, deploy and manage integration projects on the Jitterbit server.
- **Jitterbit Integration Server:** A powerful and scalable run-time engine that processes all the integration operations, fully configurable and manageable from the Jitterbit application.
- **Boomi Software:** BoomiAtomSphere is an integration service that is completely on-demand and connects any combination of SaaS, PaaS, cloud, and on-premise applications without the burden of installing and maintaining software packages or appliances. Anyone can securely build, deploy and manage simple to complex integration processes using only web browser.
- **Bungee Connect:** Bungee Connect enables cloud computing by offering an application development and deployment platform that enables highly interactive



applications integrating multiple data sources and facilitating instant deployment.

- Built specifically for cloud development, Bungee Connect reduces the efforts to integrate (mashup) multiple web services into a single application.
- **OpSource Connect:** Expands on the OpSource Services Bus (OSB) by providing the infrastructure for two-way web services interactions, allowing customers to consume and publish applications across a common web services infrastructure.
- **SnapLogic:** SnapLogic is a capable, clean, and uncluttered solution for data integration that can be deployed in enterprise as well as in cloud landscapes. The free community edition can be used for the most common point-to-point data integration tasks

The Pervasive DataCloud: Pervasive Data Cloud is the first multi-tenant platform for delivering the following

- Integration as a Service (IaaS) for both hosted and on-premises applications and data sources
- Packaged turnkey integration
- Integration that supports every integration scenario
- Connectivity to hundreds of different applications and data sources

Other Products

- Bluewolf
- Online MQ
- CloudMQ
- Linxter

**ADVANTAGES OF CLOUD INTEGRATION:** Cloud integration offers the following advantages over older, compartmentalized organizational methods:

1. Each user can access personal data in real time from any device and from any location with Internet access.
2. Each user can integrate personal data such as calendars and contact lists served by diverse application programs.
3. Each user can employ the same logon information (username and password) for all personal applications.
4. The system efficiently passes control messages among application programs.
5. By avoiding the use of data silos, data integrity is maintained.
6. Cloud integration offers scalability to allow for future expansion in terms of the number of users, the number of applications, or both.

## **THE ONSET OF KNOWLEDGE ERA**

1. Path-breaking and people-centric technologies (miniaturization, virtualization, federation, composition, collaboration, etc.) are emerging and are being

experimented, expounded, and established in order to empower the professional and the personal IT to be smart, simple, supple and sensitive towards users' situational needs and to significantly enhance peoples' comfort, care, convenience and choice.

2. In the monolithic mainframe era, one centralized and large system performed millions of operations to respond to thousands of users (one-to-many).
3. Today everyone has his own compute machine (one-to-one), and tomorrow a multitude of smart objects and electronic devices (nomadic, wearable, portable, implantable etc.) will seamlessly and spontaneously co-exist, corroborate, correlate, and coordinate with one another dynamically with dexterity to understand one or more users' needs, conceive, construct, and deliver them at right time at right place (many-to-one). Anytime anywhere computing tends towards everywhere, every time and everything computing.
4. Ambient intelligence (AmI) is the newest buzzword today with ambient sensing, networking, perception, decision-making and actuation technologies. Multimedia and multimodal technologies are flourishing in order to be make human interaction more friendly and fruitful.
5. Dynamic virtualized and autonomic infrastructures, flexible, integrated and lean processes, constructive and contributive building-blocks (service, model, composite, agent, aspect etc.), slim and sleek devices and appliances, smart objects empowered by invisible tags and stickers, natural interfaces, ad-hoc and situational networking capabilities all combine adaptively together to accomplish the grandiose goals of the forthcoming ambient intelligence days and decades. In short, IT-sponsored and splurged smartness in every facet of our living in this world is the vision. Software engineering is on the right track with the maturity of service orientation concepts and software as a service (SaaS) model.
6. Clouds chip in mightily in realizing the much-acclaimed knowledge era. Technologies form a dynamic cluster in real-time in order to contribute immensely and immeasurably for all the existing, evolving and exotic expectations of people.

## **THE EVOLUTION OF SaaS**

1. SaaS paradigm is on fast track due to its innate powers and potentials. Executives, entrepreneurs, and end-users are ecstatic about the tactic as well as strategic success of the emerging and evolving SaaS paradigm.
2. A number of positive and progressive developments started to grip this model. Newer resources and activities are being consistently readied to be delivered as a service.
3. Experts and evangelists are in unison that cloud is to rock the total IT community as the best possible infrastructural solution for effective service delivery. There are several ways clouds can be leveraged inspiringly and incredibly for diverse IT

problems. Today there is a small list of services being delivered via the clouds and in future, many more critical applications will be deployed and consumed.

4. In short, clouds are set to decimate all kinds of IT inflexibility and dawn a growing array of innovations to prepare the present day IT for sustainable prosperity.
5. IT as a Service (ITaaS) is the most recent and efficient delivery method in the decisive IT landscape. With the meteoric and mesmerizing rise of the service orientation principles, every single IT resource, activity and infrastructure is being viewed and visualized as a service that sets the tone for the grand unfolding of the dreamt service era.
6. These days, systems are designed and engineered as elegant collections of enterprising and evolving services. Infra- structures are service enabled to be actively participative and collaborative.
7. In the same tenor, the much-maligned delivery aspect too has gone through several transformations and today the whole world has solidly settled for the green paradigm 'IT as a service (ITaaS)'.
8. This is accentuated due to the pervasive Internet. Also, we are bombarded with innumerable implementation technologies and methodologies. Clouds, as indicated above, is the most visible and viable infrastructure for realizing ITaaS.
9. Another influential and impressive factor is the maturity obtained in the consumption-based metering and billing capability. HP even proclaims this evolving trend as 'everything as a service'.
10. Integration as a service (IaaS) is the budding and distinctive capability of clouds in fulfilling the business integration requirements. Increasingly business applications are deployed in clouds to reap the business and technical benefits. On the other hand, there are still innumerable applications and data sources locally stationed and sustained primarily due to the security reason. The question here is how to create a seamless connectivity between those hosted and on-premises applications to empower them to work together.
11. IaaS over- comes these challenges by smartly utilizing the time-tested business-to-

business (B2B) integration technology as the value-added bridge between SaaS solutions and in-house business applications.

12. B2B systems are capable of driving this new on-demand integration model because they are traditionally employed to automate business processes between manufacturers and their trading partners. That means they provide application-to-application connectivity along with the functionality that is very crucial for linking internal and external software securely. Unlike the conventional EAI solutions designed only for internal data sharing, B2B platforms have the ability to encrypt files for safe passage across the public network, manage large data volumes, transfer batch files, convert disparate file formats, and guarantee data delivery across multiple enterprises.
  13. IaaS just imitates this established communication and collaboration model to create reliable and durable linkage for ensuring smooth data passage between traditional and cloud systems over the Web infrastructure.
  14. The use of hub & spoke (H&S) architecture further simplifies the implementation and avoids placing an excessive processing burden on the customer sides. The hub is installed at the SaaS provider's cloud center to do the heavy lifting such as reformatting files. A spoke unit at each user site typically acts as basic data transfer utility.
  15. With these pieces in place, SaaS providers can offer integration services under the same subscription / usage-based pricing model as their core offerings. This trend of moving all kinds of common and centralised services to clouds is gaining momentum these days.
  16. As resources are getting distributed and decentralised, linking and leveraging them for multiple purposes need a multifaceted infrastructure.
  17. Clouds, being the Web-based infrastructures are the best fit for hosting scores of unified and utility-like platforms to take care of all sorts of brokering needs among connected and distributed ICT systems.
1. The Web is the largest digital information superhighway

1. The Web is the largest repository of all kinds of resources such as web pages, applications comprising enterprise components, business services, beans, POJOs, blogs, corporate data, etc.
2. The Web is turning out to be the open, cost-effective and generic business execution platform (E-commerce, business, auction, etc. happen in the web for global users) comprising a wider variety of containers, adaptors, drivers, connectors, etc.
3. The Web is the global-scale communication infrastructure (VoIP, Video conferencing, IP TV etc.)
4. The Web is the next-generation discovery, Connectivity, and integration middleware

Thus, the unprecedented absorption and adoption of the Internet is the key driver for the continued success of the cloud computing.