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MERGING SOA AND CLOUD COMPUTING IN ENTERPRISE IT INFRASTRUCTURE

Based on up-to-date Web-based reviews about two advanced information technologies — Service Oriented Architecture (SOA) and Cloud Computing, the current article summarizes the problems in merging these technologies in the modern enterprise IT infrastructure. A short description for both technologies is provided. Cleary the role of each technology in the merging process is defined. And general rules for providing suitable matching are proposed.

Key words: *Service Oriented Architecture, Cloud Computing, services.*

Introduction

Nowadays the modern enterprise faces a dual challenge of keeping the existing IT applications while providing new services at unprecedented rates. At the same time the essence of the IT business model is changing in the way applications, content, information and infrastructure are delivered. Enterprise computing incorporates maturity and defined order to provide performance, scale, resiliency and security at the most stringent standards.

Cloud Computing is an emerging style of IT delivery in which applications, data and IT resources are rapidly provisioned and provided as standardized offerings to users over the web in a flexible pricing model [6]. Cloud computing offers a promising future for enterprise IT in the form of a scalable infrastructure and pay-as-you-need pricing model.

Technologies as Service Oriented Architecture (SOA) and Web 2.0 have well established their presence in the modern enterprise. If the enterprise IT infrastructure needs to continue investing in service-oriented architecture applications and initiatives there will be a need to take full advantage of the possibility for merging with the cloud infrastructure.

Defining SOA and Cloud Computing Merging Problems.

Service Oriented Architecture (SOA) is a software design approach in which key functions are built as reusable components which implement industry standards for interoperable communications. SOA enables loose coupling, interoperability, discoverability, change management and operation of business services in a well governed environment. Business services operating in a well run SOA environment can be composed into business processes that align IT with the business.

A service is the basic building block of SOA. There is a complex list of characteristics for a well defined SOA service. It represents a discrete

piece of functionality, adheres to a contract, and is loosely coupled, independent, standards based. A service in SOA provides a business functionality of value to at least one and potentially to more than one consumer.

Composition is the basis for creating complex application functionality in a SOA enterprise [1, 7]. The application functionality that represents and automates enterprise business processes is built in a SOA enterprise from loosely coupled services using composition. In SOA parlance, composition refers to invoking services in a particular sequence in order to represent of complex business process flow.

In this way the process flow may be offered as a service so it in turn can be used by external applications or made available to user through a suitable user interface.

As an addition to these core concepts there are sets of other concepts that constitute the basis of an enterprise SOA — Enterprise Service Bus (ESB) and Business Process Management (BPM) engine. ESB is a messaging and integration platform. An ESB increases the usefulness of SOA by allowing for better integration. BPM engine helps create sophisticated process flows using standards such as BPEL.

SOA has a peculiar meaning for different types of users [2, 5]:

- Developers — SOA is a way for creating dynamic and collaborative applications;
- IT managers — SOA is a way for effectively integrating the diverse systems typical of modern enterprise data centers;
- CIO — SOA is a way for protecting existing IT investments without inhibiting the deployment of new capabilities;
- Business analyst — SOA is a way of bringing information investments more in line with business strategy.

Cloud Computing is a style of computing in which dynamically scalable and often virtualized resources are provided as a service over the internet [10]. Cloud Computing consists of reliable services delivered through data centers and built on servers with different levels of virtualization technologies. The "Cloud" appears as a single point of access for all the computing needs of consumers.

The concept of cloud computing has certain key components:

- Abstraction of infrastructure — where infrastructure is separated from other resources.
- Resource democratization — resources become a pool which can be combined and mashed up in various ways.
- Services oriented — everything is a service, including software, platform, and infrastructure.
- Dynamics — use of resources in the cloud can be scaled up or down as necessary based on an organization's needs.

- Utility model of consumption and billing –users of cloud computing pay only for the services they use, as with a utility.

The basic building components of Cloud Computing use different type of resources.

Virtualized resources — Computing resources offered in cloud computing are virtualized, meaning they make it unnecessary for consumer of the resources to worry about details of the underlying layer. The way virtualized resources are organized can be very different from the actual organization of the physical resources. It should be possible that set of small physical commodity servers are grouped and made available as single virtual m machine or a sing le powerful physical machine is split into many tiny virtual machines. This implies the use of virtualization technologies or hypervisors.

Resources are provided as a Service. Service can include anything that is useful and can b e effectively delivered to a consumer asking for it. In principle, cloud computing embraces the notion of "everything as a service". More popularly, cloud computing encompasses following categories of service:

- Software as a Service (SaaS) — Network-hosted application;
- Data as a Service (DaaS) — Customer queries against provider's database;
- Platform as a Service (PaaS) — Network-hosted software development platform;
- Infrastructure as a Service (IaaS) — Provider hosts customer VMs or provides network storage;
- Identity and Policy Management as a Service (IPMaaS) — Provider manages identity and/or access control policy for customer;
- Network as a Service (NaaS) — Provider offers virtualized networks.

There are three types of clouds:

Public clouds may be shared among dozens, hundreds, or even thousands of client companies; companies buy computing resources on a pay-as-you-go basis, paying for precisely the computing power they need on hourly basis. Public clouds usually employ virtualization technology which facilitates rapid scaling. Users usually have self-service access to provisioning and administrative functions, while providers measure, track and bill for virtual resources consumed. Public cloud users don't have access to dedicated resources, and give up a certain amount of control, which can raise security, compliance, and other issues.

Private clouds employ the same shared resources as their public counterparts, but are used by a single. Enterprises using private clouds get the same economies of scale and bi-directional scaling available to public

cloud users, with the additional benefits of more control and security. Private clouds are not necessarily hosted internally — they may be outsourced to any infrastructure provider with the resources to manage them. The key difference from public clouds is that resources may be shared only within an organization — say, among its operation divisions — but not with unknown, unpredictable third parties.

Hybrid cloud computing occurs when an enterprise uses both public and private clouds, often deploying various portions of otherwise unified infrastructure, platforms and applications across both environments. This model allows an enterprise to reap the security and control advantages of private clouds, where needed, while leveraging a public cloud environment to facilitate cross-company information sharing or to handle capacity overflows.

Cloud Computing has a peculiar meaning for different types of users [2, 5]:

- Developers — Cloud Computing is a way for creating dynamic and collaborative applications;
- IT managers — Cloud Computing a way for effectively integrating the diverse systems typical of modern enterprise data centers;
- CIO — Cloud Computing is a way for protecting existing IT investments without inhibiting the deployment of new capabilities.
- To the business analyst it's a means of bringing information technology investments more in line with the business strategy.

An important characteristic of a service in cloud computing is that a consumer pays only for service usage in contrast with a dedicated resource, where there is payment for the resource regardless of whether it is used or not [1, 3].

SaaS is the easiest way to get into the cloud. It also has the most potential to save the greatest amount of money. Instead of buying a million-dollar, or a two-million-dollar customer relationship management system, it can leverage a suitable service for under 100 dollars a month. Next step would be IaaS and that basically represents data center on demand — databases, application servers, etc. Thus instead of a data center, all is leveraged from the cloud. PaaS technology would be appropriate for any kind of application development.

Notion of services in cloud computing is much broader that of SOA. The notion of services in SOA certainly gels well with notion of the services in cloud computing. This is particularly true in cased of SaaS and when cloud services in cloud computing are provided in a hosted manner.

So software as that is delivered as a Service from cloud (SaaS) and particularly in case of hosted application services among in cloud computing could be advantageous from a fully implemented SOA set. This will

allow SaaS to take advantage of benefits that a SOA sets defines. It will include obtaining benefits from the technologies such as enterprise service bus, BPM, and more, which go into making of SOA enterprise grade.

The success for both SOA and cloud computing depends on their respective services possessing certain desirable characteristics from a functional as well as from a Quality of Service perspective [2, 12].

As a mature architectural style SOA brings in a large set of ready processes, which are potentially applicable across the complete spectrum of everything as a service in cloud. While some part of the business process resides and executes in the cloud providing with all the benefits that a cloud entails, a bulk of proprietary processes or application may continue to reside within an organization's legacy IT infrastructure [2, 11]. Using web-services as a tool for integration of these services with those on the cloud can provide means for integration between services on the cloud and not on the cloud so that the cloud and the non-cloud services form one single enterprise IT based on principles of SOA.

When cloud computing is used in enterprise IT scenario, it calls a couple of mechanisms [9, 11]. A mechanism to expose legacy functionality as service on the "cloud", a way to consume services offered from the "cloud" into enterprise. Both of the above imply a need for integration across firewalls and across technology boundaries. An enterprise service bus by definition is equipped to provide this capability and this becomes a vital component of the IT infrastructure that leverages cloud computing.

There is no particular stand one can take whether SOA can be part of cloud computing or cloud computing can be part of SOA [5, 9]. They are conceptually intertwined with each other. From one perspective, SOA as an architectural style deals with services, and services is what cloud computing provides. In this way cloud computing is an instance of SOA. From another perspective, SOA deals with application services, which form a subset of SaaS. Thus SOA can be part of cloud computing. Real wisdom lies in desisting from this debate and in figuring out how service oriented architecture and cloud computing complement each other so that mutual strengths can be leveraged in combination so that enterprise IT stands to win.

Cloud computing is expected to provide a computing capability that can scale up or scale down dynamically based on demand [7, 12]. This implies a couple of things. First it implies a very large pool of computing resources. This pool of resources may either be within the enterprise Intranet or on the Internet (on the cloud). It also calls for a mechanism to automatically provide these resources to achieve on-demand scalability.

Cloud computing incorporates attributes of flexibility and libertarian principles of form and functionality married with the ubiquity of the internet. IT is the service, whether it is content, collaboration, information, applications or infrastructure [9, 11]. The combination or assembly of ser-

vices is dependent only on the choices the market demands. A cloud delivery model can be intra-enterprise, inter-enterprise or public-wide. Each of these delivery models requires an orientation of service based on contract policy, composition and guarantee.

Already the key trends in delivering successful SOA programs which incorporate enterprise and cloud computing have been defined [4, 11, 12]:

- SOA = Architecture + infrastructure + runtime + delivery
- Need to create an SOA lifecycle model
- Service-oriented demand and supply
- Implement SOA runtime and orchestration management
- Virtualization of the service stack
- Utilize optimized SOA infrastructure service footprints
- Execution as a service utility

The Open Group, a consortium focused on standards and interoperability for enterprises has announced the availability of industry standards for the adoption of SOA and cloud computing [8]. The standards include Open Group Service Integration Maturity Model (OSIMM) and SOA Governance Framework. They represent different standards that are both important for the deployment of SOA within large organizations. Enterprises use OSIMM when considering adopting SOA, to help them determine what level of SOA is appropriate to their needs and capabilities. They use the SOA Governance Framework once they have adopted SOA to help them determine how to organize themselves to use it to their best advantage. The standards enable enterprises to accelerate SOA deployment and generate direct business value much sooner.

Summary

The result of the merging of SOA and Cloud Computing in the Enterprise IT Infrastructure provides capabilities that facilitate automation of service management tasks and a flexible way for data access and storage without compromising IT investments around security and system availability. It also facilitates improved system administration practices and improved utilization of existing IT personnel/resources.

Cloud computing provides a cost-effective means for extending the capabilities of SOA and helping organizations realize additional gains from their existing investments in SOA. Cloud computing complements on-premise SOA solutions by supporting "hybrid" on-premise and cloud-based solution architectures [1, 2, 12]. The merging of SOA and Cloud Computing in the Enterprise IT Infrastructure allows developers to leverage existing skills when building SOA-based solutions and alleviates the cumbersome details of deploying, securing and monitoring the state of SOA applications.

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На основі останніх веб-оглядів про дві сучасні інформаційні технології — Service Oriented Architecture (SOA) і Cloud Computing, дана стаття підсумовує проблеми в об'єднанні цих технологій в сучасних корпоративних IT інфраструктурах. Приведений короткий опис для обох технологій. Передбачається визначеність ролі кожної технології в процесі об'єднання та пропонуються загальні правила для забезпечення прийнятної відповідності.

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