



Platform-as-a-Service: An IBM Perspective

An IBM Redbooks® Point-of-View publication

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Highlights

Using a platform-as-a-service (PaaS) model lets your organization standardize processes, lower costs, and realize faster time to value. An end-to-end PaaS environment can provide the following key advantages:

- ▶ Reduce lead time for launching new applications.
 - ▶ Provide flexibility to support both cloud-centric or cloud-enabled workloads.
 - ▶ Enable developers to easily build, deploy, and manage cloud applications while using services and frameworks that are available in a cloud environment.
 - ▶ Capture changing trends in elastic cloud environment.
 - ▶ Take advantage of built-in operational and business support services for applications.
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Cloud computing represents a business transformation rather than an IT transformation. Trends, such as how to best use social media and mobile computing and the pressure to innovate and think differently, are pushing traditional IT delivery approaches to the breaking point. Today's businesses need to be agile in order to develop and deploy applications dynamically to meet both market and client needs. Platform as a service (PaaS) provides cloud services that can help you get agile business applications to market quicker and scale those applications as per market needs.

According to the National Institute of Standards and Technology (NIST), a PaaS cloud provides a toolkit for conveniently developing, deploying, and administering application software. A PaaS cloud is structured to support large numbers of subscribers, process very large quantities of data, and potentially be accessed from any point in the Internet. PaaS clouds typically provide a set of software building blocks and a set of development tools, such as programming languages, and support runtime environments that facilitate the construction of high-quality, scalable applications. Using a PaaS cloud environment can give your organization economics and speed, while maintaining the ability to differentiate services at the application layer.

By changing how business and society run, cloud computing has opened up huge avenues of innovation. Developers are combining systems of record with systems of engagement, and a new style of cloud-based applications is emerging, where mobile, social, analytics, and cloud systems work together to address a business challenge in an agile way. For these applications to work together without much investment and to be sustainable, cloud computing needs to be built upon open standards on a *software defined infrastructure*.

Developing and deploying solutions with a PaaS cloud provides clear benefits, but you also need to develop proper security for cloud implementations. In addition to the typical challenges of developing secure IT systems, cloud computing presents an added level of risk. Essential services are often outsourced to a third party in cloud environments. The "externalized" aspect of outsourcing makes it more difficult to maintain data integrity and privacy to support data and service availability, and to demonstrate compliance.



Typically, clients raise the following security concerns when using a PaaS cloud environment:

- ▶ How do I protect my PaaS cloud infrastructure against threats and attacks?
- ▶ How can I securely deploy application workloads in my PaaS cloud environment?
- ▶ How do I ensure that my PaaS platform meets the regulatory compliance needed for the infrastructure, middleware, and workload?

End-to-end cloud computing solution

IBM® has defined the Cloud Computing Reference Architecture (CCRA) based on years of experience of working with customers who have implemented cloud computing solutions. IBM CCRA is a blueprint for designing cloud computing implementations that is driven by functional and nonfunctional requirements (NFRs) collected from many cloud computing implementations. IBM CCRA provides guidelines and technical work products, such as service and deployment models. It defines the overarching implementations as *adoption patterns*. An adoption pattern embodies the architecture patterns that represent the ways organizations are implementing cloud computing solutions. An adoption pattern can help guide the definition and set up of your cloud computing solution.

The adoption pattern for the PaaS cloud as defined by the CCRA contains prescriptive guidance about how to design, implement, and deploy a PaaS cloud solution from both a cloud-enabled and a cloud-centric perspective. It also defines the core requirements for the PaaS cloud and provides guidance about adding new capabilities as needed.

The adoption pattern at present contains three macro patterns that each address a specific realm of business need for a PaaS cloud solution. This modular approach allows the extension of a PaaS cloud solution to add new capabilities and components as needed. A PaaS cloud adoption pattern covers the categories of cloud computing services that facilitate developing and deploying applications using a set of middleware and integrated services.

The PaaS macro patterns include the following features:

- ▶ **Middleware deployment and management**
This feature is focused on elastic services and applications platform capabilities. Virtual application patterns allow you to monitor and manage applications for performance. You can model and implement middleware patterns, thus exposing them as services in a self-service catalog. You can then automate their deployment, monitor resource utilization, and perform lifecycle management of the middleware. These capabilities and more are provided as cloud services to develop cloud-centric applications. These applications offer a wide range of services that address the social, mobile, and big data analytics solutions in a cloud.
Optionally, these features can enhance middleware management with capabilities for service level agreements (SLAs) and user-specified quality of service (QoS) through features, such as auto-scaling vertically and horizontally, workload throttling, fault detection and tolerance, high availability for unplanned failures, continuous availability for planned failures, and so on.
- ▶ **Application development and deployment**
This feature is focused on application lifecycle management (ALM) capabilities. Use cases allow you to streamline and reduce the cycle time of development, test, and time to production.
- ▶ **Cloud integration services**
These services are focused on application interfaces (APIs) for various service integrations across cloud environments that can be on or off premise. These services also include data center integration.

An integrated family of cloud technologies

With IBM's broad and integrated family of cloud technologies, you can get a cloud application platform that is built to meet your unique requirements. You can develop and test application patterns on IBM SmartCloud® Application Services and then deploy applications with the following solutions:

- ▶ IBM PureApplication™ System allows you to use IBM PaaS in your private cloud with our expert integrated system of hardware and pattern-based deployment for private cloud application management. You can capture expertise with

patterns that are ready to deploy and scale applications with policy-based automated scaling.

- ▶ IBM Workload Deployer provides pattern-based deployment support to create, deploy, and manage application environments on your hardware in a private cloud.
- ▶ IBM SmartCloud Enterprise/SoftLayer is the public infrastructure as a service (IaaS) available from IBM. IBM SmartCloud Application Services PaaS runs on, and automatically deploys virtual resources to, IBM SmartCloud Enterprise. You can use best-in-class open Java and PHP Hypertext Preprocessor (PHP) support, enjoy peace of mind with enterprise-class security, and reduce costs with pay-for-use metered pricing.

These solutions share IBM's open cloud architecture, which is based upon innovation found in OpenStack. IBM has added functionality to its products to make its architecture a complete end-to-end cloud platform.

IBM benefits from the unparalleled innovation found in open source communities such as OpenStack. Additionally, IBM benefits from the vibrant ecosystem of independent software vendor (ISV) partners that grow from these open source and open standards initiatives. IBM clients also benefit from the ability to take advantage of the open source and open standards APIs. IBM's preconfigured middleware patterns and virtual resources make the deployment of applications fast and repeatable.

Security considerations

To help ensure security and peace of mind for PaaS implementations, you need to identify and prioritize security risks before implementation. The ability to integrate PaaS applications with existing enterprise or agency security frameworks, such as identification and authorization, makes it easier to enforce enterprise or agency security policies.

Often, you will find that you have the same amount of control, if not more, with a PaaS solution. For example, for data protection, you need to understand how antivirus software is deployed on the supported systems to ensure that selected programs can identify and protect against malicious software or processes. For identity and access management issues, you need to control passwords, support privileged users, and enable role-based access to these services to enable secure deployment of application workloads. From an auditing and monitoring perspective, you need to determine how to test the infrastructure to meet the

legal, regulatory, and privacy requirements to meet any rules for governance or regulatory restraints.

What's next: How IBM can help

The adoption pattern for PaaS as defined by the CCRA includes prescriptive guidance about how to design and implement a cloud solution. Although this type of solution is never a one size fits all solution, the following sections provide information about the IBM implementation of a PaaS solution.

A PaaS solution with IBM PureApplication System

IBM PureSystems™ is family of expert integrated systems. Two of the members of this family are IBM PureFlex™ System and IBM PureApplication System. PureFlex System integrates compute, network, and storage resources and the management of these resources to accelerate delivery of infrastructure services. PureApplication System, which builds on top of PureFlex System, provides a workload aware, pre-tuned, and flexible platform for deploying and managing the lifecycle of business applications in a secure environment.

PureApplication System provides an integrated experience of PaaS through the following guiding principles:

- ▶ Patterns of expertise
- ▶ Integration by design
- ▶ Simplified experience

Providing patterns of expertise is a compelling value proposition of PureApplication System. The pattern engine built into PureApplication System provides an interface to build, deploy, and manage complex business applications through its Virtual System and Virtual Application pattern concepts.

Virtual System patterns represent traditional multitier topologies that are augmented with automation for lifecycle management. Virtual Application patterns represent an application-centric, SLA-oriented deployment model that is independent of the middleware. The goal is to provide a platform that manages the entire lifecycle of the business application.

Typically, application lifecycle stages demand distinct characteristics from the deployment platform. The pattern engine provides a flexible set of deployment

options that range from a one-click repeatable deployment, which is typically used in a fast-paced development environment or continuous delivery environment, to a controlled deployment and maintenance model, which is more prevalent in a long-running production environment.

PureApplication System ships several patterns for IBM middleware. These patterns represent the collective knowledge of thousands of deployments and established preferred practices that are codified into the system. However, an important aspect of the pattern engine is its openness. It provides pattern-based lifecycle management support for both IBM and non-IBM middleware-based applications through its pluggable framework. Through its IBM PureSystem Centre, IBM has established an ecosystem of business partners and solution providers who have delivered patterns that run IBM or non-IBM middleware on PureApplication System.

Managing a multi-tenant platform that deploys business applications can also become a complex task. A simplified user experience is another key design principle of PureApplication System. This design includes a simplified procurement experience and a single management console for managing the platform and the applications running on top of it to make it easier for administrators to manage PureApplication System. Easy integration points between PureApplication System and data center management tools allow for simplified monitoring, auditing, security, and notifications, making PureApplication System a true integrated middleware management platform for the enterprise.

PaaS with IBM Workload Deployer on an IaaS solution

Although PureApplication System represents an expert integrated system that combines the capabilities of a PaaS through a pattern engine with infrastructure as a service (IaaS) through preconfigured compute, network, storage, and virtualization in a single physical rack, IBM Workload Deployer provides the pattern engine PaaS capabilities in a bring-your-own IaaS and virtualization model.

Workload Deployer is an appliance that can deploy Virtual System and Virtual Application patterns on a VMware, IBM PowerVM®, or IBM z/VM® based virtualized infrastructure. This environment allows you to use your existing investment in hardware and virtualization and then provide higher level PaaS capabilities using a pattern-based deployment model.

Similar to PureApplication System, Workload Deployer offers lifecycle management of pattern-based deployments and a fine-grained security model for pattern assets. In addition, patterns are compatible between Workload Deployer and PureApplication System such that you can export and import patterns between the two environments, promoting reuse or allowing you to create roll-your-own solutions.

Using the IBM DevOps solution for improved ALM

The IBM DevOps solution offers an innovative approach to traditional ALM. It applies agile and lean principles to assist all stakeholders in an organization who develop, operate, or benefit from business software systems. With DevOps, an organization can broaden the scope and nature of software development and delivery.

In the agile paradigm, development teams are breaking down tasks into smaller deliverables and then delivering that work as frequently as possible to help speed the delivery cycle. Operations teams are facing shrinking budgets but are working more aggressively to keep systems up continuously. Thus, they often push back on increasing the frequency of change.

DevOps allows you to link development and operations more seamlessly, as shown in Figure 1, in order to get applications into production faster by using a collaborative environment.

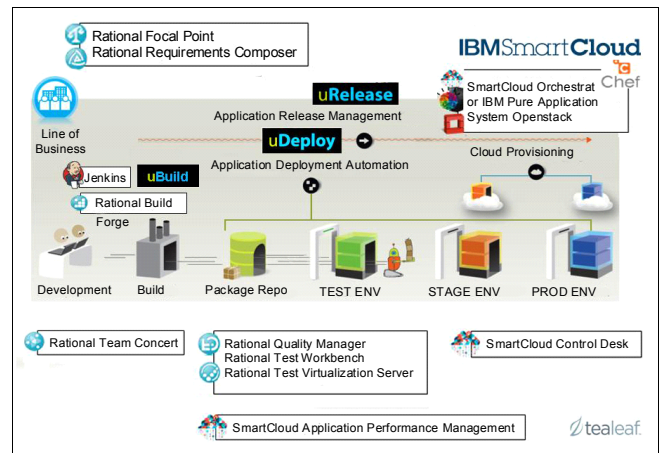


Figure 1 IBM SmartCloud DevOps Tool Chain

The value that IBM Cloud Platforms and PaaS provides throughout the delivery process is a consistent and reliable platform deployment that allows for infrastructure definitions to be treated as code. Deployments can be codified, versioned, and treated

as a part of the application lifecycle. With PureApplication System or SmartCloud technologies, developers can have reliable access to production-like deployments, and operations can deploy content with confidence based upon results through a delivery pipeline that have full traceability. The combination of cloud deployments with uDeploy provides a continuous delivery solution that meets developers need for speed with operational requirements for stability and reliability.

An end-to-end solution with IBM SmartCloud Application Services

IBM SmartCloud Application Services is the IBM PaaS offering that runs on the IBM public cloud, SmartCloud Enterprise. SmartCloud Application Services allows for fast development and deployment of applications to the cloud with middleware, databases, workload patterns, and cloud-based development tools. IBM SmartCloud Application Services offers rapid, reliable, and resilient services in the public cloud environment.

SmartCloud Application Services provides middleware and application level services but relies on the underlying IaaS for infrastructure services. SmartCloud Application Services provides open Java and PHP support to meet regulatory compliance. With its enterprise-class security, SmartCloud Application Services offers protection against security threats and attacks and provides a platform to deploy application workloads securely. Along with data security, SmartCloud Application Services offers reliability and resiliency.

Chief Information Officers (CIOs) and information technology (IT) managers often want to know “what software do we have” and “how much does it cost us.” With SmartCloud Application Services, you can measure and manage IT costs. In addition, the SmartCloud Application Services pay-for-use metered pricing allows businesses to control or even reduce IT costs.

SmartCloud Application Services uses Workload Deployer as its underlying core technology, which makes it easier to compose and deploy applications that are built from middleware components. SmartCloud Application Services are treated as additional services on a system control element for entitlements and billing. That concept is an important aspect because service management involves proactively maintaining the health of services and enabling clients to solve issues through well-defined interfaces.

SmartCloud Application Services offers both Workload Services and Collaborative Lifecycle Management Services. Additionally, SmartCloud Application Services provides several support services that are horizontal in nature, such as security, monitoring and recovery, forum, ticketing, data retention, and so on. The support and horizontal services are common to all vertical services that are available in SmartCloud Application Services.

Resources for more information

For more information about the concepts highlighted in the paper, see the following resources:

- ▶ IBM SmartCloud Enterprise
<http://www-935.ibm.com/services/us/en/cloud-enterprise>
- ▶ IBM DevOps
<http://www.ibm.com/ibm/devops/us/en>
- ▶ IBM SmartCloud Application Services
<http://www.ibm.com/cloud-computing/us/en/paas.html>
- ▶ IBM: Cloud security: Risks vs. reality
http://www.ibm.com/midmarket/us/en/article_cloud2_1209.html
- ▶ NIST recommendations for PaaS
<http://csrc.nist.gov/publications/drafts/800-146/Draft-NIST-SP800-146.pdf>

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This document, REDP-5041-00, was created or updated on October 30, 2013.



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