

# Accelerate Development of New Enterprise Solutions for the Cloud with Codename BlueMix

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## Highlights

Business success increasingly depends on applying new and innovative business models and implementing IT solutions more quickly than competitors. With the new IBM development environment for cloud-based applications, BlueMix, enterprises gain essential application development capabilities:

- ▶ Innovative new applications and services developed, deployed, and scaled in minutes rather than months.
- ▶ New born-on-the-cloud applications can be developed with speed and agility for a mobile and socially connected world, increasing customer and employee loyalty.
- ▶ Leveraging a broad ecosystem of application services, new development tools, and languages enables the enterprise to transform business and IT processes, making them more flexible and agile. BlueMix helps the enterprise avoid vendor lock-in.

## Thriving in this fast paced and connected world

A recent IBM® survey<sup>1</sup> of enterprises showed that those who adopt and leverage cloud computing for competitive advantage on average grow twice as fast and double their profit. Continued technology advancements in cloud computing are creating exceptional opportunities for enterprises to transform business models, supply chains, and their interactions with customers and partners. New technologies and tools are transforming traditional software development lifecycles. Innovation around IBM's open cloud architecture is dramatically changing the entire digital fabric inside, and outside of, the data center. This has a profound impact on how enterprises should think about their business:

- ▶ **Unlock innovation:** Cloud computing is enabling changes in how businesses and society operate and is unlocking huge avenues for innovation. These innovations are leveraging new ecosystems of application services and speeding the creation of solutions for a highly mobile, increasingly interconnected, and data intensive world.
- ▶ **Scale through open architectures:** Evolution of IBM's open cloud architecture, based on open source software and open standards, is enabling a new approach to delivering capabilities, workloads, and services. This approach results in dramatic improvements in data center operations, faster application development, and highly scalable solutions deployed on-premise and in the cloud.
- ▶ **Open ecosystems:** Leveraging open ecosystem projects, tools, and technologies can greatly enhance the enterprise's ability to adapt and leap-frog its competition. Open ecosystem projects supported, maintained, and enhanced by global partners can dramatically improve innovations. This approach is becoming the norm rather than the exception for IT going forward.
- ▶ **Develop rapid business outcomes:** Developers are taking a more central role in delivering value to the business. Rapid technology innovations in tools, frameworks, open interfaces, and languages are enabling them to create or synthesize highly interactive and dynamic applications that accelerate business outcomes. DevOps innovations coupled with composable cloud services are allowing new cloud-centric applications to be ready in days, rather than months. Deployment to and support of mobile platforms is often the first priority resulting in dramatic usability improvements when done right.

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<sup>1</sup> Under cloud cover: How leaders are accelerating competitive differentiation, CIW03086USEN.PDF, accessed via the following website: <http://www.ibm.com/press/us/en/pressrelease/42304.wss>



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- ▶ Engage social business for competitive advantage: Social applications and mobile devices are transforming customer and partner interactions. Advanced analytics processing applied against the mobile and social interactions provides insights to transform marketing and product innovation, resulting in competitive advantage for those willing to engage.
- ▶ Economics of consumption: Emergence of a cloud services consumption model (often called the *API economy*) and the availability of composite cloud services based on open standards are creating the opportunity for cost effective sophisticated solutions for enterprises large and small.

In this fast paced and connected world, each enterprise must continuously transform itself adapting to this ever-changing business landscape. To enable this continuous transformation, an enterprise needs a flexible digital fabric and application platform, coupled with the right tools, and services to rapidly deliver innovations across the enterprise (Figure 1).

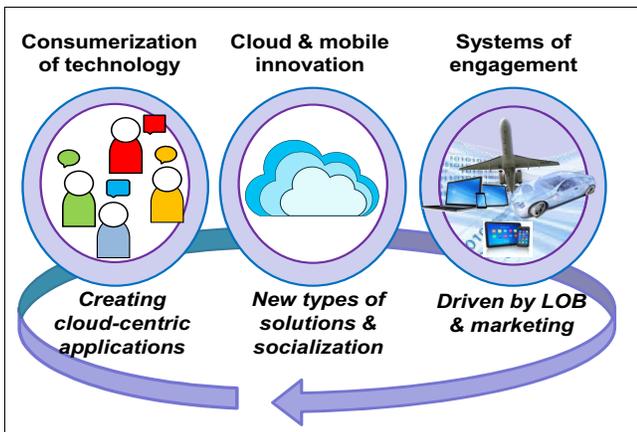


Figure 1 New IT and business environment

IBM's open cloud architecture provides the foundation of enterprise applications. IBM's strategic direction for IT services is based on this architecture. BlueMix provides a comprehensive application development environment in order to create born-on-the-cloud applications for mobile, social, and big data domains. IBM is ready to engage with your enterprise to take advantage of these technology innovations and to deliver robust enterprise solutions on your private cloud, IBM SoftLayer cloud, or a hybrid cloud environment.

## Establishing a solid enterprise foundation

IBM's open cloud architecture was announced in early 2013 and is the result of steady technology advancements, improved integration, and standardization in virtualization, management automation, and cloud scaling. The architecture has proven itself across hundreds of client engagements.

Today's business environment is demanding greater flexibility in order to introduce new products to market faster. This requirement demands that new tools be available that promote such products to an ever increasingly interconnected, mobile, and social world. As a result, the digital fabric supporting the business must be designed for utmost flexibility in order to support modern business processes, and customer and partner interactions.

IBM's open cloud architecture (Figure 2) encompasses at its most basic level three distinct layers.

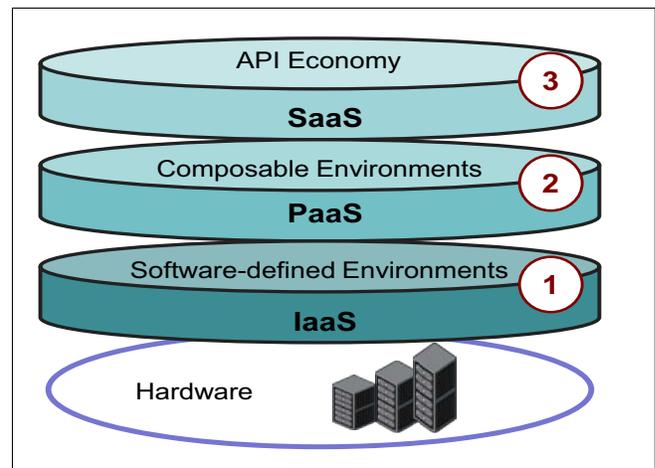


Figure 2 Open cloud architecture

The Infrastructure-as-a-Service (IaaS) layer (Figure 2, layer 1) resides above the physical hardware and supports virtualization and management of the hardware components. Virtualization has evolved to a point where it is used by most enterprises today. However, virtualizing physical hardware and creating this abstraction layer does not deliver on the full promise of the cloud. Although virtualization is a key component of the cloud infrastructure architecture, all basic infrastructure resources need to be provided as true services. As defined by National Institute of Standards and Technology (NIST)<sup>2</sup>, the full set of characteristics for IaaS includes managing all the

<sup>2</sup> NIST, <http://www.nist.gov/index.html>

infrastructure resources in a resource pool, with self-service provisioning, rapid elasticity, and as measured services. Virtualization alone does not accomplish this vision and set of characteristics. After all infrastructure resources are provided and managed as a set of capacity services, the data center can be treated as a true software-defined environment (Figure 2 on page 2, layer 1).

The value in a software-defined environment stems from two aspects. First, expressing physical infrastructure as software services that can be manipulated and automated, programmatically. Second, considering the infrastructure as a composite whole, not the network, storage, and compute as individual parts. Building the software-defined environment requires a disciplined approach. Standards (both formal and informal) are rapidly evolving to ensure portability, interoperability, and manageability of the software-defined environment. The OpenStack Foundation<sup>3</sup> has emerged as the most important consortium for the implementation of the software-defined environment by adopting many of the cross industry standards initiatives. The OpenStack Foundation was founded by IBM and several other leading IT vendors.

Enterprises take advantage of the capabilities of a software-defined environment to ensure that their applications receive the resources and performance available when demanded by the business, customers, and partners. This new design approach and architecture enables IT to deliver a much more compelling value to the enterprise. This design and architecture ensures that enterprises can optimize the utilization of infrastructure assets (physical and financial assets). The success of IaaS in public and private cloud deployments and the associated cost savings have already transformed the operations of many data centers.

IBM is investing heavily to provide world-leading IaaS capabilities. The recent IBM acquisition of SoftLayer Technologies Inc. provides a seamlessly unified global cloud computing infrastructure. It combines virtual public cloud instances, powerful bare metal servers, turnkey private clouds, and a broad range of storage, network and security devices, and services. All these services are connected via a global private network across 25 data centers, with a single control-and-command portal. A recently announced \$1.2B additional investment will bring the number of global data centers to 40 by the end of 2014<sup>4</sup>.

<sup>3</sup> OpenStack Foundation, <http://www.openstack.org/foundation>

<sup>4</sup> IBM Commits \$1.2 Billion to Expand Global Cloud Footprint, <http://www.ibm.com/press/us/en/pressrelease/42956.wss>

IBM SoftLayer customers can quickly and easily deploy globally distributed hybrid cloud architectures. These architectures are provisioned in real-time and billed hour-to-hour or month-to-month. Options that are available include GPU-powered servers, high-speed storage, and multi-processor bare metal. These options give customers access to higher levels of performance than available in commodity public clouds. The performance benefits extend to IBM SoftLayer's innovative triple-network architecture with these key capabilities:

- ▶ High-speed public connectivity
- ▶ A global private network for security
- ▶ Point-to-point intra-application and inter-data center connectivity
- ▶ Out-of-band management network for systems administration

Cloud-enabling an existing application environment or data center has resulted in increased flexibility for the enterprise providing an essential base for improvements and innovation.

More than 23,000 clients are taking advantage of IBM SoftLayer's advanced IaaS capabilities to increase their infrastructure flexibility. Many are leveraging IBM SoftLayer to deliver a new style of cloud-centric applications, often designed for a mobile and socially interconnected world. In some applications areas (such as, commerce and customer relationship management (CRM)), these cloud-centric applications are already having a dramatic impact. These cloud-centric applications take full advantage of software-defined environments and are also leveraging rapid evolutions in platform services. Developers are empowered with increased flexibility, which is further enhanced in the Platform-as-a-Service (PaaS) (Figure 2 on page 2, layer 2) layer. Bridging the software-defined environment layer with the compositional PaaS layer above it is an emerging open standard, which is based on the World Wide Web Consortium (W3C)<sup>5</sup> linked data, referred to as *Open Services for Lifecycle Collaboration (OSLC)*. The benefit is better integrated tools for developers of cloud-centric applications, and as a result, an increase in developer productivity for the enterprise.

The concept of composable environments, which consists of finer grained services that can be recombined to create new capabilities, is a key element of the cloud. Composable environments (Figure 2 on page 2, layer 2) can contain cloud services, which bring together operational, development, application, database, and third-party services. All of these cloud

<sup>5</sup> W3C, <http://www.w3.org>

services include embedded monitoring and manageability capabilities. Developers can take advantage of these cloud services to quickly build new composable applications. These new applications are built as cloud-centric (designed for and deployed to the cloud) and in a mobile-first (user interface that is designed for mobile devices) fashion.

IBM and Pivotal announced in mid-2013 their intent to collaborate on development of the Cloud Foundry open source Platform-as-a-Service framework. They also agreed to work towards defining an open governance model for the emerging Cloud Foundry community. Announced in February 2014 IBM, together with leading vendors formed the Cloud Foundry Foundation to manage the evolution of Cloud Foundry. Cloud Foundry is an interoperable PaaS framework that enables rapid application development, deployment, and scaling of new cloud-centric applications. It runs on a broad range of cloud infrastructure platforms, including OpenStack, Amazon Web Services (AWS), VMware, and IBM SoftLayer. It also supports a wide range of application programming language run times and frameworks including Java, Ruby, JavaScript, and Python. As with OpenStack at the IaaS layer, Cloud Foundry is defining the open standard at the PaaS layer, by virtue of its growing community and broad ecosystem of partners, vendors, and users. An enterprise is able to develop cloud-centric applications based on the open Cloud Foundry standard, which is the foundation for BlueMix, and take advantage of its open and vibrant cloud development platform and ecosystem without fear of vendor lock-in. Services and applications written based on the Cloud Foundry open standard are portable across vendors and infrastructures supporting and implementing this environment.

Software-as-a-Service (SaaS) is the top layer of the open cloud architecture (Figure 2 on page 2, layer 3). This layer is where end-users gain access to and leverage business applications to support the enterprise's business processes. IBM SoftLayer is today hosting thousands of SaaS-based applications, including a large share of the most popular apps available on iOS-based and Android-based mobile devices. Furthermore, IBM has over 100 enterprise SaaS-based applications available to clients today.

Modern applications are increasingly composed of a wide variety of composite services that are accessed through web-scale application programming interfaces (APIs) in order to access information and integrate with other applications. The rapid evolution of social applications, coupled together with the desire to have multi-modal applications that can be accessed from

any type of device with consistency of data and user experience, is fueling an increase in APIs. Composite applications leverage APIs from internal and external providers to build even more powerful application environments with a focus on employee productivity and efficient customer interactions. Increasingly, these APIs may participate in an economic model, where the consumption of the API is tied to a fee or on-going subscription model. As a result, this approach is often referred to as the *API economy*.

Many business models across various industries are being transformed as a result of the rapidly evolving API economy. Enterprises are making existing and new business applications and data available through APIs in order to expand their reach and drive new business opportunities for growth. The explosion in APIs is fueling a dramatic shift in the business landscape where customers, business partners, vendors, and clients can directly participate in an enterprise's business processes and gain access to enterprise data, from both inside and outside of the enterprise. APIs offer a cost-effective way to provide access to large amounts of data and the enterprise can leverage sophisticated analytics that are available to increase the value of such data.

It is important to carefully design and manage APIs because they are often published and made available in internal and external marketplaces or application stores. Many new business models are evolving around the availability of APIs. For example, APIs could be used to hail a taxi from a smartphone application, to process a mortgage application on a tablet, or to purchase health insurance from health exchanges via the web. Monetization of APIs and governance of the API lifecycle are rapidly evolving. Developing and implementing applications that take advantage of the API economy requires enhanced tools, frameworks, and programming models that are part of the PaaS layer of the cloud architecture. Cloud Foundry is the open source framework that pulls all these pieces together and is delivered from IBM in the form of BlueMix.

New enterprise applications often must leverage existing IT systems inside, as well as outside of the enterprise. Adopting Cloud Foundry is not sufficient to bridge all these requirements because the enterprise often needs to link new applications with existing business applications and data in a secure and scalable manner. IBM has worked on these challenges with its clients as their IT systems have evolved, and IBM is focused on helping enterprises bridge the gap with enterprise class solutions.

The cloud-centric application environments that incorporate mobile and social business support are often referred to as *systems of engagement*, due to their highly interactive nature. In contrast, traditional application environments are often referred to as *systems of record* because of their transaction-oriented and database-oriented nature.

Figure 3 shows the combined environment of systems of engagement and systems of record, together with the Internet of Things, referred to as *systems of interaction*.

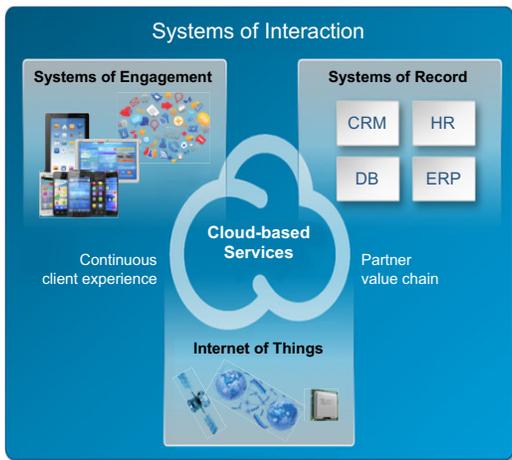


Figure 3 Systems of Interaction

IBM is leveraging its middleware platforms, IBM PureSystems™, IBM Worklight, OpenStack, and Cloud Foundry, to enable enterprises to build systems of interaction. Enterprises should build next generation applications using BlueMix to leverage the evolution of the capabilities delivered for systems of interaction. These applications take advantage of existing investments in packaged line-of-business applications including CRM, human resources (HR), and enterprise resource planning (ERP) as well as new cloud-centric applications. Through workload-optimized deployment, IBM can ensure that the enterprise receives optimal benefits out of existing line-of-business applications as they are deployed in system of interaction environments.

## Empowering developers with BlueMix

In order to take full advantage of cloud computing, the IBM open cloud architecture, and composable cloud services, applications must be designed to the emerging set of cloud-centric architectural principles. The development environment and tooling should make it easy to perform the following activities:

- ▶ Write and deploy applications

- ▶ Consume cloud services
- ▶ Publish and manage APIs for consumption by others

These activities need to be accomplished while balancing performance and security requirements. The development environment must enable the developer to build and expose secure, reliable, performant services to support an ecosystem of customer and partner applications.

Key to enabling development of cloud-centric applications is an environment built on open standards and technologies that offers a broad, extensible range of capabilities including:

- ▶ Programming languages and runtime frameworks
- ▶ Discoverable and consumable services
- ▶ Integrated application lifecycle and automation tooling enabling DevOps

Cloud-centric applications consist of multiple composable components each of which can use a different development language and framework. This approach to programming optimizes both system performance and developer productivity by promoting the selection of the right tool for each job. This approach to programming optimizes both system performance and developer productivity by promoting the selection of the right tool for each job. Traditional, compiled programming languages (such as C, C++, and Java) optimize system performance where it matters, but at the expense of developer productivity. Newer interpreted languages (such as Ruby, PHP, and Python) allow for higher developer productivity and increased agility at the expense of some performance. By combining traditional and dynamic languages, the developer can optimize the elements of an application and the development process to the application. This approach is often referred to as *polyglot programming*. Cloud Foundry and the Cloud Foundry-based BlueMix support polyglot programming through the concept of *buildpacks*. Buildpacks are predefined environments to execute applications and can be created in support of unique enterprise environments. This approach enhances flexibility in the enterprise while improving both maintainability and productivity by allowing developers to select the best language or framework for a job from a controlled, predefined set of standardized environments.

The emergence of cloud services is also transforming the way developers work by providing a means to create and use complex capabilities without the need to install, configure, and tune software in the traditional manner. A rich library of these cloud services coupled

with a marketplace that enables discovery promotes experimentation by allowing developers to quickly and easily find and use these services. To reach their potential, marketplaces must not only be populated with a variety of services targeting the many phases of the development cycle, from design, development, and test, through production and maintenance and the many types of application development, including web, mobile, big data, and Internet of Things. They must be extensible and support the addition of new categories and services. The marketplace must promote discovery through features such as, browsing by category and filtering by various attributes and packaging formats, making it easy to compare and contrast the available options. This approach helps ensure developers can quickly get started and ultimately deliver new applications to market faster.

*DevOps*, a methodology that stresses tight collaboration between development and operations, promotes speed, efficiency, and stability through the automated, rapid integration of changes. Cloud Foundry and OpenStack, the foundation of BlueMix, have robust ecosystems of add-on DevOps tooling that facilitate development of cloud-centric applications. These add-on tools help with the deployment and orchestration of application releases and complement the existing and extensive IBM DevOps portfolio, which includes the recently acquired UrbanCode Inc.

Open standards and open technologies are rapidly evolving in support of cloud-centric applications and the API economy. Open standards, especially in areas such as application security, federated identity, application APIs and access control, help deliver the interoperability and portability wanted while enabling integration with other technologies and providers. Open technologies bring vibrant ecosystems of tooling, products, and solutions with their unparalleled innovation and ability to extend. Together open standards and open technologies, supported and often led by IBM, will ensure client investments are protected by enabling interoperability and portability.

Tying together polyglot programming, marketplaces, DevOps, and open standards is what empowers the developer to bring more value to the enterprise faster. With the right platform and underlying infrastructure, developers are enabled to rapidly develop, deploy, and scale applications and manage the application lifecycle. A robust ecosystem provides a rich library of easily consumable cloud services based on proven cloud technologies that can be simply composed into a solution that is deployed with minimal effort. Solutions that are composed from these proven services are able to be delivered to market faster and with higher quality

than previously possible, ultimately leading to better business outcomes.

IBM is rapidly expanding its product portfolio to be the premier supplier of services and tooling for open cloud architectures to the enterprise. The centerpiece is the Cloud Foundry-based BlueMix. BlueMix supports polyglot programming and composition of cloud services from both IBM and its business partners in a pay-as-you-go public cloud model supported by IBM SoftLayer. The IBM Rational® family of products, including JazzHub, along with newly acquired UrbanCode Inc. support the DevOps methodology. IBM, demonstrating a broad and deep commitment to open standards and open source initiatives, is integrating and delivering these core capabilities via BlueMix.

To deliver on the promise of faster delivery and higher quality offered by composed cloud-centric applications, developers need a rich portfolio of trusted, proven services. BlueMix offers these services from three sources: the IBM portfolio, third parties, and open source projects. Initial services from the IBM portfolio will be drawn from IBM WebSphere®, IBM InfoSphere® BigInsights™, IBM Tivoli®, and IBM Rational. Third-party services come from across the industry, including both IBM business partners and independent software vendors (ISVs), and will continue to expand through IBM's open cloud architecture. Popular open source projects such as PostgreSQL, MySQL, and RabbitMQ will also be provided.

Supporting the developer with software development in the cloud is JazzHub. *JazzHub* is a premier DevOps service on BlueMix that provides a place to collaborate with others to plan, track, and develop software. A hosted service, the simple user interface allows a project to be started quickly and coding to begin immediately without downloads through the use of a web-based source code editor. Developers preferring traditional GUI-based integrated development environments (IDEs) such as Eclipse or Microsoft Visual Studio can continue using them through the IBM Rational Team Concert™ client. JazzHub projects can be public or private and come with source code management, project planning and work item tracking services, and a customizable reporting dashboard. JazzHub provides a simple yet powerful path to getting started with BlueMix.

As an IBM survey<sup>6</sup> shows, enterprises that leverage cloud and deploy cloud-centric applications outpace their peers in both growth and profits. More importantly, pace-setters are not just using cloud to optimize their infrastructure, they were leveraging cloud to deliver new business models and new modes of engaging their customers and business partners. With BlueMix, the application developers have self-service access to the tools, services, and technologies they need to develop and deliver cloud-centric applications. These applications often support new business models and systems of engagement, enabling enterprises to achieve remarkable results.

## A trusted partner is key

IBM is in a unique position to help transform its clients' IT infrastructure and development environments. IBM has led the way in embracing new technologies to provide business solutions that benefit enterprises. Now, IBM is helping to define this new era of cloud computing via the IBM open cloud architecture, which is based on software-defined environments and composable cloud services. These composable cloud services can be created and used in BlueMix by developers. IBM is using continuous delivery methods for the design, construction, deployment, and maintenance of applications within this platform.

The new technologies and tools outlined in this paper bring both challenges and great opportunities to enterprises. However, most enterprises should not embark down this road without a knowledgeable partner who is investing in the core technologies and providing service and maintenance. Optimizing application development and delivery has its challenges. Only an experienced and trusted partner is able to provide world-class support, service, and the long-term maintenance capabilities that are needed to make these projects successful on your cloud environment. This partner must be able to support your cloud environment be it a private cloud, a public cloud (such as IBM SoftLayer), or a hybrid cloud environment.

IBM has successfully introduced and integrated new technologies into the enterprise in the past with its leadership in Linux, Apache, and now with OpenStack Foundation and Cloud Foundry Foundation. To thrive, enterprises need to develop and acquire new skills and

embrace different approaches. In return, the enterprise has the opportunity to deepen its relationships with customers, find new ways to deliver value, and grow its business.

IBM invests heavily in the development of open source and open standards to support the security, cloud, social, mobile, big data, and analytics requirements of its clients. IBM is a founding member of The OpenStack Foundation as well as the new Cloud Foundry Foundation. IBM is also a founding member of the Object Management Group (OMG) Cloud Standards Customer Council (CSCC) where customers, vendors, and consultants collaborate to influence the evolution of the open cloud. IBM is working closely with Pivotal and other members of the Cloud Foundry community to make it the leading PaaS platform across the industry. These initiatives and investments combined with other standards activities help to advance broad industry adoption of the IBM open cloud architecture. The IBM open cloud architecture reduces concerns of vendor lock-in and fosters an open API economy. The standards also improve the ability of developers to interchange component services when they need to modify or enhance their applications.

Through BlueMix and the recent acquisition of SoftLayer, IBM has introduced the core capabilities necessary to enable the enterprise for the world of systems of interaction and cloud-centric applications. IBM continues to enhance BlueMix and continues this journey of innovation for its clients. IBM intends to collaborate within the ecosystems around OpenStack and Cloud Foundry by direct contributions and to expand the portfolio of cloud services and capabilities available within BlueMix. IBM is also working with business partners and ISVs to foster a broad ecosystem of services and capabilities to develop and deploy system of interaction applications. The IBM acquisition of SoftLayer greatly enhances the IBM capability to provide a world class and scalable cloud platform to its clients. Investments into the open source OpenStack community will help ensure OpenStack remains the market leading cloud infrastructure platform. With IBM investments into and support of the base PaaS capabilities around the Cloud Foundry project, a significant new ecosystem of cloud services is expected to rapidly emerge across the industry. IBM has launched BlueMix to pull all of these initiatives together into a single development platform environment for easy consumption by developers. This platform provides the home for building and deploying new system of engagement enterprise applications on the cloud.

<sup>6</sup> Under cloud cover: How leaders are accelerating competitive differentiation, CIW03086USEN.PDF, accessed via <http://www.ibm.com/press/us/en/pressrelease/42304.wss>

## What's next: Getting started with BlueMix

IBM is investing to help enterprises realize their vision. IBM is working with thousands of enterprises, helping them adopt cloud computing and leverage new applications for maximum business outcomes. IBM partners and clients are providing feedback and identifying best practices based on real world projects. IBM continues to share this collective knowledge and expertise with its clients and will continue to incorporate lessons learned into BlueMix.

You can start your journey by learning more about BlueMix and IBM SoftLayer from these web addresses:

IBM application development environment Codename BlueMix

<http://www.bluemix.net>

IBM Cloud - Cloud Platform (PaaS)

<http://www.ibm.com/cloud-computing/us/en/paas.html>

IBM SoftLayer offering

<http://www.softlayer.com>

## Resources for more information

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

- ▶ IBM's open cloud architecture  
<http://www.ibm.com/developerworks/cloud/library/cl-open-architecture>
- ▶ Ebook: *Cloud Services for Dummies*  
<http://www.ibm.com/cloud-computing/files/cloud-for-dummies.pdf>
- ▶ *IBM survey of enterprises adopting cloud computing*  
<http://www.ibm.com/press/us/en/pressrelease/42304.wss>
- ▶ *All Clouds are Not Created Equal: A Logical Approach to Cloud Adoption in Your Company*  
[http://www.ibm.com/services/be/en/attachments/pdf/SmartCloud\\_Enterprise\\_-\\_IBM\\_-\\_Frost\\_and\\_Sullivan\\_Whitepaper.pdf](http://www.ibm.com/services/be/en/attachments/pdf/SmartCloud_Enterprise_-_IBM_-_Frost_and_Sullivan_Whitepaper.pdf)
- ▶ IBM is a leader in cloud open standards  
<http://www.ibm.com/cloud-computing/us/en/open-standards.html>

- ▶ *The Twelve-Factor App*  
<http://www.12factor.net>
- ▶ *The Citizen Developer*  
<http://thecitizendeveloper.com>
- ▶ *Systems of Engagement and the Future of Enterprise IT: A Sea Change in Enterprise IT*  
<http://www.aiim.org/futurehistory>
- ▶ *IBM's open cloud architecture* blog  
<http://www.ibm.com/developerworks/cloud/library/cl-open-architecture/index.html>

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