CHAPTER 3

ASR Router and Nexus Switch Configuration

This section provides a configuration guide for the Cisco ASR 9001 Router and Cisco Nexus 9396PX Switch relative to the VMS Pod. It includes configuration snippets for access, management, and interface configuration designed to provide the minimum necessary configuration to bring up the VMS Top of Rack Router and Switch.

This section is not designed as a comprehensive best-practice configuration guide.

Logical Network Topology

This section provides a high-level overview of the physical and logical network design, inclusive of the VLAN topology connecting the UCS, Switch, and Router. This understanding is important for use in configuring the Top of Rack Cisco ASR 9001 Router and Cisco Nexus 9300 Series Switch in support of the VMS Pod.

Figure 3-1 shows the high-level network overview of the VMS Pod. All UCS connect to the Nexus 9300 Series Switch while the ISR CPE’s connect to the VMS via an external network, whether locally connected via a switch, or across the Internet. A DHCP Server may be required to provide an IP Address to the ISR CPE’s.

As can be seen in Table 3-1 and Figure 3-2, the various networks used by VMS are grouped into Management and External (public) networks. The networks identified have specific purposes. For obvious security reasons, the Management networks should be kept separated from the External networks. While there are numerous methods to accomplish secure separation between Management and External networks, for purposes of simplicity this VMS Pod Guide has designated the Cisco Nexus 9300 Series Switch responsible for all Layer 2 forwarding while the Cisco ASR 9001 Router is responsible for all Layer 3 forwarding and routing. Therefore the Management networks will be kept separate from the External networks by using two VRF instances on the Top of Rack ASR 9001 Router as shown in Figure 3-3.

The information in Table 3-1 will be used during the configuration of the Top of Rack ASR 9001 Router and Nexus 9300 Series Switch and will be requested during the OpenStack, Cloud Foundry and VMS installation procedures. As such, it is recommended that the network administrator create a reference matrix similar to Table 3-1 with the VLAN IDs, subnets, and VRF names to be used. While all information in the Table may be changed as desired by the network administrator it is highly recommended that the VLAN Names (currently named to easily associate their purpose in configuration and troubleshooting) and Subnet Masks (as presently sized) should not be changed.

Note

The external facing subnets (orch-internet, vnf-outside, and vnf-internet) should be assigned from public IP address space if testing Portal reachability or CPE connectivity from the Internet.
Table 3-1  VLANs, Subnets, and VRFs

### VLAN Group 1: VMS External Facing Networks

<table>
<thead>
<tr>
<th>Network</th>
<th>VLAN Name</th>
<th>VLAN ID Example</th>
<th>IP Subnet / Mask Example</th>
<th>VRF Name Example</th>
<th>Referenced by Installers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet Orchestration</td>
<td>orch-internet</td>
<td>101</td>
<td>11.17.1.0 /24</td>
<td>external</td>
<td>Yes</td>
</tr>
<tr>
<td>VNF WAN</td>
<td>vnf-outside</td>
<td>102</td>
<td>11.17.16.0 /20</td>
<td>external</td>
<td>Yes</td>
</tr>
<tr>
<td>VNF Internet</td>
<td>vnf-internet</td>
<td>103</td>
<td>11.17.32.0 /20</td>
<td>external</td>
<td>Yes</td>
</tr>
<tr>
<td>Public</td>
<td>public</td>
<td>150</td>
<td>11.17.0.0 /30</td>
<td>external</td>
<td>No</td>
</tr>
</tbody>
</table>

### VLAN Group 2: VMS Management Networks

<table>
<thead>
<tr>
<th>Network</th>
<th>VLAN Name</th>
<th>VLAN ID Example</th>
<th>IP Subnet / Mask Example</th>
<th>VRF Name Example</th>
<th>Referenced by Installers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco UCS CIMC Mgmt</td>
<td>cimc-mgmt</td>
<td>200</td>
<td>10.10.1.0 /24</td>
<td>vms_mgmt</td>
<td>Yes</td>
</tr>
<tr>
<td>PXE / OpenStack Mgmt</td>
<td>pxe-osmgmt</td>
<td>201</td>
<td>10.20.0.0 /20</td>
<td>vms_mgmt</td>
<td>Yes</td>
</tr>
<tr>
<td>Applications Mgmt</td>
<td>app-mgmt</td>
<td>202</td>
<td>10.10.2.0 /24</td>
<td>vms_mgmt</td>
<td>Yes</td>
</tr>
<tr>
<td>Orchestration Mgmt</td>
<td>orch-mgmt</td>
<td>203</td>
<td>10.10.3.0 /24</td>
<td>vms_mgmt</td>
<td>Yes</td>
</tr>
<tr>
<td>VNF Management</td>
<td>vnf-mgmt</td>
<td>204</td>
<td>10.20.16.0 /20</td>
<td>vms_mgmt</td>
<td>Yes</td>
</tr>
</tbody>
</table>

ESC creates host mapping pools for each of the compute nodes for the three vnf-xxx networks. These pools are at least 80 addresses, and are not configurable, therefore the vnf-xxx networks are required to be larger than a /24. A /20 is therefore recommended.

A DHCP Server will need to be provided for the 1941 ISR CPE’s to retrieve their IP Address.

As seen when cabling the UCS Servers, and shown in Figure 3-2, each UCS has 5 cabled interfaces - one CIMC, two one-Gigabit Ethernet, and two ten-Gigabit Ethernet interfaces. The first 1GE interface on each UCS is dedicated to the PXE installation. With the exception of the MaaS/Bootstrap server, the
second 1GE interface is for the OpenStack management after installation. The two 10G interfaces are bundled with 802.1ad for redundancy and encapsulated with 802.1Q for transport of the multiple networks. The MaaS/Bootstrap server is dedicated for the bring up and installation of the system.

The 2nd 1GE interface on the MaaS/Bootstrap server is connected to the public network for the purpose of downloading the OpenStack software as well as related Cloud Foundry and VMS packages.

**Figure 3-2 VMS Pod Logical Connectivity**

Note

IMPORTANT—The MaaS GE-2 interface requires connectivity to the public network for retrieving the OpenStack software and packages used in deploying the OpenStack nodes. Figure 3-2 shows just one option for connecting the MaaS GE-2 interface to the public network.

### Cisco ASR 9001

This section provides the basic configuration necessary to enable the Cisco ASR 9001 Router in the VMS Pod. It is expected that the user has prior experience with Cisco IOS-XR Command Line Interface.

**Figure 3-3 ASR 9001 VRFs**
The ASR 9001 configuration actually has three (3) VRFs: one for ASR 9001 management (mgmt); one for VMS management (vms_mgmt); and one for external networks (external) as seen in Figure 3-3. Special care must be taken in the configuration of the Cisco ASR 9001 Router to ensure there is no leakage between the two groups of VLANs (Internal Facing VMS Management VLANs versus External Facing VLANs).

### ASR 9001 Configuration Management

Three primary commands will be helpful as you enter and terminate configuration mode, as well as commit the configuration changes. Recognize that any changes made to the configuration of an IOS-XR platform, such as the ASR 9001, do not become active until committed using the “commit” command.

Each of these three commands has defaults and optional parameters.

- **Configure**—To enter global configuration mode or administration configuration mode, use the configure command in EXEC or administration mode.
- **Commit**—To commit the target configuration to the active (running) configuration, use the commit command in any configuration mode.
- **End**—To terminate a configuration session and return directly to EXEC or administration EXEC, use the end command in any configuration mode.

Refer to the Configuration Management Commands, document for command defaults, parameters, and detailed explanations.

### ASR 9001 Management and Access

This section provides configuration guidance for configuring the ASR 9001 management access, including naming the router, configuring the clock, access authentication, console, management Ethernet, and some protocol configuration commands.

Note that this section contains guidelines and configuration snippets, and does not include every potential configuration option. Cisco has many guides available for further configuration. Refer to Chapter B, “Reference Documentation”.

Once the following configuration – with IP addresses, subnets, and network masks modified appropriate to the installation network – has been applied you should be able to connect to the ASR 9001 for remote management.

#### Table 3-2 ASR 9001 Management Access Configuration

<table>
<thead>
<tr>
<th>Configuration Section</th>
<th>Configuration Snippet Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hostname &amp; Clock</td>
<td>hostname ASR9K-1</td>
</tr>
<tr>
<td></td>
<td>clock timezone EST -5</td>
</tr>
<tr>
<td></td>
<td>clock summer-time EDT recurring</td>
</tr>
<tr>
<td></td>
<td>clock set 18:25:00 EDT August 15, 2015</td>
</tr>
<tr>
<td>Local Authentication</td>
<td>username vmsadmin</td>
</tr>
<tr>
<td></td>
<td>group sysadmin</td>
</tr>
<tr>
<td></td>
<td>group root-system</td>
</tr>
<tr>
<td></td>
<td>secret 0 ciscovms</td>
</tr>
<tr>
<td></td>
<td>!</td>
</tr>
<tr>
<td></td>
<td>aaa authentication login default local line</td>
</tr>
<tr>
<td></td>
<td>!</td>
</tr>
</tbody>
</table>
This section provides configuration guidance for configuring the ASR 9001 interfaces to support proper inter-communication of the VMS devices as well as separation of VMS Management and External networks. This includes configuration of VRFs, physical Ethernet interfaces, as well as logical bundle interfaces and sub-interfaces.

If external reachability will be required, routing will need to be added to the configuration. The subnets associated with VMS External Facing VLANs in Table 3-3 will need to be distributed, or statically added to the customer Lab Router (ie External Network in Figure 3-1). Likewise, the Routing section below will need to be modified to identify the Customer Lab Router as the next-hop default gateway. The Routing section below includes a sample static routing configuration.
Be sure to modify the various sub-interface IDs, 802.1Q IDs, interface IP address, IP subnets and network masks as appropriate for the installation network as noted in the reference matrix recommended in Table 3-1.

**Table 3-3  ASR 9001 VMS Interfaces**

<table>
<thead>
<tr>
<th>Configuration Section</th>
<th>Configuration Snippet Examples</th>
</tr>
</thead>
</table>
| Interconnection of ASR 9001 Router with Nexus 9300 Series Switch | vrf vms_mgmt  
description VMS Management Interfaces VRF  
address-family ipv4 unicast  
!  
vrf external  
address-family ipv4 unicast  
!  
!  
interface Bundle-Ether1  
description Inter-connection with ToR Nexus Switch  
mtu 9200  
!  
interface Bundle-Ether1.101  
description orch-internet  
vrf external  
ipv4 address 11.17.1.1 255.255.255.0  
encapsulation dot1q 101  
!  
interface Bundle-Ether1.102  
description vnf-outside  
vrf external  
ipv4 address 11.17.16.1 255.255.240.0  
encapsulation dot1q 102  
!  
interface Bundle-Ether1.103  
description vnf-internet  
vrf external  
ipv4 address 11.17.32.1 255.255.240.0  
encapsulation dot1q 103  
!  
interface Bundle-Ether1.150  
description *** Customer Lab Internet Connection ***  
vrf external  
ipv4 address 11.17.0.2 255.255.255.252  
encapsulation dot1q 150  
!  
interface Bundle-Ether1.200  
description cimc-mgmt  
vrf vms_mgmt  
ipv4 address 10.10.1.1 255.255.255.0  
encapsulation dot1q 200  
!  
interface Bundle-Ether1.201  
description pxe-osmgmt  
vrf vms_mgmt  
ipv4 address 10.20.0.1 255.255.240.0  
encapsulation dot1q 201  
!  
interface Bundle-Ether1.202  
description app-mgmt  
vrf vms_mgmt  
ipv4 address 10.10.2.1 255.255.255.0  
encapsulation dot1q 202  
!
Nexus 9396PX

This section provides the basic configuration necessary to enable the Cisco Nexus 9396PX Switch in the VMS Pod. It is expected that the user has prior experience with Cisco NX-OS Command Line Interface.

Nexus 9396PX Management and Access

This section provides configuration guidance for configuring the Nexus 9396PX management access, including naming the switch, configuring the clock, access authentication, console, management Ethernet, and some protocol configuration commands.

Note that this section contains guidelines and configuration snippets, and does not include every potential configuration option. Cisco has many guides available for further configuration. A few document references have been included in the Reference Documents section at the end of this chapter.

Once the following configuration has been applied you should be able to connect to the Nexus 9396PX for remote management.

---

### Table 3-3 ASR 9001 VMS Interfaces (continued)

<table>
<thead>
<tr>
<th>Configuration Section</th>
<th>Configuration Snippet Examples</th>
</tr>
</thead>
</table>
| Interconnection of ASR 9001 Router with Nexus 9300 Series Switch | interface Bundle-Ether1.203  
  description orch-mgmt  
  vrf vms_mgmt  
  ipv4 address 10.10.3.1 255.255.255.0  
  encapsulation dot1q 203  
  !  
  interface Bundle-Ether1.204  
  description vnf-mgmt  
  vrf vms_mgmt  
  ipv4 address 10.20.16.1 255.255.240.0  
  encapsulation dot1q 204  
  !  
  interface TenGigE0/0/2/0  
  description *** To ToR Nexus 9300 Switch Eth 1/45 ***  
  bundle id 1 mode active  
  carrier-delay up 10000 down 0  
  load-interval 30  
  !  
  interface TenGigE0/0/2/1  
  description *** To ToR Nexus 9300 Switch Eth 1/46 ***  
  bundle id 1 mode active  
  carrier-delay up 10000 down 0  
  load-interval 30  
  ! |

Routing Section

router static  
  vrf external  
  address-family ipv4 unicast  
  0.0.0.0/0 11.17.0.1  
  !  
  !  
  vrf vms_mgmt  
  address-family ipv4 unicast  
  !  
  !

---
Nexus 9396PX VMS Interfaces

This section provides configuration guidance for configuring the Nexus 9396PX interfaces to support proper inter-communication of the VMS devices, ASR 9001 and Customer lab external network. This includes configuration of VLANs, physical Ethernet interfaces, and logical port-channel interfaces.
### Table 3-5  Nexus 9396PX VMS Interfaces Configuration

<table>
<thead>
<tr>
<th>Configuration Section</th>
<th>Configuration Snippet Examples</th>
</tr>
</thead>
</table>
| Features, Protocols, and VLANs | feature udld  
feature lacp  
spanning-tree mode mst  
vlan 101-103,150,200-204  
vlan 101  
name orch-internet  
vlan 102  
name vnf-outside  
vlan 103  
name vnf-internet  
vlan 150  
name public  
vlan 200  
name cimc-mgmt  
vlan 201  
name pxosmgmt  
vlan 202  
name app-mgmt  
vlan 203  
name orch-mgmt  
vlan 204  
name vnf-mgmt  
spanning-tree mst configuration  
name vms-pod  
instance 1 vlan 1-4000 |
| Uplink to ASR9k      | interface port-channel1  
description Inter-connection with ToR ASR Router  
switchport mode trunk  
switchport trunk allowed vlan 101-103,150,200-204  
logging event port link-status  
mtu 9216  

interface Ethernet1/45  
description *** To ToR ASR 9001 Te 0/0/2/0 ***  
switchport mode trunk  
logging event port link-status  
channel-group 1 mode active  

interface Ethernet1/46  
description *** To ToR ASR 9001 Te 0/0/2/1 ***  
switchport mode trunk  
logging event port link-status  
channel-group 1 mode active |
| UCS 1G-1 & 1G-2 Interfaces | interface Ethernet1/x  
description UCS 1G-1, 1G-2, pxosmgmt  
switchport mode access  
switchport access vlan 201  
spanning-tree port type edge  
logging event port link-status  
mtu 9216 |
| [Except UCS C220  
MaaS/Bootstrap 1G-2] | N9K Ethernet 1/17,19-32 |
### Table 3-5  Nexus 9396PX VMS Interfaces Configuration (continued)

<table>
<thead>
<tr>
<th>Configuration Section</th>
<th>Configuration Snippet Examples</th>
</tr>
</thead>
</table>
| **UCS C220 MaaS/Bootstrap 1G-2 Interface** | interface Ethernet1/18  
  description UCS C220 MaaS/Bootstrap 1G-2, orch-internet  
  switchport mode access  
  switchport access vlan 101  
  spanning-tree port type edge  
  logging event port link-status  
  mtu 9216 |
| **N9K Ethernet 1/18** | interface Ethernet1/18  
  description UCS C220 MaaS/Bootstrap 1G-2, orch-internet  
  switchport mode access  
  switchport access vlan 101  
  spanning-tree port type edge  
  logging event port link-status  
  mtu 9216 |
| **UCS C220 Intf 10G 1-2** | interface port-channel220z  
  description To UCS C220-z 10Gs  
  switchport mode trunk  
  switchport trunk allowed vlan 101-103,202-204  
  spanning-tree port type edge trunk  
  mtu 9216  
  logging event port link-status |
| **Ethernet 1/x** | interface Ethernet1/x  
  description To UCS C220-z 10G-1  
  switchport mode trunk  
  mtu 9216  
  logging event port link-status  
  channel-group 220z mode active |
| **x = 1, 3, 5, 7, 9** | interface Ethernet1/x  
  description To UCS C220-z 10G-1  
  switchport mode trunk  
  mtu 9216  
  logging event port link-status  
  channel-group 220z mode active |
| **y = 2, 4, 6, 8, 10** | interface Ethernet1/y  
  description To UCS C220-z 10G-2  
  switchport mode trunk  
  mtu 9216  
  logging event port link-status  
  channel-group 220z mode active |
| **z = 1, 2, 3, 4, 5** | interface Ethernet1/y  
  description To UCS C220-z 10G-2  
  switchport mode trunk  
  mtu 9216  
  logging event port link-status  
  channel-group 220z mode active |
| **UCS C240 Intf 10G 1-2** | interface port-channel240z  
  description To UCS C240-z 10Gs  
  switchport mode trunk  
  switchport trunk allowed vlan 101-103,202-204  
  spanning-tree port type edge trunk  
  mtu 9216  
  logging event port link-status |
| **Ethernet 1/x** | interface Ethernet1/x  
  description To UCS C240-z 10G-1  
  switchport mode trunk  
  spanning-tree port type edge trunk  
  mtu 9216  
  logging event port link-status  
  channel-group 240z mode active |
| **x = 11, 13, 15** | interface Ethernet1/x  
  description To UCS C240-z 10G-1  
  switchport mode trunk  
  spanning-tree port type edge trunk  
  mtu 9216  
  logging event port link-status  
  channel-group 240z mode active |
| **y = 12, 14, 16** | interface Ethernet1/y  
  description To UCS C240-z 10G-2  
  switchport mode trunk  
  spanning-tree port type edge trunk  
  mtu 9216  
  logging event port link-status  
  channel-group 240z mode active |
| **z = 1, 2, 3** | interface Ethernet1/y  
  description To UCS C240-z 10G-2  
  switchport mode trunk  
  spanning-tree port type edge trunk  
  mtu 9216  
  logging event port link-status  
  channel-group 240z mode active |
### Table 3-5  Nexus 9396PX VMS Interfaces Configuration (continued)

<table>
<thead>
<tr>
<th>Configuration Section</th>
<th>Configuration Snippet Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCS CIMC Interfaces</td>
<td>interface Ethernet1/x</td>
</tr>
<tr>
<td></td>
<td>description UCS CIMC, cimc-mgmt</td>
</tr>
<tr>
<td></td>
<td>switchport mode access</td>
</tr>
<tr>
<td></td>
<td>switchport access vlan 200</td>
</tr>
<tr>
<td></td>
<td>spanning-tree port type edge</td>
</tr>
<tr>
<td></td>
<td>logging event port link-status</td>
</tr>
<tr>
<td></td>
<td>mtu 9216</td>
</tr>
<tr>
<td>N9K Ethernet 1/33-40</td>
<td></td>
</tr>
<tr>
<td>Uplink to Cust Lab Inf 1/10G</td>
<td>interface port-channel13</td>
</tr>
<tr>
<td></td>
<td>description Interconnection to Customer Lab Router (Internet)</td>
</tr>
<tr>
<td></td>
<td>switchport mode access</td>
</tr>
<tr>
<td></td>
<td>switchport access vlan 150</td>
</tr>
<tr>
<td></td>
<td>spanning-tree port type edge</td>
</tr>
<tr>
<td></td>
<td>spanning-tree bpduguard enable</td>
</tr>
<tr>
<td></td>
<td>spanning-tree bpdufilter enable</td>
</tr>
<tr>
<td></td>
<td>logging event port link-status</td>
</tr>
<tr>
<td></td>
<td>interface Ethernet 1/48</td>
</tr>
<tr>
<td></td>
<td>description *** To Customer Lab Router (Internet) ***</td>
</tr>
<tr>
<td></td>
<td>switchport mode access</td>
</tr>
<tr>
<td></td>
<td>switchport access vlan 150</td>
</tr>
<tr>
<td></td>
<td>channel-group 3 mode active</td>
</tr>
</tbody>
</table>

This table continues the configuration snippets for Nexus 9396PX interfaces, focusing on specific configurations for UCS CIMC Interfaces and Uplink to Cust Lab Inf 1/10G. Each snippet includes key commands and configurations necessary for proper interface management and connectivity in a VMS 2.0 setup.