

# SAPC VNF Network Configuration Guide

Ericsson Service-Aware Policy Controller

USER GUIDE

## **Copyright**

© Ericsson España 2017. All rights reserved. No part of this document may be reproduced in any form without the written permission of the copyright owner.

## **Disclaimer**

The contents of this document are subject to revision without notice due to continued progress in methodology, design and manufacturing. Ericsson shall have no liability for any error or damage of any kind resulting from the use of this document.

## **Trademark List**

All trademarks mentioned herein are the property of their respective owners. These are shown in the document Trademark Information.

## **Abstract**

The purpose of this document is to give detailed information about the network configuration of the SAPC.



# Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
1.1	Document Purpose and Scope	1
<b>2</b>	<b>Overview</b>	<b>3</b>
2.1	Hardware Components	4
2.2	Software Components	5
2.3	Network	7
<b>3</b>	<b>Networks Configuration Solutions</b>	<b>9</b>
3.1	Solution to Define Unique OAM and Traffic Networks	9
3.2	Solution to Define Unique OAM and Multiple Traffic Networks	17





# 1 Introduction

## 1.1 Document Purpose and Scope

This document provides information to define the hardware, software, network components, and network configuration needed to run the SAPC in the supported Cloud environments:

- Ericsson Cloud Execution Environment (CEE)
- VMware vSphere





## 2 Overview

This section provides an overview of the hardware and software components used for the SAPC internal and external networks in a Cloud deployment, as well as a general network description. The Cloud deployment, as one of its intrinsic characteristics, untie the SAPC Node from hardware, therefore all hardware components, and some of the software components are not part of the SAPC Node but the Cloud provided platform.

Even though those components are not part of the SAPC and they are out of the scope of this document, they are briefly described in this chapter to make it more understandable.

From the point of view of network configuration, the following elements must be considered:

### — Hardware components

- Border Gateway, specified as part of the Cloud Infrastructure.
- Compute Hosts on which the virtual machines execute, specified as part of the Cloud Infrastructure.
- Controller Hosts on which the CEE Cloud Infrastructure Controller executes, specified as part of the Cloud Infrastructure for CEE deployments.
- Hosts on which the Cloud Manager, ECM for CEE deployments and vCenter for VMware, execute, specified as part of the Cloud Infrastructure.

### — Software components

- CEE: Based on Mirantis OpenStack, includes Ubuntu Linux as operating system, Kernel-based Virtual Machine (KVM) as hypervisor and the Open Virtual Switch (OVS) as virtual switch on the compute hosts.
- VMware: vSphere virtualization platform including ESXi as operating system and hypervisor and Distributed Virtual Switches (vDS) for the switching configuration.
- Virtual Routers (Part of the virtual SAPC Node).
- The SAPC software.

The Figure 1, describes the SAPC network model used on current Cloud environment. There are eight virtual machines each one of them with a different role. The external access to the application can only be done through included Virtual Routers VR-1, VR-2, VR-3, and VR-4, which abstract the SAPC Node from the Cloud environment and makes its deployment much more flexible and independent.

- SC-1 and SC-2 are the system controllers (SC).
- PL-3 and PL-4 are the traffic payloads.
- VR-1 and VR-2 are the virtual routers providing access to the SAPC OAM VIP.
- VR-3 and VR-4 are the virtual routers providing access to the SAPC Traffic VIP.

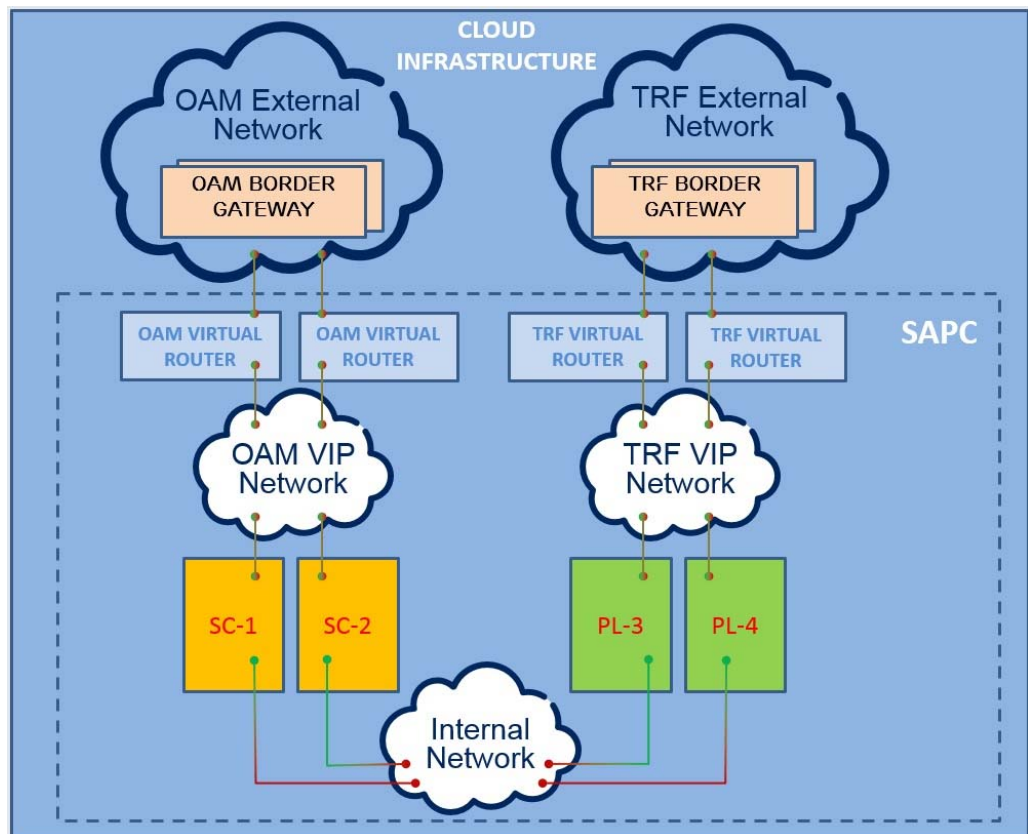


Figure 1 SAPC Node deployed in Cloud Environment

## 2.1 Hardware Components

### 2.1.1 Border Gateway

The Border Gateway is the connection point between the physical world and the Cloud virtual infrastructure.





### 2.1.2 Compute Hosts

Compute hosts provides infrastructure resources (CPU, RAM, and Disk) to the Cloud environment and they make possible connectivity among different virtual machines deployed in the Cloud environment.

### 2.1.3 Controller Hosts

Controller hosts manage infrastructure resources (CPU, RAM, and Disk) to the Cloud environment and it provides the OpenStack APIs towards upper layer (that is Ericsson Cloud Manager application).

### 2.1.4 Cloud Manager Hosts

Hosts where the Cloud Manager is deployed. The Cloud Manager is the central point for managing the Cloud infrastructure and the vAPPs deployed on top of it.

## 2.2 Software Components

### 2.2.1 Mirantis OpenStack (MOS)

The OpenStack delivery included into CEE, provided by Mirantis.

### 2.2.2 Ubuntu Hypervisor (KVM)

Linux distribution used on physical hosts as part of CEE Both compute and controller hosts counts on this Linux distribution as Operating System to provide required services as part of the OpenStack Cloud Manager Platform.

However Kernel-Based Virtual Machine (KVM) modules are only installed in Compute Hosts case, while controllers do not require them since they do not provide any compute or infrastructure resources to the cloud environment. Ubuntu OS and KVM modules are included into Mirantis OpenStack delivery (CEE) and they are automatically deployed into the specific physical hosts depending on the assigned role during deployment.

As far as KVM is concerned, KVM is a full virtualization solution for x86 processors supporting hardware virtualization (Intel VT or AMD-V). It consists of two main components: A set of Kernel modules (kvm.ko, kvm-intel.ko, and kvm-amd.ko) providing the core virtualization infrastructure and processor-specific drivers and a userspace program (qemu-kvm) that provides emulation for virtual devices and control mechanisms to manage VM Guests (virtual machines). The term KVM more properly refers to the Kernel level virtualization functionality, but is in practice more commonly used to reference the userspace component. VM Guests (virtual machines), virtual storage, and networks can be managed with libvirt-based and QEMU tools. Libvirt is a library that provides an API to manage



VM Guests based on different virtualization solutions, among them KVM and Xen. It offers a graphical user interface and a command line program. The QEMU tools are KVM/QEMU specific and are only available for the command line.

### 2.2.3 Open Virtual Switch

Similarly to KVM, Open Virtual Switch modules are used to provide network connectivity among all members of the OpenStack Cloud Manager Platform, being the base for virtual machines connectivity in the Cloud Infrastructure.

Open vSwitch is also included into Mirantis OpenStack delivery (CEE) and is also deployed at the time of CEE installation.

### 2.2.4 vSphere ESXi

VMWare hypervisor for deploying and serving virtual machines.

### 2.2.5 vSphere Distributed Virtual Switch

vSphere Distributed Switch (VDS) provides a centralized interface to configure, monitor, and administer virtual machine access switching for the entire data center.

### 2.2.6 Virtual Router

Virtual routers are deployed with the SAPC Node and their main purpose is to abstract it from the specific Cloud Infrastructure in which is deployed. They eliminate the need of OSPF manual configuration and OSPF protocol support or license handling in the physical routers in which the SAPC Node is finally deployed during SAPC instantiation.

By introducing them, OSPF is not longer a prerequisite for the Cloud infrastructure and ensure that, all VIPs for OAM and Traffic are available for any other node, if proper routing has been established to interconnect both nodes.

Also, they provide redundancy access to the SAPC Node from the Cloud environment through VRRP protocol.

Virtual routers use Vyatta Software for this purpose.

### 2.2.7 eVIP

The eVIP Component is used for announcing an IP address and isolate the SAPC cluster to the outside network. The way to be announced is using OSPF v2 protocol by creating adjacency with the OSPF neighbors, in this case, the virtual routers.



## 2.3 Network

### 2.3.1 General Overview

The following networks are used for SAPC connectivity:

- Network for internal communication purposes between all the virtual machines in the SAPC Cluster.
- Network for TIPC communication purposes between all the virtual machines belonging to the SAPC cluster.
- Network for OAM VIPs between the System Controllers virtual machines and the Virtual router VR-1. Used to provide access to OAM VIP for the SAPC. OSPF v2 protocol is enabled in this network.
- Network for OAM VIPs between the System Controllers virtual machines and the Virtual router VR-2. Used to provide access to OAM VIP for the SAPC. OSPF v2 protocol is enabled in this network.
- Network or networks for Traffic VIPs between the Traffic Payloads virtual machines with external access (PL-3 and PL-4) and the Virtual router VR-3. Used to provide access to Traffic VIP for the SAPC. OSPF v2 protocol is enabled in this network.
- Network or networks for Traffic VIPs between the Traffic Payloads virtual machines with external access (PL-3 and PL-4) and the Virtual router VR-4. Used to provide access to Traffic VIP for the SAPC. OSPF v2 protocol is enabled in this network.
- External OAM network to provide external access to VR-1 and VR-2.
- External Traffic network or networkS to provide external access to VR-3 and VR-4.

### 2.3.2 External Connectivity

In the SAPC Node, every virtual machine composing the cluster, and virtual routers are connected through vNIC. Virtual routers are also connected to external world by Ethernet interfaces through External OAM and Traffic networks, which are the only Subnets with external exposure in the SAPC Node.

The SAPC Node provides several VIPs addresses to provide service to other Network Virtualization Functions which are VIPs for OAM to serve Operations and Managements functions and VIPs for Traffic to provide Policy Controller functions to the rest of the nodes.

VIPs for OAM are provided by both SCs while VIPs for Traffic are provided by a maximum of 6 PLs at the same time. Those VIPs addresses are reachable from outside world through Virtual Routers (VR-1, VR-2, VR-3, and VR-4) which discover them through OSPF protocol.

### 2.3.2.1 SAPC networks Designated for OSPF Discovery

Several networks are used in the SAPC Node for OSPF interconnection between so called Node Front Ends (SC-1 and SC-2 to provide VIPs for OAM and some of the PLs to VIPs for Traffic) and Virtual routers. OAMVip<x> and TrafficVip<y> networks are used for this purpose and are part of OSPF Areas.

Because of OSPF protocol activation among these virtual machines and virtual routers, all VIPs addresses are automatically included in the routing tables of the virtual routers, and the SAPC Node automatically learn their default routes.

Also, these networks provide redundancy to the SAPC Node to guarantee VIPs availability in the event of any possible failure (One SC down, One Traffic Payload down, or One Virtual Router Down). As previously mentioned in this document, these networks are internal and not visible or routable from the customer network.

An OSPF Backbone Area (Area 0) is configured in the Virtual Routers to interconnect with the OSPF backbone of the customer network, and learn the routes needed to communicate with the neighbor nodes.

### 2.3.3 Internal Connectivity

In the SAPC Node, the SAPC cluster consists of four processors in the minimal configuration of the node, SC-1, SC-2, PL-3, and PL-4 that requires connectivity among them for the different traffic that needs to be interchanged for different purposes. This is possible through two internal Subnets, one for TIPC communication and other for other internal communication. All VMs are connected internally through those Subnets through **eth0** and **eth1** interfaces.

### 2.3.4 Preconfigured Values

The particular values of the networking configuration described in this document, are the ones preconfigured in the SAPC . Some of them can be changed, based on operator needs, during deployment. To check which values can be modified, see SAPC VNF Descriptor Generator Tool.



## 3 Networks Configuration Solutions

This section specifies how the SAPC Node is connected to the network. All the external networks and IP addresses described in this chapter are reachable through customer network after a successful SAPC deployment in Cloud environment. Since the SAPC Node Cloud based uses full previously installed images for their virtual machines, all the details (IP addresses, Networks, and Gateways) referenced in this section are already configured by default in the SAPC Node.

### 3.1 Solution to Define Unique OAM and Traffic Networks

This section describes the SAPC configuration to support one OAM Network to serve Operations and Managements functions and one Traffic Network to provide Policy Controller functions to the rest of the nodes.

Next figure shows the general network overview:

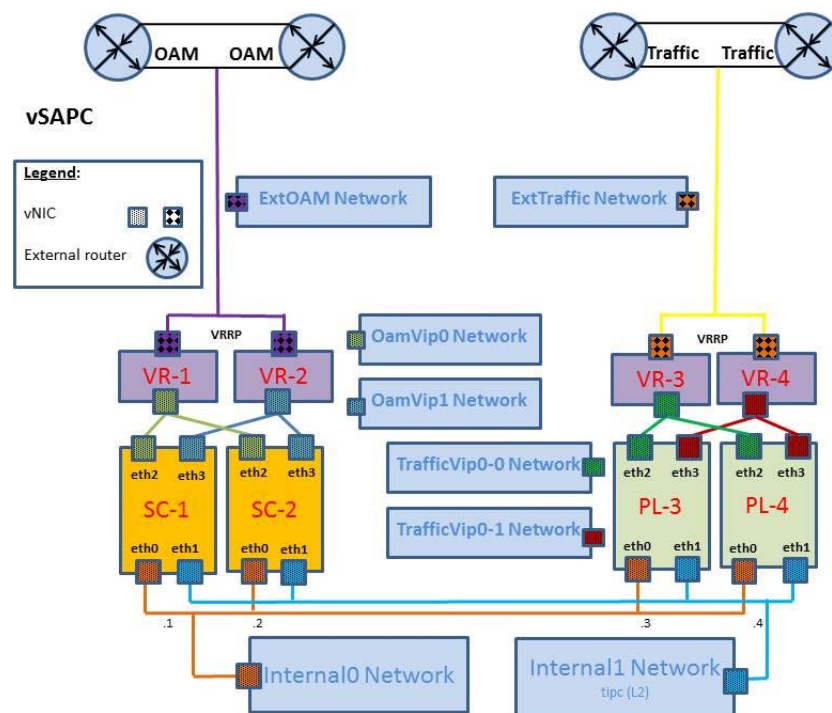


Figure 2 SAPC node solution with Unique OAM and Traffic Networks



### 3.1.1 Internal Network Configuration

#### 3.1.1.1 IP Addressing

The **Internal0** and **Internal1** networks, see Figure 2, provides network connectivity between processors in the SAPC cluster. Each processor has two interfaces, **eth0**, and **eth1** connected to internal networks composing the SAPC backplane.

Table 1 Internal0 (Cluster Internal Network)

IP Address	Assign To
172.16.100.0/24	Network
.1	SC-1
.2	SC-2
.3	PL-3
.4	PL-4
.x	PL-X in case more traffic payloads are needed

Table 2 Internal Network 1 (TIPC Network)

TIPC Node Address	Assign To
1.1.1	SC-1
1.1.2	SC-2
1.1.3	PL-3
1.1.4	PL-4
1.1.x	PL-x in case more traffic payloads are needed

#### 3.1.1.2 Extra Services over Internal0 Network

Every service (NFS, and so on) is offered in a different IP and is offered by the SC acting as primary.

Table 3 Extra IPs on 172.16.100.0/24 Network

IP Address	Assign To
172.16.100.0/24	Network
.100 <sup>(1)</sup>	SC-1 SC-2
.200 <sup>(2)</sup>	SC-1 SC-2
.244 <sup>(3)</sup>	PL-3 <sup>(4)</sup> PL-4 <sup>(4)</sup>



IP Address	Assign To
.245 to .254 <sup>(5)</sup>	Scalability temporary pool for any added payload
.255	Broadcast

(1) NFS movable IP. eth0:1 alias interface

(2) boot movable IP. eth0:3 alias interface

(3) SCTP movable IP. eth0:1 alias interface

(4) In the minimal configuration of the SAPC node

(5) Scalability temporary pool

## 3.1.2 VIP Networks Configuration

### 3.1.2.1 Networks for OSPF v2

The following table shows the networks allocated inside the SAPC node images, in which OSPF protocol is enabled. They are already defined by default in the SAPC Node and in the configuration of the virtual routers to ensure a proper operation after the SAPC deployment in Cloud environment.

Table 4 Private Networks Allocated inside the SAPC Node for SAPC VIPs population Through OSPF Protocol

Network Name	Subnet	Use
OamVip0	172.16.213.0/29	OSPFv2 Attachment between SCs and VR-1
OamVip1	172.16.213.16/29	OSPFv2 Attachment between SCs and VR-2
TrafficVip0-0	172.16.113.0/28	OSPFv2 Attachment between PL-3 and PL-4, and VR-3
TrafficVip0-1	172.16.113.16/28	OSPFv2 Attachment between PL-3 and PL-4, and VR-4

### 3.1.2.2 SAPC VIP Addresses

Table 5 VIP Addresses

VIP Description	VIP	Use
VIP-OAM	10.58.31.7/32	SAPC OAM VIP Address
VIP-PROVISIONING <sup>(1)</sup>	N/A	SAPC Provisioning VIP Address
VIP-GX	10.58.31.137/32	SAPC Traffic VIP Address. All the payload traffic from all the available interfaces (Gx, Rx, Sy, and so on) is handled through this VIP
VIP-ExtDB <sup>(2)</sup>	N/A	VIP address for handling the access to the external Database

(1) Only for deployment that requires Provisioning Address different than OAM Address.

(2) Only in deployment with an external database.

### 3.1.2.3 eVIP Configuration

This section describes the mapping of networks to vNICs in the different pieces of networking equipment related to eVIP components.

This section describes the eVIP configuration defined in the SAPC Node images for Cloud environment. The `evip.xml` configuration file included into the SAPC Node images holds many parameters however this document describes the ones that are key to the design.

#### 3.1.2.3.1 eVIP Configuration Overview

Traffic is separated in four networks through which **VIP-OAM** and **VIP-GX** VIPs are propagated. OAM-VIP networks enclose SCs and Traffic-VIP networks encloses PLs. From eVIP point of view, one FEE manages each kind of traffic in each processor they run on.

The following figure shows how VIP-OAM is configured as specified at Section 3.1.2.3.3 on page 14.

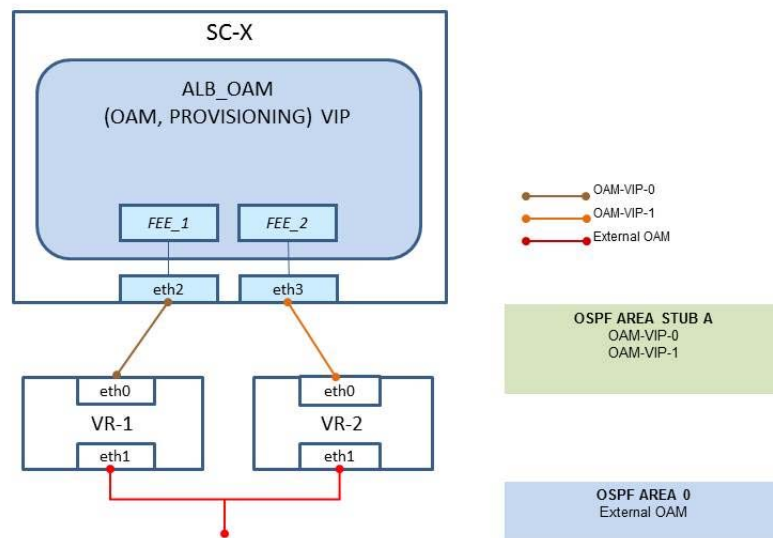


Figure 3 eVIP VIP-OAM Overview

In deployments that requires Provisioning Address different than OAM Address, SAPC requires a new Virtual IP for handling Provisioning, VIP-PROVISIONING. This new VIP is published to the External Network through the same FEEs than VIP-OAM.





The following figure shows how VIP-GX is configured as specified at Section 3.1.2.3.3 on page 14.

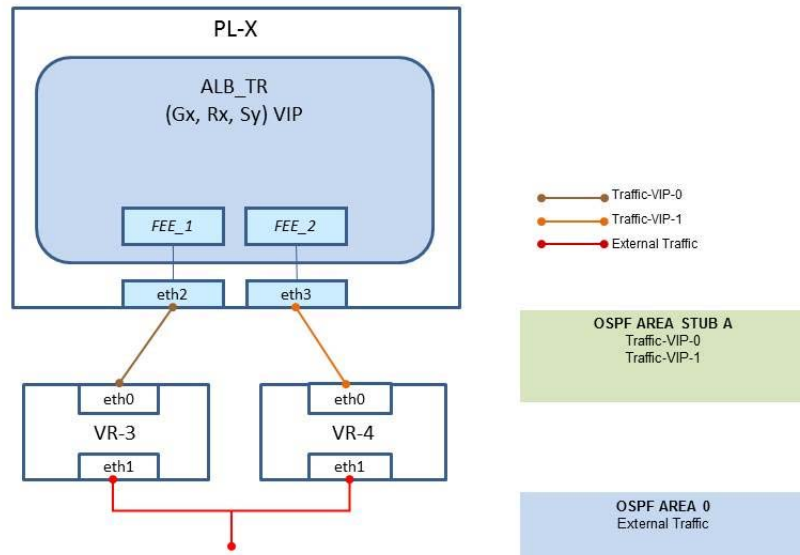


Figure 4 eVIP VIP-GX Overview

In deployments with an external database like CUDB, SAPC requires a new Virtual IP for handling the LDAP traffic and the SOAP notifications traffic with the external database. This new VIP is published to the External Network through the same FEEs than VIP-GX.

### 3.1.2.3.2 eVIP Elements

In the table below, the distribution of eVIP elements is listed. The location of eVIP front ends (FEE) requires corresponding configuration in the network, that is, virtual routers. This configuration is already made by default and adjustment is not required.



Table 6 Distribution of eVIP Elements

Abstract Load Balancer (ALB)	VIP	Front-End Element (FEE)	Load Balancer Element (LBE)	Security Element (SE)
alb_oam	<VIP-OAM> 10.58.31.7/32	SC-1 (fee_1) SC-2 (fee_2) SC-1 (fee_3) SC-2 (fee_4)	lbe_1 lbe_2	se_1 se_2
alb_tr	<VIP-GX> 10.58.31.137/32 <VIP-ExtDB> <sup>(1)</sup>	PL-3 (fee_1) PL-4 (fee_2) PL-5 (fee_3) PL-6 (fee_4) PL-7 (fee_5) PL-8 (fee_6) PL-3 (fee_7) PL-4 (fee_8) PL-5 (fee_9) PL-6 (fee_10) PL-7 (fee_11) PL-8 (fee_12)	lbe_1 lbe_2 lbe_3 lbe_4 lbe_5 lbe_6	se_1 se_2 se_3 se_4 se_5 se_6

(1) Only in deployment with an external database.

## 3.1.2.3.3

## OSPF v2 Areas

The traffic is separated into two OSPF v2 areas and ALBs. Each ALB has links with IPs defined for the FEEs and the remote gateway which are the virtual routers in this design. Next table shows how the networks IPs are defined in this Cloud configuration.

Table 7 FEEs and OSPF v2 Configuration

Abstract Load Balancer (ALB)	Front-End Element (FEE)	Network	FEE IP	FEE Interface	Virtual Router IP
alb_oam Area=10.1.13.1 Hello=3 Dead=9 Retransmit=5 Delay=1 Priority=0	fee_1	172.16.213.0/29	.2	SC-1 eth2	.1
	fee_2		.3	SC-2 eth2	
	fee_3		.18	SC-1 eth3	
	fee_4	172.16.213.16/29	.19	SC-2 eth3	.17



Abstract Load Balancer (ALB)	Front-End Element (FEE)	Network	FEE IP	FEE Interface	Virtual Router IP
alb_tr Area=10.1.13.2 Hello=3 Dead=9 Retransmit =5 Delay=1 Priority=0	fee_1	172.16.113.0/28	.2	PL-3 eth2	.1
	fee_2		.3	PL-4 eth2	
	fee_3		.4	PL-5 eth2	
	fee_4		.5	PL-6 eth2	
	fee_5		.6	PL-7 eth2	
	fee_6		.7	PL-8 eth2	
	fee_7	172.16.113.16/28	.18	PL-3 eth3	.17
	fee_8		.19	PL-4 eth3	
	fee_9		.20	PL-5 eth3	
	fee_10		.21	PL-6 eth3	
	fee_11		.22	PL-7 eth3	
	fee_12		.23	PL-8 eth3	

### 3.1.2.4

### Virtual Router Configuration

Virtual router configurations are part of their images, similarly to other virtual machines composing the SAPC Node. Apart of the OSPF-related configuration previously described into Section 3.1.2.3.3 on page 14, the following remarkable configuration has been set up into the respective images and is part of the SAPC delivery.

Table 8 OSPF Areas for Internal Networks Configuration

OSPF Area	Router IDs	OSPF Parameters	Use
10.1.13.1	172.16.213.1 (Virtual Router 1)	Hello=3 seconds Dead=9 seconds Retransmit =5 seconds Delay=1 second Priority=1	SAPC OAM and Provisioning VIP Addresses
	172.16.213.17 (Virtual Router 2)		
10.1.13.2	172.16.113.1 (Virtual Router 3)		SAPC Traffic VIPs Addresses
	172.16.113.17 (Virtual Router 4)		

### 3.1.3

### External Networks Configuration

#### 3.1.3.1

#### External Networks

The following networks are configured to interconnect the SAPC Node with the customer network.



Table 9 External-OAM Networks

Network Name	Network	Default Gateway	Use
External-OAM	10.41.30.224/29	10.41.30.225	OAM network for the SAPC Node
External-Traffic	10.41.70.224/29	10.41.70.225	Traffic network for the SAPC node (VR-3, VR-4),

### 3.1.3.2 IP Addressing

Each SAPC Node includes a set of IP addresses configured.

#### 3.1.3.2.1 Virtual Routers IP Addresses

Table 10 IP Addresses

IP Address	Network	Value	Use
VR-1 OAM	10.41.30.224/29	10.41.30.229/29	IP Address of VR-1 on ExtOAM Network
VR-2 OAM		10.41.30.230/29	IP Address of VR-2 on ExtOAM Network
OAM VRRP		10.41.30.226/29	IP Address for OAM VRRP (Virtual Router Redundancy Protocol)
VR-3 Traffic	10.41.70.224/29	10.41.70.229/29	IP Address of VR-3 on ExtTraffic Network
VR-4 Traffic		10.41.70.230/29	IP Address of VR-4 on ExtTraffic Network
Traffic VRRP		10.41.70.226/29	IP Address for Traffic VRRP (Virtual Router Redundancy Protocol)

#### 3.1.3.2.2 IP Addresses of External Elements

This section covers all the IP addresses in the customer network that do not belong to the SAPC Node but are configured in the SAPC Node to interoperate with other nodes. No default values are configured for them, since they are customer dependant.

Table 11 IP Addresses of External Elements

IP Address	Network	Use
<NTP-SERVER>	<NTP-NETWORK>/<NTP-NETMASK>	NTP Server
<SNMP-SERVER>	<SNMP-NETWORK>/<SNMP-NETMASK>	SNMP Server
<DNS-SERVER>	<DNS-NETWORK>/<DNS-NETMASK>	DNS Server

There can be several NTP, SNMP, and DNS servers.



NTP servers are configured by the `adapt_cluster` tool during deployment. For further details, see [SAPC VNF Descriptor Generator Tool](#).

SNMP servers are configured for Fault Management. For security reasons, it is highly recommended to use [Create SNMPv3 Target](#). Also, legacy versions can be used as [Create SNMPv2C Target](#) and [Create SNMPv1 Target](#).

For DNS servers configuration, refer to [LDE Management Guide](#).

### 3.1.3.3 Virtual Router Configuration

Virtual router configurations are part of their images, similarly to other virtual machines composing the SAPC Node. The following remarkable configuration has been set up into the respective images and is part of the SAPC delivery.

Table 12 OSPF Backbone Area Configuration

OSPF Area	OSPF Parameters	Use
<b>Backbone area (0.0.0.0)</b>	Dead Interval: 9 seconds, Hello Interval: 3 seconds, Retransmit: 5 seconds, Delay: 1 second, Priority= 1	OSPF backbone

Table 13 VRRP Configuration

VRRP Group	Virtual Router	VRRP Parameters	Use
<b>10</b>	Virtual Router 1	Priority= 150	External OAM VRRP ( <b>10.41.30.226</b> )
	Virtual Router 2	Priority= 100	
<b>20</b>	Virtual Router 3	Priority= 150	External Traffic VRRP ( <b>10.41.70.226</b> )
	Virtual Router 4	Priority= 100	

## 3.2 Solution to Define Unique OAM and Multiple Traffic Networks

This section describes the SAPC configuration to support one OAM Network to serve Operations and Managements functions and two Traffic Networks to provide Policy Controller functions to the rest of the nodes. These functions are separated as follows:

- Network for Rx and Sy traffic support.
- Network for the rest of Policy Controller functions supported, mainly Gx traffic support.

Next figure shows the general network overview:

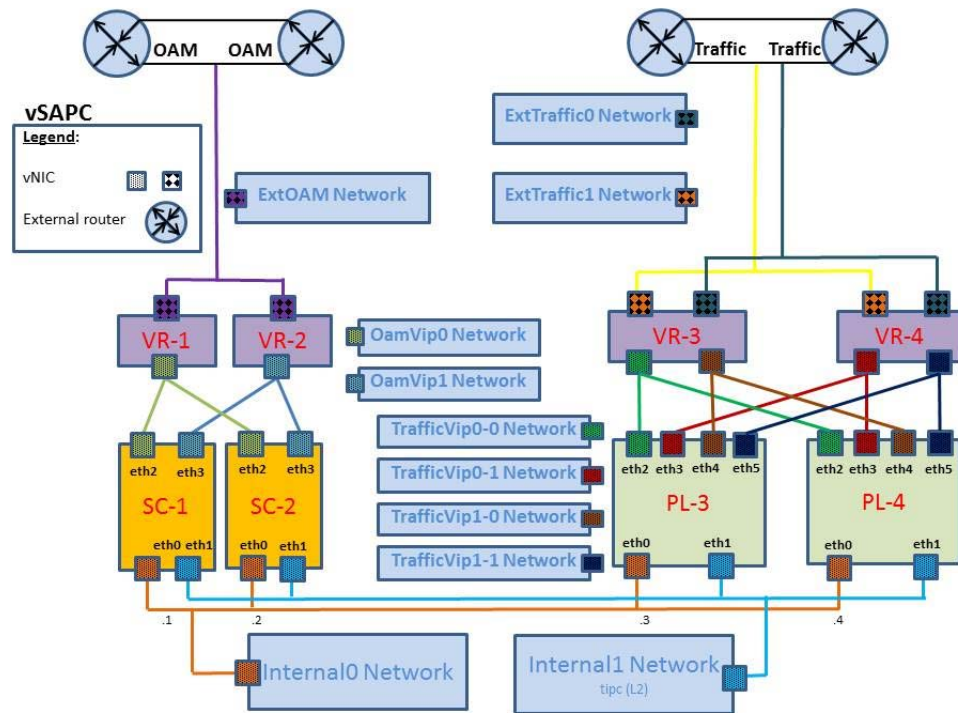


Figure 5 SAPC Node solution with Unique OAM and two Traffic Networks

### 3.2.1 Internal Network Configuration

In this section applies the same configuration described into Section 3.1.1 on page 9.

### 3.2.2 VIP Networks Configuration

#### 3.2.2.1 Networks for OSPF v2

The following table shows the networks allocated inside the SAPC node images, in which OSPF protocol is enabled. They are already defined by default in the SAPC Node and in the configuration of the virtual routers to ensure a proper operation after the SAPC deployment in Cloud environment.

Table 14 Private Networks Allocated inside the SAPC Node for SAPC VIPs population Through OSPF Protocol

Network Name	Subnet	Use
OamVip0	172.16.213.0/29	OSPFv2 Attachment between OAM FEEs and VR-1



Network Name	Subnet	Use
OamVip1	172.16.213.16/29	OSPFv2 Attachment between OAM FEEs and VR-2
TrafficVip0-0	172.16.113.0/28	OSPFv2 Attachment between Traffic-1 FEEs and VR-3
TrafficVip0-1	172.16.113.16/28	OSPFv2 Attachment between Traffic-1 FEEs and VR-4
TrafficVip1-0	172.16.113.32/28	OSPFv2 Attachment between Traffic-2 FEEs and VR-3
TrafficVip1-1	172.16.113.48/28	OSPFv2 Attachment between Traffic-2 FEEs and VR-4

### 3.2.2.2 SAPC VIP Addresses

Table 15 VIP Addresses

VIP Description	VIP	Use
VIP-OAM	10.58.31.7/32	SAPC OAM VIP Address
VIP-PROVISIONING <sup>(1)</sup>	N/A	SAPC Provisioning VIP Address
VIP-GX	10.58.31.137/32	SAPC Traffic VIP Address for Gx mainly
VIP-RX	10.58.32.142/32	SAPC Traffic VIP Address for Rx/Sy
VIP-ExtDB <sup>(2)</sup>	N/A	VIP address for handling the access to the external Database

(1) Only for deployment that requires Provisioning Address different than OAM Address.

(2) Only in deployment with an external database.

### 3.2.2.3 eVIP Configuration

This section describes the mapping of networks to vNICs in the different pieces of networking equipment related to eVIP components.

This section describes the eVIP configuration defined in the SAPC Node images for Cloud environment. The `evip.xml` configuration file included into the SAPC Node images holds many parameters however this document describes the ones that are key to the design.

#### 3.2.2.3.1 eVIP Configuration Overview

Traffic is separated in six networks through which **VIP-OAM**, **VIP-GX** and **VIP-RX** VIPs are propagated. VIP-OAM networks enclose SCs, VIP-GX, and VIP-RX enclose PLs. From eVIP point of view, one FEE manages each kind of traffic in each processor they run on.

The following figure shows how VIP-OAM is configured as specified at Section 3.2.2.3.3 on page 22.

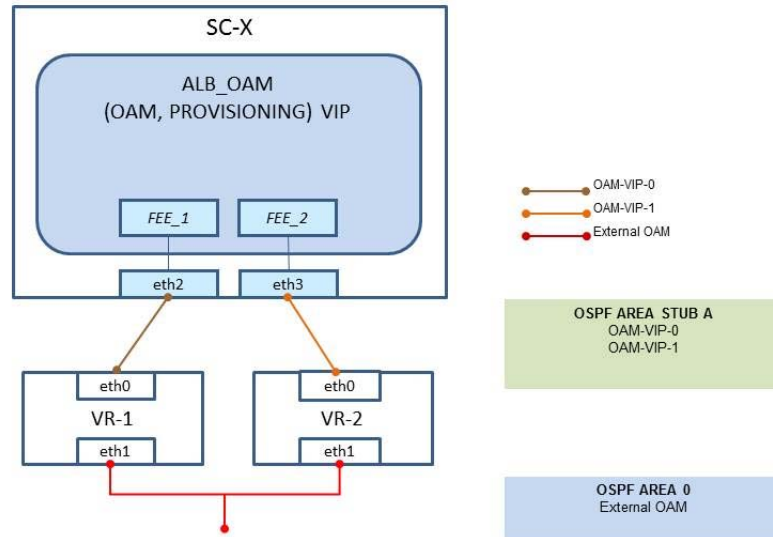


Figure 6 eVIP VIP-OAM Overview

In deployments that requires Provisioning Address different than OAM Address, SAPC requires a new Virtual IP for handling Provisioning, VIP-PROVISIONING. This new VIP is published to the External Network through the same FEEs than VIP-OAM.

The following figure shows how VIP-GX and VIP-RX are configured as specified at Section 3.2.2.3.3 on page 22.



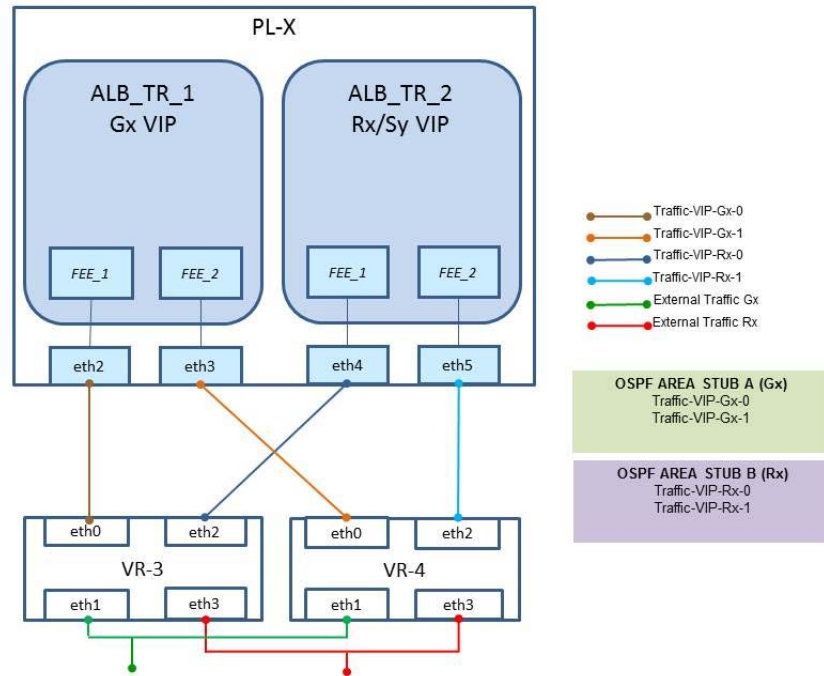


Figure 7 eVIP VIP-GX Overview

In deployments with an external database like CUDB, SAPC requires a new Virtual IP for handling the LDAP traffic and the SOAP notifications traffic with the external database. This new VIP is published to the External Network through the same FEEs than VIP-GX.

### 3.2.2.3.2

#### eVIP Elements

In the table below, the distribution of eVIP elements is listed. The location of eVIP front ends (FEE) requires corresponding configuration in the network, that is, virtual routers. This configuration is already made by default and adjustment is not required.

Table 16 Distribution of eVIP Elements

Abstract Load Balancer (ALB)	VIP	Front-End Element (FEE)	Load Balancer Element (LBE)	Security Element (SE)
alb_oam	<VIP-OAM> 10.58.31.7/32	SC-1 (fee_1) SC-2 (fee_2) SC-1 (fee_3) SC-2 (fee_4)	lbe_1 lbe_2	se_1 se_2



Abstract Load Balancer (ALB)	VIP	Front-End Element (FEE)	Load Balancer Element (LBE)	Security Element (SE)
alb_trf_1	<VIP-GX> <b>10.58.31.137/32</b> <VIP-ExtDB> <sup>(1)</sup>	PL-3 (fee_1) PL-4 (fee_2) PL-5 (fee_3) PL-6 (fee_4) PL-7 (fee_5) PL-8 (fee_6) PL-3 (fee_7) PL-4 (fee_8) PL-5 (fee_9) PL-6 (fee_10) PL-7 (fee_11) PL-8 (fee_12)	lbe_1 lbe_2 lbe_3 lbe_4 lbe_5 lbe_6	se_1 se_2 se_3 se_4 se_5 se_6
alb_trf_2	<VIP-RX> <b>10.58.32.142/32</b>	PL-3 (fee_1) PL-4 (fee_2) PL-5 (fee_3) PL-6 (fee_4) PL-7 (fee_5) PL-8 (fee_6) PL-3 (fee_7) PL-4 (fee_8) PL-5 (fee_9) PL-6 (fee_10) PL-7 (fee_11) PL-8 (fee_12)	lbe_1 lbe_2 lbe_3 lbe_4 lbe_5 lbe_6	se_1 se_2 se_3 se_4 se_5 se_6

(1) Only in deployment with an external database.

### 3.2.2.3.3

### OSPF v2 Areas

The traffic is separated into three OSPF v2 areas and ALBs. Each ALB has links with IPs defined for the FEEs and the remote gateway which are the virtual routers in this design. Next table shows how the networks IPs are defined in this Cloud configuration.



Table 17 FEEs and OSPF v2 Configuration

Abstract Load Balancer (ALB)	Front-End Element (FEE)	Network	FEE IP	FEE Interface	Virtual Router IP
alb_oam Area=10.1.13.1 Hello=3 Dead=9 Retransmit =5 Delay=1 Priority=0	fee_1	172.16.213.0/29	.2	SC-1 eth2	.1
	fee_2		.3	SC-2 eth2	
	fee_3	172.16.213.16/29	.18	SC-1 eth3	.17
	fee_4		.19	SC-2 eth3	
alb_trf_1 Area=10.1.13.2 Hello=3 Dead=9 Retransmit =5 Delay=1 Priority=0	fee_1	172.16.113.0/28	.2	PL-3 eth2	.1
	fee_2		.3	PL-4 eth2	
	fee_3		.4	PL-5 eth2	
	fee_4		.5	PL-6 eth2	
	fee_5		.6	PL-7 eth2	
	fee_6		.7	PL-8 eth2	
	fee_7	172.16.113.16/28	.18	PL-3 eth3	.17
	fee_8		.19	PL-4 eth3	
	fee_9		.20	PL-5 eth3	
	fee_10		.21	PL-6 eth3	
	fee_11		.22	PL-7 eth3	
	fee_12		.23	PL-8 eth3	
alb_trf_2 Area=10.1.13.3 Hello=3 Dead=9 Retransmit =5 Delay=1 Priority=0	fee_1	172.16.113.32/28	.34	PL-3 eth4	.33
	fee_2		.35	PL-4 eth4	
	fee_3		.36	PL-5 eth4	
	fee_4		.37	PL-6 eth4	
	fee_5		.38	PL-7 eth4	
	fee_6		.39	PL-8 eth4	
	fee_7	172.16.113.48/28	.50	PL-3 eth5	.49
	fee_8		.51	PL-4 eth5	
	fee_9		.52	PL-5 eth5	
	fee_10		.53	PL-6 eth5	
	fee_11		.54	PL-7 eth5	
	fee_12		.55	PL-8 eth5	

### 3.2.2.4

### Virtual Router Configuration

Virtual router configurations are part of their images, similarly to other virtual machines composing the SAPC Node. Apart of the OSPF-related configuration previously described into Section 3.2.2.3.3 on page 22, the following remarkable



configuration has been set up into the respective images and is part of the SAPC delivery.

Table 18 OSPF Areas for Internal Networks Configuration

OSPF Area	Router IDs	OSPF Parameters	Use
10.1.13.1	172.16.213.1 (Virtual Router 1)	Hello=3 seconds  Dead=9 seconds  Retransmit =5 seconds  Delay=1 second  Priority=1	SAPC OAM and Provisioning VIP Addresses
	172.16.213.17 (Virtual Router 2)		
10.1.13.2	172.16.113.1 (Virtual Router 3)		SAPC VIPs Addresses for the rest of the traffic, mainly for Gx traffic
	172.16.113.17 (Virtual Router 4)		
10.1.13.3	172.16.113.33 (Virtual Router 3)		SAPC VIP Address for Rx/Sy traffic
	172.16.113.49 (Virtual Router 4)		

### 3.2.3 External Networks Configuration

#### 3.2.3.1 External Networks

The following networks are configured to interconnect the SAPC Node with the customer network.

Table 19 External-OAM Networks

Network Name	Network	Default Gateway	Use
External-OAM	10.41.30.224/29	10.41.30.225	OAM network for the SAPC Node
External-Traffic-1	10.41.70.224/29	10.41.70.225	Traffic network for Gx traffic for the SAPC node (VR-3, VR-4),
External-Traffic-2	10.41.90.224/29	10.41.90.225	Traffic network for Rx and Sy traffic the SAPC node (VR-3, VR-4),

#### 3.2.3.2 IP Addressing

Each SAPC Node includes a set of IP addresses configured.



### 3.2.3.2.1 Virtual Routers IP Addresses

Table 20 IP Addresses

IP Address	Network	Value	Use
VR-1 OAM	10.41.30.224/29	10.41.30.229/29	IP Address of VR-1 on ExtOAM Network
VR-2 OAM		10.41.30.230/29	IP Address of VR-2 on ExtOAM Network
OAM VRRP		10.41.30.226/29	IP Address for OAM VRRP (Virtual Router Redundancy Protocol)
VR-3 Traffic-1	10.41.70.224/29	10.41.70.229/29	IP Address of VR-3 on ExtTraffic-1 Network
VR-4 Traffic-1		10.41.70.230/29	IP Address of VR-4 on ExtTraffic-1 Network
Traffic-1 VRRP		10.41.70.226/29	IP Address for Traffic-1 VRRP (Virtual Router Redundancy Protocol)
VR-3 Traffic-2	10.41.90.224/29	10.41.90.229/29	IP Address of VR-3 on ExtTraffic-2 Network
VR-4 Traffic-2		10.41.90.230/29	IP Address of VR-4 on ExtTraffic-2 Network
Traffic-2 VRRP		10.41.90.226/29	IP Address for Traffic-2 VRRP (Virtual Router Redundancy Protocol)

### 3.2.3.2.2 IP Addresses of External Elements

In this section applies the same configuration described into Section 3.1.3.2.2 on page 16.

### 3.2.3.3 Virtual Router Configuration

Virtual router configurations are part of their images, similarly to other virtual machines composing the SAPC Node. The following remarkable configuration has been set up into the respective images and is part of the SAPC delivery.

Table 21 OSPF Backbone Area Configuration

OSPF Area	OSPF Parameters	Use
<b>Backbone area (0.0.0.0)</b>	Dead Interval: 9 seconds, Hello Interval: 3 seconds, Retransmit: 5 seconds, Delay: 1 second, Priority= 1	OSPF backbone



Table 22 VRRP Configuration

VRRP Group	Virtual Router	VRRP Parameters	Use
10	Virtual Router 1	Priority= 150	External OAM VRRP (10.41.30.226)
	Virtual Router 2	Priority= 100	
20	Virtual Router 3	Priority= 150	External Traffic-1 VRRP (10.41.70.226)
	Virtual Router 4	Priority= 100	
30	Virtual Router 3	Priority= 150	External Traffic-2 VRRP (10.41.90.226)
	Virtual Router 4	Priority= 100	