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The Cloud and SOA - Creating the Architecture for Today and Future

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Abstract

The way organizations do business is changing at a rapid pace. In the 21st Century, organizations no longer operate in a fixed, predictable environment. Moreover, in this constantly changing landscape, the role of IT is changing as well. Allowing individuals to use PCs independently, IT departments missed the shift to a new IT architecture and had to invest millions to retrace their steps and introduce standardized systems. The immediate benefit of combining SOA and Cloud Computing is the need of hour. Reaching out to the cloud for business or technology capabilities allows SOA initiatives to compress time to value. In the longer term, the benefits include improved collaboration, customer satisfaction and business growth. By offering SOA-based business capabilities to the cloud, businesses can improve interactions with business partners and existing customers, which will generate new revenue streams.

Keywords: *SOA, Cloud, SaaS, PaaS.*

1. Introduction

The cloud is the future. It provides almost infinite flexible and scalable external computing and processing services that not only offer significant cost benefits, but also provide the ability to connect with customers, partners and suppliers like never before. However, without Service-Oriented Architecture (SOA), organizations will find it almost impossible to reach the cloud.

The cloud will enable real-time delivery of products, services and solutions over the Internet. It will become essential to business because of its capability to deal with rapid change in external markets.

SOA, a flexible, modular approach to delivering IT services, is an essential foundation for emerging technologies like cloud and it provides significant advantages over current IT architectures. While it lowers costs, its primary benefit is the improvement in agility that it provides to organizations, enabling them to respond to the increasing rate of change occurring in nearly every business around the world.

2. What is the Cloud?

In just a few short years, the cloud has gone from being a hypothetical concept in analyst reports to headline news. Along the way , it has suffered from a great deal of industry hype and confusion, with many vendors attaching a “cloud” label to services that are probably closer to hosted applications or on-demand computing[3]. It is important to clarify what the word “cloud” actually means. There are a number of computing models that are related.

Right now, most large organizations own their IT infrastructures. But that doesn’t need to be the case. It may very well be more cost effective to utilize computing infrastructures that are provided by an outside entity. By leveraging economies of scale, providers may be able to supply all the required processing power at a lower cost than could be achieved by organizations internally. This is especially the case when the required volume fluctuates significantly. This model is best defined as utility computing—the offering of pools of computing infrastructure that is delivered to users.

Cloud computing is different. It is a specific type of utility computing. Cloud computing is the IT environment—encompassing all elements of the full “stack” of IT and network products (and supporting services)—that enables the development, delivery and consumption of cloud services. Properly defined, cloud computing has three key technical characteristics [2]:

Scale: cloud computing systems incorporate tens of thousands of servers, offering processing power vastly greater than a traditional data center.

Flexibility: cloud computing can be used to handle very small or large processing tasks, and can be adjusted in real-time to match demand. If an organization needs 10 servers one day and 5,000 the next, the cloud can handle such a dynamically varying request.

Efficiency: unlike traditional data centers, clouds offer pooled computing power, performing like a single large machine. Sharing tasks across this pool reduces costs and massively improves processing speeds.

2.1 Cloud layers:

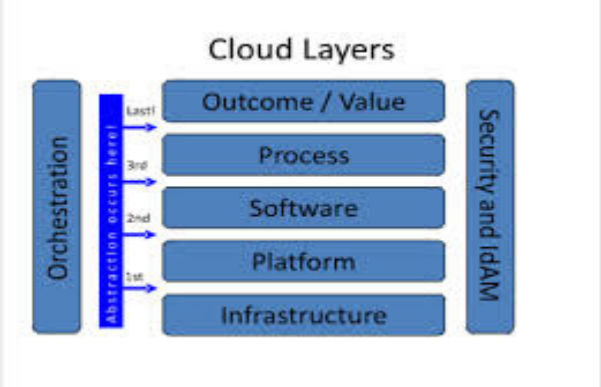

Figure 1: Cloud layers

Cloud services are different from cloud computing. Services provide the automated processes that are delivered using cloud computing. Cloud services are a specific type of Software-as-a-Service (SaaS), and can usefully be thought of as being made up of three distinct layers:

The first layer shown in the figure 1 holds all the computing power and resources that enterprises need to deliver a service or application, including storage, processing, networks and servers. Some cloud services may use all of these components; others just one or two.

The middle layer is a platform that enables the enterprise to add specific services that rely on the cloud computing layer for their power. Example platforms include Google Application Engine or Microsoft's Azure, which provide platforms that are available to developers.

This final layer comprises the cloud services themselves. Services may be internally or externally facing, and may be developed by the enterprise itself or by a third party. Many services will combine elements of both approaches.

This third layer is important because this is where businesses can differentiate themselves in a SOA and cloud environment—by buying services, adding value and selling them, companies can create enormous flexibility and competitive advantage.

On the other hand, cloud computing is about providing ease of access to and usage of services. Cloud computing delivers a number of "x as a service" capabilities, such are Software as a Service (SaaS) or Platform as a Service (PaaS).

Software as a Service (SaaS)[1] provides end-users standardized, network-delivered IT applications. The service provider retains ownership of the software and hardware assets and handles all maintenance and support. The end-user is able to add and subtract licenses on-demand. The most prominent example is Salesforce.com.

Platform as a Service (PaaS) provides end-users an application development environment delivered over a network (typically the Internet). The PaaS model makes all of the facilities required to support the complete life cycle of building applications entirely available from the network. It is generally billed on a per-seat or per-login basis. Examples include Force.com and Google App Engine.

Cloud computing employs repeatability and standardized, easy access to shared hardware and software at low cost. Together SOA and cloud can provide a complete services-based solution.

An interesting analogy for cloud and SOA is to think of books in a library. The books represent the services that customers can access once the library acquires them, and the library building represents the cloud where people come to check out the books/services. Books are reusable, and several books might make up a series or topic. Someone writes the book once and it is reused many times.

Using our analogy of books in the library, there are two components to consider when thinking about services in a cloud environment. One is the providing of services (books) to the cloud (library). And the other is the consuming (checking out) of those services (books). Each has different requirements.

3. What is meant by SOA?

SOA is an architectural style for building applications, loosely coupled, allowing composition and SOA is an architectural approach [4] that creates services that can be shared and reused. It converts current vertical applications into a number of components called services that can be reused across multiple applications as shown in figure 2, thus providing savings and improved agility to make changes faster and more cost effectively.

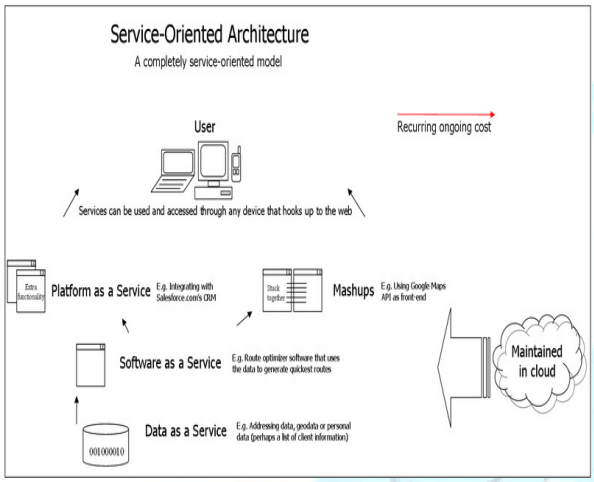

Figure 2: A Complete service oriented model

3.1 SOA: Solving today's Problems While Preparing for Cloud

In today's global organizations, technology is more than a source of competitive advantage; it is frequently the product and sometimes the business itself. This means IT must provide services that are reliable, scalable, cost-effective and agile—able to adapt on one hand quickly to a change in business strategy.

The conventional enterprise IT architecture—based on a static, centralized infrastructure and centrally-administered applications—is not designed to support rapid changes in functionality , or to handle sudden spikes in demand. In addition, new functions can be quickly deployed in a SOA environment because IT organizations can reuse components from one service to create new services. If an organization is interested in cloud, all organizations will inevitably choose to utilize the cloud, SOA is especially important. The best and perhaps the only way to prepare an organization to successfully exploit the cloud is to transform its internal IT infrastructure to utilize SOA. There are five key reasons for this:

3.1.1 Accessibility

The cloud is accessible through a SOA interface. All services are invoked using the protocols and standards that SOA utilizes.

3.1.2 Visibility

Organizations using SOA have already encountered this issue and addressed it. In a well governed SOA, new tools and techniques are utilized to find a group of potential services and then to determine which one most closely meets a company's needs. Unless an organization deploys SOA, it will not be able to utilize these techniques, and it will be next-to-impossible to find the service it needs.

3.1.3 Extensibility

It is great to be able to find services in the cloud and be able to access them, but there will be many cases where an organization cannot find a service that exactly meets its needs. It may need to put multiple services together, and from time-to- time it will certainly need to modify the operation of a service. Cloud services can be modified and customized using SOA techniques; so organizations will want to utilize the same architecture in their in-house IT systems.

3.1.4 Matching expectations

One of the most intricate parts of working with the cloud in any significant manner is ensuring that the service is provided in a way that matches the expectation of the user. Two common questions illustrate the point: When is the service available? What type of response time does the service deliver?

It is critical that both sides understand and agree upon the answers to these and many more questions: What is the escalation procedure if there is an issue with the service? What is the change process? What is the enhancement request process? How frequently can the service be called? How much data can the service accept? Even, how much does the service cost? If there is a misunderstanding between the two parties on any of these questions, the relationship will likely be rocky at best.SOA has dealt with this issue, with the concept of "contracts" agreements that specify the responsibilities of each party. When an organization uses the cloud, everyone in IT should know how to work with contracts, and the best way to create this knowledge is by using SOA as the internal architecture in addition to the interface to the cloud.

3.1.5 Adherence to standards

Since services delivered through the cloud will use SOA, it is important that a company's applications follow all standards that the cloud service will expect.

How does the enterprise ensure that all its services meet these standards and even industry-wide best practices? Policy enforcement is used within a SOA to automatically ensure that standards and best practices are followed by all of the services accessing the cloud.

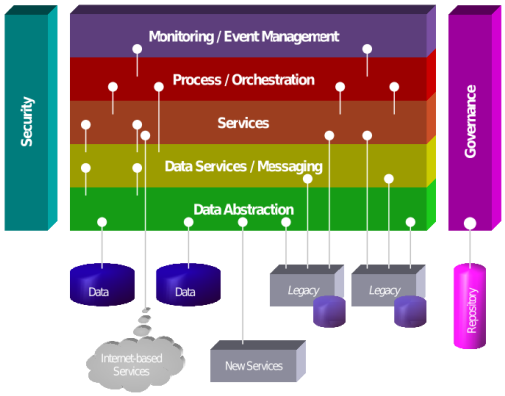

Figure 3: SOA Framework

4. SOA Components

Many organizations have already begun an IT transformation to utilize a Service-Oriented Architecture and are seeing the benefits of increased agility and reduced costs. Others have begun the SOA journey but have not yet seen success, and still others haven't started utilizing SOA figure 3 represents the SOA framework for providing efficient IT infrastructure.

4.1 SOA Governance

SOA governance is the definition and implementation of enterprise-wide policies for activities including:

- proposing and developing new services
- modifying existing services
- retiring services at the end of the lifecycle
- exposing services to third parties
- publishing and finding services
- reuse of services
- monitoring the progress of SOA
- Determining the value of SOA.

One of the most difficult aspects of SOA governance to get right is escalation and lines of responsibility. In a traditional, centralized "command and control" IT architecture, it is easy to establish lines of responsibility and to create escalation procedures for situations when things go wrong.

4.2 SOA Service Management

The second key management process is service management. This is distinct from the governance policy—a governance policy concerns how services are created and well the service works day-to-day.

Service management also deals with what happens when problems occur. Policies must specify who is responsible for reporting problems and who takes action to resolve them—no simple matter if multiple organizations or teams are involved in delivering a service or application.

4.3 SOA Quality Management

SOA quality management [3] is the process of making sure the services and applications that are being built meet the requirements of the business, and so can be trusted.

5. SOA Key benefits

SOA builds on computer engineering approaches of the past to offer an architectural approach for enterprise systems, oriented around the offering of services on a network of consumers. A focus of this service-oriented approach is on the definition of service interfaces and predictable service behaviors. A set of industry standards, collectively labeled "Web Service" standards in this paper, provide and implement the general SOA concept and have become the predominant set of practical tools used by enterprise engineers for current SOA projects. Some Web Service standards have become foundational and more widely adopted, while many are still seeking broad industry or Government acceptance. SOA, as implemented through the common Web Services standards, offers

5.1 Language-neutral integration:

Contemporary Web Services standards use eXtensible Markup Language, which is focused on the creation and consumption of delimited text. Regardless of the development language used, these systems can offer and invoke services through a common mechanism. Programming language neutrality is a key differentiator from past integration approaches.

5.2 Component reuse

Given current Web Service technology, once an organization has built a software component and offered it as a service, the rest of the organization can then utilize that service. With proper service governance, emphasizing topics such as service provider trust, service security, and reliability, Web Services offer the potential for aiding the more effective management of an enterprise portfolio, allowing a capability to be built well once and then shared.

5.3 Organizational agility

SOA defines building blocks of software capability in terms of offered services that meet some portion of the organization's requirements. These building blocks, once defined and reliably operated, can be recombined and integrated rapidly.

5.4 Leveraging existing systems

One common use of SOA is to define elements or functions of existing application systems and make them available to the enterprise in a standard agreed-upon way, leveraging the substantial investment already made in existing applications. The most compelling business case for SOA is often made regarding leveraging this legacy investment, enabling integration between new and old systems components.

5.5 Dependence on the network

SOA is fundamentally dependent on the network to connect the service provider with the consumer. For example, Web Service protocols ride on Internet protocols to invoke software functions distributed across the network. Poorly performing networks can make a large impact on the availability of Web Services to the consumer.

5.6 Provider costs:

Creating a generic reusable software component for a broad audience takes more resources (20 percent to 100 percent more) than creating a less generic point solution. The cost of reuse, therefore, shifts to the service providers, which benefits the consumers.

5.7 Enterprise standards:

When many components are being simultaneously developed by individual teams, it becomes critical for the interface of a provider's service to match up to the "call" of a consumer. Similarly, it helps everyone involved if the interfaces across services have some commonality in structure and security access mechanisms. Choosing and communicating a comprehensive set of enterprise standards is a responsible approach to aid in enterprise SOA integration.

5.8 Agility

When we discuss "agility" as it relates to SOA, we are often referring to organizational agility, or the ability to more rapidly adapt a Federal organization's tools to meet their current requirements. An organization's requirements of IT might change over time for a number of reasons, including changes in the business or mission, changes in organizational reporting requirements, changes in the law, new technologies in the commercial marketplace, attempts to combine diverse data sources to improve the organization's operational picture, and many other reasons. The larger promise of an enterprise SOA is that once a sufficient quantity of legacy-wrapped components exist, and are accessible on the internet protocol (IP) wide area network (WAN), they can be reassembled more rapidly to solve new problems.

6. Comparing Cloud Computing and SOA

Cloud computing and SOA have important overlapping concerns and common considerations, as shown in Figure 4. The most important overlap occurs near the top of the cloud computing stack, in the area of Cloud Services, which are network accessible application components and software services, such as contemporary Web Services.

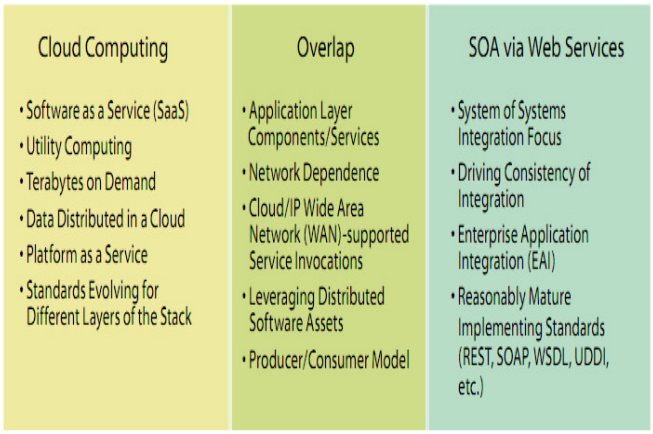

Figure 4: Comparison of SOA with Cloud computing

Both cloud computing and SOA share concepts of service orientation [5]. Services of many types are available on a common network for use by consumers, Cloud computing focuses on turning aspects of the IT computing stack into

commodities that can be purchased incrementally from the cloud based providers and can be considered a type of outsourcing in many cases. For example, large-scale online storage can be procured and automatically allocated in terabyte units from the cloud.

Similarly, a platform to operate web-based applications can be rented from redundant data centers in the cloud. However, cloud computing is currently a broader term than SOA and covers the entire stack from hardware through the presentation layer software systems.

6.1 Network dependence

Both cloud computing and SOA count on a robust network to connect consumers and producers and in that sense, both have the same foundational structural weakness when the network is not performing or is unavailable.

6.2 Forms of outsourcing

Both concepts require forms of contractual relationships and trust between service providers and service consumers. Reuse of an SOA service by a group of other systems is in effect an "outsourcing" of that capability to another organization. With cloud computing, the outsourcing is more overt and often has a fully commercial flavor. Storage, platforms, and servers are rented from commercial providers who have economies of scale in providing those commodities to a very large audience. Cloud computing allows the consumer organization to leave the detailed IT administration issues to the service providers.

6.3 Standards

Both cloud computing and SOA provide an organization with an opportunity to select common standards for network accessible capabilities. SOA has a fairly mature set of standards with which to implement software services, such as Representational State Transfer (REST), SOAP, and Web Services Description Language (WSDL), among many others.

Cloud computing is not as mature, and many of the interfaces offered are unique to a particular vendor, thus raising the risk of vendor lock-in.

7. Critical Success Factors for SOA and Cloud

While SOA requires new policies around governance, quality and service management, these policies alone will not guarantee a successful SOA architecture, nor will they ensure successful use of the cloud. It is recommended that organizations also consider the following critical success factors of SOA and cloud.

7.1 Skills and Training

Clearly, moving to SOA and to cloud will entail the use of new technologies, new processes and even new ways of thinking. In many ways, learning new skills and approaches, along with other traditional change management issues, is the largest challenge an organization will face. Many organizations over-emphasize technology training; it is important to understand new programming techniques and standards, but the analysts need to include training that concentrates on how to introduce new business processes as well.

7.2 Requirements Gathering

How will an organization define and specify services? How will it know if it is using the right cloud service? This might sound obvious but if a company is moving to a Service-Oriented Architecture, it is vital that it have in place common ways of defining services, and how it will be created.

7.3 Scalability

One of the key advantages of a Service-Oriented Architecture is the ability to integrate with new services quickly and easily , enhancing an organization' s agility .

8. Prerequisites for providing services in a cloud

Before providing services into a cloud computing environment, number of requirements that need to be in place to take advantage of cloud computing. For example, to provide Software as a Service requires tools for creating new software services, and these will already be in place.

8.1 Virtualization

In current IT environment the services can be run in the most cost-effective place. This relates to the horizontal view of services in SOA across the organization. Cloud just extends that definition beyond a single organization. Virtualization in the cloud takes services from the local server, helping to cut costs and balance workload.

8.2 Reusability support

Multiple people can use the service at the same time. A consistent deployment methodology makes sure each service does not have to be treated individually.

8.3 Governance and management of services

This is a SOA-related requirement to provide improved governance and management of services within a cloud environment where they may not be under direct control.

8.4 Security and access control

Along with consistent deployment, there is the requirement for well-defined security and access control policies provided, for example, by IBM Tivoli Security Policy Manager.

8.5 Chargeback and pricing for services

This important cloud requirement is also a key SOA focus area: chargeback and pricing for services developed using an industry standard process like the SOA Governance and Management Method.

These key cloud computing areas are based on function available today with SOA.

9. Prerequisites for consuming services in a cloud

On the service consumption side of cloud computing is another set of requirements related to actually running and exploiting services in the cloud.

9.1 Ease of access of services

This is a key value proposition for cloud that can be provided by a user interface, such as WebSphere Portal.

9.2 High availability of services

Along with easy access, service usage must be fast and have high availability at a lower cost than when done within internal IT organization. A well-managed, well-architected SOA environment helps to achieve these benefits and be able to measure the values that are gaining from the cloud.

9.3 Service discovery

To consume a service will first require the discovery of that service, which is a key capability provided by a registry product as shown in figure 5, like WebSphere Service Registry and Repository

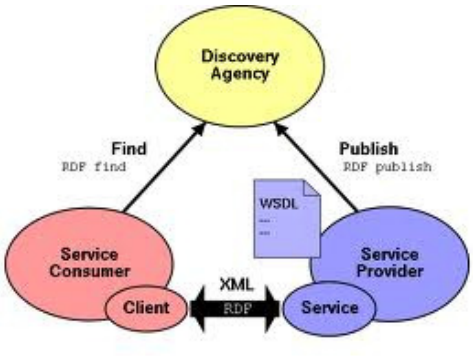

Figure 5:-Service Discovery Mechanism in Cloud

9.4 Network dependence:

Both cloud computing and SOA count on a robust network to connect consumers and producers and in that sense, both have the same foundational structural weakness when the network is not performing or is unavailable.

9.5 Security and data privacy:

As with the provisioning side of the equation, enforcement of security and data privacy will be key requirements, provided, for example, by WebSphere Data Power SOA Appliance. Similarly, a platform to operate web-based applications can be rented from redundant data centers in the cloud. However, cloud computing is currently a broader term than SOA and covers the entire stack from hardware through the presentation layer software systems.

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Conclusion

The emphasis of cloud computing is to leverage the network to outsource IT functions across the entire stack. While this can include software services as in an SOA, it goes much further. Cloud computing allows the marketplace to offer many IT functions as commodities, thus lowering the cost to consumers when compared to operating them internally.SOA and cloud computing share many common principles, but also differ significantly in their role in IT architecture. SOA is mainly an application architecture with horizontal services; while cloud computing is an IT architecture with vertical services. So Cloud and SOA are not an either/or situation; cloud computing and SOA are complementary, not replacements for each other. They work best together and have a number of common characteristics, such as the focus on agility and flexibility, and being based on services and reuse of services. SOA and service orientation in place can make moving to cloud easier and less complex because a cloud computing environment is also based on services. Having a service oriented architecture already in place helps businesses achieve value from cloud computing more quickly. Both cloud and SOA are all about delivering services to the business with increased agility, speed and cost effectiveness, and that can lead to greater innovation and improved return on investment.

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