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Lab Guidance

Note: It will take more than 90 minutes to complete this lab. You should expect to only finish 2-3 of the modules during your time. The modules are independent of each other so you can start at the beginning of any module and proceed from there. You can use the Table of Contents to access any module of your choosing.

The Table of Contents can be accessed in the upper right-hand corner of the Lab Manual.

This Hands on Lab will help users:

- Learn about the IP Multimedia Subsystem (IMS) and Session Border Controller (SBC) service functions, value of virtualizing IMS and SBC functions for core mobile network service delivery on the VMware vCloud NFV Platform using VMware integrated OpenStack.
- Learn how to deploy VMware Integrated OpenStack version 2.5.1.
- Upgrade VMware Integrated OpenStack 3.1.
- Deploy the Metaswitch Clearwater virtual IMS and SBC core network function.
- Learn about the operational tools and capabilities available in vRealize Operations, vRealize Network Insight and Metaswitch Metaview to manage a virtual IMS network function.

Lab Module List:

- **Module 1: An Introduction to the IP Multimedia Subsystem (IMS) network function and Network Function Virtualization.** (15 minutes) (Basic) This module will introduce the IP Multimedia Subsystem (IMS) and Session Border Controller (SBC) Network Functions, why Service Providers deploy IMS and the value of virtualizing IMS and SBC functions for core mobile network service delivery.
- **Module 2: VMware Integrated OpenStack Deployment** (15 minutes) (Intermediate) This module will guide users through the steps required to deploy VMware Integrated OpenStack version 2.5.1.
- **Module 3: Upgrading VMware Integrated OpenStack** (15 minutes) (Intermediate) This module will guide users through the steps required to upgrade VMware Integrated OpenStack from ver. 2.5.1 to 3.1.
- **Module 4: Metaswitch vIMS and vSBC Deployment** (15 minutes) (Intermediate) This module will guide users through the steps required to deploy the Metaswitch Clearwater vIMS and Metaswitch Perimeta vSBC network functions through VMware Integrated OpenStack on the VMware vCloud NFV platform.
• **Module 5: Operational Tools for Managing vIMS and vSBC deployments** (15 minutes) (Intermediate) This module will guide users through a series of tools and capabilities available in VMware vRealize Operations, vRealize Network Insight and Metaswitch Metaview.

**Lab Captains:**

- Module 1 - Neil Moore, Staff NFV Solutions Architect, United States
- Module 2 - Neil Moore, Staff NFV Solutions Architect, United States
- Module 3 - Neil Moore, Staff NFV Solutions Architect, United States
- Module 4 - Neil Moore, Staff NFV Solutions Architect, United States
- Module 5 - Neil Moore, Staff NFV Solutions Architect, United States

This lab manual can be downloaded from the Hands-on Labs Document site found here: [http://docs.hol.vmware.com](http://docs.hol.vmware.com)

This lab may be available in other languages. To set your language preference and have a localized manual deployed with your lab, you may utilize this document to help guide you through the process:

Location of the Main Console

1. The area in the RED box contains the Main Console. The Lab Manual is on the tab to the Right of the Main Console.
2. A particular lab may have additional consoles found on separate tabs in the upper left. You will be directed to open another specific console if needed.
3. Your lab starts with 90 minutes on the timer. The lab can not be saved. All your work must be done during the lab session. But you can click the EXTEND to increase your time. If you are at a VMware event, you can extend your lab time twice, for up to 30 minutes. Each click gives you an additional 15 minutes. Outside of VMware events, you can extend your lab time up to 9 hours and 30 minutes. Each click gives you an additional hour.

Alternate Methods of Keyboard Data Entry

During this module, you will input text into the Main Console. Besides directly typing it in, there are two very helpful methods of entering data which make it easier to enter complex data.
Click and Drag Lab Manual Content Into Console Active Window

You can also click and drag text and Command Line Interface (CLI) commands directly from the Lab Manual into the active window in the Main Console.

Accessing the Online International Keyboard

You can also use the Online International Keyboard found in the Main Console.

1. Click on the Keyboard Icon found on the Windows Quick Launch Task Bar.
Click once in active console window

In this example, you will use the Online Keyboard to enter the "@" sign used in email addresses. The "@" sign is Shift-2 on US keyboard layouts.

1. Click once in the active console window.
2. Click on the \textbf{Shift} key.

Click on the \texttt{@} key

1. Click on the \texttt{"@ key"}.

Notice the @ sign entered in the active console window.
Activation Prompt or Watermark

When you first start your lab, you may notice a watermark on the desktop indicating that Windows is not activated.

One of the major benefits of virtualization is that virtual machines can be moved and run on any platform. The Hands-on Labs utilizes this benefit and we are able to run the labs out of multiple datacenters. However, these datacenters may not have identical processors, which triggers a Microsoft activation check through the Internet.

Rest assured, VMware and the Hands-on Labs are in full compliance with Microsoft licensing requirements. The lab that you are using is a self-contained pod and does not have full access to the Internet, which is required for Windows to verify the activation. Without full access to the Internet, this automated process fails and you see this watermark.

This cosmetic issue has no effect on your lab.

Look at the lower right portion of the screen
Please check to see that your lab is finished all the startup routines and is ready for you to start. If you see anything other than "Ready", please wait a few minutes. If after 5 minutes your lab has not changed to "Ready", please ask for assistance.
Module 1 - Introduction to the IP Multimedia Subsystem (IMS) (15 Minutes)
An Introduction to the IP Multimedia Subsystem (IMS) network function and The VMware NFV Infrastructure Platform

The IP Multimedia Subsystem (IMS) is an architectural framework for delivering IP multimedia services. IMS was originally developed by a group of telecommunications associations, working in collaboration as part of the 3G partnership project (3GPP) to evolve mobile architecture specifications toward 3rd generation mobile networks. The IMS architectural framework was designed specifically to transition mobile voice services from circuit switched networks to Internet Protocol (IP) packet switched networks.

IMS is responsible for signaling and control functions for multimedia services including voice, video and data. The IMS architecture is made up of 3 primary functions P-CSCF, I-CSCF and S-CSCF. The IMS specification standardized on using IETF based protocols. One of those protocols is: Session Initiation Protocol (SIP). IMS uses SIP for call signaling and control. SIP is a key enabler to standardizing call signaling and control access across both wireline and wireless networks.

IMS Architecture

The diagram above shows a high-level view of the IMS architecture.
Since IMS was meant to standardize access to the applications providing multimedia services and not the applications themselves, the IMS signaling and control architecture is specified as an independent layer. Both application and transport layers are independent of the IMS signaling and control layer.

3GPP IMS Architectural Overview

The diagram above shows the layered approach as defined by 3GPP.

3GPP IMS Architectural Overview

The IMS signaling and control layer is a perfect layer to virtualize. The IMS layer functions Proxy-Call Server Control Function (P-CSCF), Interrogating Call Server Control Function (I-CSCF), Serving Call Server Control Function (S-CSCF) are relatively easy to virtualize, unlike the transport layer and several vendors including Metaswitch, have
built scalable virtual IMS network functions that run extremely well on NFV infrastructure platforms like the VMware vCloud NFV infrastructure platform.

Part of this lab will focus on the deployment of a Session Border Controller (SBC). A session border controller isn’t part of the IMS specification. However, IMS does have functions for handing both signaling and media control at access and interconnect points. These functions are called something different for both mobile networks and wireline networks. In mobile networks, the Access-Border Gateway Function (A-BGF) or Core Border Gateway Function (C-BGF) functions are responsible for access and the IMS Interconnection Border Gateway Function (I-BGF) or Transition Gateway (TrGW) functions are responsible for interconnect. For wireline networks, the IMS P-CSCF function is responsible for access and the IMS IBCF function is responsible for interconnect. Telecoms & Internet converged Services & Protocols for Advanced Networks (TISPAN) is a wireline IMS architecture standardized by European Telecommunications Standards Institute (ETSI) as an extension to the IMS specification.

**Architecture continued**

A Session Border Controller (SBC) provides equivalent signaling and media control functions for IMS access and interconnect. An SBC handles the signaling and media stream control functions involved in setting up, managing and tearing down voice calls and other interactive media communications. Session refers to the signaling function, ‘border’ refers to the access gateway and interconnect function and ‘controller’ refers to the session control function of the SBC.

So why include an SBC in this lab if it only replicates the functions already defined in current 3GPP IMS (mobile) and ETSI-TISPAN IMS (wireline) architecture specifications? Because an SBC provides greater functionality, than the functions currently defined in both mobile and wireline specifications. According to Metaswitch, an SBC can also provide:

- **Interoperability modifications to signaling and media**: This is essential for IMS deployment. Despite IMS doing a good job of pulling together the various SIP standards into a consistent profile, the reality of deploying a network is that you will need to interoperate with legacy SIP devices that don’t follow the IMS standards precisely. Even for devices that do support the IMS standards, the question then becomes “which release”. 3GPP are now standardizing rel-13 (as well as continuing to evolve earlier releases).
- **Transcoding**: IMS is supposed to provide unified services for mobile and fixed line devices. However those devices operate in different environments, with different requirements. Take ‘high-definition’ audio. Fixed line devices generally opt for G.722 as there are no codec patent royalties to pay, they have sufficient quality bandwidth and don’t have to worry about battery life. Whereas mobile devices tend to use Adaptive Multi-Rate Wideband (AMR-WB) as it provides better quality of experience in mobile devices, and the patent costs are dwarfed by the cost of
the device itself. However if a mobile calls a fixed-line some device somewhere needs to transcode for them, and the SBC at the edge of the network is a great place if you want to avoid backhauling media into the core.

- **Lawful Intercept**: Lawful Intercept is a regulatory requirement. While IMS does define some of the interfaces between the core and the Law Enforcement Agency, the breakdown of functions within the core is not well defined. An SBC with proven interoperability for lawful intercept functions in non-IMS networks, deployed at the border of the network with access to both signaling and media is a logical place to perform this function.

- **Security**: DoS prevention, rogue device identification, per-flow policing are important. IMS has a fairly substantial security framework for securing access to the network. This includes dynamic IPSec (or more recently Transport Layer Security) connections to each IMS user, which provides excellent identification and authorization. However it doesn’t address how to protect against Denial of Service attacks, whether malicious or accidental, which are the bread and butter of SBCs.

As well as a couple other additional features that support wireline deployments:

- IP network bridging
- Private Branch Exchange (PBX) connection in IMS

While there are other functional elements in the IMS network architecture that can provide some of these capabilities, very few implementations based on the individual components exist today in Service Provider networks. Managing these functions individually creates a great deal of complexity. As a result, almost every IMS deployment today features an SBC to provide some of the functions above. The addition of an SBC reduces complexity and provide greater functionality than the standardized set of IMS architecture components.

For this lab, we are using both Metaswitch Clearwater IMS core and Metaswitch Perimeta SBC virtual network functions combined to deliver an IMS multimedia signaling and control solution that can be deployed by both mobile and wireline Service Providers to deliver fixed-mobile converged multimedia services.
Value of Virtualizing

The Value of Virtualizing Network Functions such as IMS and SBC

Service Providers today are rapidly embracing Network Function Virtualization (NFV) platforms to virtualize both mobile and wireline functions. Mobile network functions such as IMS, Evolved Packet Core (EPC) and various GiLAN functions for packet processing such as Firewall (FW), Dynamic Packet Inspection (DPI) and Network Address Translation (NAT) are ideal for virtualization. While common Wireline functions such as Core Routing, Route Reflectors, Customer Premise (Routers) Equipment (CPE), SBC, FW, DPI, DNS and NAT are ideal candidates for virtualization.

The value of NFV to Service Providers is three fold:

- Decrease the operational cost associated with Physical (appliance) Network Functions.
- Improve Operational Agility. Faster time to service deployment and re-configuration.
Monetize new differentiating services with rapid time to market.

By virtualizing network functions, Service Providers can combine multiple unique functions to build new differentiating services faster, operational tasks such as scaling and capacity planning are more efficient and services can be deployed in market faster than with traditional non-virtualized appliance based network functions. Virtualized service deployment and reconfiguration can be done in hours, rather than days using physical appliance based network functions.

The diagram above shows how an SBC can be combined with IMS to deliver fixed-mobile convergence services. There are two interface points that SBC plays a role. One is the User Network Interface (UNI) and the other is the Network-Network Interface (NNI).

In order to virtualize network functions, service providers need a NFV infrastructure platform that provides virtual compute, virtual networking and software defined storage infrastructure resources to vIMS and vSBC applications. A rich Operations toolset for managing vIMS and vSBC resources and a carrier grade Virtual Infrastructure Manager (VIM) are also required for successful production deployment and resource management.

The value of deploying a Common NFV Infrastructure platform
Initial Virtual Network Function (VNF) deployments were purpose built on vertical stacks, hosting only one function per stack. Each stack contained optimized hardware, storage, compute virtualization software, operations management software and a single VNF. The vertical stack was designed around and optimized for the VNF.

While vertical VNF stacks enabled Service Providers to scale network functions more efficiently and helped to lower cost by offering COTS based hardware options, they also protected vendor leverage and prevented the full utilization of hardware across functions. This significantly limited the cost reduction potential of virtualization.

The diagram above shows the evolution of NFV platforms, from appliance to vertical stack to the prevailing Common Platform Approach.

In 2014, VMware developed a new “Common NFV Infrastructure Platform Approach” for the Service Provider market called vCloud NFV. The VMware vCloud NFV Infrastructure platform is a “common” NFV infrastructure for hosting multi-vendor VNFs and delivering multi-domain services. COTS hardware could now be utilized across VNFs and since vCloud NFV provided a consistent vendor-neutral platform foundation for hosting any and all applications, applications could now be easily decoupled from the underlying resource infrastructure and supporting software.

The Common Platform Approach increased the value of NFV by making applications easy to remove and replace, thereby reducing vendor leverage and motivating VNF vendors to lower the cost of their VNFs. The Common Platform approach also enabled the use of COTS hardware resource sharing across all VNFs hosted on the platform and provided a single operational model for managing all VNFs.

The vCloud NFV Common Platform is helping Service Providers realize the value of virtualizing network functions by lowering operational costs and increasing operational efficiency and agility, also lowering applications cost by making applications more portable and lowering hardware costs by improving resource utilization.

To enable the full value of NFV, Service Providers must implement a VIM. A VIM is responsible for controlling and managing NFV infrastructure resources and providing platform multi-tenancy capabilities. The VMware vCloud NFV Infrastructure platform current supports two carrier grade VIM options:

1. vCloud Director
2. VMware Integrated OpenStack (VIO)

For this lab, we have chosen to use VIO. Metaswitch Clearwater IMS core services applications and Metaswitch Perimeta SBC application will be deployed onto the vCloud NFV platform, through the VMware Integrated OpenStack VIM.
A Carrier Grade OpenStack VIM: VMware Integrated OpenStack (VIO)

VMware Integrated OpenStack is a production-grade OpenStack distribution that is integrated with the vCloud NFV platform. VMware OpenStack provides vendor-neutral, DefCore compliant OpenStack APIs for managing NFV infrastructure resources. VMware OpenStack also offers complete support for OpenStack services: Nova, Neutron, Cinder, Glance, Horizon, Keystone, Ceilometer and Heat.

With rich points of integration into the VMware vCloud NFV Infrastructure platform, VIO OpenStack deployments can take advantage of the vRealize Operations toolset for resource planning, visibility and troubleshooting and the advanced networking and security capabilities of NSX.

VMware OpenStack can be deployed easily from a vSphere web client, runs as a VM and can be upgraded without impacting the ESXi hypervisor. VIO also supports Heat Templates to automate the deployment of OpenStack resources.

In this lab, you will use VMware VIO to deploy OpenStack, upgrade OpenStack and deploy a heat template to create a stack for the Metaswitch IMS and SBC application deployment.

Summary

IMS is an architectural framework for delivering IP multimedia services. IMS signaling and control functions play a critical role in both mobile and wireline multimedia services. A SBC provides additional functional value in IMS deployments, while also enabling fixed-mobile convergence services.

Significant economic value can be realized by virtualizing IMS and SBC functions on a Common NFV Infrastructure Platform. The ability to deploy multi-vendor VNFs on a single platform that can provide shared virtual compute, network and storage resources and offers a rich operational toolkit, can significantly lower both CapEX and Operational costs, increase service agility and help Service Providers monetize new differentiating services faster.

The key to successful production NFV deployments is selecting and deploying a mature and robust VIM to manage NFV infrastructure resources. VMware Integrated OpenStack combines the maturity and rich feature set of the VMware vCloud NFV platform with a DefCore compliant distribution of OpenStack. With vCloud NFV and VIO, Service Providers can expect to achieve carrier grade availability, functionality and manageability, in their OpenStack deployments.
By combining the VMware vCloud NFV Infrastructure platform with Metaswitch vIMS and vSBC virtual network function applications, Service Providers can successfully deliver production multimedia services with unmatched scalability, availability, functionality and operational efficiency. With over 70 Service Provider production deployments, VMware and Metaswitch have demonstrated the ability to deliver carrier grade multimedia services to several hundred million subscribers globally.
Module 2 - VMware Integrated OpenStack Deployment (15 minutes)
Introduction

VMware Integrated OpenStack (VIO) consists of OpenStack code preconfigured to use the VMware OpenStack drivers, and the tools required to install, upgrade, and operate an OpenStack cloud on top of VMware technologies. VMware Integrated OpenStack is very easy to install. In this module we will walk through the steps to deploy VIO version 2.5.1 on top of the VMware vCloud NFVI platform.

In this lab to make it simple we have uploaded the VIO Open Virtualization Format (OVA) file and pre-deployed the VIO appliance for you. The management server is thus ready for deploying VIO through the vSphere web client.

For this lab and subsequent modules, we will be using Hands-on Labs Interactive Simulations.
Hands-on Labs Interactive Simulation: VMware Integrated OpenStack Deployment

This part of the lab is presented as a **Hands-on Labs Interactive Simulation**. This will allow you to experience steps which are too time-consuming or resource intensive to do live in the lab environment. In this simulation, you can use the software interface as if you are interacting with a live environment.

1. [Click here to open the interactive simulation](#). It will open in a new browser window or tab.
2. When finished, click the “Return to the lab” link to continue with this lab.
Module 3 - Upgrading VMware Integrated OpenStack (15 Minutes)
Introduction

Disruptive upgrades continue to be one of the biggest challenges with other 3rd party distributions of OpenStack. Seamlessly upgrading to a higher release without service impact, is an important telco requirement. VMware Integrated OpenStack runs as a virtual machine, offers 3 version backward compatibility with ESX hypervisor software releases and therefore, is capable of being upgraded without requiring upgrades to the ESX hypervisor.

For this lab and subsequent modules, we will be using Hands-on Labs Interactive Simulations.
Hands-on Labs Interactive Simulation: Upgrading VMware Integrated OpenStack

This part of the lab is presented as a Hands-on Labs Interactive Simulation. This will allow you to experience steps which are too time-consuming or resource intensive to do live in the lab environment. In this simulation, you can use the software interface as if you are interacting with a live environment.

1. Click here to open the Interactive Simulation, It will open a new browser window or tab
2. When finished, Click the "Return to the lab" link in the upper right portion of the window
Conclusion

By completing this lab you have seen how VIO can be upgraded on vCloud NFV without service impact. We will now move into module 4 and deploy the IMS and SBC components.

You've finished Module 3

Congratulations on completing Module 3.

If you are looking for additional information on [subject], try one of these:

- Click on this link
- Or go to http://tinyurl.com/nx5qxca
- Or use your smart device to scan the QRC Code.

Proceed to any module below which interests you most. [Add any custom/optional information for your lab manual.]

- Module 4 - Title (XX minutes) (Basic/Advanced) Replace Text with Module 3 Description.

How to End Lab

To end your lab click on the END button.
Instructions (Not to copied into actual HOL manual)

• The additional information is optional but recommended per the module topic. Use the 3 methods to offer easy access now and later to your material. After copying the QRC code in as a picture resize by dragging the corners to reduce the overall size.
• Place a hyperlink for each module pointing to the beginning of each module in the manual. Instructions can be found in the Lab Guide.
Module 4 - Metaswitch vIMS and vSBC Deployment (15 Minutes)
Introduction

This module will guide users through the steps required to deploy the Metaswitch Clearwater vIMS and Metaswitch Perimeta vSBC network functions through VMware Integrated OpenStack on the VMware vCloud NFV platform.

For this lab and subsequent modules, we will be using Hands-on Labs Interactive Simulations.
Hands-on Labs Interactive Simulation: Metaswitch vIMS and vSBC Deployment

This part of the lab is presented as a Hands-on Labs Interactive Simulation. This will allow you to experience steps which are too time-consuming or resource intensive to do live in the lab environment. In this simulation, you can use the software interface as if you are interacting with a live environment.

1. Click here to open the Interactive Simulation. It will open a new browser window or tab
2. When finished, Click the "Return to the lab" link in the upper right portion of the window
Conclusion

In this lab you have seen how VNFs can be on-boarded on the VMware vCloud NFV platform. We have shown how the VNFs from MetaSwitch and OpenSource Clearwater IMS VNFs can be deployed using OpenStack heat templates. Once deployed we have shown how seamlessly the various configuration, provisioning of resources, dependency and interdependency is automatically built between the VNFs and they are activated for providing service. Once the VNF’s are ready for service subscribers are added and the system is ready for call processing. We will learn about how to make 4G voice calls in this setup and troubleshoot if a problem occurs in the next Module.

You've finished Module 4

Congratulations on completing Module 4.

If you are looking for additional information on [subject], try one of these:

• Click on this link
• Or go to http://tinyurl.com/nx5qxca
• Or use your smart device to scan the QRC Code.

Proceed to any module below which interests you most. [Add any custom/optional information for your lab manual.]

• **Module 5 - Title** (XX minutes) (Basic/Advanced) Replace Text with Module 5 Description.
How to End Lab

To end your lab click on the **END** button.
Module 5 - Operational Tools for Managing vIMS and vSBC deployments (15 minutes)
Introduction

Network Function Virtualization (NFV) helps to virtualize both mobile and wireline functions. NFV helps Service Providers to decrease the operational cost, improve Operational Agility, Faster time to service deployment and re-configuration. Virtual Network Functions (VNFs) that are required to deploy a virtual IP Multimedia Subsystem (vIMS) along with a virtual Session Border Controller (vSBC) have been deployed using VMware Integrated OpenStack (VIO) as Virtual Infrastructure Manager (VIM) on a VMware vCloud NFV platform. Subscribers have been pre-provisioned in the system, service activation has been done and the VNFs are ready to provide call processing and multi-media services.

For this lab and subsequent modules, we will be using Hands-on Labs Interactive Simulations.
Hands-on Labs Interactive Simulation: Operational Tools for Managing vIMS and vSBC Deployments

This part of the lab is presented as a **Hands-on Labs Interactive Simulation**. This will allow you to experience steps which are too time-consuming or resource intensive to do live in the lab environment. In this simulation, you can use the software interface as if you are interacting with a live environment.

1. **Click here to open the Interactive Simulation**, It will open a new browser window or tab
2. When finished, Click the "Return to the lab" link in the upper right portion of the window
Conclusion

In this module we have learned how to use VRNI for troubleshooting purpose.

Overall we started out with a high level view on what vIMS is and how it works on the VMware vCloud NFV platform. We used VMware Integrated OpenStack (VIO) as the VIM of Choice. We were able to show how VIO can be seamlessly upgraded from one release to another on the VMware vCloud NFV platform. We then on-boarded Virtual Network Functions from Metaswitch. We made VoLTE calls between two parties. We then walked through different operations, management and troubleshooting tools to show the NFV solution offered by VMware is Stable, Open and will meet the needs of communications service provider. This common platform architecture platform can be used for Access, transport or Core networks. It can be used for Wireline, Wireless, Content data and Software Defined Wide Area Networks.
Conclusion

Thank you for participating in the VMware Hands-on Labs. Be sure to visit http://hol.vmware.com/ to continue your lab experience online.

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