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SOA and Cloud Technologies, Two Pieces of the Same Puzzle

Luis Rodero-Merino, Luis-Miguel Vaquero-González, Juan-Antonio Cáceres-Expósito, and Juan-José Hierro-Sureda

This paper describes the relationship between cloud computing technologies and Service Oriented Architectures (SOA). We try to explain how cloud computing does not replace SOA architectures. Quite the contrary, cloud systems are being built using the same basic guidelines associated with SOA (simple, specific and standard-based APIs). This paper also discusses how systems built using these same SOA principles can benefit from cloud services, and how SOA conventions can be applied to develop more complex systems from the combination of basic cloud services.

Keywords: Architecture, Cloud Computing, Composition, Service, Service-oriented Architecture, SOA.

1 Introduction

Cloud computing [1] is a new paradigm for infrastructure and platform provision, where platform control and management related tasks are addressed by the cloud provider (CP). Thus, providers of any services (social networks, online booking systems, etc.), which we will call service providers (SP), can focus on the development and operation of the service, as they are freed from setting up and maintaining the infrastructure their services need. Furthermore, SPs do not need to purchase hardware infrastructure and software tools that may be underutilized. Cloud services are on-demand services that follow a pay-per-use billing model. If an SP does not need a particular cloud resource any more, they only need to release that resource. If, on the other hand, more resources are required (such as virtual machines), these can be quickly obtained from the cloud. Hence, clouds are said to have a key feature in that they are elastic; that is, they allow fast scaling up and down of platform resources. Therefore, we may say that cloud computing helps reduce fixed and operational expenses (CAPEX and OPEX) of infrastructure acquisition and control. Clouds can be managed by third parties that charge for their use (public clouds), be built in internal data centres for private use (private clouds), or be a combination of both (hybrid clouds).

The term "cloud computing" is not only applied to the offering of virtual hardware resources (known as Infrastructure-as-a-Service (IaaS)), platform resources (Platform-as-a-Service (PaaS)) and software as a service (Software-as-a-Service (SaaS) or Mashup-as-a-Service), it can also be used to refer to on-demand access to software and SOI systems (cloud computing, dynamic provision of services and SOA and Cloud Technologies, Two Pieces of the Same Puzzle).
SOA can be regarded as an approach to the conception and design of complex systems that applies the old "split and conquer" principle. SOA-compliant systems are split into several independent (or at least loosely-coupled) services that expose their functionality through network-enabled interfaces. Open, platform-independent standards must be used for interface specification, request/reply formatting and message transport protocols. Thus, SOA services can be accessed by different clients regardless of the service implementation technology. Also, SOA interfaces should be simple (ideally stateless) and focused on specific tasks. Web services have traditionally been the technology of choice to implement SOA systems.

In the SOA context, IaaS are also labelled as Service-Oriented Infrastructures (SOI). Taking a look at some of the most important IaaS providers, we can see how these same basic ideas have strongly influenced infrastructure cloud services. Quite significant is the fact that Amazon, arguably the most well known IaaS provider today, denotes its cloud services as "Amazon Web Services" (AWS, <http://aws.amazon.com>). AWS is a complete ecosystem of cloud infrastructure services, which offers resources such as virtual machines (Elastic Compute Cloud, EC2) or plain storage (Simple Storage Service S3). Amazon services are exposed by interfaces defined in WSDL and accessed through SOAP. FlexiScale, <http://www.flexiscale.com>, another prominent IaaS provider, also provides a WSDL-based interface that remote clients can access with the SOAP protocol.

WSDL and SOAP are not the only choice for IaaS providers. REST interfaces are also used by other cloud players. It is important to clarify that, although REST is sometimes regarded as an alternative to SOA, this is a misunderstanding. The confusion comes from the fact that the term SOA is automatically identified with WSDL+SOAP standards. REST should be considered as an alternative to WSDL+SOAP to implement SOA systems. In REST, the focus is on the resources exposed by the service. Each resource is identified by a URI (accessible through a URL), represented by a certain MIME type (such as XML or JSON), and accessed and controlled using POST, GET, PUT or DELETE HTTP methods. SOA services based on REST expose the resources they manage through (and only through) these four methods (sometimes this approach is referred to as Resource Oriented Architecture, ROA). GoGrid, <http://www.gogrid.com>, another important IaaS provider, defines a REST interface to create and control virtual hardware resources in its cloud.

Even more important is the initiative from the Open Grid Forum (OGF) to create an open standard to interact with cloud infrastructures: the Open Cloud Computing Interface (OCCI). This standard defines a REST interface where each cloud infrastructure element (computing, storage and network) is mapped to a REST resource, controlled, and accessed using HTTP methods.

PaaS interfaces have also been built using the same SOA philosophy found in IaaS systems. PaaS clouds such as Google App Engine (GAE, <http://code.google.com/appengine>) or Heroku, <http://heroku.com>, offer full runtime environments to run Python, Java or Ruby applications while at the same time they hide the task of controlling the underlying infrastructure. Heroku runtime can be managed through REST calls. Also, the execution environment in both GAE and Heroku provide software stacks to execute remote HTTP calls. Other PaaS systems provide a graphical interface to develop web applications. These systems are more oriented to
users with no strong development skills. Typically, these clouds also offer SOAP and/or REST interfaces so third-party applications can also interact with the systems running in them. Examples are Microsoft Azure, <http://www.microsoft.com/windowsazure>, and Force.com, <http://force.com>.

There are also some PaaS systems that do not offer a generic framework to run applications, but focus instead on providing a particular service. For example we can cite Messaging as a Service (MaaS) systems such as Amazon SQS, <http://aws.amazon.com/sqs>, and OnlineMQ, <http://www.onlinemq.com>, which offer REST and/or SOAP interfaces to interact with the messaging bus and queues that they provide.

Finally, SaaS systems, which offer final (web) applications (mail, office suites, etc.) that run in the cloud, can also enable a remote interface so others can interact with those applications through SOA-style calls. An example would be the QuickBooks application from Intuit, <http://quickbooks.intuit.com>.

From all these examples, we can conclude that SOA principles have deeply influenced all kinds of cloud systems. They implement standard-based web interfaces that allow to use and interact with those services in a SOA manner.

3 SOA Services in Cloud Environments

As shown in Figure 1, the evolution of the usage of the different resources available for the end user evolved from mere access to the network (ISP 1.0) to access to servers (ISP2.0) or racks (ISP 3.0) at the edge network. After granting access to hardware resources linked to the user access point new techniques were developed that enabled traditionally developed software to be hosted in these same hardware environments, so that the user could focus on developing without the burden of managing the servers. The next logical step (ISP 4.0) produced further distribution of the servers and the applications dwelling in them (ISP 4.5). This trend has continued maturing to deliver us the power of fully distributed Internet enabled applications. Web and grid services [4][5] made a giant step towards the transition from edge services to fully distributed services on several networks (e.g. grid virtual organizations). This, however, remained insufficient for the scale- and user-based distribution inherent to some of the most successful applications today. Today, the underlying Internet platform is capable of managing the automatically scalable software running on top of the provider hardware (see GAE for instance), paying for these services on a pay-as-you-go basis.

In this new setting some of the traditional application delivery methods employed for provisioning web and grid services are still usable [7][8][9]. Techniques to specify the services to be deployed in the cloud, the way they interact, etc. are still required. And yet new elements are still needed.

Scalability rules indicating how a SOA composition can scale in/out, with these rules handy service providers and programmers can focus on their businesses while benefiting from automated scalability within user-defined limits. Of course, service providers are charged a fee for cloud services. Thus, advanced monitoring mechanisms enabling the receipt of resource usage services become essential features (see Amazon’s Cloud Watch, <http://aws.amazon.com/cloudwatch>, for example). Having this data about of resource usage services, advanced accounting and billing mechanisms can be implemented that help maximize the benefit obtained by both parties [10]. Needless to say, a paying service provider requires a contract clearly stating the terms under which the service is provided, in the form of service level agreements (SLAs) guaranteeing hosting-scaling services for our software in the cloud.

![Figure 1: Service Delivering Evolution. (Based on data from [6].)
4 Exposing Cloud Services as SOA Building Blocks

The cloud will evolve to an ecosystem where Internet services will proliferate and be combined to offer ever more sophisticated ones. Concepts from SOA such as service composition and the mash-up of applications [11] should be supported by new PaaS providers, which will act as service enablers. The list of common services and APIs that could facilitate the task of programmers, integrated into the "next generation" PaaS, is far too long to be included here: security services, composition services, lifecycle management services, versioning and upgrade services, backup and data recovery elements, etc.

Telco Operators may play a key role in this new cloud marketplace. The conversion of Telecom networks and all information content to digital has created an electronic network infrastructure that facilitates the convergence of formerly discrete Telecom services (mobile, POTS, IP networks, etc.) on a single Telecom network. More recently, extended applications over IP have permitted the convergence of services on the Internet to include not only data, pictures, music and video, but also voice communication (including public voice services).

Telco Operators are struggling to become cloud Providers (BT, Verizon, Telefónica, etc.). They have a privilege position to improve the QoS of cloud services as they own the underlying network among cloud sites, the service providers and the end-users.

In addition, Telcos may offer in the marketplace common network services through open APIs (SMS, SIP, JTAPI, etc.) and some other IT Services (service-usage accounting, billing, service discovery and composition, etc.) that will facilitate service delivery in the cloud through a complete cloud offer combining IaaS, SaaS and PaaS capabilities. Also, Telco can add to their services portfolio advanced network acquisition and control capabilities (Network as a Service, NaaS).

Telefónica is already building some of these blocks in an SOA (SaaS) manner. Some time ago Telefónica opened some APIs to help integrate communication services (such as SMS sending services) with developed applications. More recently, Network as a Service features are planned that will help a programmer code an application capable of asking for more bandwidth to perform some operations (e.g. upload a huge file) to increase the quality of experience for the end user. These and other similar services help to deliver the vision of an actual convergence between traditional communication networks and SOA.

Indeed, the provision of convergent and supporting services helps to minimize the time-to-market of the applications provided and can help build added value services which benefit from improved quality of experience. As explained above, the existence of Web Services or REST technologies enables the standard delivery of services over the Internet. These techniques foster the creation of a service marketplace with standard interfaces that can be seamlessly composed to build more sophisticated applications.

5 Conclusion

Some may perceive that cloud computing has replaced SOA as the "tech term of the day", and even conclude that SOA has failed to position itself as a dominant technology in the ICT field. It is true that cloud is at the peak of its hype cycle [3], which means that we can still expect it to be the main technology topic in the near future. Furthermore, the fact that this technology is already implemented by several different vendors, and that all main ICT players are trying to set a long term cloud strategy (becoming CPs themselves), seems to show that it will still play a very relevant role in the coming years.

Yet this should not lead to a false conclusion. Cloud computing does not replace SOA at all. Cloud computing brings an innovative solution to the problem of remotely providing users with resources (infrastructure, platform and applications), so they do not have to address the cumbersome tasks of obtaining, setting and managing those resources. This is not an alternative to SOA. As this paper discusses, SOA is a style for building complex systems architectures that:

- have heavily influenced cloud computing system design,
- can be used to implement systems that run on top of cloud technologies,
- can be used to orchestrate several cloud services so they can be used to build new complex systems.

Therefore, cloud can be regarded as a solution that has (at least partially) based its success on a set of lessons learned and best practices obtained from precedent works in the field of SOA. Also, SOA can be used to build systems that further develop the potential of cloud computing. Thus, cloud computing is in fact a proof of the impact that SOA can (and probably will) have on future developments in the ICT area.

References


