SUSE Cloud Integration with Cisco UCS and Cisco Nexus Platforms

What You Will Learn

Cloud computing is on the minds and agendas of many IT professionals and is a focus of a growing number of organizations offering cloud-based products. Hoping to manage the ever-growing complexity and sprawl of their current infrastructure, IT staffs look to the automation and increased efficiency of cloud computing principles to free their resources so that they can focus on more strategic endeavors. Cloud computing also offers much needed agility for line-of-business owners so that they can quickly respond to changing priorities, yet provide scalable, production-ready services. To address these needs, Cisco and SUSE have partnered to offer a complete, integrated, cloud-based ecosystem for you to create and deploy private cloud instances within your own network space and with computing resources under your own control.

This document discusses this private cloud solution. It highlights the integration aspects of the solution, which combines the strengths of each company's products into a cohesive platform. The highly automated nature of this private cloud instance can then be applied to any phase or type of workload deployment, from testing to production services, and can even include components to manage the overall lifecycle of the cloud computing infrastructure and the workloads. The target audience for this document is individuals seeking an overall view of such an ecosystem solution, which consists of several offerings from Cisco and SUSE. However, this document is not intended to be a detailed deployment guide, nor does it describe more advanced setups.

Introduction

Cloud computing models have existed for some time, especially for public clouds, to provide access to resources such as hardware, software, and services over the network. By abstracting the complex infrastructure it is built on from end users and, to some extent, from some administrators and development and information technology operations (DevOps) professionals, virtual instances or workloads can be provisioned on demand from predefined templates. Services, consisting of many such workloads, can be provisioned for use in minutes and then scaled appropriately to meet service demands. For additional information, you can read about the core characteristics of cloud computing in the National Institute of Standards and Technology's (NIST) Definition of Cloud Computing.

Although public cloud services have existed for a while, your company may want to take advantage of this framework to implement a private cloud, which offers better security and more control of the resources with less impact on performance resulting from the sharing of resources with others. Private clouds also affect your return on investment (ROI) because, unlike public clouds, deployment of a private cloud instance requires locally maintained infrastructure; however, because resources are still shareable and scalable with potentially higher overall utilization, your total cost of ownership (TCO) is likely to be lower than the TCO of traditional IT infrastructure deployments, including simple virtualization consolidation. The increased flexibility and high level of automation further contribute to the appeal of this solution, allowing you to rapidly respond to your changing business conditions without overburdening IT resources.

Private Cloud Solution

This document provides an overview of a complete private cloud solution, including the core physical infrastructure, integrated with enterprise-ready versions of many open source offerings. With this solution, you can gain agility, scalability, and improved utilization of resources and still have the benefits of a supported, secure, enterprise-class approach.

To provide infrastructure as a service (IaaS), three core components of computing, storage, and networking resources must be integrated, through a cloud operating system, to cooperatively provide the foundation for applications and services to be layered with the deployed workloads. Computing resources are provided with physical or virtual machines running on top of a hypervisor. Storage resources can be provided using either dedicated storage elements or distributed, resilient file systems across commonly available computing systems, each with local storage. Networking is the unifying component that connects computing and storage together. Given the complexity of such an infrastructure, the network must be fully configurable and must be capable of adapting to change requests on demand.

Finally, it is the cloud operating system that provides the user interface for setup, configuration, maintenance, and long-term operation of these three core components, bonding them into a cohesive service offering. The emerging private cloud standard implementation relies on Linux operating systems. The current reference framework for the cloud operating system, OpenStack, is open source software like Linux itself. Many of the subcomponents, such as the Citrix Xen and Linux Kernel-Based Virtual Machine (KVM) virtualization technologies and deployment engines for OpenStack, are likewise open source software.

The following sections elaborate on each of these core components for a private cloud instance: the networking, computing, and storage systems and cloud operating system layers.

Networking

Cisco is the market leader in network technology, providing 10 Gigabit Ethernet solutions that scale with the demands of heavily virtualized, private cloud environments. Cisco is also the data center networking leader, with more than 40,000 customers for Cisco Nexus® Family switches. The Cisco Nexus product line uses the Cisco® NX-OS Software operating system and provides both the performance benefits of a hardware-based networking solution and the flexibility of a software-based networking solution. The Cisco Nexus 3000, 5000, 6000, and 7000 Series Switches provide top-of-rack and core data center hardware-based networking solutions. The Cisco Nexus 1000V Switch is a software-based networking solution that integrates with leading hypervisors and includes support for network service chaining with Cisco vPath for advanced networking services including firewalls, Cisco Virtual Extensible LAN (VXLAN) technology, and application delivery. Cisco Nexus plug-ins are provided in the OpenStack Networking component, enabling transparent support across the Cisco Nexus product line for Layer 2 and Layer 3 networking services (Figure 1).

Figure 1.   Cisco Nexus Plug-in
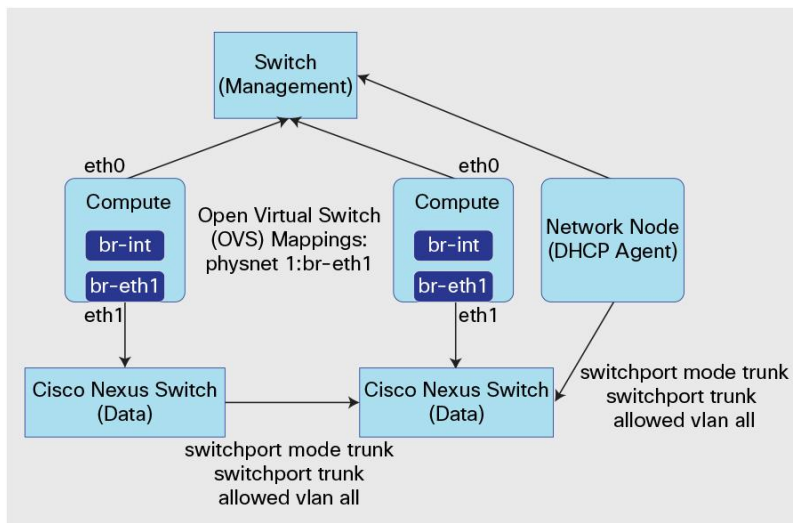
The Cisco Unified Computing System™ (Cisco UCS®) provides greater network density with less cabling and complexity to address the increasing need for better design and simpler control. Cisco's unified fabric integrates Cisco UCS servers with a single high-bandwidth, low-latency network that supports all system I/O. This fabric carries IP, storage, and management traffic over redundant 10 Gigabit Ethernet and Fibre Channel over Ethernet (FCoE) networks. This approach simplifies the architecture and reduces the number of I/O interfaces, cables, and access-layer switch ports required for traditional cloud infrastructure deployments. This unification can reduce network complexity by up to a factor of three, and the system's wire-once network infrastructure increases agility and accelerates deployment with zero-touch configuration (Figure 2).

Figure 2.   Cisco Unified Fabric
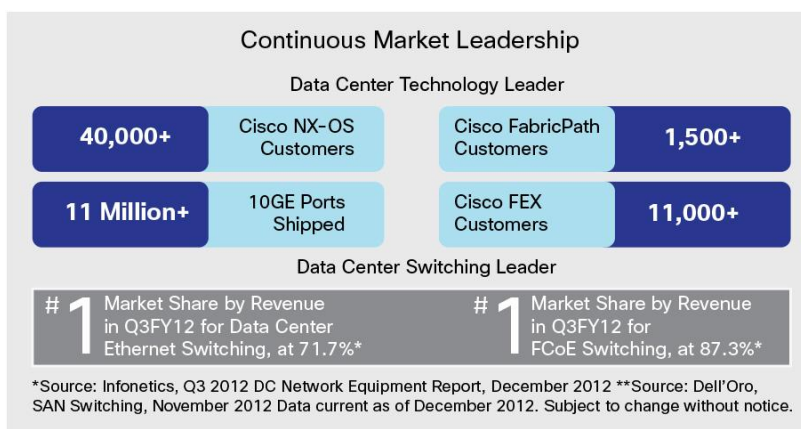
All I/O traffic meets at a single specific, redundant point at which it is efficiently and consistently managed, increasing network security, simplifying management, and reducing errors. This approach eliminates server and hypervisor-resident switching, condensing three network layers into one and reducing capital and operating costs. With the capability to interconnect physical servers and virtual machines as functional equivalents, the architecture delivers outstanding visibility and control that lets virtual networks be managed with the same level of control as physical networks.

Computing Systems

At the computing and storage system layers, Cisco UCS excels in a private cloud setting. Cisco UCS enables cloud infrastructure to meet ever-increasing guest operating system memory footprint demands on fewer physical servers. The system's high-density, high-performance design increases consolidation ratios for 2-socket servers, saving the capital, operating, physical space, and licensing costs of running virtualization software. Cloud infrastructure can host applications using less-expensive servers without sacrificing performance. As a result, IT departments can put more virtual machines on each server, reducing physical server sprawl and breaking down management silos.

A model like the Cisco UCS C220 M3 Rack Server is excellent for high-density computing roles, and the Cisco UCS C240 M3 Rack Server is excellent for fulfilling the storage role in your private cloud implementation. Depending on your objectives, one of three common starter configurations, covering the range of workloads, will likely meet your needs. As shown in Table 1, these preconfigured solutions are designed for cloud deployments and can be upgraded to match your specific memory, local storage, and I/O requirements.

Table 1.   Representative Cloud Reference Configurations

|	High-Density Configuration	Mixed-Workload Configuration	Storage-Intensive Configuration
Computing	6 Cisco UCS C220 M3 Rack Servers: ● 2 Intel Xeon processors E5-2665 ● 128 GB of memory ● LSI MegaRAID 9266-CV 8i card ● Cisco UCS Virtual Interface Card (VIC) 1225 ● Redundant power supplies ● 2 x 900-GB SAS hard disk drives	6 Cisco UCS C220 M3 Rack Servers: ● 2 Intel Xeon processors E5-2665 ● 128 GB of memory ● LSI MegaRAID 9266-CV 8i card ● Cisco UCS VIC 1225 ● Redundant power supplies ● 2 x 600-GB SAS hard disk drives 2 Cisco UCS C240 M3 Rack Servers: ● 2 Intel Xeon processors E5-2665 ● 256 GB of memory ● LSI MegaRAID 9271-CV 8i card ● Cisco UCS VIC 1225 ● Redundant power supplies ● 12 x 900-GB SAS hard disk drives	8 Cisco UCS C240 M3 Rack Servers: ● 2 Intel Xeon processors E5-2690 ● 256 GB of memory ● LSI MegaRAID 9271-CV 8i card ● Cisco UCS VIC 1225 ● Redundant power supplies ● 12 x 900-GB SAS hard disk drives
Networking	2 Cisco UCS 6296UP 96-Port Fabric Interconnects 2 Cisco Nexus 2232PP 10GE Fabric Extenders	2 Cisco UCS 6296UP 96-Port Fabric Interconnects 2 Cisco Nexus 2232PP 10GE Fabric Extenders	2 Cisco UCS 6296UP 96-Port Fabric Interconnects 2 Cisco Nexus 2232PP 10GE Fabric Extenders

Specific details, including the complete bill of materials for these configurations, can be found in the document Cisco UCS Solution Accelerator Paks for OpenStack Cloud Infrastructure Deployments.

The Cisco UCS management framework provides robust APIs to manage all system configuration and operations. It also helps increase cloud data center staff productivity, enabling staff to better manage storage, networking, and computing resources and to collaborate on the definition of service profiles for applications. Cisco UCS service profiles help automate provisioning, consistently provisioning applications in minutes instead of days. This capability creates an environment of stateless computing, in which a computing node has no inherent state pertaining to the application that might be running on it at any given time. So at any given time, a machine can be running operating system X, and then the next minute it can be rebooted and running hypervisor Y. Hence, the computing node is just a processing engine with CPU, memory, and storage resources. A core concept of a stateless computing model is separation of the access to the application from the processing of the application. Stateless computing provides a holistic way to address configuration management, rapid provisioning, upgrades and downgrades, scalability, policy enforcement, and auditing.

Cloud Operating System

Despite the daunting list of software choices and technology options, the goal of a completely functional, usable private cloud solution is still easily obtainable. SUSE Cloud allows you to create a dynamic and flexible infrastructure, letting you respond to changing business needs, and it includes all the necessary elements of a private cloud, as illustrated in Figure 3.

Figure 3.   Cloud Computing Elements
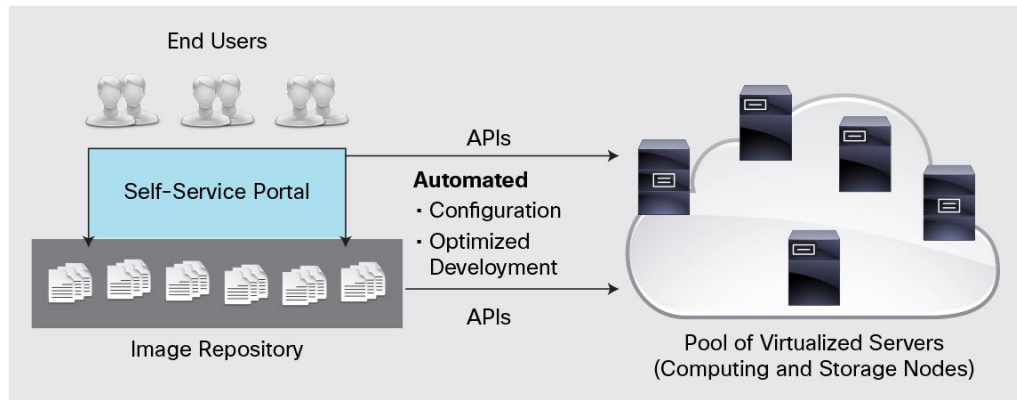
SUSE has more than 20 years of experience in turning open source innovation into enterprise-class solutions, which continues with SUSE's work in the OpenStack community. SUSE Cloud provides a cloud operating system that delivers a secure, reliable, ready-to-use and fully supported private cloud solution that is easy to deploy and manage, particularly in combination with Cisco network equipment and computing platforms. SUSE Linux Enterprise Server (SLES) is used as the underlying operating system for all cloud infrastructure devices (also called nodes). With this operating system deployed on SUSE YES certified hardware options, including Cisco UCS servers, you can confidently deploy your favorite target systems in a private cloud infrastructure.

Note that all the OpenStack APIs are maintained by the SUSE Cloud product, enabling other products to be selectively integrated into your overall solution as needed. The details of such integrations are beyond the scope of this document, but you may want to consider these examples of extensibility:

- The Cisco Intelligent Automation for Cloud product delivers a scalable, open, and flexible portal for you to orchestrate workload deployments, which can span heterogeneous cloud environments and contain multiple cooperating guests and services.

- With SUSE Studio Onsite, you can build virtual application workloads within a convenient web user interface. In SUSE Studio Onsite, a developer can create a complete software appliance, iterating as much as needed to provide a known working solution. Each build, through API interaction between SUSE Studio Onsite and the image repository module of SUSE Cloud, appears in the SUSE Cloud dashboard as a workload guest image. These images are then ready for testing, qualification, or production deployment on the various cloud infrastructure computing node resources.

- To manage and report on the status of resources and the workloads over their useful life, [SUSE Manager](#) can be set up to automatically incorporate them. This setup helps ensure that monitoring, compliance, and other service management practices are maintained over the entire lifecycle of resources, including modules for patch and update management. With a simple postinstallation hook, the new resources and workloads automatically register with the SUSE Manager server, becoming managed entities. If desired, this same SUSE Manager console can help you manage other system resources in your environment and is extensible through various APIs.

SUSE Cloud provisions a number of nodes to deliver a private cloud offering:

- The SUSE Cloud product includes a unique central administration server that coordinates the deployment of the required resource nodes and the provisioning, configuration, and management of the various OpenStack components (Figure 4).

Figure 4.   SUSE Cloud Administration Server
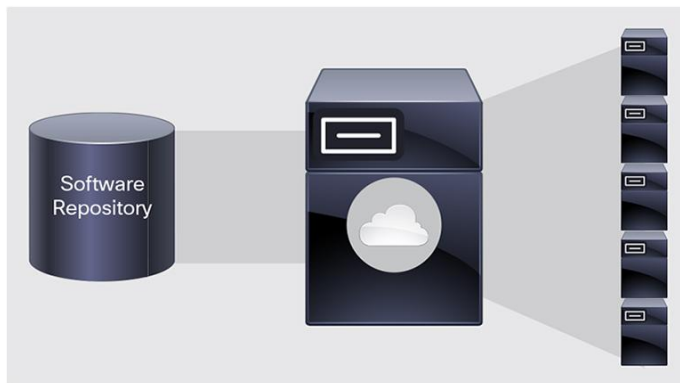
This node provides an abstraction of all the infrastructure complexity and interactions of the various software components, providing an easy way to set up your private cloud implementation. It provides the services needed to set up and deploy all other nodes in the cloud. These installation services, including Domain Host Configuration Protocol (DHCP), Domain Name System (DNS), Network Time Protocol (NTP), Preboot Execution Environment (PXE), and Trivial FTP (TFTP), are provided in the cloud deployment engine. The SUSE Cloud Administration Server also commonly hosts the necessary software repositories for SUSE Linux Enterprise Server and SUSE Cloud because they are needed for deployment and provisioning of the other nodes. Optionally (if no other sources for the software repositories are available), it hosts the SUSE Subscription Management Tool ([SMT](#)), providing up-to-date repositories for cloud updates and SLES operating system patches for the resource nodes. The remaining required nodes of the SUSE Cloud infrastructure can be set up, configured, and managed from the administration node web interface as long as the system can be configured to PXE boot from the administration server.

The remaining nodes result from the use of the SUSE Cloud deployment framework and form the infrastructure core of the private cloud instance, consisting of the controller, computing, and storage functions (Figure 5).

Figure 5.   SUSE Cloud Nodes
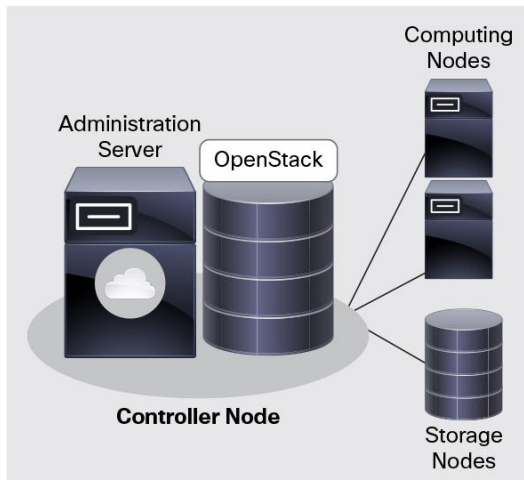
- The controller node typically hosts all required OpenStack services and modules needed to orchestrate the workload virtual machines deployed on computing and storage nodes in SUSE Cloud. It is configured and deployed through the SUSE Administration Server web interface. Ultimately, this is where the multitenant-capable OpenStack web interface will be installed and accessed by users of your private cloud infrastructure to deploy workload virtual machines for their various projects. For small to medium-sized private cloud deployments, a single controller node is sufficient; however, these services can be spread across multiple nodes if either scale or availability becomes a concern. Although this topic is beyond the scope of this document, note that many of these core OpenStack services can be set up in high-availability mode to address potential component failure.

- The computing node is a physical server running a hypervisor, serving as a virtualization host for workload guest virtual machines. A SUSE Cloud infrastructure has one or more computing nodes, which also house the root and ephemeral disk images of the running workload guests, but this disk space is reclaimed when the guest is terminated. With SUSE Cloud, these computing nodes can offer either Linux KVM or Citrix Xen hypervisors for the workloads, but SUSE Cloud can also accommodate other computing node choices by deploying Microsoft Hyper-V nodes and by managing VMware vCenter nodes. This hypervisor flexibility helps ensure that you can run your workloads in the environment of your choice in your private cloud instance, using your existing expertise with the lowest total cost of ownership (TCO).

- The storage nodes act as controllers for persistent cloud-based storage elements and are often built on industry-standard servers with direct-attached storage drives. Either object, a file-like container of large amounts of data or volume-based block devices, can be configured and provided to your private cloud users and tenants. The SUSE Cloud infrastructure can contain one or more groups of storage nodes. This multiplicity of storage nodes, configured together, provides the necessary resiliency to accommodate node outages without degrading overall private cloud functions. Other dedicated storage products from partners such as EMC and NetApp can also be integrated into your cloud instance through the modular, plug-in architecture of the OpenStack Block Storage (or Cinder) component, but these are beyond the scope of this document.

Cisco and SUSE Cloud Value-Added Integration

The previous sections discussed the general components and feature sets of a private cloud infrastructure based on Cisco technologies and SUSE Cloud. Supported on any of the Cisco UCS Solution Accelerator Paks for OpenStack, SUSE Cloud has specific, value-added integrations that differentiate such an integrated solution and that are the direct result of the close partnership between Cisco and SUSE:

- Available under an Apache open source license, the Cisco UCS Integration Module for SUSE Cloud uses the power of Cisco UCS Manager APIs to deliver exacting configurations through Cisco UCS service profiles. The Cisco UCS Integration Module transparently passes the computing and storage node initial association and provisioning tasks to Cisco UCS Manager, and when these tasks are complete, the nodes show up in a discovered state, ready for allocation within the cloud instance. In effect, this module helps automate, standardize, and deploy the nodes most necessary to scale your private cloud to whatever size is needed. Figure 6 shows the integration and workflow.

Figure 6.   SUSE Cloud and Cisco UCS Manager Workflow
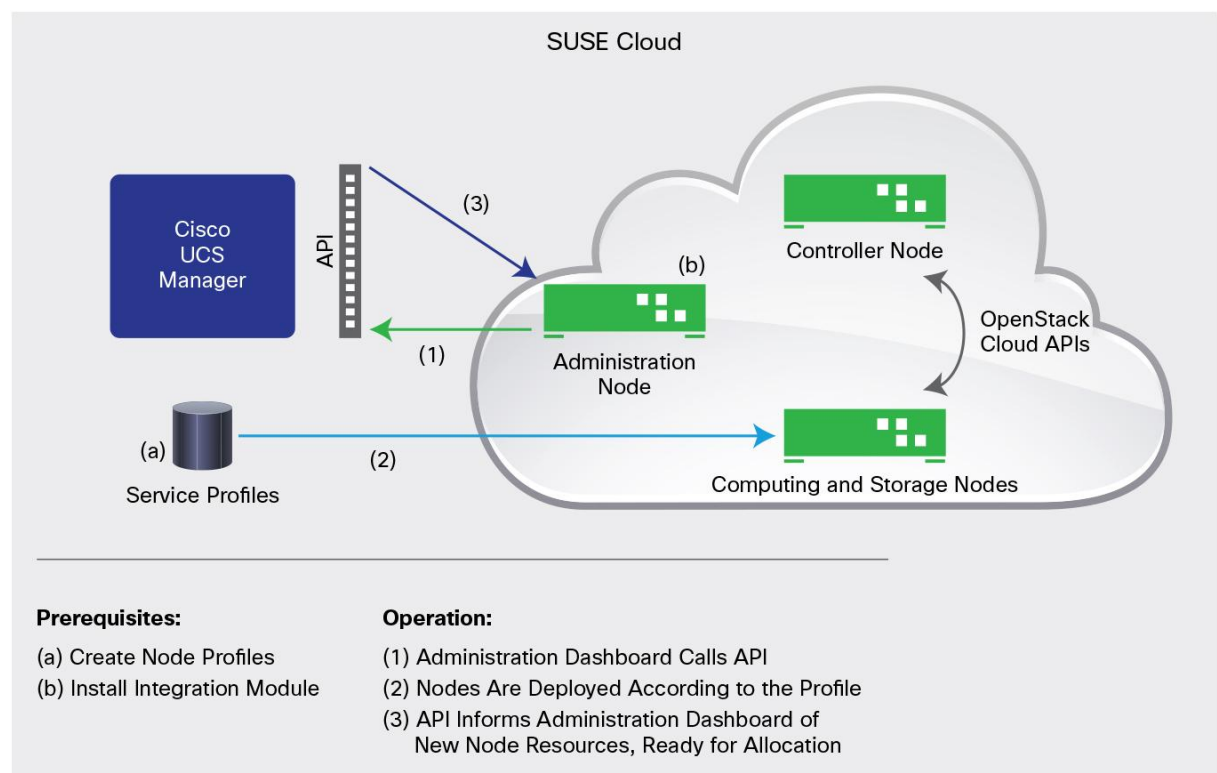
In Cisco UCS Manager, configuration is initiated by the creation of the computing and storage node service profile templates at the root organization level. Make sure that the primary boot device policy is ultimately set to the network (PXE), and you will meet the other configuration requirements noted in section 2 of the SUSE Cloud Deployment Guide for these node types for the Cisco UCS hardware that you have available (Figure 7).
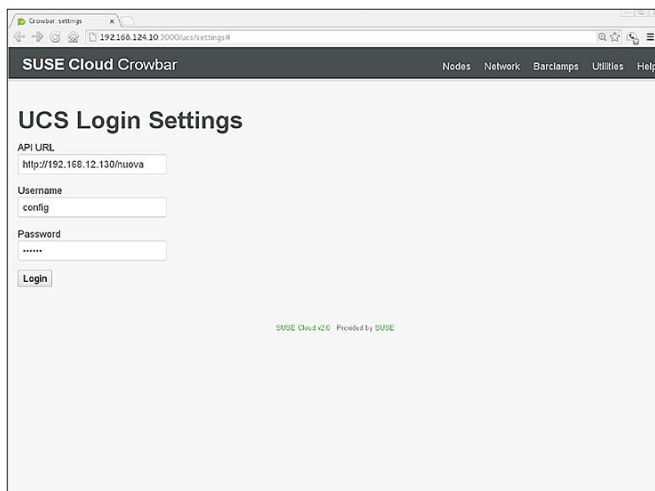
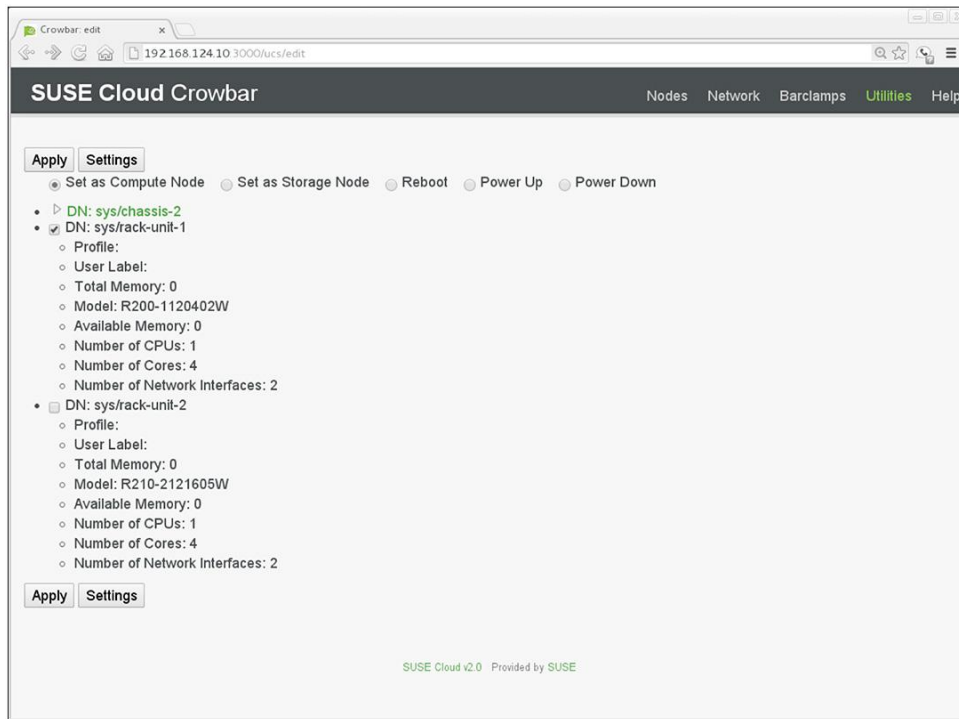**Figure 7.**   Cisco UCS Manager Service Profile Template
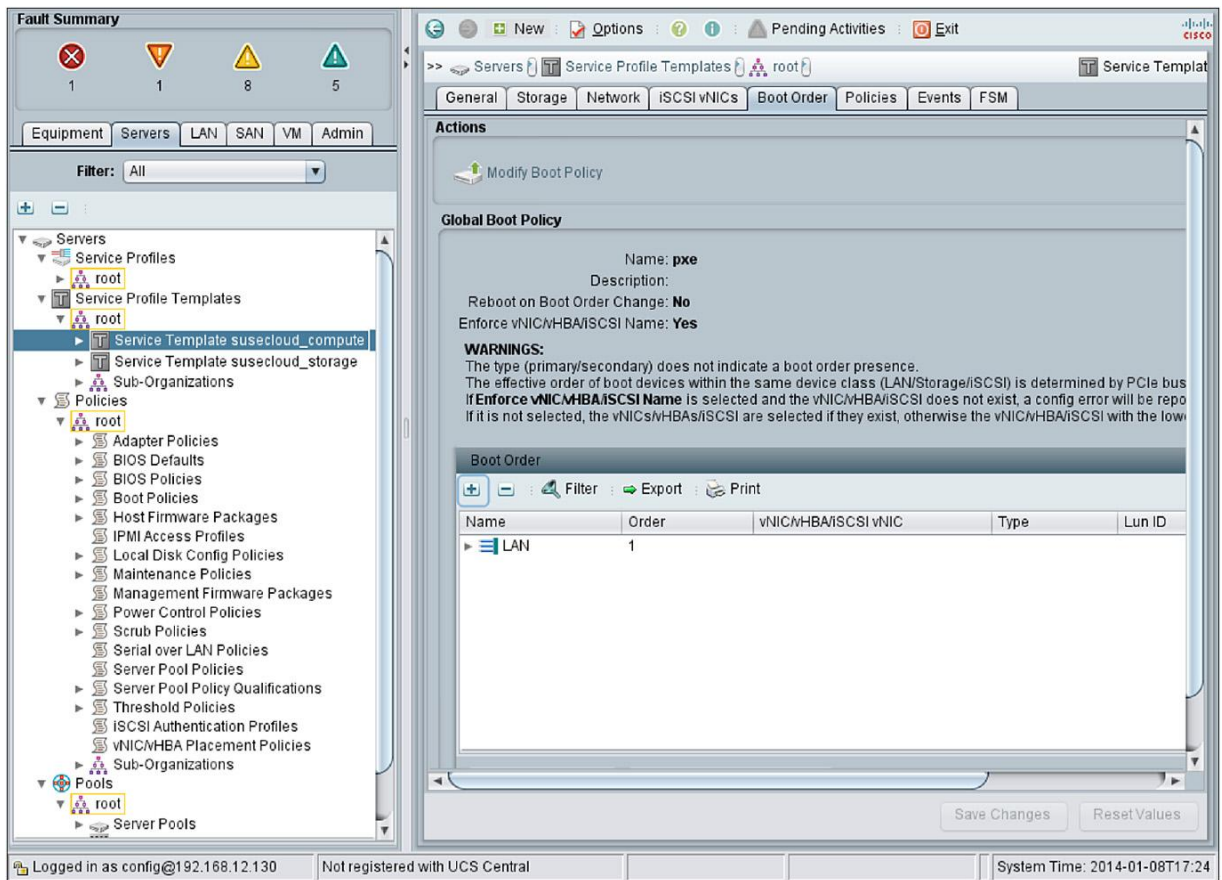
This unique integration module is delivered with the SUSE Cloud product completely integrated with the SUSE Administration Server web interface and ready to use. The only necessary configuration action on the SUSE Cloud side that you need to take is to provide the URL of the Cisco UCS Manager API and the login credentials (Figure 8).

Figure 8.   SUSE Cloud and Cisco UCS Manager Integration

At this point, you will be presented with a list of the available Cisco UCS nodes and can associate each node with either of the respective service profiles (Figure 9).

Figure 9.   SUSE Cloud and Cisco UCS Manager Association

After the selection has been made and applied, the node will proceed through the setup and configuration steps as directed by Cisco UCS Manager and the selected service profile, and it will then PXE boot to the administration server as a fully discovered node, ready to be associated and integrated into the SUSE Cloud instance.

Another notable integration point is a direct result of collaboration between Cisco and SUSE both as business partners and through their collective work on the OpenStack project: the capability to control devices through software-defined networking (SDN) modules. Cisco Nexus plug-ins are provided in the OpenStack Networking (or Neutron) component and included as a main feature in SUSE Cloud, which enables transparent support across the Cisco Nexus product line for Layer 2 and Layer 3 networking services (Figure 10).

Figure 10.   SUSE Cloud and Cisco Nexus Integration

Using this plug-in with the Cisco Nexus Family of switches, you can segment networks through VLAN or Generic Routing Encapsulation (GRE) tunnels as overlays on top of the OVS layer. In the VLAN mode, ports and host configurations can be managed across multiple switches and for multiple hosts per switch. Over time, this feature will become increasingly valuable, providing a way to manage the network complexity inherent in private cloud deployments.

Conclusion

Using best-in-class offerings from Cisco and SUSE, you can quickly and confidently deploy a production-ready, enterprise-class private cloud instance. In addition to the core components of such a solution, the unique integration points included in this Cisco and SUSE Cloud solution provide more functions by building on the core value propositions of both companies, effectively differentiating this solution from other combinations. By adopting this solution, your business can increase its IT services deployment agility and increase the ROI for infrastructure expenditures, and the automation inherent in the solution can free time to allow you to spend more time focusing on other initiatives.

For More Information

Both Cisco and SUSE can provide further guidance, training, support, and services for more sophisticated deployments than described in this document. You should also consult the respective product manuals for each of the components to learn more about the products described and refer to the following websites for additional information:

- Cisco and OpenStack: http://www.cisco.com/go/openstack
- Cisco UCS: http://www.cisco.com/go/ucs
- Cisco UCS Manager: http://www.cisco.com/go/ucsm
- Cisco cloud computing solutions: http://www.cisco.com/go/cloud
- Cisco UCS Solution Accelerator Paks for OpenStack: http://www.cisco.com/web/solutions/openstack/le_sb_open.pdf
- SUSE: https://www.suse.com/
- SUSE Cloud: https://www.suse.com/products/suse-cloud/
- SUSE Studio Onsite: https://www.suse.com/products/susestudio/
- SUSE Manager: https://www.suse.com/products/suse-manager/

If you already have access to the necessary Cisco networking and Cisco UCS products, you can evaluate the SUSE Cloud software solution. Download the SUSE software from https://www.suse.com/download-linux/. For the evaluation, you are encouraged to use the default configurations for easier setup and installation.