How Citrix CloudPlatform enables enterprise application workloads

Technical features for scale-up workloads.
Cloud computing is increasingly being adopted by enterprise IT and lines of business to achieve business agility and efficiency. The types of applications or workloads that IT is delivering as cloud services can vary widely, ranging from traditional enterprise, scale-up to cloud-native, scale-out application workloads.

While the benefits of cloud computing are evident, IT faces a new set of challenges including which cloud solutions to use, what the right architecture should be and perhaps most importantly, which workloads to run. Defining the right strategy to these core questions enables both IT and the line of business owners to maximize the potential of their cloud architecture and develop a long-term strategy.

With cloud computing, IT can become the strategic supplier that aggregates cloud services provided from internal application development teams to commercial applications. IT becomes a business partner and service provider to the lines of business, making a fundamental paradigm shift from being a technology operator to a service curator, which manages and governs a catalog of cloud services from public, private and third-party applications and services. As the organization further embraces and adopts cloud computing, the scope of workloads and application types IT will deliver expands to include both traditional enterprise and cloud-native application workloads.

**Traditional, enterprise application workloads versus cloud-native application workloads**

Enterprises have long relied on off-the-shelf, on premise applications for day-to-day operations. These applications tend to support back-office functions such as HR, Finance, Manufacturing and Operations. They are often deployed on scale-up architectures that are CPU, memory intensive, high I/O and designed for redundancy. These application workloads are typically client-server or n-tier applications built to run on a single server or a cluster of servers and databases and achieve scale by scaling up the infrastructure as the size of the application grows. The load on the application is well-known and steady state. Application growth in instances or users is planned, often with significant lead time and potential application down time.

In contrast to the traditional, scale-up application workloads, the cloud-native application workloads are designed for resiliency, failure to any node will not disrupt the service. These types of scale-out applications include, for example, rich internet applications like gaming and mobile applications, High Performance Computing (HPC), Big Data, social apps and batch processing. The rate of dynamic scaling and elasticity of these types of application workloads would not be feasible or cost effective with traditional datacenter architectures. Instead,
a new approach to application development and architectures was required to achieve “web scale”. Use of data republication methods such as sharding allow for data retaining logical schemas to live in different physical servers (even geographically disparate datacenters) without needing to share with other shards. In this style of distributed computing, the application can be horizontally scaled across compute, network and storage nodes. Internet companies such as Amazon, Google, Zynga and Facebook are able to cost-effectively support the load generated by many millions of users.

**Different workloads, different architectures**

Clouds are typically used to run either scale-up or scale-out application workloads. Traditional or scale-up application workloads are often responsible for back office, ERP, operational aspects of the company and may be centrally managed by IT. Cloud-native or scale-out application workloads supporting business units such as sales and marketing, or R&D can be found de-centralized throughout the enterprise.

It is not uncommon to find traditional, enterprise and cloud-native application workloads running in the same company and/or even in the same department. For example, car manufacturers could analyze real-time big data using Apache Hadoop to optimize their parts supply chain. Within the same manufacturing department, their discrete manufacturing application for plant operations could be a traditional application workload like SAP.

Nonetheless, the two types of enterprise application workloads have distinct characteristics.

**Table 1. Characteristics of cloud application workloads – scale-up and scale-out**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Scale-up/traditional enterprise</th>
<th>Scale-out/cloud-native</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compute/Memory Intensive</td>
<td>Massively Parallel, Real Time Constraints</td>
<td></td>
</tr>
<tr>
<td>Intended Usage</td>
<td>Steady state</td>
<td>Elastic, Transient and/or Long-Live</td>
</tr>
<tr>
<td>Availability</td>
<td>Designed with Redundancy</td>
<td>Designed for Resiliency</td>
</tr>
<tr>
<td>Infrastructure Resource</td>
<td>Stateful</td>
<td>Stateless/Ephemeral/ Share Nothing</td>
</tr>
<tr>
<td>Redundancy</td>
<td>Fault Tolerance built-in the infrastructure</td>
<td>Multi-site redundancy</td>
</tr>
<tr>
<td>Data</td>
<td>Structured Data (relational DB)</td>
<td>Massive Datasets (noSQL)</td>
</tr>
<tr>
<td>Processing type</td>
<td>OLTP</td>
<td>Batch Processing</td>
</tr>
</tbody>
</table>
Table 1. Characteristics of cloud application workloads – scale-up and scale-out (cont.)

<table>
<thead>
<tr>
<th></th>
<th>Scale-up/traditional enterprise</th>
<th>Scale-out/cloud-native</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application Areas</td>
<td>ERP, on-premise CRM, BI/DW, Custom Business Applications</td>
<td>Dev/Test, Email, Search, Web, Mobile, data serving, eCommerce, MapReduce, media streaming, Industry-specific analytics &amp; modeling</td>
</tr>
<tr>
<td>Software Vendors</td>
<td>Microsoft, Oracle, SAP, SAS</td>
<td>Adobe, Apache Hadoop, MongoDB, SAP Hana, Wordpress</td>
</tr>
</tbody>
</table>

Table 2. Infrastructure Resource Profile

<table>
<thead>
<tr>
<th></th>
<th>Scale-up/traditional enterprise</th>
<th>Scale-out/cloud-native</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypervisor</td>
<td>Heterogeneous</td>
<td>Pre-set choices</td>
</tr>
<tr>
<td>VM</td>
<td>Configuration varies</td>
<td>Fixed-size</td>
</tr>
<tr>
<td>Network</td>
<td>Dedicated IP Pool, VLAN</td>
<td>Shared IP</td>
</tr>
<tr>
<td>Storage</td>
<td>Network SAN</td>
<td>Local, NFS, Block</td>
</tr>
<tr>
<td>Availability/DR</td>
<td>Mission critical</td>
<td>Best effort/Adhoc</td>
</tr>
<tr>
<td>Security</td>
<td>Central Authorization</td>
<td>De-centralized</td>
</tr>
<tr>
<td>Utilization</td>
<td>Highly optimized</td>
<td>Peaks &amp; variable</td>
</tr>
</tbody>
</table>

**Enabling traditional, scale up application workloads with CloudPlatform**

Citrix CloudPlatform, powered by Apache CloudStack, is the industry’s only future-proofed, application-centric cloud solution proven to reliably orchestrate both existing scale-up enterprise application workloads and cloud-native scale-out application workloads within a single unified cloud management platform. CloudPlatform combines the best private cloud foundation for enterprise application workloads like CRM and ERP with true Amazon-style scale, elasticity and operational efficiency for cloud-native application workloads like social applications, Big Data and HPC.

When considering how a traditional enterprise application workload could run in the cloud, one needs to consider the workload is designed to run on reliable, enterprise-grade hardware, where the underlying servers and storage provide infrastructure level redundancy that isn’t expected to fail during the normal course of operations. Complex enterprise technologies such as network link aggregation, storage multi-pathing, virtual machine (VM) high availability, fault tolerance and VM live migration are used to ensure reliability of these applications. Sophisticated backup and disaster recovery procedures are also put in place to handle the unlikely scenario of hardware failure.
Traditional application workloads require fault tolerant infrastructure architectures and are built using enterprise-grade infrastructure components, which can include repurposed components of the existing datacenter. Typical components include:

- Commercially supported hypervisors such as Citrix XenServer or VMware® vSphere™
- High-performance SAN devices for VM image storage
- Traditional physical network routers, firewalls and layer 2 switches
- VLANs to isolate traffic among servers and tenants
- VPN tunneling for secure remote and site-to-site access through existing network edge devices

CloudPlatform enables enterprises to create workload specific availability zones or regions, which support these same fundamental architecture and infrastructure requirements. Enterprises can run complex enterprise application workloads with best in class virtualization and networking to deliver true private cloud isolation, ensure SLA, compliance, security and availability for running mission critical applications.

**Dedicated private cloud isolation**

Cloud infrastructure layers—zones, pods, clusters and hosts—and virtual machine resources—CPU, memory, storage and network—can be granularly grouped into different isolated logical partitions for true multi-tenant private cloud deployments. Dedicated resources can be applied to any of the infrastructure layers to support virtual private cloud use cases to meet requirements for compliance, security and performance.
Logical isolation

With CloudPlatform, enterprises can organize their private cloud into multiple discrete logical abstraction layers including availability zones or regions, each comprising resources in one or more physical datacenters. CloudPlatform uses a logical isolation hierarchy that includes Domain, Sub-domain, Account and Users. Usage quotas can be applied to any layer in the hierarchy. This logical isolation hierarchy can be used to model the organizational structure in typical enterprises in a domain to represent a business unit; users can also be grouped into Accounts which could represent a team. A sub-domain could represent a division in a larger business unit. CloudPlatform ensures that all memory, CPU, network, and storage resources are both available and isolated from one user account to another.

Hypervisor agnostic

CloudPlatform supports the leading commercially supported hypervisors including Citrix XenServer, VMware® vSphere® Oracle® VM (OVM), and KVM. Bare metal infrastructure without a hypervisor is also supported, all from a single cloud infrastructure. Customers have complete freedom to choose the right hypervisor for their application workload instead of being locked into technology from one single vendor.

Traditional enterprise availability zones typically begin with bare metal or a supported hypervisor, such as VMware® vSphere or Citrix XenServer which supports live migration of VMs. CloudPlatform has a two-tier storage hierarchy. Root and data volumes are stored on a primary storage tier which can be local storage, FC, iSCSI or NFS for performance. VM templates and volume snapshots are stored on secondary storage, typically NFS or object storage.

Advanced VMware integration

Virtualization has been broadly adopted by enterprises and service providers alike over the past decade. With the VMware® vCenter® integration, CloudPlatform can help organizations move their enterprise application workloads seamlessly from the datacenter to the cloud and still leverage their existing VMware investments, configurations and expertise. vCenter® features such as virtual hardware hot add, vMotion®, VMware HA & DRS, Storage vMotion, and CPU and RAM overcommit are all enabled in CloudPlatform. CloudPlatform leverages VMware’s dvSwitch and PVLAN features to provide further network segmentation and VM isolation on the same network. Additional storage integrations allow for VM level snapshots as well as volume level snapshots.

Enterprise-grade cloud networking

CloudPlatform enables organizations to deploy traditional physical network infrastructure components such as firewalls and Layer 2 switching as well as the use of VLANs to isolate traffic between servers and tenants. CloudPlatform can automate the creation of private VLANs for tenant-based isolation. For n-tier applications, admins can configure a separate VLAN and access control policy for each tier. For example, a unique policy for the application front end, another for the middle tier, and finally a third policy or VLAN for the database tier. Granular
firewall and networking rules and non-standard port numbers help thwart port scanning and prevent malicious activity. VPN tunneling provides secure remote and site-to-site access through existing network edge devices.

CloudPlatform employs infrastructure hardening techniques such as link aggregation via bonded NICS for networking. Deep control of the physical network layer allows CloudPlatform to modify existing Layer 2 resources including adding/removing/updating physical networks in a zone, configuring VLANs on a physical network, specifying properties such as network speed, configuring a name so that the network can be recognized by a hypervisor, configuring the IP addresses trunk to a physical network and specifying what type of traffic is carried on the physical network. CloudPlatform has an in-built virtual router that provides granular control of network services like Dynamic Host Configuration Protocol (DHCP), Network Address Translation (NAT), load balancing, firewall, and port forwarding.

Traditional enterprise zones are designed with 99.999% application availability, often using Application Delivery Controllers (ADCs) to provide server load balancing. Advanced features such as compression, connection multiplexing, caching, and SSL offload found in ADCs are becoming increasingly helpful in taking the load off of overburdened networks and servers and increasing application availability. CloudPlatform supports a broad ecosystem of ADCs and networking devices including Citrix NetScaler, F5 load balancers, Cisco hardware and software (UCS, Nexus 1000v, ASA1000v), Juniper firewalls and VMware Distributed Virtual Switch. Enterprise networking requirements for architecture, scale, SLAs, load balancing can be met using best of breed networking solution for the most demanding enterprise applications and availability requirements.

In particular, the Citrix NetScaler Global Server Load Balancing (GSLB) feature is enabled through CloudPlatform which enables distribution of traffic across multiple sites and helps to manage disaster recovery. GSLB works by controlling how the system routes incoming client requests by directing DNS requests to the best-performing GSLB site in a distributed Internet environment. Pre-defined NetScaler policies and configurations can be orchestrated by CloudPlatform to send traffic. For example, a policy could direct traffic to the closest availability zone, a region with the lowest latency or the least amount of load, or to a secondary datacenter in case of an outage.

CloudPlatform with Citrix NetScaler offers AutoScale technology that automatically expands and contracts the cloud according to business demands. Citrix NetScalr has the ability to monitor CPU usage, server health or application responsiveness. Working in unison with CloudPlatform, changes to application load can prompt Citrix NetScaler to scale up or scale down the corresponding backend services or guest VMs.

Citrix NetScaler comes with a choice of configurations, as a physical appliance or as a Virtual Machine that runs on Citrix XenServer. CloudPlatform treats Citrix NetScaler just like any other infrastructure resource, for which it can be added into the resource pool.
Virtual Private Clouds

Virtual Private Cloud (VPC) is a private, isolated grouping of resources in CloudPlatform. Enterprise applications in traditional datacenters have network tiers connected to them for connection to databases, load balancing, and firewalls. A VPC can have its own virtual network topology that resembles a traditional physical network.

Using the VPC feature, cloud administrators can launch VMs in a virtual network containing private addresses to recreate the network architecture of their traditional enterprise applications, including IP ranges and VLANs. The ability to group similar kinds of instances based on IP address range or network tier definition makes the datacenter transformation to the cloud computing easier. Through the recreation of traditional enterprise network topologies including granular network segmentation for traditional applications, the transition to cloud computing can be simplified.

N-tier applications

In traditional multi-tier application, VLANs have been traditionally used to produce network segregation and correct traffic flow. In the above multi-tier example, the application is composed of a web front end tier, an application tier and a database tier. Each tier is isolated by an individual VLAN. For large scale deployments, administrators using this n-tier application architecture in CloudPlatform could create granular networks, routing, firewall and load balancing policies, or affinity/anti-affinity rules for individual tiers.
Affinity/Anti-Affinity Group

To architect an application service to ensure the maximum level of application availability, cloud administrators require a mechanism to control the placement of VMs relative to the other VMs in the application group providing service. With Host Anti-Affinity Groups, CloudPlatform can ensure that VMs in a certain group type (such as a Web or an App or a Database) are not placed on the same host. Being able to judiciously place VMs when creating or updating VMs or physical hosts allow admins to place their web VMs as far apart as possible in a zone for higher availability.

Granular tracking and metering

The usage engine in CloudPlatform provides users with real-time visibility of resources consumed, historical usage reports and creates billing invoices by integrating with metering data generated by the Usage Engine. In addition, CloudPlatform defined service offerings can be tracked and metered for chargeback/showback to individual users, business units or projects. Cloud operators can integrate with popular billing software such as WHMCS/Uberversmith/Hostbill using the the CloudPlatform billing API. In situations where more advanced metering is required, CloudPlatform integrates with CloudPortal Business Manager for more comprehensive metering, billing, chargeback and workflow approval scenarios.

Designing for resiliency and simplified cloud operations

Architectures that support scale-out workloads tend to be designed for resiliency. CloudPlatform can support high availability measures such as reserving and tagging specific physical infrastructure such as a blade server to create a reserve buffer. In the case of a failure, the platform will provision to the standby infrastructure.

CloudPlatform also simplifies ongoing cloud operations and maintenance. Upgrades and hardware maintenance can be achieved in the cloud with no downtime for guest VMs. CloudPlatform will live-migrate any VMs from hosts that have been targeted for maintenance to prevent any disruption of service.

Storage management

CloudPlatform orchestrates over block, file, and object storage irrespective of the storage technologies and protocols underneath. Periodic storage maintenance can be performed by administrators by gracefully shutting down all guest VMs with a single click. Once maintenance has been completed, all guest VMs tied to that storage server are automatically restarted.

Since data volumes attached to the VM are not automatically deleted when the VM is deleted, snapshots taken on a schedule or ad hoc can be part of an enterprise’s backup and data recovery procedure. In CloudPlatform, admins can even adjust the intervals when volumes are expunged or physically deleted depending on the enterprises’ data retention policies.
Event management

CloudPlatform supports publishing events from the management server to a message queue using Rabbit MQ as the message broker. This is an alternative method to polling for events using the HTTP API. This transport mechanism allows for use cases such as the tracking of virtual machines in a separate database to more complex scenarios such as synchronizing account meta data between management servers deployed in multiple regions.

**Trusted to power the world’s leading clouds and the most demanding workloads**

With over 200+ enterprise clouds in production, CloudPlatform powers the clouds of leading enterprises and higher education institutions like Disney, Autodesk, Nokia, Amdocs, University of Sao Paulo and Royal Melbourne Institute of Technology to web-centric companies like Edmunds.com, Spotify and Overstock.com. These diverse customers chose CloudPlatform because it is the only application-centric cloud orchestration solution designed for all of workloads.

Only CloudPlatform is proven to reliably orchestrate both today’s existing workloads and tomorrow’s cloud-native workloads. Enterprise workloads and cloud-native apps can each be delivered with the optimal infrastructure for their distinct requirements and cost models, while being managed in a unified environment through a single pane of glass. In doing so, CloudPlatform allows enterprises to quickly deploy private clouds that can orchestrate and automate existing workloads and infrastructure, while providing a path to the future via its best-of-breed support for next generation cloud workload architectures.

**Interested in learning more?**

Future proofing your cloud: Why workloads define cloud strategies

Citrix CloudPlatform for the enterprise

Citrix CloudPlatform for the service provider

How Citrix CloudPlatform enables cloud-native application workloads

CloudPlatform Deployment Reference Architecture
Citrix (NASDAQ:CTXS) is the cloud company that enables mobile workstyles—empowering people to work and collaborate from anywhere, easily and securely. With market-leading solutions for mobility, desktop virtualization, cloud networking, cloud platforms, collaboration and data sharing, Citrix helps organizations achieve the speed and agility necessary to succeed in a mobile and dynamic world. Citrix products are in use at more than 260,000 organizations and by over 100 million users globally. Annual revenue in 2012 was $2.59 billion. Learn more at www.citrix.com.

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