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Real World Cloud Infrastructure with Red Hat Enterprise Virtualization and Red Hat Network Satellite

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Agenda

Brief Virtualization, Satellite and Cloud Overview

Understanding our customer's requirements

Architecting the solution

Customer benefits

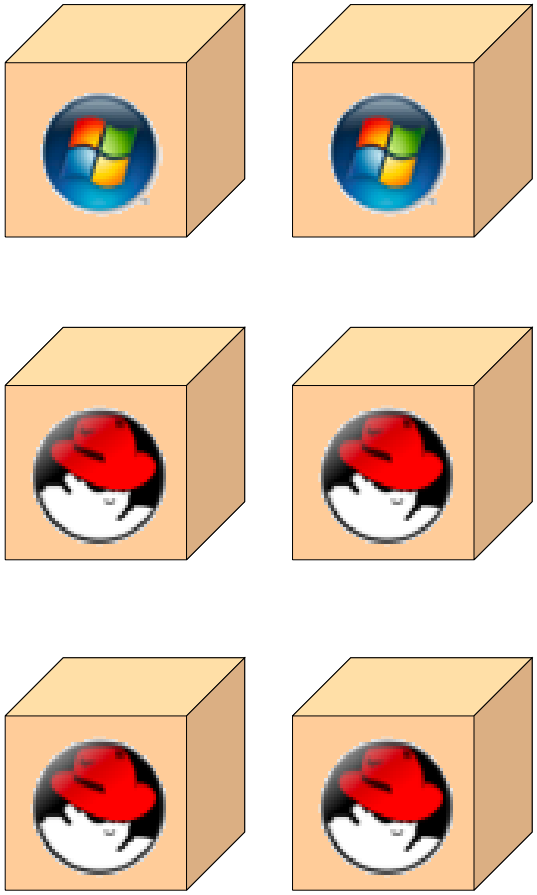
Lessons learned

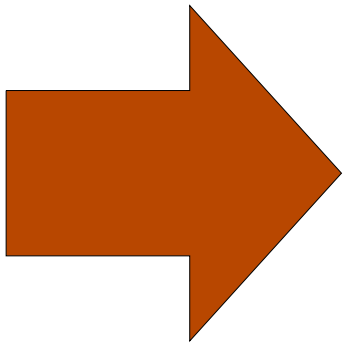
Future growth and expansion

Before we can build the solution, we need to understand the technologies..

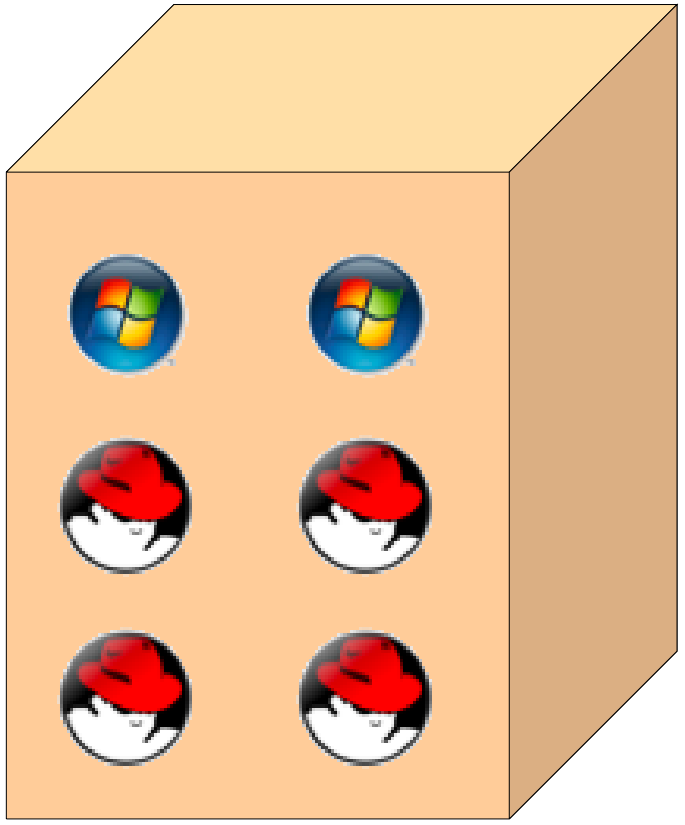
Virtualization in a nutshell

6 OS on 6 discrete platforms



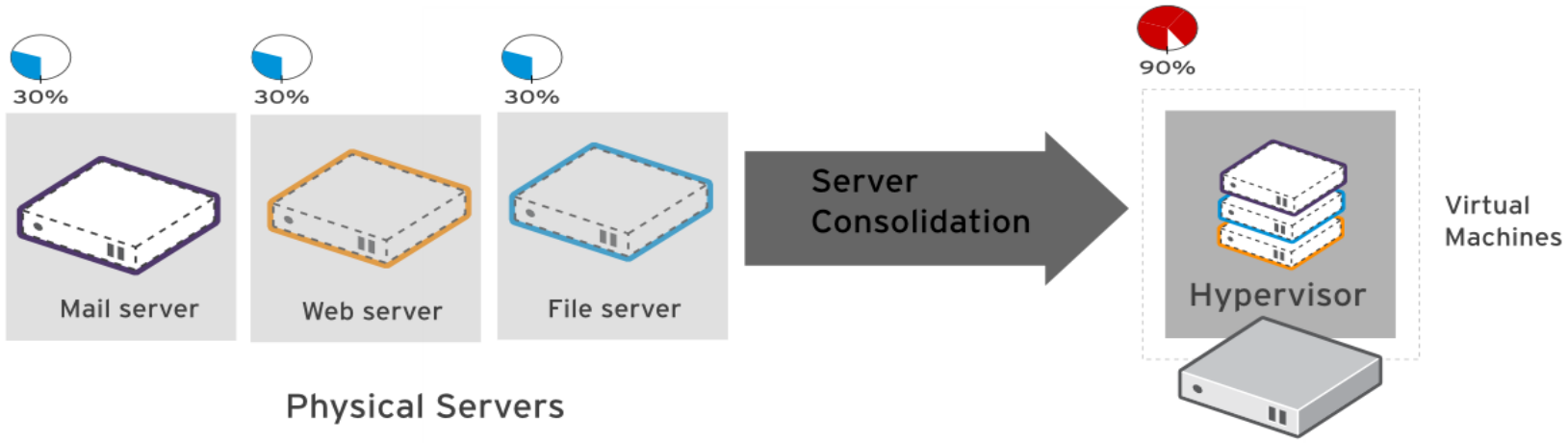


6 OS on 1 discrete platform



Benefits of Virtualization

- Reduce Costs
  - Improve server utilization
  - Reduce hardware costs
  - Reduce power and cooling costs
  - Improve management efficiency
  - Increase capital efficiency
- Improve Business Agility
  - Rapidly respond to business needs
  - Operational scalability
  - Rapid provisioning
  - Business continuity
- Security
  - System isolation and sVirt

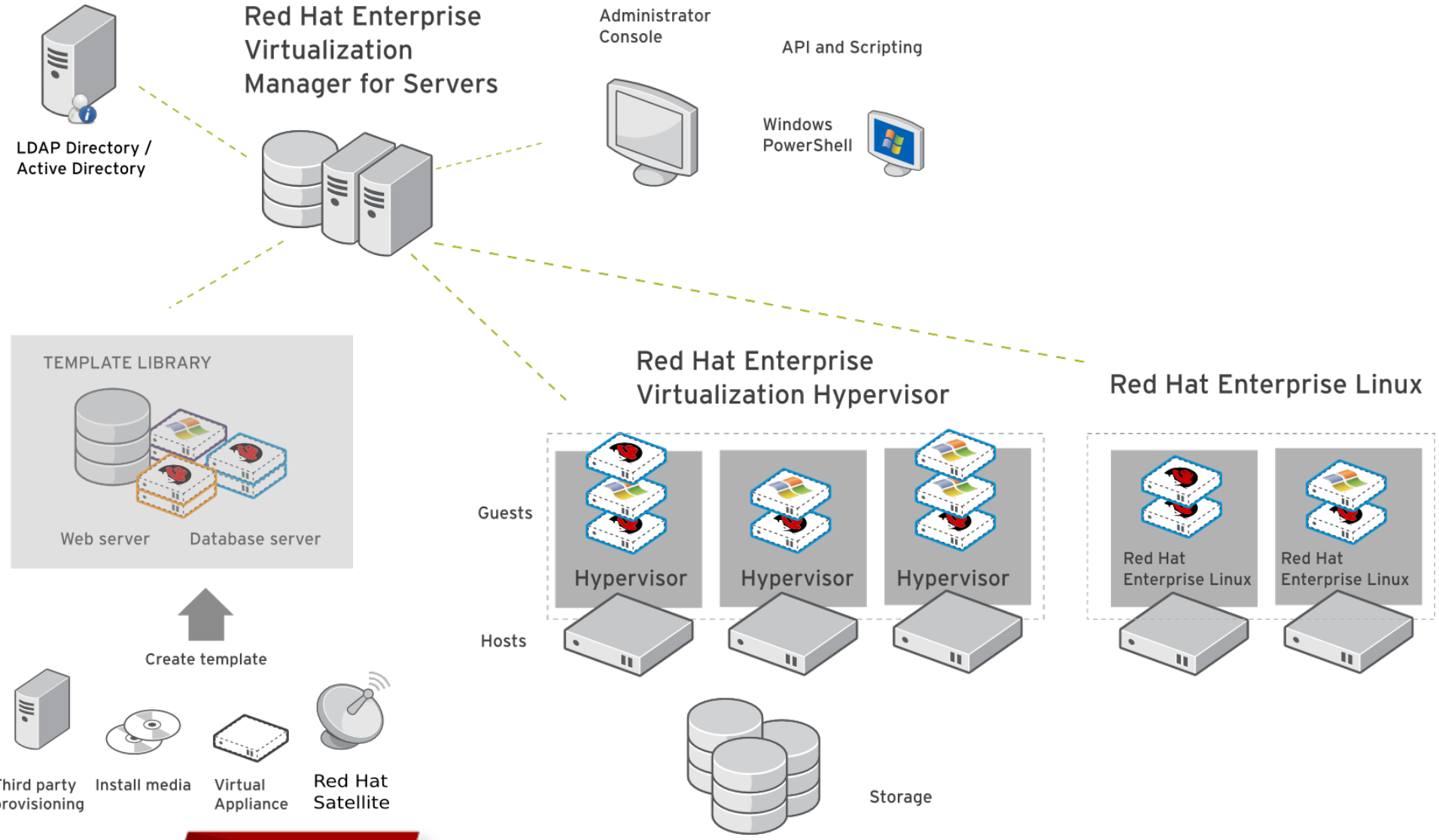


Red Hat Virtualization

Currently 3 Approaches

- Xen in RHEL
  - Supported until 2014
- KVM in RHEL
  - Full Virtualization
  - Part of the RHEL 5 distro
- Red Hat Enterprise Virtualization (RHEV)
  - Full Virtualization
  - < 100MB Distribution = really tiny.

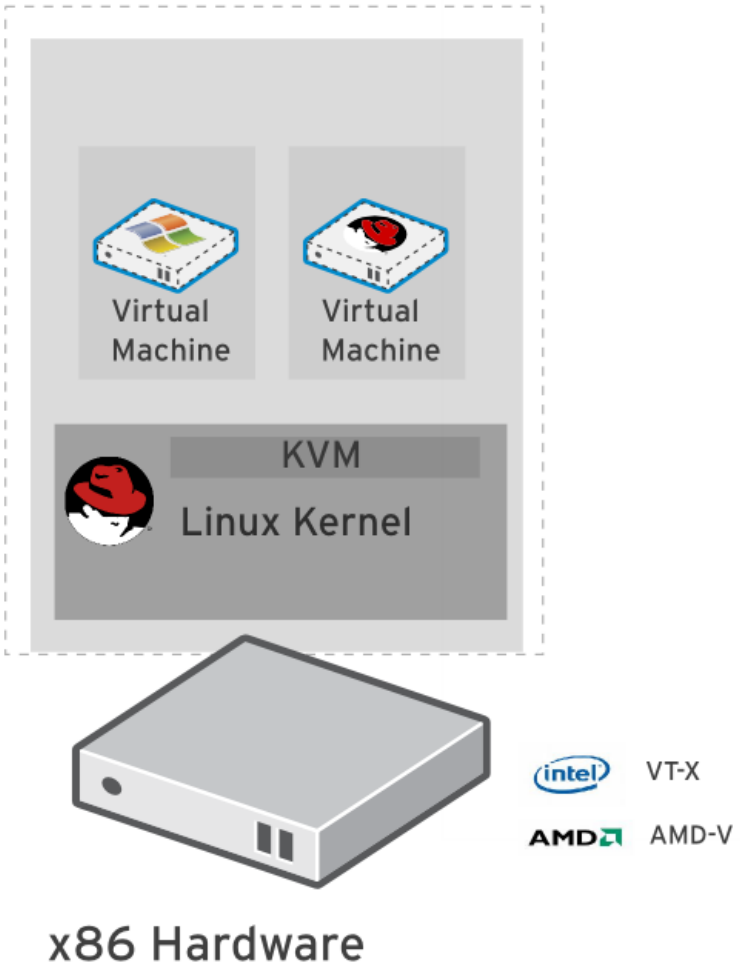
Red Hat Enterprise Virtualization



Red Hat Enterprise Virtualization Features

Feature	Description
High Availability	Restart VMs from failed hosts automatically on other hosts
Live Migration	Move running VM from one host to another – 0 downtime, 0 sessions lost
System Scheduler	Continuously load balance VMs based on resource usage/policies
Power Saver	Concentrate VMs on fewer servers during off-peak hours – save power
Maintenance Manager	0 downtime for VMs during planned maintenance window
Image Manager	Snapshots, templates, overlays, save/restore
Monitoring and Reporting	For all objects in system – VM guests, hosts, networking, storage, etc.

RHEV Hypervisor



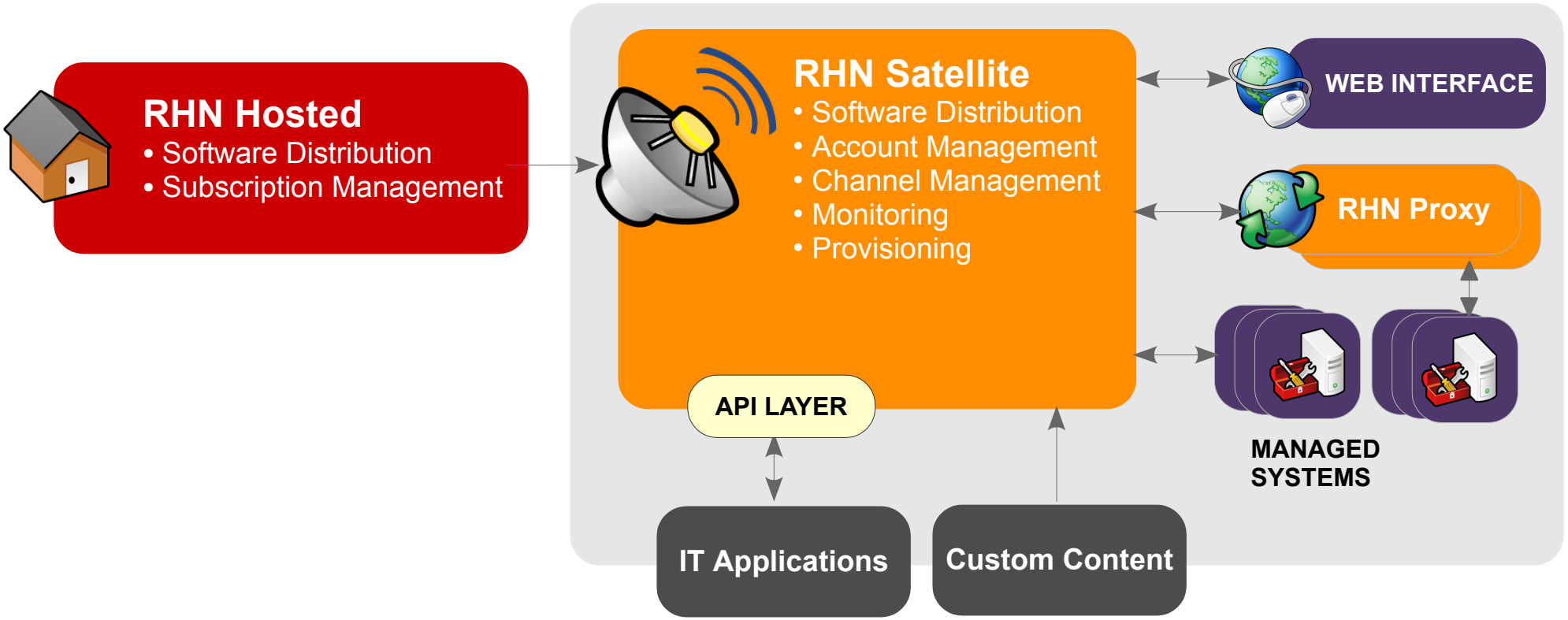
- Standalone Hypervisor
  - Small footprint < 100MB
    - Customized 'spin' of RHEL 5
    - Security hardened image
    - Runs on all RHEL5 hardware with VT/AMD-V
    - 'Just enough' RHEL to run virtual machines
  - Easy to install, configure and upgrade
    - PXE boot, USB boot, CD or Hard drive
  - Scalability
    - 256 cores & 1TB ram on Host
    - 16 virtual CPUs and 256GB ram guest

Red Hat Satellite

Your own personal RHN...

- Systems Management Platform for Linux and x86 Solaris
- Management, Provisioning and Monitoring
- Host custom channels
- Hierarchical model for layers of distribution management in large deployments

Satellite Deployment Model



- Syncs content from RHN Hosted and custom content distribution
- Can run disconnected from the Internet
- Local database stores all packages, profiles, and system information

Automated Provisioning

- Concepts
  - Network (PXE) Boot raw OS or bootstrap a template
  - Scripted / Machine driven installation/configuration
- Provisioning Tools
  - Cobbler Linux installation server https://fedorahosted.org/cobbler
  - Puppet http://www.puppetlabs.com/
  - Satellite (Contains Cobbler Functionality)
- Ghosting and Imaging are not (purist) provisioning
  - Configuration Management becomes cumbersome

What is Cloud Computing?

- A way to access application hosted on the web through your web browser (Software as a Service)
- A pay-as-you-go model for IT resources accessed over the Internet (Platform as a Service)
- Use of commodity computers, distributed throughout an internet, to perform parallel processing, distributed storage, indexing and mining of data
- Gartner: “Cloud computing is a style of computing where massively scalable IT-related capabilities are provided 'as a service' across the Internet to multiple external customers”

Before we can design a solution, we need to understand the requirements..

Customer Mission

- “Provide C4ISR Infrastructure to enable a secure scalable environment to support R&D, DT/OT&E, exercises, experimentation, acquisition development and direct warfighter support”

  - **C4ISR:** Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance
  - **DT:** Developmental Test
  - **OT&E:** Operational Test and Evaluation

Customer's Practice...

Customer's Current Approach

- Manual Labor Intensive & time consuming
  - Cabling (power, comms, peripherals)
  - Compute hardware setup/teardown measured in weeks
- No Persistence
  - Trials, experiments and configurations vanish as hardware is re-used by the next customer
- Inventory
  - Literally rooms of hardware on the shelf waiting to be used
  - Inventory management a full-time job

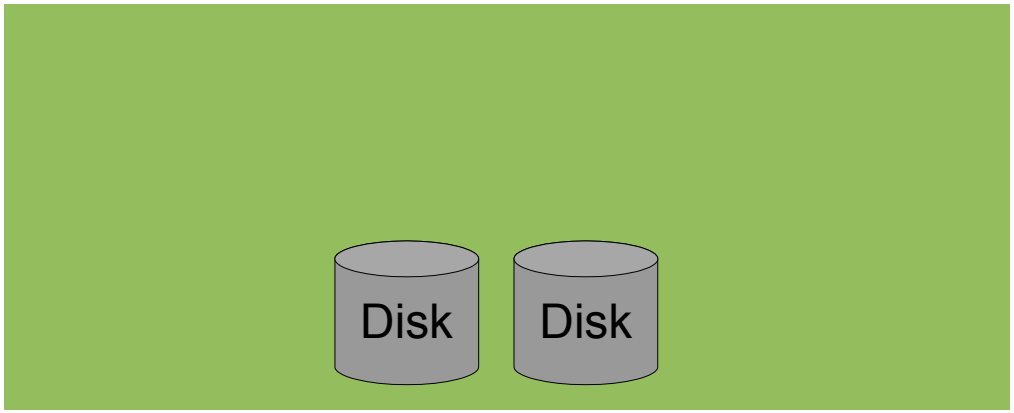
Derived Requirements

- Customer basically needs to provide:
  - Basic compute platforms, storage and networks
  - Environmental – HVAC, power, floor/rackspace, etc
  - Operations and maintenance manpower
  - Access to a variety of networks
    - Open and closed
    - Various classification levels
  - Security (physical, network, data)

Our Goal

Leverage modern virtualization and storage technology to facilitate the customer's mission and streamline their operations and processes

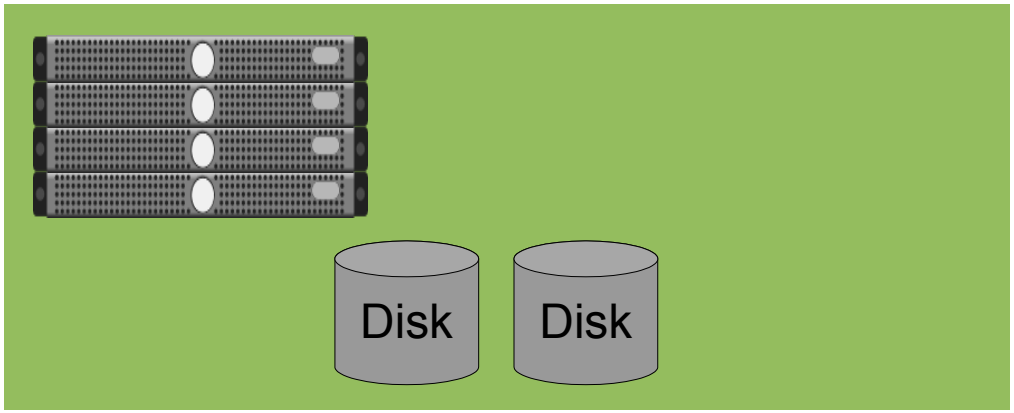
Architecture



Storage

- 3 TB NAS
  - RAID 5 + 1
  - Roughly 1.3 TB usable
- House VM Images
- Critical to VM migration amongst hypervisors

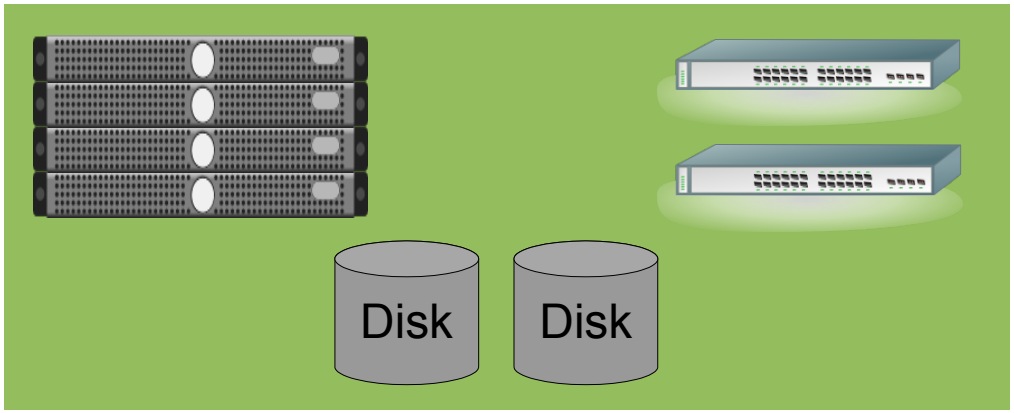
Architecture



Processing Hardware

- Dell 1950s
  - VT Capable
  - 8-16 GB RAM per
- Multiple NICs
- Local disk space negligible

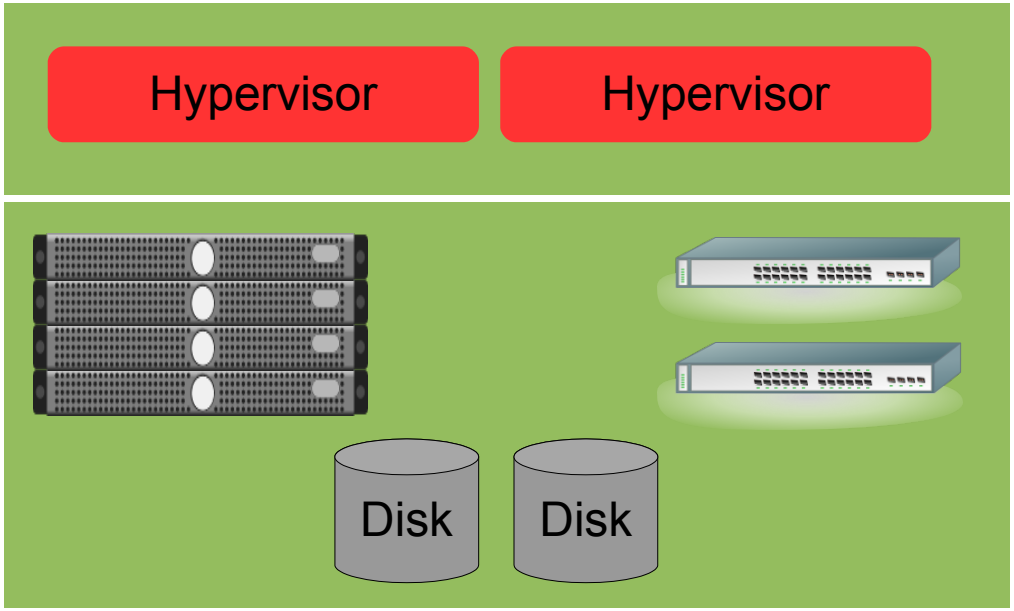
Architecture



Networking

- Virtual Networks
  - Bridges and Switches
- Physical Switches
  - Storage: 1000/s
  - Management: 1000/s
  - Internal: 100/s
  - Outbound: 100/s

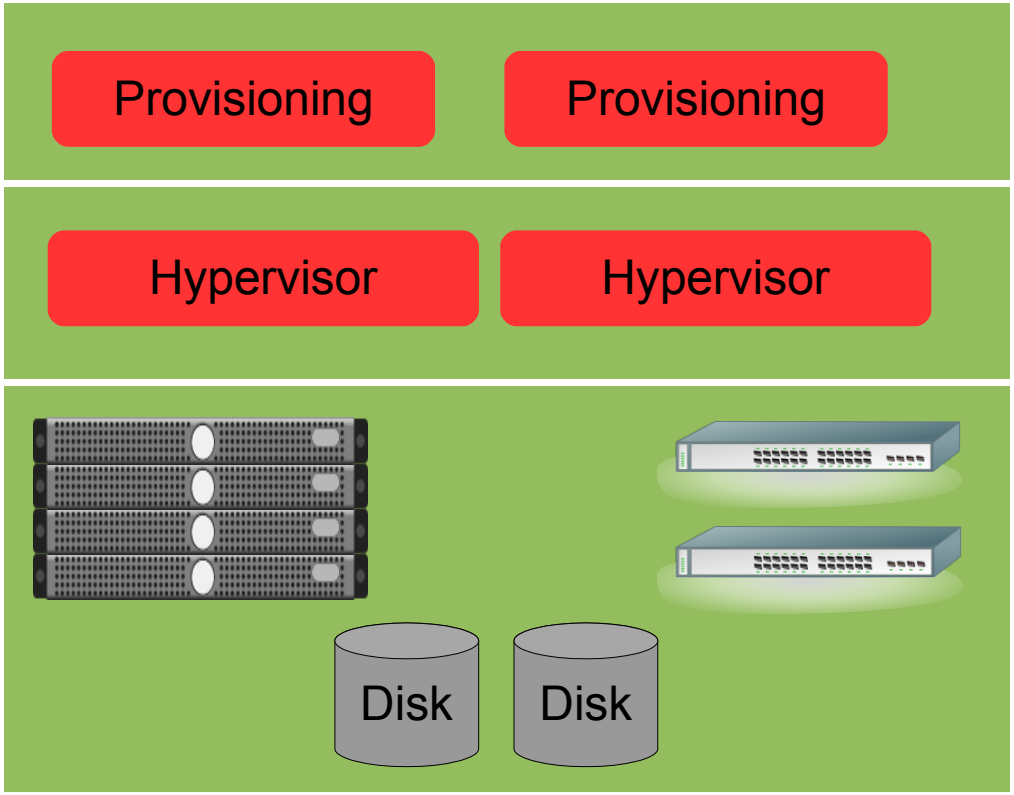
Architecture



Hypervisor

- RHEV-H
- “RHEL-H”
  - RHEL 5.4 AP
  - KVM
  - RHEV Extensions
    - Connect to RHEV-M
- VMware ESX

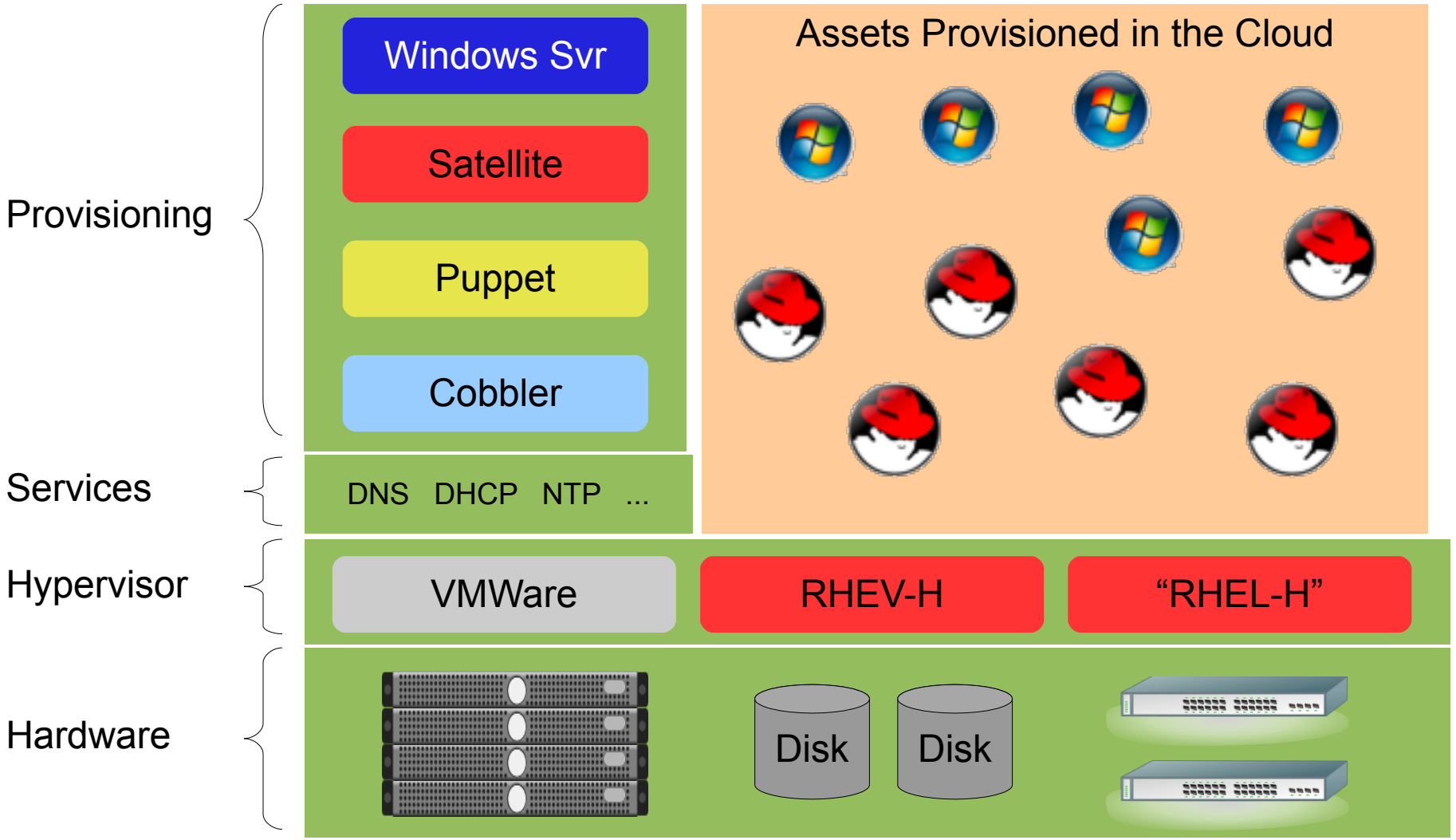
Architecture



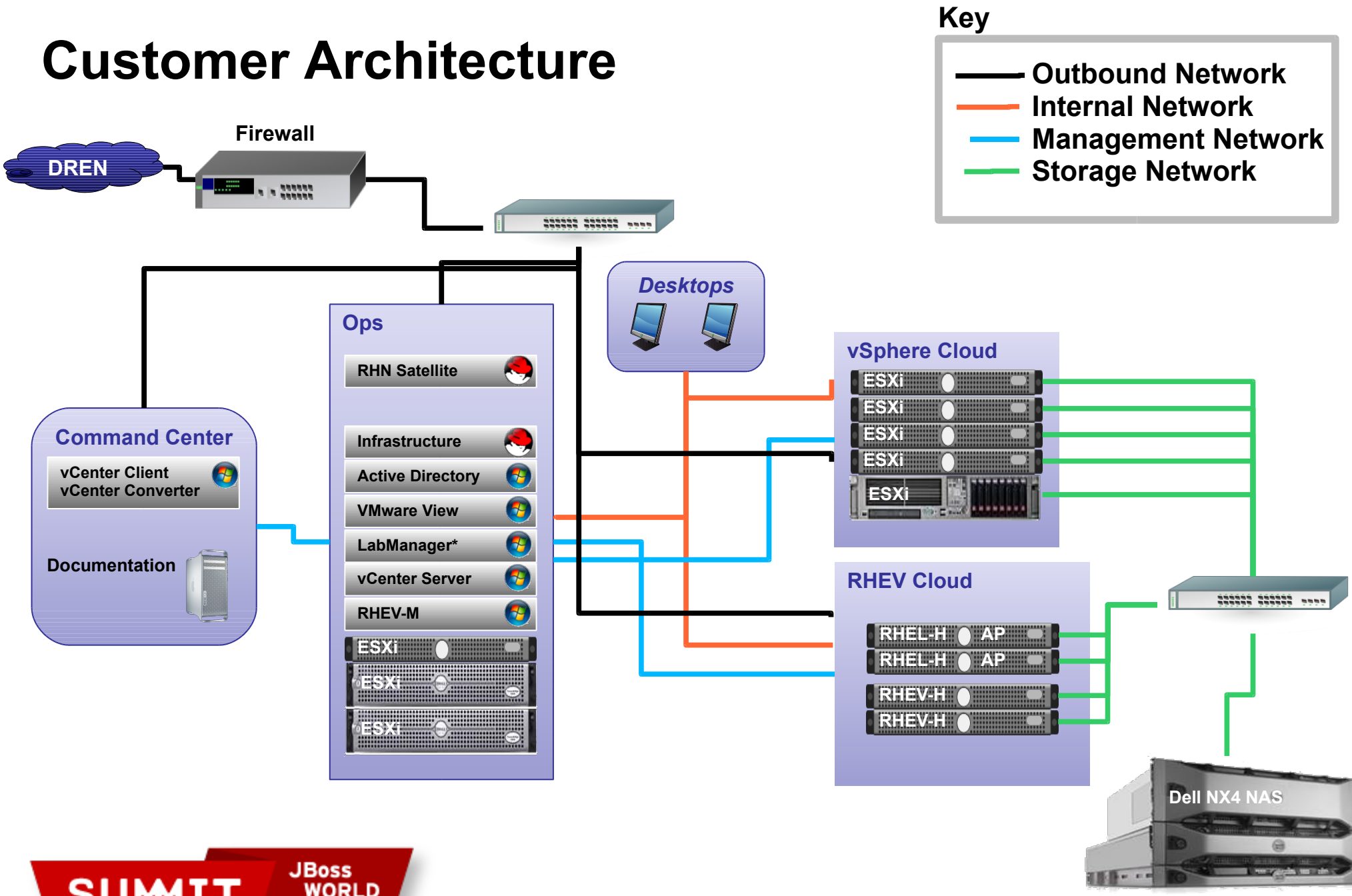
Provisioning

- Satellite
  - PXE Boot new VMs
  - Updates for VMs
  - Create custom channels
  - Distribute custom RPMs

Putting it all together



Customer Architecture



How do we get there?

No Big Bang!

- Gradual building out of the environment
  - Cloud patterns offer the ability to add resources as needed, perfect for building over time so long as the right architecture is implemented from the start
- Satellite at the core
  - Provision and update RHEL VMs
  - Provision and update RHEV Hypervisors!
- New technologies phased in over time

Physical Environment

- Racks
  - Mounted like-equipment together
  - Lots of cable ties
- Networking
  - At least 4 NICs per server to support separated networks
- Install basic infrastructure server
  - DNS, DHCP, NTP, etc

Satellite

- Hardware Configuration
  - Dell 2850, 3.0 GHz Xeon, 12GB RAM
  - RHEL 5.4, x86_64 with Xen Hypervisor
- Satellite Server
  - Guest OS, RHEL 5.4 with 8GB dedicated RAM
  - OS Disk: 20GB RAID 1
  - Satellite Disk: 100GB RAID 5
    - /var/satellite (60GB) and /rhnsat (15GB)
- Use Satellite to provision the other Red Hat systems

Build out Hypervisors

- RHEV-M
  - Install first to have available for hypervisors to discover during install
- RHEV-H
  - Super-simple installation
  - Boot off RHEV-H CD, follow prompts to install
    - Only the “management” network interface is required at this point of the build process
    - Configuring other interfaces will only get in the way of joining hypervisors to RHEV-M

Build out Hypervisors

- “RHEL-H” AP
  - Install minimal RHEL 5
    - Basically just Base and vi
  - Firewall and SELinux on, enabled and enforcing
  - Don't create any users
  - RHN or Satellite registration recommended
    - Recommended: build a “RHEL-H” channel for additional packages

- On RHN:
  - bridge-utils
  - kvm-qemu-img
- Separate Download:
  - OpenIPMI-tools
  - lm_sensors
  - net-snmp
  - net-snmp-utils
  - sg3_utils-libs
  - sg3_utils
  - pexpect
  - fence_agents

Configure Storage

- Dell NX4 (rebranded EMC Celerra)
  - Configure RAID device
  - Set up iSCSI target(s)
- Attach hypervisors/managers to storage

Install other infrastructure if needed

- VMware
- Windows
- Solaris
- etc...

Cloud is ready

- Install test guests
- Configure and test migration amongst hypervisor hardware
- Made cloud available to first customer
  - Technical Exchange Meeting for demo/integration
  - Over 20 virtual machines imported into the cloud and used in integration and interoperability experiments and demonstrations
- Turned the cloud over to the customer

Cloud Benefits for customer

- Reduced Manual Labor
  - Centralized resource pooling (CPU, storage)
  - Minimal cabling to run and contained in processing racks
- Persistence
  - VMs can be stored on SANs for later use
  - VMs can be archived for historical purposes
- Physical Space
  - Hardware inventory is consolidated into resource pools and used on-demand - no rooms set aside for hardware storage

Automated Provisioning Benefits for customer

- Repeatable configurations
  - Makes DT and OT manageable
    - Automated portions of system configurations are automatically documented and controlled
  - Take exact config from test directly to operations
- Reduced build time and cost
  - Machine provisioning inherently faster than manual
  - Reduced demand on SysAds and Engineers
  - Build the automated routine once, reuse often

Results = Zero to Cloud in 30 days...

- Design and build the cloud
- Customer training on the cloud environment
  - Administration and maintenance of the infrastructure
  - How to leverage for their future use
- Environment was completed to support a Technical Exchange Meeting for an unrelated customer
  - Over 20 VMs imported into the environment and used for demo and experimentation purposes
- Initial seed for future growth and expansion

Lessons Learned

- Second-hand equipment took a while to reconnoiter and repair before we could use it
  - Literally 3 attempts to resurrect old NAS hardware before receiving permanent solution (Dell NAS)
  - Firmware upgrades, broken parts, bad disks, etc

Lessons Learned

- We were so excited to build, we didn't plan enough
  - Plan, plan and plan until you can't take it anymore
    - It'll save moving equipment in the long run
  - Didn't account for the time needed to refurb equipment
  - Numerous architecture changes (IP spaces, equipment allocation, etc) slowed us down

Lessons Learned

Networking

- Use separate switches for each network, if possible
  - VLANs are workable, but add complexity to configuration
- Color-coded CAT6 helps a LOT

Lessons Learned

- SAN vs. NAS
  - A SAN is the more appropriate platform to provide shared storage for a cloud
    - Fibre channel is faster, but more expensive
    - iSCSI on the SAN more cost effective
    - SAN more suited to expansion and growth than NAS
  - iSCSI from a NAS is sufficient for small deployments
    - Risk bogging down storage network as deployment grows

Lessons Learned

- Satellite Server should be cornerstone
- Need to market this capability to potential customers, or no one will know about it
- Paradigm shift more difficult than the technology
  - Admins need to learn the “cloud way” of doing things
  - Think in abstract resources vice tangible hardware
  - Users need to be comfortable with machines they can't physically touch

Future efforts

- Implement RHEV-D
  - Allows for “guest terminals”
  - Provide user workstations for access to Cloud VMs
- Deeper Satellite integration
  - Add RHEV-H provisioning
  - Augment “RHEL-H” provisioning
  - Automate security lockdown (guests and hypervisors)
- DeltaCloud

Useful Satellite Features

- Custom Channels
- PXEBoot bare-metal to RHEV hypervisor
- PXEBoot bare-metal or bare-VM to RHEL
- Consolidated views of managed inventory
  - OS and Update levels
  - System inventory
    - Management, grouping, etc

Useful RHEV Features

- Quickly and easily manage storage and hosts
- ParaVirt drivers increase performance on full virt guests

Concluding Thoughts...

- A small initial investment can produce REAL results in a very short timeframe
- Clouds allow for small and large organizations to start with what they need, and grow over time by adding additional storage and processing
- Small learning curve on technologies
  - Satellite and RHEV super easy to implement and use
- Planning is key!
  - Required capacity
  - Physical layout

Questions...

Grid on a Cloud (GoaC), coming up next...

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