



# IBM Cloud Computing Reference Architecture

R. Stifani, S. Pappe, G. Breiter, M. Behrendt

A Reference Architecture provides a technical blueprint for a system with a well-defined scope, the requirements it satisfies, and the architectural decisions it realizes. It ensures consistency and quality across development and delivery projects.

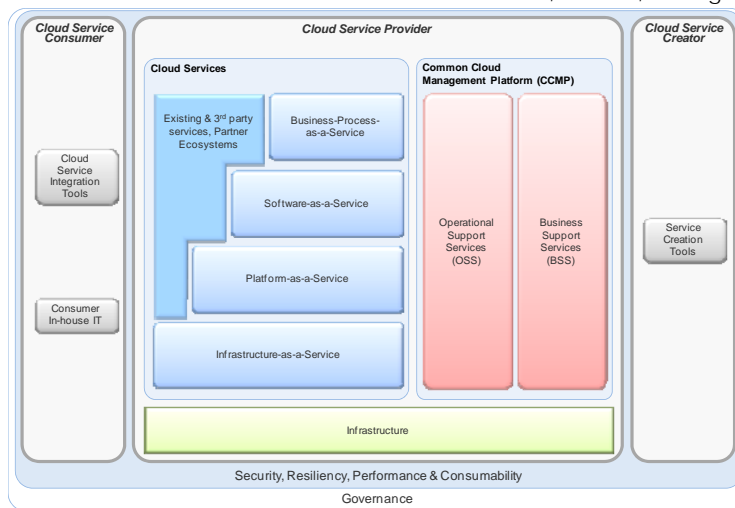
The **IBM Cloud Computing Reference Architecture (CC RA)** is a design for cloud services which optimizes resource and labor utilization and achieves economies of scale during operation. The IBM Cloud Computing Reference Architecture is based on real-world input from many cloud implementations across IBM. It defines the fundamental architectural elements which underpin and provide guidelines for creating a cloud environment. The architecture defines three main roles: Cloud Service Consumer, Cloud Service Provider and Cloud Service Creator. Each role can be fulfilled by a single person or by a group of people or by one or more organizations.

A **Cloud Service Consumer** is an organization, a human being or an IT system that consumes service instances delivered by a particular Cloud Service Provider. Besides IT capabilities consumed as cloud services, consumers may continue to have *in-house IT* managed in a traditional non-cloud fashion. The functionality of *Cloud Service Integration Tools* is required to integrate the existing in-house IT with cloud services consumed from a cloud service provider.

The **Cloud Service Provider** has the responsibility of providing cloud services to Cloud Service Consumers. Those services are delivered by a Common Cloud Management Platform (CCMP) either by running CCMP infrastructure or consuming one as a service. *Cloud Services* represent any type of (IT) capability provided by the Cloud Service Provider to Cloud Service Consumers. These services have cloud characteristics (on-demand self-service, broad network access, resource pooling, rapid elasticity and measured service). There are four cloud service models within the context of the IBM Cloud Computing Reference Architecture: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS) and Business Process as a Service (BPaaS). IaaS, PaaS and SaaS are defined according to the definition of Cloud Computing released by NIST<sup>1</sup>; BPaaS is an IBM-specific definition ("Business Process Services are any business process delivered through the Cloud service model"). The *Common Cloud Management Platform (CCMP)* exposes a set of Operational Support Services (OSS) and Business Support Services (BSS); it also includes User Interfaces serving the three main roles defined in the Cloud Computing Reference Architecture: a Service Consumer Portal to be used by Cloud Service Consumers for self-service delivery and management; a Service Provider Portal serving Cloud Service Provider administrators to support production operations; and a Service

Development Portal used by Cloud Service Creators. *Operational Support Services* represents the set of operational management and technical-related services exposed by the CCMP and needed by Cloud Service Creators to implement a cloud service. Many management domains of the OSS are also encountered in traditionally managed data centers (e.g. monitoring and event management, provisioning, incident and problem management, etc.) while other components are new and specific to the degrees of automation and efficiency associated with clouds (e.g. service automation, image lifecycle management, etc.). *Business Support Services* represents the set of business-related services exposed by the CCMP, which are needed by Cloud Service Creators to implement a cloud service. *Infrastructure* represents all infrastructure elements needed to provide cloud services (data center facilities, servers, storage, system software and network resources, etc.).

The **Cloud Service Creator** is responsible for creating a cloud service which can be run by a Cloud Service Provider and exposed to Cloud Service Consumers. A Cloud Service Creator designs, implements and maintains runtime and management artifacts specific to a cloud service. *Service Development Tools* are used by the Cloud Service Creator to develop new Cloud Service Definitions, including runtime artifacts and management-related aspects (monitoring, metering, provisioning, etc.).



"*Security, Resiliency, Performance and Consumability*" span the CCMP Reference Architecture, the hardware infrastructure and Cloud Services. IBM's design views these non-functional aspects from an end-to-end perspective.

The top-level architectural principles for the definition of any cloud implementation are: design for Cloud-scale efficiency, lean service management, leverage of commonalities, generic management throughout the lifecycle of Cloud services and a focus on delivery efficiency.

IBM has recently submitted a subset of the IBM Cloud Computing Reference Architecture to the Cloud Architecture Project of The Open Group.

**RAFFAELE STIFANI** is an IBM Executive Architect, expert in architectural design and technology implementation.

**STEFAN PAPPE** is an IBM Fellow and CTO for Cloud Services, expert in architectural and technical solution design.

**GERD BREITER** is a Distinguished Engineer and Tivoli Chief Architect for Cloud Computing.

**MICHAEL BEHRENDT** is an IBM Architect, expert on Cloud Computing Architecture

<sup>1</sup> [http://csrc.nist.gov/publications/drafts/800-145/Draft-SP-800-145\\_cloud-definition.pdf](http://csrc.nist.gov/publications/drafts/800-145/Draft-SP-800-145_cloud-definition.pdf)