Globally Distributed IaaS Platform
Examples AWS and SoftLayer
Building Data Centers – The Software Defined Way

- Common command and control interface across a unified architecture
- Combine bare-metal servers, public cloud instances and private cloud deployments into distributed hybrid architectures and manage from a single control pane and API
- All deployed on-demand and provisioned in real-time

Unique **Triple Network Architecture** allows seamless communication across distributed environments

**Infrastructure Management System** provides orchestration and automation
Standardized, modular infrastructure

- Highly flexible architecture
- One platform for public cloud servers, private clouds, bare metal servers
- Complete integration
- Unified systems management & API
- Technology-neutral platform
- Support for broad range of operating systems, virtualization platforms
- Build hybrid, distributed, high-performance architectures and manage from a single pane of glass
- Pay by the hour or the month for a truly variable IT operations model
“Provision your own automated” cloud environment – from private dedicated servers (including bare metal) to shared (public) multi-tenant models - pay-as-you-go.

- Dedicated servers (bare metal and virtual), virtual servers (private or public shared multi-tenant) - Build Your Own Cloud
- Complete control of your cloud environment (2000’s APIs): applications and management – BYO or select from SL’s image catalog
- Global, highly secure, agile IPv4 & IPv6 networks end-to-end (Triple Network architecture), local and global load balancing that is pay-as-you-go
- Common x86 hardware architecture for all SoftLayer cloud models – ease of scalability and adoption of other models
- Flex Images™ image management - capture an image —physical or virtual—provision or migrate between technologies
- Perfect Fit for Cloud Native Workloads
Compute & Storage

- **Public Cloud Instances**
  - Virtual server instances
  - Dedicated physical nodes available

- **Bare Metal Servers**
  - Dedicated servers deployed on demand
  - Hourly & monthly pricing
  - Complete range of options
  - GPU servers for HPC

- **Private Clouds**
  - Support for multiple virtualization platforms
  - Turnkey solution for Citrix CloudPlatform

- **Multiple local storage options**
  - SAS
  - SATA
  - SSD
  - SAN
  - NAS

- **QuantaStor Storage Server**

- **Object Storage**
  - Global platform
  - Meta tagging

- **Backup services**
**Describing Cloud - Overview**

*Bare metal* servers and flexible *virtual* server instances to provide the *appropriate* platform for your workload.

![Diagram showing the Cloud architecture with Physical Servers and Virtual Servers]

- **Physical Server**
  - Single-Tenant
  - Optional (unmanaged) Hypervisor
  - Bare Metal Server (physical)
- **Physical Server**
  - Multi-Tenant
  - Managed Hypervisor
  - Virtual Server Public Node
- **Physical Server**
  - Single-Tenant
  - Managed Hypervisor
  - Virtual Server Private Node
**Describing Cloud – Bare Metal servers**

A **Bare Metal Server** is an on-demand, single-tenant **physical** server, with highly customizable compute and configuration options.

**Key features:**
- **Single-tenant physical server**
- **Hourly and monthly billing (hourly billing is restricted to certain models)**
- **Large processor choice (up to Quad CPU / 8 Core)**
- **Free 20 TB outbound public data transfer (monthly billing only)**
- **2-4 hour deployment time (some deployments faster)**
A **Bare Metal Server** is an on-demand, single-tenant physical server, with highly customizable compute and configuration options.

### Configuration options:
- Selected models with hourly billing and faster deployment, 2-16 x 2 GHz cores, no hypervisor (formerly "bare-metal")
- NVIDIA Tesla GPUs for HPC workloads
- Up to 36 internal hard drives with (optional) storage server solutions (Nexus QuantaStor)
- Redundant power supplies
- Other options include private network and dedicated rack

### Specific configurations and options:
- Hourly filling
- Faster deployment (limited customization)
  - GPUs (HPC)
  - Mass storage servers
  - Redundant power supplies

Cloud

Physical Server
Single-Tenant
optional (unmanaged)
Hypervisor

Bare Metal Server
(physical)
Describing Cloud – public virtual instances

A public virtual server is a virtual instance provisioned on multi-tenant hardware on the public cloud. Physical server resources will be shared with multiple customers.

Key features:
- Virtual server on multi-tenant hardware (formerly public cloud computing instance -CCI)
- Managed hypervisor - Citrix Xen
- Hourly or monthly billing
- Up to 16 cores with minimum 2.0 GHz per core
- Choice of local storage or storage area network (SAN)
- Free 5 TB outbound public data transfer (monthly billing only)
- Provisioning time less than 15 minutes

Specific configurations and options:
- Hourly billing
- Faster deployment (limited customization)
  - GPUs (HPC)
  - Mass storage servers
  - Redundant power supplies
Describing Cloud – private virtual instances (cont.)

A private virtual server is provisioned on a single-tenant physical server. The physical server is dedicated to the customer (hypervisor managed by Cloud Provider).

Specific configurations and options:
- Hourly billing
- Faster deployment (limited customization)
  - GPUs (HPC)
  - Mass storage servers
  - Redundant power supplies

Key features:
- Virtual server on **dedicated hardware** (formerly private cloud computing instance - CCI)
- No minimum quota on the number of virtual servers
- *Typically used in environments with specific performance or compliance requirements*
- Remaining features identical to Public Node
A **private cloud** is a single-tenant cloud consisting of host servers running virtual instances, all deployed in a self-service model with an unmanaged hypervisor.

### Capabilities of a private cloud

- **Single-tenant**
- **Private**
- **Highly customizable**
- **Hypervisor agnostic**

#### Private Cloud

- **Citrix Xen**
- **VMWare**
- **Hyper-V**
- **Parallels**
- **Any**

* Any desired hypervisor
Benefits and use cases of private cloud; you have…

**Pros**
- …flexibility to build your own virtual environment.
- …in-depth compute customization capabilities.
- …a wide range of hypervisor support.

**Cons**
- …the responsibility to manage and maintain hypervisor.
- …manual provisioning; not rapid.
- …maintain management and host software.

**Benefits**
- …management and access control.
- …flexibility to build cloud for workloads that require greater granularity.

**Sample use cases**
- Special infrastructure requirements
- Governance requirements
- Cloud bursting with scalable web applications
Networking overview

The global network seamlessly integrates three distinct and redundant network architectures – private, public, and management - into a Network-within-a-Network topology for maximum accessibility, security, and control.
Networking overview (cont.)

From a computing resource point of view:

- Each server is complimented with a five physical NIC configuration.
- Two public adaptors (red), one management adaptor (green), and two private facing adaptors (blue). All adaptors are 1 Gb.

*Note*: All dedicated infrastructure follows the same routing and rules, however, the number of adaptors differs by chosen configuration.
Describing a VLAN

What is a VLAN?
Virtual LAN (VLAN) is a networking concept in which network interfaces on different routers, switches, and servers act as if they're on the same local network broadcast domain.

How are VLANs used by Cloud?
Servers can be provisioned on “private VLANs” that are created per router (in a data center) for the public and private networks allowing for segmentation of network traffic.
Managing VPN connections

There are three overall types of VPN or direct connections to SoftLayer – VPN System Administration Management, VPN Production Access, and Customer Ethernet circuit handoff.

VPN System Administration Management
- 1 Gb link for VPN access for customers to perform administrative tasks on the private network.
- Additional tunnels can be requested through the Customer Portal ($99 retail per tunnel).
- SSL VPN, PPTP VPN, and IPSec VPN connections available through the Customer Portal.
Direct Link option

NAT Options

Customer location 1

Customer location 2

Legend
- Customer Dedicated WAN link
- SoftLayer infrastructure
- Single-mode 3- or 10Gbit Ethernet uplink

Demarcation point
1-/10Gbit Single mode fiber handover
Working with firewalls

What is a firewall?

A *firewall* is deployed in either hardware or software form (or both) to prevent unauthorized access to servers connected to the network.

SoftLayer utilizes both hardware and software firewall methods to help users protect themselves. These deployable options are available as:

- Shared hardware firewalls
- Dedicated hardware firewalls
- Dedicated firewall appliances
Using the Vyatta gateway appliance

The Vyatta gateway appliance is designed to allow for advanced network routing and configuration of a portion of or the entire account for a customer. Capabilities include: IPSec VPN tunnels Network address translation (NAT) Firewall services Router services

All Vyatta capabilities can be managed through either the secure shell (SSH) command line interface (CLI) or by connecting to the Vyatta Network OS.

Note: A customer may not have a shared or dedicated firewall service and a Vyatta network gateway device assigned to the same VLAN.
Local load balancing is based on Array Networks and utilizes industry-standard techniques to distribute the processing and communication of web traffic between servers in a single geographic location.
Global load balancing is based on Citrix NetScaler and allows you to distribute the processing and communication of web traffic between servers in multiple Cloud data centers.
Storage Options

- A bare metal server with any software you like (e.g. NFS, GPFS…)

- Object Storage
  - Based on OpenStack Swift + indexing & CDN integration

- QuantaStor Storage OS
  - SAN (iSCSI) and NAS (NFS) access
  - Advanced and easy to use web administration
  - Thin provisioning of storage volumes
  - Asynchronous replication of storage volumes
  - Dynamic expansion of storage pools
  - Software and hardware integrated – QuantaStor manages the RAID controller

- iSCSI SAN
  - Remote mounted, reliable, enterprise grade, fast, 1 TB or less

- NAS / FTP
  - Remote mounted, cost effective, reliable, 2 TB or less
Understanding Storage

Cloud Storage is designed to integrate multiple storage technologies – including File Transfer Protocol (FTP), Network Attached Storage (NAS), Internet Small Computer System Interface (iSCSI), and an online data backup and recovery tool – into a unified offering with the ultimate level of security, reliability, and flexibility.

Cloud storage design provides enterprise-grade services, including automated backup, high-availability solutions, and data replication.
Virtual Machines using local storage

Local disk storage is ideal for storage-intensive applications with high I/O needs.

Example uses are:
- Operating system
- Database software
- Application software

Option 1: First disk as local disk

- Local disk VSI's are based on SATA drives.
- SSD based VSI's are on the horizon but not generally available today. Some nodes are already provisioned with SSD's but you can't request it today.
## Virtual Machines using SAN storage

**Option 2: First disk as SAN disk**

### Maximum 2 TB disks

<table>
<thead>
<tr>
<th>Range of virtual instance SAN disk sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 GB</td>
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<tr>
<td>20 GB</td>
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<tr>
<td>25 GB</td>
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<tr>
<td>30 GB</td>
</tr>
<tr>
<td>50 GB</td>
</tr>
<tr>
<td>75 GB</td>
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<tr>
<td>100 GB</td>
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</tbody>
</table>
Building your own storage

Unmanaged storage solution

SoftLayer offers a customer the ability to design and build their own storage solution utilizing a mass storage server available in the SoftLayer ecosystem.

Examples of why a customer would want to build their own storage include:
- Privacy concerns on customer data
- Government regulations
- Requirement or want for specific storage software
- Extremely high I/O
## Building your own storage example - QuantaStor

<table>
<thead>
<tr>
<th>SoftLayer pairs mass storage dedicated servers with QuantaStor Storage Appliance Software by OS Nexus for private SAN or NAS.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deployed on preferred SoftLayer dedicated servers and configured with a range of 4 TB to 128 TB to fulfill specific needs including:</td>
</tr>
<tr>
<td>• Content storage</td>
</tr>
<tr>
<td>• File archival</td>
</tr>
<tr>
<td>• Disk-to-disk backup</td>
</tr>
<tr>
<td>• Hadoop deployment</td>
</tr>
<tr>
<td>Designed as SAN (iSCSI) or NAS (NFS v3 and v4) storage system.</td>
</tr>
<tr>
<td>• Advanced storage features, including thin-provisioning and remote-application, are ideal for VM application deployments, virtual desktops, and web and application servers.</td>
</tr>
<tr>
<td>QuantaStor Manager Web Manager interface via the customer’s web browser.</td>
</tr>
<tr>
<td>Can be deployed in a storage cluster.</td>
</tr>
<tr>
<td>The QuantaStor storage appliance OS that is used for this deployment is a storage system OS built on top of Ubuntu Server (Linux), which works on any 64-bit server hardware.</td>
</tr>
</tbody>
</table>
Understanding Object Storage

Object Storage is designed to archive, manage, and serve large amounts of data. Example uses of Object Storage include:
- Long-term storage of static data
- Media object storage
- Media distribution

Object Storage is built on OpenStack with built-in index and search.
- Storage price is $0.04 per GB per month.
- Private network and public inbound bandwidth is free.
- PUT, COPY, POST, or LIST requests are free.
- Get and all other requests are free.
- Public outbound bandwidth is $0.10 per GB.
- CDN Integration is available for all Object Storage clients, which provides the option to replicate data to PoPs. The price for this is $0.12 per GB or $0.15 per GB with CDN SSL.
- 5 GB is the maximum file size.
- **Clustered backend** with internal data center replication across at least three servers.
- **Note**: There is no support to automatically replicate data between data centers. The user is responsible to write data to multiple data centers if needed (for example, geographic redundancy).
## Understanding Cloud storage

<table>
<thead>
<tr>
<th>Storage type</th>
<th>Performance indication</th>
<th>Average Cost</th>
<th>Persistent</th>
<th>Target volume size</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAS</td>
<td>Shared file storage</td>
<td>Low</td>
<td>Yes</td>
<td>Small to medium</td>
</tr>
<tr>
<td>Local disk bare metal</td>
<td>Very high I/O</td>
<td>Low to High</td>
<td>No</td>
<td>Small to extra large</td>
</tr>
<tr>
<td>Local disk option VM's</td>
<td>Medium to high I/O</td>
<td>Low to medium</td>
<td>No</td>
<td>Small to extra large</td>
</tr>
<tr>
<td>San disk option VM's</td>
<td>Medium I/O</td>
<td>Low to medium</td>
<td>No</td>
<td>Small to extra large</td>
</tr>
<tr>
<td>Legacy iSCSI Storage</td>
<td>Multi-tenant med I/O</td>
<td>Medium to High</td>
<td>Yes</td>
<td>Medium to large</td>
</tr>
<tr>
<td>Legacy iSCSI Storage - Dedicated</td>
<td>Single-tenant med I/O</td>
<td>High</td>
<td>Yes</td>
<td>Large to extra large</td>
</tr>
<tr>
<td>Block - / File Storage</td>
<td>Multi-tenant high I/O</td>
<td>High</td>
<td>Yes</td>
<td>Medium to extra large</td>
</tr>
<tr>
<td>(Consistent Performance)</td>
<td>Content delivery</td>
<td>Low</td>
<td>Yes</td>
<td>Small to extra large</td>
</tr>
<tr>
<td>Object Storage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quantastor</td>
<td>For customers looking for cost effective, mass storage with stable IOPS</td>
<td>Low</td>
<td>When solutioned in that way</td>
<td>Small to extra large</td>
</tr>
</tbody>
</table>
Online Collaboration Solution
• Several thousand users through public internet
• DevOps pipeline through dedicated connection
• High availability requirement of file sharing – 99.99%

Application components
• File sharing (several TB)
• Metadata in database (hundreds of GB)
• Web application servers stateless
• Identity service

What should be considered for
• Servers
• Storage
• Network connectivity
• Network planning
• How to achieve scale for each component
• How to achieve resilience / robustness / availability
Exercise

User Access
Public Internet

Load Balancer

DC 1

LDAP App Replication

Stateless webserver app

DB HA cluster – log shipping

File store

Admin/DevOps Access Direct Link

DC 2

Managed Block store

Object store

Replication

Object store
Thank you!

For more information, please visit: ibm.com/cloud

Or contact me at: boas@de.ibm.com