Citrix CloudPlatform for the service provider
The shift of computing resources from the datacenter to the cloud is just beginning, and it presents a massive opportunity to the well-armed service provider. Analyst firm Gartner, for example, expects the Infrastructure as a Service (IaaS) market to surpass $24 billion by 2016, representing a 43 percent compound annual growth rate (CAGR) from the estimated $4.2 billion market in 2011.¹

To fully seize the cloud computing opportunity, service providers must be prepared for shifts in industry adoption and application readiness as the market matures. While startups and Web 2.0 use cases constituted much of the earliest adoption of cloud computing, recent growth in IaaS has been dominated by enterprise adoption of cloud services for a wide variety of production applications. This trend is expected to continue.

Whereas Internet companies, the earliest users of cloud computing, were aggressive in their adoption of new technologies and trends—including mobile and social applications, REST-based web services and NoSQL databases—the vast majority of enterprise applications do not yet embrace cloud-native architectural principles. Rather, these traditional application workloads, such as SAP ERP, Oracle database apps and Microsoft® Exchange, are based on n-tier application architectures that predate the cloud.

With enterprise adoption growing rapidly and workload diversity on the rise, savvy service providers are evolving their offerings beyond the Amazon-style commodity clouds that dominated the early market. By introducing new, tiered offerings that provide both shared public and hosted private cloud services, these service providers are able to simultaneously cater to cloud-native application, as well as traditional application workloads.

Successfully delivering tiered cloud offerings demands a cloud orchestration solution able to meet the needs of both these workload styles. Citrix CloudPlatform, powered by Apache CloudStack, is the only cloud orchestration solution built from the ground up to enable tiered cloud computing service offerings. With CloudPlatform, service providers’ clouds can support any business application, whether a traditional or cloud-native application workload, right out of the gate. Alternatively, they may be designed for one style of workload initially, and later expanded to support additional workload style.

By enabling tiered cloud computing offerings, CloudPlatform helps service providers position themselves effectively for the coming wave of enterprise migration to the cloud, while achieving rapid time-to-value, improved business and infrastructure performance and increasing competitiveness today.
The tiered cloud opportunity

Cloud workloads have come a long way since the introduction of the first cloud computing environments. Early on, public cloud offerings, like shared and managed hosting before it, were dominated by web applications. The vast majority of these applications followed the same basic pattern established by the client/server applications that preceded them in the enterprise: the web application was delivered by a web or application server, and these servers stored application data in a SQL database hosted on the same or a different machine. More often than not, when the application needed to scale to serve more users, the application server or the database server was replaced with a more capable—and more expensive—machine.

Under the growing influence of the consumer Internet and advancing enterprise technologies, the architectures, and thus the deployment environments, of modern web applications and traditional enterprise applications have significantly diverged.

Cloud-native application workloads

Around the time when cloud computing began driving change in the application hosting environment, a growing need to achieve “web scale” forced an evolution of web application architectures. According to the new thinking, rather than purchase ever-larger servers as the primary strategy for achieving scalability, it was preferable to scale applications across many loosely coupled, commodity-grade computing and storage nodes. By running multiple application servers in parallel, employing liberal use of caching strategies and replicating data to multiple traditional or distributed database servers, Internet companies such as Amazon, Google, Zynga and Facebook are able to cost-effectively support the load generated by many millions of users.

This new approach to architecting web applications became the basis for a new set of best practices for delivering cloud-native application workloads. Workloads of this type include not only web and social media applications, but also big data, high-performance computing (HPC), batch processing applications and more, as shown in Table 1.

<table>
<thead>
<tr>
<th>Cloud-native application workload examples</th>
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<tbody>
<tr>
<td>Web services</td>
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<tr>
<td>Web applications</td>
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<td>Rich Internet applications</td>
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<td>Disaster recovery</td>
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<tr>
<td>HPC</td>
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<td>Collaboration/social media</td>
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Cloud-native application workload examples

<table>
<thead>
<tr>
<th>Batch processing</th>
<th>Predictive usage for processing large workloads such as data mining, warehousing, analytics, business intelligence</th>
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<tbody>
<tr>
<td>Development and test</td>
<td>Software development and test processes and image management</td>
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Table 1. Cloud-native application workload examples

Traditional enterprise workloads

Within the enterprise, traditional application workload architectures also continued to evolve. Large enterprise applications such as those offered by Microsoft, Oracle and SAP, became n-tier applications built to run on a small cluster of enterprise-grade front-end and application server nodes, backed by a single, high-performance database server. See Table 2 for additional examples of traditional enterprise workloads. The introduction of virtualization technology allowed IT to consolidate enterprise and departmental applications, which previously required their own infrastructure, onto fewer physical machines.

Whereas Internet companies hosting cloud-native application workloads assume that the underlying infrastructure can and will fail, developers of traditional enterprise applications do not expect the underlying server or storage cluster to fail during the normal course of operation. As a result, traditional enterprise applications rely on complex enterprise technologies such as network link aggregation, storage multipathing, virtual machine (VM) high availability or fault tolerance and VM live migration to ensure reliability of these applications.

<table>
<thead>
<tr>
<th>Traditional application workloads</th>
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<tbody>
<tr>
<td>Communications/ productivity</td>
</tr>
<tr>
<td>CRM / ERP/ database</td>
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<tr>
<td>Desktop</td>
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</table>

Table 2. Traditional enterprise workload examples
The fundamental differences between traditional enterprise workloads and cloud era workloads are summarized in Table 3.

<table>
<thead>
<tr>
<th></th>
<th>Traditional application workload</th>
<th>Cloud-native application workload</th>
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<tbody>
<tr>
<td>Scale</td>
<td>Tens of thousands of users</td>
<td>Millions of users</td>
</tr>
<tr>
<td>Reliability</td>
<td>99.999% uptime</td>
<td>Assumes failure</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Proprietary</td>
<td>Commodity</td>
</tr>
<tr>
<td>Software stack</td>
<td>Java + Oracle, .NET + Microsoft® SQL Server®</td>
<td>LAMP</td>
</tr>
<tr>
<td>Applications</td>
<td>SAP, Microsoft, Oracle</td>
<td>Web content, web apps, social media</td>
</tr>
<tr>
<td>Support model</td>
<td>Commercial</td>
<td>Community, internal</td>
</tr>
</tbody>
</table>

Table 3. Traditional vs. cloud-native application workloads

**Tiered cloud offerings**

With traditional application workloads strongly rooted in the enterprise and cloud-native application workloads representing the road ahead for social, mobile and web applications, mixed workloads will be a reality for service providers for many years to come. At the same time, enterprise datacenters themselves are evolving towards highly automated private clouds. As a result, enterprise cloud computing is increasingly becoming a tiered, hybrid system, where workloads are hosted in the environment that makes the most sense for the business and migrated between environments as needs change.

It follows that any enterprise-focused service provider cloud must support both traditional and cloud-native application workloads by offering both:

- **Shared public cloud**, enabling support for cloud-native applications based on multi-tenant commodity infrastructure running community-supported hypervisors

- **Hosted private cloud**, providing all the benefits of elastic computing for traditional application workloads, delivered on dedicated servers with exclusive network access control and highly available commercial components

Supporting both these cloud types via a tiered offering enables service providers to optimize efficiency, meet the evolving needs of customers and avoid a narrow focus that can leave business on the table. Here are the reasons for this strategy:

- Offering shared public cloud services alone and supporting only cloud-native application workloads mean the service provider fails to deliver a solution compatible with the applications running in today’s enterprise datacenters. In offering commodity cloud computing services, the provider relegates itself to competing with Amazon Web Services (AWS), leaving high-value, highly differentiated enterprise application hosting to competitors.

- Offering only hosted private clouds, without support for cloud-native applications, is not the answer either, as it fails to provide a path to the future. Even worse, service provider clouds that are capable of supporting only traditional application...
workloads often do not take into consideration the strong evolutionary trend of today’s traditional application workloads, which are becoming increasingly distributed and less dependent on traditionally architected infrastructure, eventually to emerge a cloud-native application workloads.

• Finally, supporting separate clouds environments for each workload style is also prone to failure because of gross operational inefficiency. Separate environments require duplication of software, infrastructure, labor and operational processes and procedures, eating away at service provider profitability and agility.

In spite of the clear need to support both traditional and cloud-native application workloads, most cloud orchestration solutions do not even attempt to accommodate the former. CloudPlatform is the exception to this rule. The solution incorporates an open and flexible architecture that supports both shared public cloud and hosted private cloud offerings via a single, unified cloud environment, which is easily managed through a single-pane-of-glass interface.

Introducing Citrix CloudPlatform

CloudPlatform orchestrates the datacenter resources that make up a cloud infrastructure and is used to deploy, manage and configure public, private and hybrid cloud environments. With CloudPlatform, service providers can easily deploy tiered cloud computing environments. By supporting both commodity and enterprise-grade infrastructure to support cloud-native application and traditional application workloads via shared public and private clouds, CloudPlatform allows service providers to rapidly field competitive cloud offerings that meet the needs of today’s enterprise customers.

CloudPlatform is:

Proven – With hundreds of successful service-provider deployments at companies including BT, China Telecom, Data Pipe, KDDI, KT, NTT Communications, Rackspace, SoftLayer, Telus and Vodacom, CloudPlatform has been battle hardened in real-world production service provider environments.

Platform agnostic – CloudPlatform works with a variety of hypervisors, even within a single cloud deployment. You have the complete freedom to choose the right hypervisor for your customers’ workloads. CloudPlatform works with the community-supported Xen and KVM hypervisors, as well as commercially supported hypervisors such as Citrix XenServer, VMware® vSphere® and Oracle VM (OVM). For workloads whose needs are unmet by today’s hypervisors, CloudPlatform can also orchestrate bare-metal servers as part of the cloud.

Massively scalable – CloudPlatform meets the needs of the largest global service providers, orchestrating tens of thousands of physical or virtual servers in multiple, geographically distributed datacenters, while allowing the resultant cloud(s) to be easily managed via a user-friendly single-pane-of-glass interface. No individual component is a single point of failure, and periodic maintenance of the management server can be performed without affecting the VMs running in the cloud.
Highly efficient – CloudPlatform features dynamic workload management that automates the distribution of compute, network and storage while adhering to defined policies on load balancing, data security and compliance. A real-time view of aggregated storage, IP pools, CPU, memory and other resources in use gives service providers the visibility and control they need to remain competitive.

Supported by a strong ecosystem – CloudPlatform is the center of a vibrant ecosystem spanning over a thousand certified Citrix cloud applications, hundreds of CloudPlatform Certified Partners and tens of thousands of members of the CloudStack.org open source community. Jointly developed and supported integrations allow customers to take advantage of complementary solutions from vendors such as Cisco, NetApp and CA.

Part of a complete solution – Service providers benefit from the fact that CloudPlatform is part of a single-vendor, end-to-end solution that includes Citrix CloudPortal Business Manager, Citrix XenServer, Citrix NetScaler, Citrix NetScaler Branch Repeater and Citrix NetScaler CloudBridge. Providers choosing the Citrix platform can take advantage of a turnkey solution offering simple deployment, experienced professional services for design and architecture support and an integrated management experience, resulting in lower risk, shorter time-to-value and reduced operational costs. In addition, these service providers experience streamlined purchasing, a single support contract and features that complement one another across the stack, each in an open, hypervisor-agnostic way.

Building tiered cloud offerings with Citrix CloudPlatform

The ability to support both traditional and cloud-native application workloads lies in the openness and flexibility of the CloudPlatform architecture. Service providers can deliver robust, tiered clouds with multiple “availability zones,” each comprising resources in one or more physical datacenters.

Within each availability zone, a different combination of hypervisor, storage and networking configurations is supported. This flexibility allows service providers to offer both public and private clouds and meet the needs of different enterprise cloud workloads. Each availability zone can deliver multiple, distinct levels of service with specific reliability, scalability, security, compliance, performance, cost and other parameters.

CloudPlatform also supports AWS-like Regions and S3 based object storage. With regions, service providers can create Amazon Web Service like availability regions that can consist of multiple zones and datacenters for increased scalability and availability. Regions ensure geographic wide object store access, high availability through multiple zones, low latency and can help meet compliance requirements for geo-specific cloud locations. Service providers can also enable Amazon S3 like object storage in a region or across multiple zones for increased workload availability, operations efficiency and management simplicity. Cloud-native application workloads that require object storage can easily run in CloudPlatform and have transparent access to storage wherever the workload is deployed.
Architecting shared public availability zones for cloud-native application workloads

Due to the distributed nature of cloud-native application workloads, shared public availability zones are typically designed to minimize cost at the expense of traditional enterprise features. As a result, shared public availability zones are primarily constructed using commodity servers running a community-supported hypervisor such as Xen, XenServer or KVM.

Figure 1 illustrates how a shared public availability zone can be constructed to support cloud-native application workloads with CloudPlatform.

In shared public availability zones, VM images are stored on relatively inexpensive local disk or NFS volumes and an object store can be offered to store data that must persist through availability zone failures.

Software defined networking (SDN) is increasingly common in shared public availability zones. CloudPlatform supports any OpenFlow-compatible virtual switch, including those provided by BigSwitch, OpenDayLight, Brocade Communications, Cisco, Juniper networks, Midokura and many others.

To overcome VLAN scalability limitations, CloudPlatform, like AWS, uses Layer 3 security groups to provide multi-tenant isolation. (Shared networks, which are accessible by VMs that belong to different accounts, are supported as well.) Elastic load balancing (ELB) or global server load balancing (GSLB) is used to redirect user traffic to less-busy servers in multiple availability zones.

Public clouds delivered via shared public availability zones provide your customers and their developers with a high-performance yet low-cost environment for new applications being built according to cloud-native architectural patterns. Because of their architectural similarity and API compatibility with the AWS public cloud, public availability zones can leverage third-party tools developed for AWS, which are readily available and have tested, proven integrations with CloudPlatform.
Architecting hosted private availability zones for traditional application workloads

Hosted private availability zones for traditional enterprise workloads are typically designed for high availability and fault tolerance, as dictated by the recovery point objective and recovery time objective of these workloads and the corresponding SLA that is offered to the customer. Hosted private availability zones use enterprise-grade infrastructure components common to a modern datacenter to meet those needs.

Figure 2 illustrates how a CloudPlatform hosted private availability zone can be constructed to support traditional enterprise workloads.

Hosted private availability zones typically begin with a commercially supported hypervisor, such as vSphere or XenServer, which supports live migration of VMs and has built-in high-availability features. VM images are typically stored on high-performance SAN devices. Traditional physical network infrastructure such as firewalls and Layer 2 switching are used and VLANs are incorporated to isolate traffic between servers and tenants. VPN tunneling provides secure remote and site-to-site access through existing network edge devices. Applications are packaged using industry-standard OVF files.

CloudPlatform employs infrastructure hardening techniques to ensure desired reliability levels, including link aggregation via bonded NICs for networking, multipathing for storage, and high availability, fault tolerance and live migration at the VM layer. The solution provides deep control of physical network properties, allowing cloud orchestrations to include activities such as adding/removing/updating physical networks in a zone, configuring VLANs on the physical network, specifying properties such as network speed, configuring a name so the network can be recognized by hypervisors, configuring the IP addresses trunked to a physical network and specifying what type of traffic is carried on the physical network.
Because they provide the reliability and other features that enterprise applications depend upon, hosted private availability zones allow you to readily migrate existing applications into a hosted private cloud and take advantage of its cost and operational efficiencies.

**Advanced cloud networking**
Cloud operators can create advanced cloud networking configurations and Network-as-a-Service offerings including comprehensive portable IP capabilities, advanced load balancing and GSLB, AWS like Health Checks, dedicated network resources and VLANs that best fits their needs.

**Putting it all together**
Figure 3 illustrates how the shared public and hosted private availability zones described above can be combined to create a tiered cloud environment managed by a single CloudPlatform instance.

![CloudPlatform diagram](image)

**Figure 3.** Tiered cloud featuring shared public and hosted private availability zones

In this example, the service provider cloud includes shared public and hosted private availability zones distributed across several geographic regions. Using CloudPlatform, this single service provider cloud would support both cloud-native application and traditional application workload types. A single-pane-of-glass console would streamline and unify operational processes and procedures and provide a single point of compliance reporting and enforcement. Duplication of infrastructure would be minimized, and investments in staff training would yield maximal returns.

**Additional considerations for service providers**
CloudPlatform API – CloudPlatform features a versatile, REST-based API that makes it easy for service providers to integrate the platform into existing management portals. The API provides detailed usage and chargeback data along with a variety of other innovative features, ensuring that every bit of resource usage is counted and billed for.
CloudPortal Business Manager – For service providers without an existing customer and management portal, or who seek to skip the time and expense of API integration, Citrix offers CloudPortal Business Manager. This purpose-built business support system, operations support system, or BSS/OSS, works in conjunction with CloudPlatform. It provides powerful, easy-to-use account and partner management, pricing and billing, customer management and reporting capabilities that accelerate the time-to-market and onboarding processes.

Network as a Service (NaaS) – The ability to offer a wide variety of on-demand network services—such as advanced firewalls, quality-of-service (QoS) controls, VPNs and WAN optimization—gives service providers a valuable and profitable means to meet complex enterprise requirements. CloudPlatform enables service providers to deploy and manage NaaS offerings by orchestrating and managing a wide variety of software and hardware-based network services, and by integrating NaaS usage statistics into the platform’s billing and reporting capabilities.

High availability/disaster recovery – CloudPlatform is architected to allow service providers to achieve the highest levels of cloud reliability and performance. In that there is no single point of failure, periodic maintenance of the management server can be performed without affecting the virtual machines running in the cloud.

Granular access controls – CloudPlatform offers robust, role-based access controls. Service providers can define multiple administrative and reporting roles and limit the operations available to each to enable a strict separation of responsibilities and meet a wide variety of compliance requirements. Likewise, customers can define n-levels of hierarchical access control groups, flexibly mapping groups and roles to access permissions to meet a wide variety of business requirements.

Cloud as a platform – Cloud is increasingly the platform and entry point for a wide variety of value-added enterprise services such as Desktop as a Service (DaaS), Platform as a Service (PaaS), and Disaster Recovery as a Service (DRaaS). CloudPlatform supports these services through a variety of complementary solutions from Citrix and its partners, allowing service providers to drive increased value and profits.
Conclusion
Driven by surging enterprise interest in hosted cloud services, the IaaS opportunity is a large and growing. To fulfill the complex and varied needs of enterprise customers, however, service providers must evolve their offerings beyond commodity-oriented public cloud services. Only in fielding enterprise-grade private cloud offerings, capable of hosting a range of traditional enterprise workloads, will service providers be positioned to capitalize on enterprise cloud adoption.

CloudPlatform is the only cloud orchestration solution to incorporate an open and flexible architecture that permits service providers to quickly deploy tiered offerings including public and private clouds and supporting both emerging and legacy enterprise workload types. By providing a turnkey solution to tiered cloud computing offerings, CloudPlatform helps service providers achieve rapid time-to-value, improved business and infrastructure performance and increased overall competitiveness.

For technical details on how CloudPlatform fits in your datacenter view, read CloudPlatform deployment reference architecture. To get started using CloudPlatform today, download the 90-day trial at http://www.citrix.com/products/cloudplatform/try


About Citrix
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