Agenda

- Data Center Strategy
- Network Design
- Compute Design
- Storage Strategy
- Cloud and Virtualization
Our Journey to the IaaS Cloud

VMWare Virtualization

Service Catalogue
Show/chargeback

Service Unit | Cost
-------------|-------
VM 2x4 – Silver | $
Bare-metal 8x64 | $$$

*OVF = Open Virtualization Format

Unified Infrastructure
(compute/netw)

Virtualization

Automation

Self-service

Multi-tenancy

Elasticity

Cisco Nexus
Cisco UCS x86

IaaS Provisioning
CMDB Integration

Logical segmentation
Control, security & fault isolation

Image repository

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Cisco IT
Data Center Strategy
Global Data Center Strategy

Transformation
- Run IT as a business
- Internal service provider model
- Service-oriented architecture

Growth Enablement
- New markets and business models
- Global expansion
- User experience

Resiliency
- Increase data center tiers
- Multi-site architecture
- Move out of high risk geographies

Capacity
- Build and occupy data centers
- Optimize demand
- Consolidate where appropriate
For our critical applications: MVDC

Metro-based Virtual DC (MVDC) Architecture

2x Tier-III Texas

RTP, NC
Non-Production + Repurpose-based DR

Richardson, TX  Allen, TX

Active-active DC Pair to support mission-critical production services
Logical Design: MVDC + DR

Conflict-free data services: active-active
Conflict-sensitive data services: active-standby
Datastore A Single-master

Application services: active-active

Disaster Recovery
Tiered application recoverability
Full databunker
Quorum site

DC1                    DC2
Active datastore       Normal operations
Standby datastore     Failure situation

Metro-based DC Pair
DR DC
Cisco IT
Network Building Blocks
Reference Architecture – Infrastructure

Definition
- Modular resource pool (compute/network)
- Fault domain (L2/3 boundary)
- Logical concept; physical constraints

Multiple pod types:
- Internal vs. DMZ
- NAS vs. Compute
- Production vs. non-production
Datacenter Blocks: Nexus and UCS key components

- **Data Center Cluster Block**
- **Data Center Aggregation Block**
- **Network Services Block**
- **Access Block**

**SAN Aggregation**
- SAN A
- SAN B

**L3**
- **Nexus 7000** (7010 or 7018)

**L2**
- **Catalyst 6509** + ACE + NAM

1) UCS cluster
2) Nexus 5000/2000 (legacy servers and filers)
3) Nexus 1000v where we have ESX
Virtualization of the Network

- Nexus VRF Technology
- **Multi-Purpose** Infrastructure:
  - Collapse Internal and DMZ network
  - Single network / compute hardware at aggregation, access & server level
  - Network & Compute Automation
  - ‘2 to 1’ mapping ~ ‘traditional network to Nexus/UCS network’
- **Collapse** of non-production MVDC environment:
  - 2 Active / Active Data Centers collapsed onto a single network infrastructure
  - Also collapsing security zones (sim-DMZ, Internal)
- **Running Disaster Recovery infrastructure** on non-production infrastructure. In case of a DR the routing is in place.
Network + Security Automation in the VM world

- vCenter
- VM Context
- Nexus 1000V
- Port Profile
- Security Profile
- VNMC
- Management/Orchestration tools: Tidal / vCloud (VDCs)
- VSG

Server Team
Network Team
Currently not automated

- Non virtual network components (Nexus 7000 / Catalyst 6000)
- Loadbalancing (ACE modules) configuration
- Looking at integrating Overdrive/Linesider product into our Cloud Environment for network automation
Cisco IT
Compute Design
UCS offers an ideal platform for:
- virtualization / automation and cloud services
- physical server migration (bare metal)
- movement off proprietary HPUX / Solaris platforms
UCS Adoption

UCS is the ‘de facto’ compute platform in Cisco

- **x86 Virtual Machines (VMs)**
  - Bulk, largely transparent
  - Completed January 2011
  - >6,500 VMs on UCS

- **x86 Bare Metal (BMs)**
  - Virtualization and consolidation opportunity, align with HW lifecycle

- **Non-x86 (Legacy UNIX)**
  - Extended planning: big/little-endian conversion, filesystem changes
  - RISC to CISC
  - Major cost savings opportunity

5041 Total UCS Blades Deployed* Globally

*Count covers all lifecycles and all stages of blade commissioning, including IT DC, Lab & Engineering DC, Oct 4 2011
UCS Building Blocks

UCS Manager
Embedded—manages entire system

UCS Fabric Interconnect
20 Port 10Gb FCoE
40 Port 10Gb FCoE

UCS Fabric Extender
Remote line card

UCS Blade Server Chassis
Flexible bay configurations

UCS Blade Server
Industry-standard architecture

UCS Virtual Adapters
Choice of multiple adapters
## UCS designs

<table>
<thead>
<tr>
<th>Low I/O</th>
<th>High I/O</th>
<th>Very High I/O</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Chassis per cluster</td>
<td>5 chassis per 6120 cluster</td>
<td>5 chassis in a 6140 cluster</td>
</tr>
<tr>
<td>2 connections from chassis to FI</td>
<td>4 connections from chassis to FI</td>
<td>4 connections from chassis to FI</td>
</tr>
<tr>
<td>Engineering DCs</td>
<td>Production DCs</td>
<td>Production DCs</td>
</tr>
<tr>
<td>Mixed of virtual and physical</td>
<td>Virtual and physical not mixed onto 1 cluster</td>
<td>Physical only (high performance – Databases)</td>
</tr>
<tr>
<td>B200 / B250 / B440</td>
<td>B200, B250, and B440</td>
<td>B200, B250, and B440</td>
</tr>
</tbody>
</table>

### (High I/O model)

<table>
<thead>
<tr>
<th>(High I/O model)</th>
<th>Nexus 7010</th>
<th>Nexus 7018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slots available for downlink cards</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Number of downlinks</td>
<td>64</td>
<td>160</td>
</tr>
<tr>
<td>Number of access FI 6120 (6140 / 2)</td>
<td>32</td>
<td>80</td>
</tr>
<tr>
<td>Number of UCS clusters supported (6140 / 2)</td>
<td>16</td>
<td>40</td>
</tr>
<tr>
<td>Number of servers</td>
<td>256</td>
<td>640</td>
</tr>
<tr>
<td>Max amount of IPs</td>
<td>4000</td>
<td>8000 ~ 10000</td>
</tr>
</tbody>
</table>
UCS Manager

Service profiles to manage the identity of server

- Quick initial server setup
- Hardware failure recover
- Hardware lifecycle management

Empower the system administrator

On UCS server side, everything made available for the server administrator
- Vlan selectable
- WWIN pools created and selectable
- MAC address pools created and selectable
- BIOS settings selectable

Preconfigure network and storage devices

XML API

- Automation capabilities via scripting
- Integration with 3rd party apps
- Integration with cloud wwwwin-ucs
NDCS Storage Capacity

<table>
<thead>
<tr>
<th>Storage Service (IT)</th>
<th>Raw Capacity (PB)</th>
<th>Usable Capacity (PB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>File (NAS)</td>
<td>8.7</td>
<td>6.4</td>
</tr>
<tr>
<td>Block (SAN)</td>
<td>20.4</td>
<td>13.4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>29.3</strong></td>
<td><strong>19.8</strong></td>
</tr>
</tbody>
</table>

4-Year SAN Raw Capacity Trend

Year-over-Year Trends:
- Data & Raw Capacity: >60% YoY
Storage Service Offerings Overview

SAN – Block Storage

NAS – File-based Storage

Cloud – Object-based Storage

Data Protection – Database, File and Desktop Backup

Video Proliferation

User Generated Data

Data Archiving

Collaborative Applications

NEW
Storage strategy / policy

Oracle DB
Host Storage

SAN (Block)

1. “Mid-Tier SAN”
   Introduce new cost-effective platforms

NAS (File)

2. “Right-Tiering”
   Move to appropriate tier per policy (criticality)

3. “Oracle/VM on NAS”

Shared Storage
Desktop Backup

4. “S-Cloud”
   Introduce new multi-site cost-effective storage

Cloud (Object)

5. “Right-Sizing”
   Utilization

<table>
<thead>
<tr>
<th>Raw Size</th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prod</td>
<td><img src="image1" alt="Disk" /></td>
<td><img src="image2" alt="Disk" /></td>
<td></td>
</tr>
<tr>
<td>MVDC (FY12)</td>
<td><img src="image3" alt="Disk" /></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Prod</td>
<td><img src="image4" alt="Disk" /></td>
<td><img src="image5" alt="Disk" /></td>
<td></td>
</tr>
<tr>
<td>Backup</td>
<td><img src="image6" alt="Disk" /></td>
<td><img src="image7" alt="Disk" /></td>
<td><img src="image8" alt="Disk" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Raw Size</th>
<th>I</th>
<th>II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prod</td>
<td><img src="image9" alt="Disk" /></td>
<td></td>
</tr>
<tr>
<td>MVDC (FY12)</td>
<td><img src="image10" alt="Disk" /></td>
<td></td>
</tr>
<tr>
<td>Non-Prod</td>
<td><img src="image11" alt="Disk" /></td>
<td><img src="image12" alt="Disk" /></td>
</tr>
<tr>
<td>Backup</td>
<td><img src="image13" alt="Disk" /></td>
<td><img src="image14" alt="Disk" /></td>
</tr>
</tbody>
</table>

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Right Tiering

- Improving Service Visibility
- Client utilization accountability
- Purge and Archive Alignment

Right Sizing

- Policy Compliance enables improved client experience
- Foundation for Automation
- High-touch support as needed

FAST Track Extension

Criticality Matrix drives
- Scalable entitlement
- Mapping of data to storage service (“what goes where”)

Exception Management (VP)

- Business/cost/risk decision making
- Extended planning needed
## Storage – Unit TCO
Cost in $ per usable TB per month

<table>
<thead>
<tr>
<th>Service Offering</th>
<th>Data Protection included</th>
<th>Unit TCO Q4 FY11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAN Tier I</td>
<td>✓</td>
<td>$1,907</td>
</tr>
<tr>
<td>SAN Tier II</td>
<td>✓</td>
<td>$1,398</td>
</tr>
<tr>
<td>SAN Tier III</td>
<td>×</td>
<td>$463</td>
</tr>
<tr>
<td>NAS Tier I</td>
<td>✓</td>
<td>$581</td>
</tr>
<tr>
<td>NAS Tier II</td>
<td>✓</td>
<td>$541</td>
</tr>
<tr>
<td>S-Cloud</td>
<td>✓</td>
<td>$119</td>
</tr>
<tr>
<td>Data Protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DBBS - Tape</td>
<td>n/a</td>
<td>$883</td>
</tr>
<tr>
<td>Continuous Data Protection (CDP)</td>
<td>n/a</td>
<td>$1,174</td>
</tr>
<tr>
<td>File System</td>
<td>n/a</td>
<td>$271</td>
</tr>
<tr>
<td>Connected Backup</td>
<td>n/a</td>
<td>$8 per user</td>
</tr>
</tbody>
</table>

- **Mid-Tier platform change:** - 25% opportunity over 3 yr
- **Highly cost-effective multi-DC solution**
- **Highly resilient protection for critical data**
Storage challenges

- Cost factor, increased storage capacity year of year
- Storage Management (no single platform to manage all the different storage platforms)
- Data retention (when to we remove a copy)
- Network / Storage / Compute platform integration
- FCoE:
  - recent ratified standard
  - Merging network and storage infrastructure (MDS / Nexus) currently only at (UCS access layer)
- Storage evolutions (HDD – SDD)
- Stateless nature
Cisco IT
Cloud & Virtualization
Introducing CITEIS – Concept
A Framework for Providing Infrastructure as a Service

Before CITEIS
- Machine-oriented
- Manual provisioning
- Hard to control utilization
- High provisioning & ops cost
- Extended provisioning time
- Configuration risk

After CITEIS
- Service-oriented
- Self-service; automated provisioning
- Elasticity (capacity-on-demand)
- Optimized provisioning & ops cost
- Rapid provisioning
- Increased Resiliency and Availability
**Agile**

- Ability to Deploy Infrastructure Services When You Need Them
- Increase or Decrease Infrastructure to Match Demand

**Flexible**

- Choice of Prebuilt Virtual Images or Custom Images That You Design Based on Specific Needs

**Cost Effective**

- Comparable Pricing Models to Third-Party Service Providers

**Secure**

- Available to Internal Cisco Users Only - Data Remains Inside Cisco
- Limit Access to Only Those Users You Entitle

---

**CITEIS Gen2**
CITEIS Gen2

CITEIS VDCs – Tenant Customizable and Elastic

Tenant X

Tenant Y

Tenant ...

75 VM Capacity

Tenant VDC

120 VM Capacity

Tenant VDC

Large

Tenant VDC

Jumbo

Current Capacity; Tenant Can Increase By Adding Additional Building Blocks

Current Capacity; Tenant Can Increase By Adding Additional Building Blocks

Tenant X

Tenant Y

Tenant …
CITEIS Gen2
Virtual Data Center Offering

- CITEIS VDCs Customized Based on Tenant Needs
  - Tenant Owner “Pieces Together” Virtual Infrastructure Resources to Build VDC
  - Based on “Building Blocks”

- CITEIS VDCs are Elastic
  - Virtual Infrastructure Resources Can Be Added or Deleted

- Driven through Service Catalog

- Virtual Resources
  - Virtual CPU (ghz)
  - Virtual Memory
  - Segmented vLan

- Storage Allocation

- Support Option
  - IT Managed
  - Self Managed

- Service Type
  - Internal
  - DMZ
<table>
<thead>
<tr>
<th>CITEIS VDC Building Block(s)</th>
<th>Mini</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
<th>Jumbo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum # of Virtual Machines (constrained by size of vLan)</td>
<td>10</td>
<td>25</td>
<td>55</td>
<td>120</td>
<td>250</td>
</tr>
<tr>
<td>Reserved Compute Power (performance equivalent)</td>
<td>20 vCPUs / 20 gHz</td>
<td>50 vCPUs / 50 gHz</td>
<td>110 vCPUs / 110 gHz</td>
<td>240 vCPUs / 240 gHz</td>
<td>500 vCPUs / 500 gHz</td>
</tr>
<tr>
<td>Total Reserved Memory for Tenant Virtual Machines</td>
<td>40 gb</td>
<td>100 gb</td>
<td>220 gb</td>
<td>480 gb</td>
<td>1000 gb</td>
</tr>
<tr>
<td>Storage Allocation</td>
<td>250 GB</td>
<td>500 GB</td>
<td>1375 GB</td>
<td>3000 GB</td>
<td>6250 GB</td>
</tr>
<tr>
<td>Engagement Model</td>
<td>Self Service</td>
<td>Self Service</td>
<td>Self Service</td>
<td>Self Service</td>
<td>Self Service</td>
</tr>
<tr>
<td>CIU Base Container Cost</td>
<td>$X / Month</td>
<td>$X / Month</td>
<td>$X / Month</td>
<td>$X / Month</td>
<td>$X / Month</td>
</tr>
<tr>
<td>Select vLan Container (One vLan per building block)</td>
<td>/28, /27, /26, /25 or /24</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Select Support Options (Must Select One)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 - Client Managed OS Support</td>
<td></td>
<td>No Additional Charge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 - NDCS Managed OS Support</td>
<td></td>
<td>Add $Y per VM / Month</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base Service Agreements</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service Availability</td>
<td>99.9%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Support Window (based on support option)</td>
<td>Monday – Friday 8am – 8pm CST</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monthly Maintenance Window</td>
<td>Maintenance Occurs 1800 – 0800 Local Business Hours Only Monthly Window: Second Thursday of Each Month</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Order Fulfillment SLA</td>
<td>Three (3) Business Days</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CITEIS EXPRESS (on Demand Services)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Maximum # of Virtual Machines per User</strong></td>
<td>Two (2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Maximum IP Addresses</strong></td>
<td>One (1) DHCP Address per VM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| **Virtual Machine Supported Configurations** | Option 1: 1cpu x 2gb  
Option 2: 2cpu x 4gb |
| **Supported Images** | Client Provided and Uploaded into CITEIS Express  
Charged per GB Used – $ Y per gb |
| **Virtual Machine Expiration** | 30 Days |
| **Storage Options** |
| **OS and Data Storage** | 25 GB Increments |
| **Snapshots** | Not Available |
| **Backup and Recovery** | Not Available |
| **Service Agreements** |
| **Service Availability Target** | 99.9% |
| **Standard Support Window** | Best Effort |
| **Monthly Maintenance Window** | Maintenance Occurs 1800 – 0800 Local Business Hours Only  
Monthly Window: Second Thursday of Each Month |
| **Order Fulfillment SLA** | On Demand via Service Catalog |
| **Service Costs** |
| **1cpu x 2gb VM Option** | $ X per Month  
(does not include storage) |
| **2cpu x 4gb VM Option** | $ X per Month  
(does not include storage) |
| **Per GB of Storage Allocated** | $ Y per GB per Month |

Note: Service is capped at 200 VMs and 10Tb of Storage. Once consumed, new requests will not be fulfilled until existing VMs expire or released by clients
Our Journey to the IaaS Cloud

CITEIS – Cisco IT Elastic Infrastructure Services

VMware Virtualization:
- vCloud
- ESXi
- Nexus 1000v

Service Catalogue
Show/chargeback

Unified Infrastructure (compute/netw)
Virtualization
Automation
Self-service
Multi-tenancy
Elasticity

compute automation: tidal
Network automation: OD/Linsider

Security: VNMC
VSG / Virtual ASA

*OVF = Open Virtualization Format
Thank you.
## Storage Tiering:

<table>
<thead>
<tr>
<th>Criteria's</th>
<th>Attribute</th>
<th>TIER I</th>
<th>TIER II</th>
<th>TIER III</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area</td>
<td>Throughput (IO/s)</td>
<td>Very High to Med</td>
<td>Very High to Low</td>
<td>Med to Low</td>
</tr>
<tr>
<td></td>
<td>Bandwidth (MB/s)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Latency (ms)</td>
<td>Very Low to Low &lt;5 ms</td>
<td>Very Low to Med &lt;10 ms</td>
<td>Low to Med &lt;15 ms</td>
</tr>
<tr>
<td></td>
<td>Mobility</td>
<td>Non-Disruptive</td>
<td>Non-Disruptive or Failover</td>
<td>Planned Downtime</td>
</tr>
<tr>
<td><strong>Availability</strong></td>
<td>Unplanned Downtime*</td>
<td>99.995% &lt;26.5 min/yr</td>
<td>99.99% &lt;52.6 min/yr</td>
<td>99.9% &lt;8.8 hr/yr</td>
</tr>
<tr>
<td></td>
<td>Protection</td>
<td>MVDC and DR</td>
<td>MVDC or DR</td>
<td>Single Copy**</td>
</tr>
<tr>
<td><strong>Recoverability</strong></td>
<td>ART / Acceptable</td>
<td>&lt;1 hr</td>
<td>&lt;4 hr</td>
<td>&lt;24 hr</td>
</tr>
<tr>
<td></td>
<td>Recovery Time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ADL / Acceptable Data</td>
<td>Zero</td>
<td>Zero</td>
<td>&lt;1 hr</td>
</tr>
<tr>
<td></td>
<td>Loss</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>RTO / Time Required for</td>
<td>&lt;4 hr</td>
<td>&lt;24 hr</td>
<td>&lt;48 hr</td>
</tr>
<tr>
<td></td>
<td>Recovery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>RPO / Amount of Data</td>
<td>&lt;1 hr</td>
<td>&lt;1 hr</td>
<td>&lt;24 hr</td>
</tr>
<tr>
<td></td>
<td>Loss</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reduced Performance</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
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<tr>
<td></td>
<td>Acceptable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Access Protocols</strong></td>
<td>FC / FCoE</td>
<td>Yes</td>
<td>Yes</td>
<td>Maybe</td>
</tr>
<tr>
<td></td>
<td>NFS / CIFS</td>
<td>Maybe</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>HTTP/s</td>
<td>N/A</td>
<td>Maybe</td>
<td>Yes</td>
</tr>
</tbody>
</table>