

# vMRF Networks and Connectivity

## Virtual Media Resource Function

### Function Specification

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# 1 Introduction

This document describes the internal and external network connectivity of a vMRF VNF residing in the IMS core network.



## 2 Network Connectivity Overview

vMRF handles media-based services, for example, announcements, conference services, tone and DTMF handling in the core network. The IP layer (L3) is always terminated in the vMRF.

vMRF has several requirements on L2 and L3 infrastructure that must be met for its operation. For more information, see [vMRF Infrastructure Requirements](#).

IPv4 is supported for all interfaces. IPv6 is supported only for media interfaces. Specifications in this document are valid for both IPv4 and IPv6, unless explicitly stated.

The traffic can be separated into logical networks that are mapped to different Virtual Private Networks (VPNs) using Virtual Router (VR) and Virtual Local Area Network (VLAN) separation. Traffic separation is used to treat traffic differently, depending on requirements on security (for example, limiting or isolating traffic between different logical networks), signaling or media functionality, and Quality of Service (QoS).

[Figure 1](#) shows an example of different VPNs in a vMRF configuration.

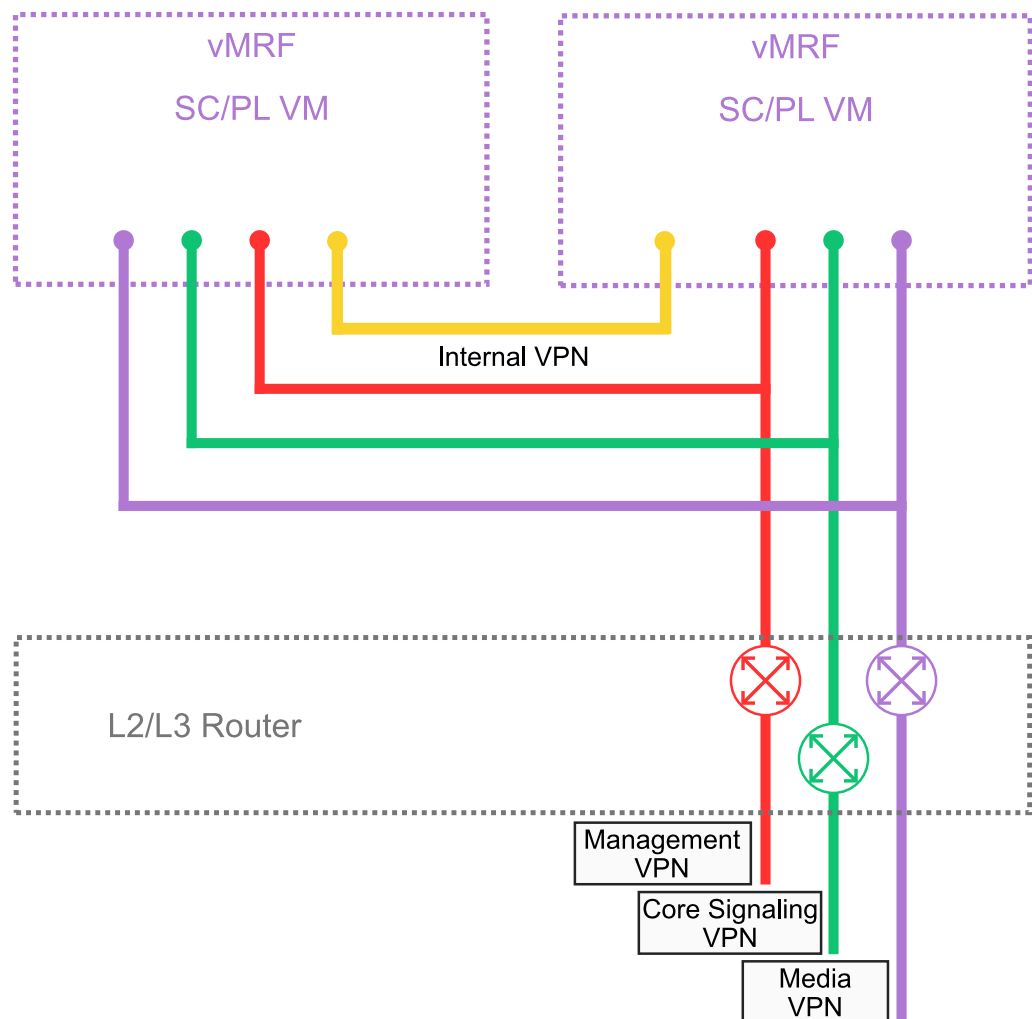


Figure 1 VPNs in vMRF

#### Internal VPN

Internal VPN is used for communication between the VMs of the vMRF VNF. The network is used for IP and TIPC transport between VMs, for example, for configuration data replication from the active SC VM to other VMs, common system function access from PL VMs to SC VMs (FM, CM, PM, and so on).

The Internal VPN must not be exposed to external networks.

#### Management VPN

Management VPN is used for O&M traffic between vMRF and a common management network for all nodes.

#### Core signaling VPN

Core signaling VPN is used for H.248 control signaling (single-homing) between MTAS and vMRF. The VLAN is



always terminated in the cloud platform (access vNIC) and connected to vMRF over signaling vNIC.

### **Media VPN**

Core media VPN is used for media traffic between vMRF and interconnecting nodes in the core network. The VLAN is always terminated in the cloud platform (access vNIC) and connected to vMRF over trusted network vNIC.

All vMRF VMs have the same VPNs attached to them.

One external VLAN is configured per media network. The VLAN is terminated in the cloud platform (access vNIC).

Each external VPN uses its own VR in the L2/L3 router with different routing tables. The external VPNs are mapped to vMRF VLANs in the L2/L3 router.



## 3 Configuration

### 3.1 General Description

vMRF acts as a Multimedia Resource Function Processor (MRFP). It is controlled by an MTAS in the role of MRFP over H.248 through the Mp interface. vMRF is connected to other IMS media entities over the Mb interface.

The MRFP function can be handled by several vMRF VNFs, or by one vMRF VNF, depending on available resources and security requirements.

Since SIP signaling and media traffic are handled separately (that is, MTAS (MRFC) handles SIP signaling traffic, and vMRF handles media traffic processing), the signaling and media processing capacity can be scaled independently.

An MRFC can control multiple MRFP (vMRF) instances, however, a vMRF can be controlled by only one MRFC. To configure the link to the controlling MTAS, see [Initial Configuration Guide](#).

The following IP address configuration is needed in vMRF:

- vMRF-local IP addresses
- Next hop addresses within the local subnet

IP address consumption is shown in [Table 1](#).

Table 1 IP Address Consumption in vMRF Networks

Network	Typical IP Address Type	Amount of IP Addresses
VNF-internal	link-local or private IP <sup>(1)</sup>	one per VM
Internal O&M	public or private IP <sup>(2)(1)</sup>	one per VM
	public or private IP <sup>(2)(1)</sup>	one per VNF
External O&M <sup>(3)</sup>	public or private IP <sup>(1)</sup>	one per VNF
Core signaling	private IP <sup>(1)</sup>	one per VM
Media	private IP	one per VM

(1) Only IPv4 IP addresses are supported.

(2) In CEE, the O&M IP is a public IP.

(3) In CEE, the public management IP is not applicable.

In addition to the amount of IP addresses shown in [Table 2](#), additional IP addresses are needed during vMRF upgrade, when using the in-service upgrade method.



Depending on the cloud platform and the deployment option chosen, local (vMRF) IP addresses for all networks, and the next hop addresses for O&M and signaling networks are allocated in vMRF by the following mechanisms:

Table 2 IP Address Allocation Mechanisms

IP Address Allocation Mechanism	Supported Platforms	Detailed Description
From cloud platform IP address pools provided for vMRF VMs using <code>cloud-init</code> (OpenStack, CEE) or OVF templates (VMware)	OpenStack, CEE, and VMware	<ul style="list-style-type: none"><li>—<a href="#">Provision of IP Address Pools in OpenStack, using cloud-init on page 10</a></li><li>—<a href="#">Provision of IP Address Pools in CEE, using cloud-init on page 12</a></li><li>—<a href="#">Provision of IP Address Pools in VMware vSphere Client, using cloud-init on page 13</a></li><li>—<a href="#">Provision of IP Address Pools in VMware vCloud Director, using cloud-init on page 15</a></li></ul>
By IPv6 Stateless Address Autoconfiguration for media interfaces, according to standards		<ul style="list-style-type: none"><li>—<a href="#">RFC 4862</a></li></ul>
By configuring IP addresses in each VM during vMRF deployment and scaling, or providing them through OVF templates (VMware)	VMware	<ul style="list-style-type: none"><li>—<a href="#">Manual IP Address Configuration during Deployment and Scaling on page 16</a></li></ul>

## 3.2 vNIC and IP Address Configuration

[Figure 2](#) shows access vNIC configuration in vMRF.

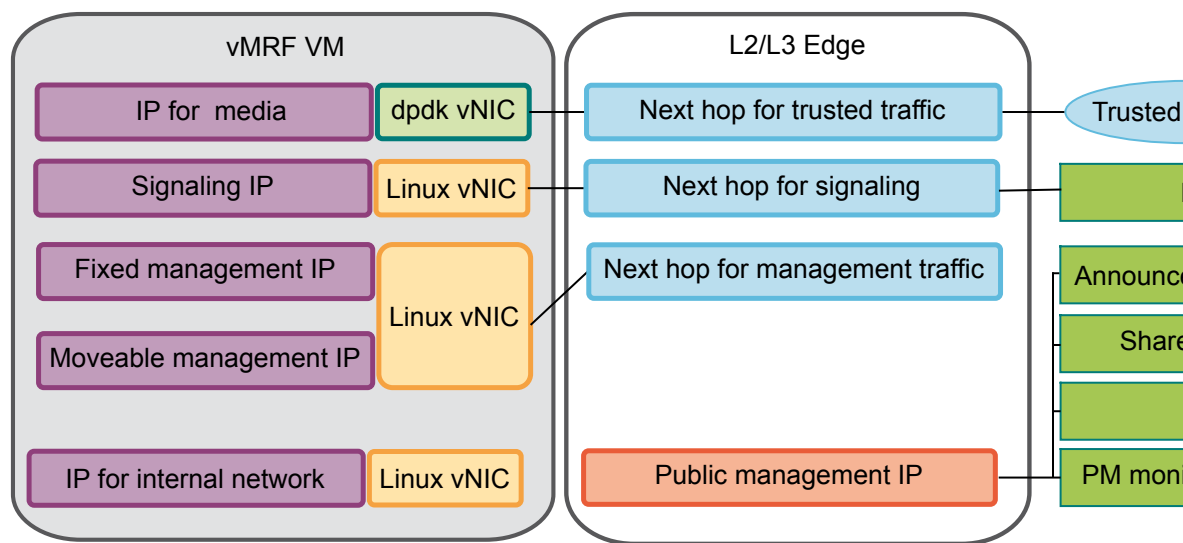


Figure 2 Access vNIC Configuration in vMRF

Table 3 IP Address Configuration in vMRF

Interface Type	Label in Figure	IP Version	Description	Configuration	Routing
Internal	IP for internal network	IPv4	VM-specific local IP address used for VM-to-VM communication	Dependent on cloud platform and IP allocation method	Direct communication in Linux IP host of the VM guest OS
Management	Moveable management IP		Management IP address of the vMRF VNF		Default route in Linux IP host of the VM guest OS
	Fixed management IP		VM-specific local IP address used for outbound management traffic		
	Public management IP		Public management IP address of		



Interface Type	Label in Figure	IP Version	Description	Configuration	Routing
			the vMRF VNF		
	Next hop for management traffic		VRRP address of the management network VR		
	Announcement storage IP <sup>(1)</sup>		IP address of the announcement storage server		
	Shared storage IP <sup>(1)</sup>		IP address of the shared storage server		
	NTP IP		IP address of the NTP time synchronization server		
	PM monitoring server IP <sup>(1)</sup>		IP address of the PM monitoring server		
Signaling	Signaling IP		VM-specific local IP address used for MTAS communication		Auto-created in Linux IP host of the VM guest OS
	MTAS IP		Remote MTAS address		
	Next hop for signaling		VRRP address of the core signaling		



Interface Type	Label in Figure	IP Version	Description	Configurati on	Routing
			network VR		
Media	IP for media	IPv4 or IPv6	VM-specific local IP address used for media communication towards the IMS core network		According to the vMRF media configuration
	Next hop for trusted traffic		VRRP address of the IMS core network VR		
	Trusted network		Subnet address of the remote network where remote media server resides		

(1) Optional value.



## 4 Cloud Platform IP Address Pools Provided for vMRF VMs

The following sections summarize IP configuration in vMRF when IP addresses are provided to vMRF VMs from a cloud platform IP address pool.

### 4.1 Provision of IP Address Pools in OpenStack, using cloud-init

The following HOT files of the `openstack` directory are used for vMRF deployment:

- `vmrf.yaml` for creating the vMRF stack in Heat using the `heat stack-create` command.
- `example_environment.yaml` is used by the OpenStack Environment function and contains network-specific data. This file is populated with example parameter values and needs to be modified to match your network environment.

For more information on OpenStack HOT files, see [Deployment Guide for OpenStack](#).

Table 4 IP Address Configuration using cloud-init in OpenStack

Interface Type	Label in Figure	IP Version	Data Received From
Internal	IP for internal network	IPv4	Dynamically assigned from <code>internal_net</code> IP allocation pool. <code>internal_net</code> issues the full subnet created in CIDR parameter <code>internal_subnet</code> in <code>vmrf.yaml</code> . The default value is <code>192.168.0.0/24</code> .
Management	Moveable management IP		Dynamically assigned from <code>management_net</code> IP allocation pool. <code>management_net</code> is created with



Interface Type	Label in Figure	IP Version	Data Received From
			management_network.yaml with input from example_environment.yaml.
	Fixed management IP		Dynamically assigned from IP allocation pool attribute management_net
	Public management IP		Dynamically assigned from IP allocation pool attribute external_net_name. The public_management_IP is associated with management_movable_IP during deployment.  The optional OM_ip_address parameter in vmrf.yaml can be used for a fixed public management IP.
	Next hop for management traffic		Assigned from parameter gateway_ip in management_subnet.
	Announcement storage IP		example_environment.yaml parameter announcement_storage_server_ip
	Shared storage IP		example_environment.yaml parameter shared_storage_server_ip
	NTP IP		example_environment.yaml



Interface Type	Label in Figure	IP Version	Data Received From
			parameters ntp_server_1, and ntp_server_2
Signaling	Signaling IP		Dynamically assigned from parameter allocation_poo ls in Signaling subnet
	MTAS IP		remoteIpAddres s attribute of the MrfH248Interfa ce MO
	Next hop for signaling		Assigned from parameter gateway_ip in Signaling subnet
Media	IP for media	IPv4 or IPv6	Dynamically assigned from paramter allocation_poo ls in Media subnet
	Next hop for media		Assigned from parameter gateway_ip in Media subnet

## 4.2 Provision of IP Address Pools in CEE, using cloud-init

The following HOT files of the `cee` directory are used for vMRF deployment:

- `vmrf.yaml` for creating the vMRF stack in Heat using the `heat stack-create` command.
- `scaling_group.yaml`
- `example_environment.yaml` is used by the OpenStack Environment function and contains network-specific data. This file is populated with example parameter values and needs to be modified to match your network environment.

For more information on OpenStack HOT files, see [Deployment Guide for Cloud Execution Environment \(CEE\)](#).



IP address configuration is the same as described in [Provision of IP Address Pools in OpenStack, using cloud-init](#) on page 10 with the following differences:

Management	Moveable management IP	IPv4	Configured manually with parameter <code>management_ip_address</code>
	Public management IP		Not applicable
	Fixed management IP		Dynamically assigned from <code>management_net</code> IP allocation pool

### 4.3 Provision of IP Address Pools in VMware vSphere Client, using cloud-init

vMRF deployment is performed using the OVF file `vmrf.ovf`. For more information, see [Deployment Guide for VMware vSphere](#).

Table 5 IP Address Configuration using cloud-init in VMware vSphere Client

Interface	Label in Figure	IP Version	Data Received From
Internal	IP for internal network	IPv4	IP Pool attribute of the vSphere Network protocol profile associated to the internal network
Management	Moveable management IP		OVF vApp property <code>Movable IP address</code>
	Public management IP		OVF vApp property <code>Public_OAM_IP address</code>
	Fixed management IP		IP Pool attribute of the vSphere Network protocol profile associated to the management network



Interface	Label in Figure	IP Version	Data Received From
	Next hop for management traffic		gateway attribute of the vSphere Network protocol profile associated to the internal network
	NTP IP		OVF vApp property Ntp_addresses
	Announcement storage IP		OVF vApp property Announcement_storage_server_ip
	Shared storage IP		OVF vApp property Shared_storage_server_ip
	PM monitoring server IP		OVF vApp property Pm_data_monitoring_hosts_ip_address
Signaling	Signaling IP		IP Pool attribute of the vSphere Network protocol profile associated to the signaling network
	MTAS IP		remoteIpAddress attribute of the MrfH248Interface MO
	Next hop for signaling		gateway attribute of the vSphere Network protocol profile associated to the signaling network
Media	Next hop for trusted traffic	IPv4	gateway attribute of the vSphere Network protocol profile associated to the trusted media network



Interface	Label in Figure	IP Version	Data Received From
	IP for media	IPv6	IP Pool attribute of the vSphere Network protocol profile associated to the trusted media network
	Next hop for trusted traffic		Automatically obtained from Router advertisement
	IP for media		Automatically generated based on stateless IPv6 autoconfiguration

The IP addresses chosen from IP pools during deployment are visible in **IP Addresses** in **VM summary** in vSphere.

## 4.4 Provision of IP Address Pools in VMware vCloud Director, using cloud-init

vMRF deployment is performed using the OVF file `vmrf.ovf`. For more information, see [Deployment Guide for VMware vCloud Director](#).

IP address configuration is similar to the one described in [Provision of IP Address Pools in VMware vSphere Client, using cloud-init](#) on page 13, with the following differences:

- IP pools are configured in Provider vDC External networks **Static IP pool**
- Nexthops for management and signaling networks are configured in vCloud Director External networks **Gateway address**
- OVF vApp properties are located in vApp **Guest properties**



## 5 Manual IP Address Configuration during Deployment and Scaling

### 5.1 Manual IP Address Configuration in VMware vCloud Director

vMRF deployment is performed using the OVF file `vmrf_man_ip.ovf`. For more information, see [Deployment Guide for VMware vCloud Director](#).

IP address configuration is similar to the one described in [Manual IP Address Configuration in VMware vSphere Client](#) on page 16, with the following differences:

- Management and signaling network nexthops are configured in vCloud Director External networks **Gateway address**
- OVF vApp properties are located in vApp **Guest properties**
- OVF VM properties are located in VM **Guest properties**
- When a vMRF is connected to a network using access vNIC, the logical network identities, such as VLAN ID, are configured in the vSphere distributed or standard vSwitch port group.

### 5.2 Manual IP Address Configuration in VMware vSphere Client

vMRF deployment is performed using the OVF file `vmrf_man_ip.ovf`. For more information, see [Deployment Guide for VMware vSphere](#).

Details of manual IP address configuration are shown in [Table 6](#).

Table 6 Manual IP Address Configuration in VMware vSphere Client

Interface	Label in Figure	IP Version	Data Received From
Internal	IP for internal network	IPv4	OVF VM property Internal_IPaddress
Management	Moveable management IP		OVF vApp property OAM_IPaddress



Interface	Label in Figure	IP Version	Data Received From
	Public management IP		OVF vApp property Public_OAM_IPaddress
	Fixed management IP		OVF VM property Management_IPaddress
	Next hop for management traffic		gateway attribute of the vSphere Network protocol profile associated to the internal network
	NTP IP		OVF vApp property Ntp_addresses
	Announcement storage IP		OVF vApp property Announcement_storage_server_ip
	Shared storage IP		OVF vApp property Shared_storage_server_ip
	PM monitoring server IP		OVF vApp property Pm_data_monitoring_hosts_ip_address
Signaling	Signaling IP		OVF VM property Signaling_IPaddress
	MTAS IP		remoteIpAddress attribute of the MrfH248Interface MO
	Next hop for signaling		gateway attribute of the vSphere Network protocol profile associated to the signaling network



Interface	Label in Figure	IP Version	Data Received From
Media	Next hop for trusted traffic	IPv4	OVF vApp property Media IPv4 Gateway
	IP for media		OVF VM property Trusted media IPv4 address
	Next hop for trusted traffic	IPv6	OVF vApp property Media IPv6 Gateway
	IP for media		OVF VM property Trusted media IPv6 address



## 6 Redundancy

### 6.1 vMRF SC Redundancy

In vMRF, O&M functions are secured with a redundancy scheme called Roaming SC. This means that all VMs can process payload and also act as a system controller when necessary. If the SC fails, any VM in the cluster can take over the SC role. When a VM takes the SC role, it activates the movable IP address in the management network and sends a gratuitous ARP message to advertise the movable IP address in the management network. For more information on roaming SC, see [vMRF Overview](#).

### 6.2 L2/L3 Router Redundancy

Virtual Router Redundancy Protocol (VRRP) is assumed to be used for router redundancy. The VRRP address is configured as nexthop address in vMRF.

VRRP is used by the L2/L3 Routers to assign the routing responsibilities dynamically to one of the routers, the master router. In the event of a router or link failure in the master router, the IP address and the corresponding VRRP MAC address are changed to direct to the backup router.

Object tracking between internal and external interfaces can also be used in the router to secure that the same router is the master router on both the external and internal side.



## 7 Connectivity

### 7.1 Internal Connectivity

Internal communication between SC and PL VMs is handled on a dedicated internal communication network using IPv4 transport.

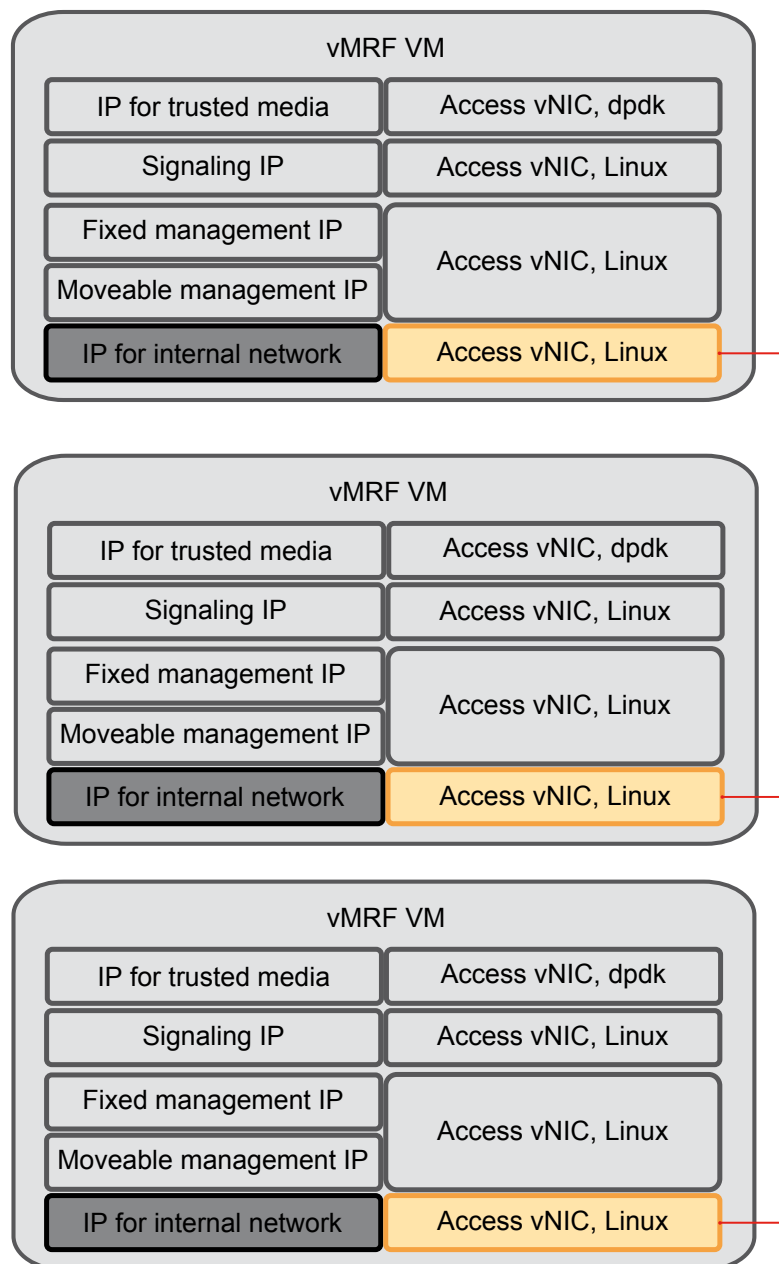


Figure 3 Internal Connectivity in vMRF

Each VM has one access vNIC connected to a subnet used for cluster-internal communication. Only IPv4 is supported for this network.

vMRF uses an untagged VLAN for the internal communication, that is, the vMRF is not adding a VLAN tag for the packets sent in this network. It is assumed that the virtualized infrastructure uses a separate VPN (for example, a VLAN) for



vMRF-internal communication. This VLAN is only accessible from VMs within one vMRF VNF instance.

Table 7 shows the details of the internal network.

Table 7 Internal Network Details in vMRF

Traffic	Transport Protocol	Source	Source Port	Destination	Destination Port	Direction	IP Version
Cluster-internal communication	TIPC, TCP, UDP	vMRF VM	*	vMRF VM	*	bidirectional	IPv4

## 7.2 External Connectivity

### 7.2.1 O&M Connectivity

Figure 4 shows vMRF connected to the O&M network through NBI when the O&M network is behind NAT.

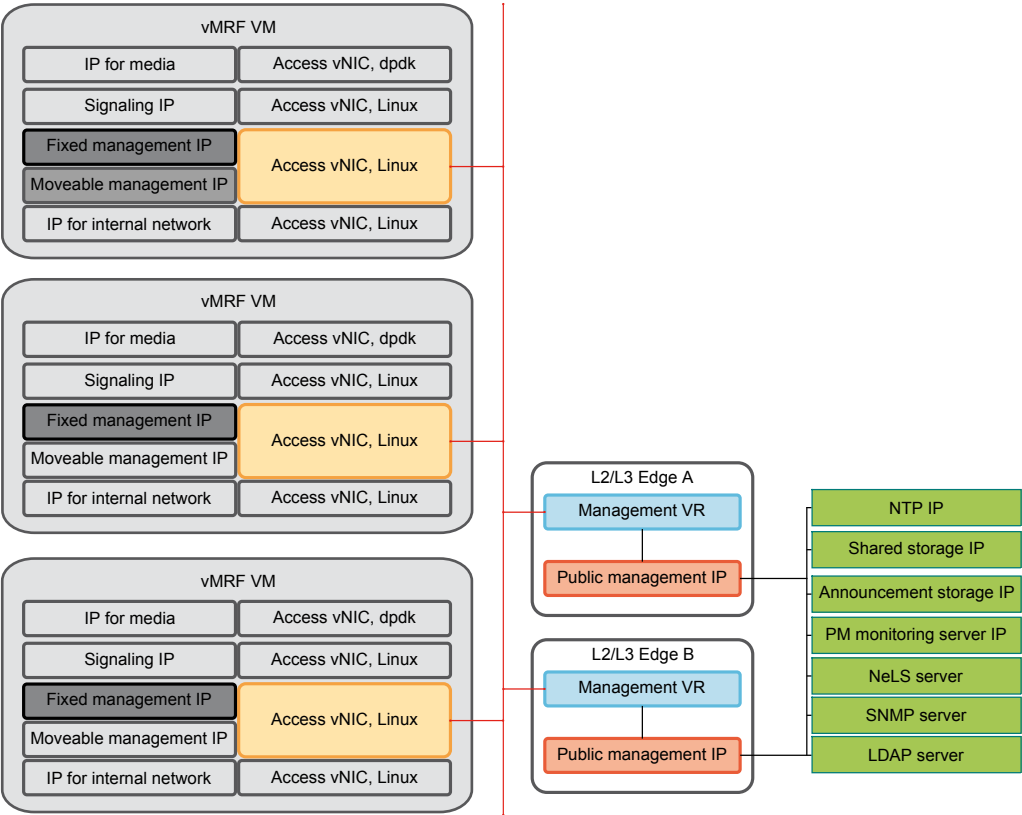


Figure 4 O&M Connectivity in vMRF Using NAT

Figure 5 shows vMRF connected to the O&M network through NBI when no NAT is used.

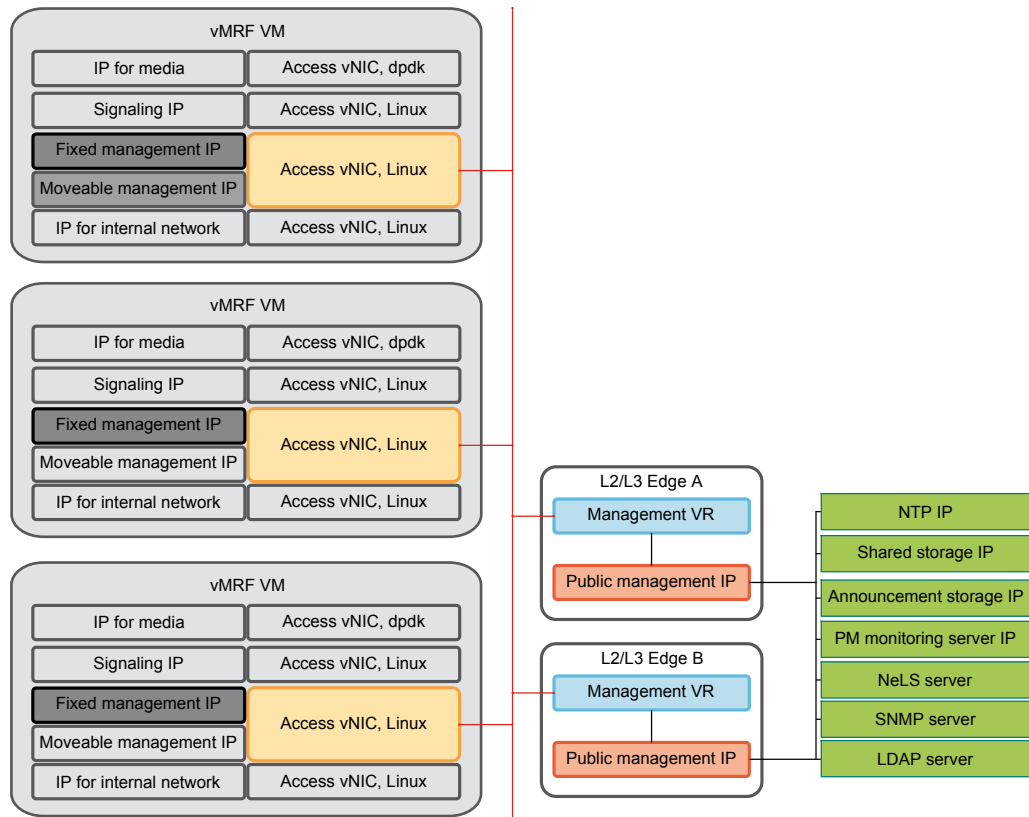


Figure 5 O&M Connectivity in vMRF Without NAT

Each VM has one access vNIC connected to a subnet for vMRF management communication. Only IPv4 is supported in this network. There is one movable IP address in the active SC VM for incoming management traffic, and one fixed IP address per VM for outgoing traffic, used, for example, for time synchronization.

There is an O&M VR in the L2/L3 routers for communication with routers in an external O&M network. All VMs are connected to the O&M VRs over the management VLAN. The management VLAN and a subnet are used for handling data on the NBI towards the SC VM. The management interface is used automatically as the default route in the Linux OS routing table.

**Note:** The management VLAN is created in the virtualized infrastructure by a cloud manager. VLAN tagging is not performed by the vMRF application.

Table 8 shows the traffic passing through over the NBI.

Table 8 O&M Network Details in vMRF

Traffic	Protocol	Source	Source Port	Destination	Destination Port	Direction	Transport Protocol	IP Version
CLI	SSH	user client	*	vMRF MIP	22	incoming	TCP	IPv4



Traffic	Protocol	Source	Source Port	Destination	Destination Port	Direction	Transport Protocol	IP Version
NETCONF	SSH	ENM	*	vMRF MIP	830			
	TLS	ENM	*	vMRF MIP	6513			
PM files, alarm and alert logs	SFTP	ENM	*	vMRF MIP	115			
Synchronization	NTP	vMRF VM (MIP or management_fixed_IP)	*	NTP Server		bidirectional <sup>(1)</sup>	UDP	
SNMP	SNMP	vMRF MIP SNMP server	*	SNMP target vMRF MIP	162 161	outgoing incoming		
LDAP	TLS	vMRF MIP	*	LDAP server	configurable	outgoing	TCP	
	LDAPS		*		configurable			
Shared storage	SFTP (SSHFS)	vMRF VM (MIP or management_fixed_IP)	*	shared storage server	configurable	bidirectional		
PM monitoring	UDP	vMRF VM (MIP or management_fixed_IP)	*	PM monitoring server	configurable	outgoing	UDP	



Traffic	Protocol	Source	Source Port	Destination	Destination Port	Direction	Transport Protocol	IP Version
Announcement storage	SFTP (SSHFS)	vMRF VM	*	announcement storage server	configurable	bidirectional	TCP	
NeLS	TLS	vMRF VM	*	network license server	9095	incoming	TCP	

(1) Association is initiated by vMRF VM.

## 7.2.2

### H.248 Connectivity to MTAS

vMRF communicates with MTAS over the core signaling VPN. Upon configuring MTAS in vMRF, vMRF performs H.248 MG registration towards MTAS. This allows MTAS to utilize vMRF media handling resources for SIP sessions. [Figure 6](#) shows vMRF connected to MTAS on the core signaling network.

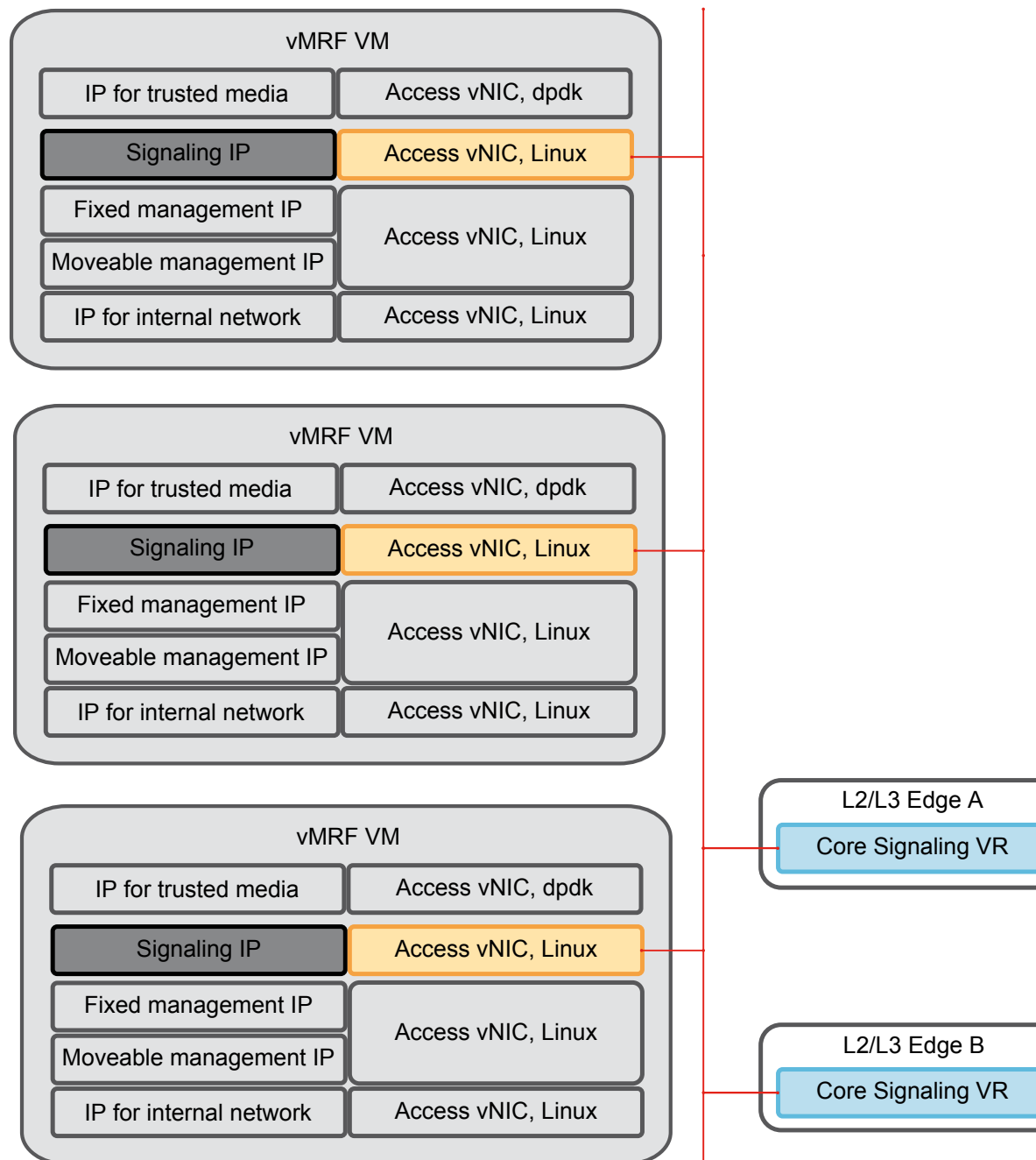


Figure 6 H.248 Connectivity to MTAS

vMRF supports SCTP single-homing for MTAS H.248 signaling connectivity. SCTP single-homing implies that only one local SCTP IP address is configured per vMRF VM. For single-homing connectivity, only one path is available between two SCTP endpoints, so the SCTP association goes down if the path is not available. In addition, the VR redundancy between two L2/L3 routers is controlled by VRRP.



Each VM has one access vNIC connected to a subnet used for vMRF signaling. Only IPv4 is supported for this network.

There is a core signaling VR in L2/L3 routers for communication with routers in a signaling network. All VMs are connected to the signaling VRs over the core signaling VLAN. All VMs communicate with the configured MTAS endpoint over the network. MTAS endpoint configuration is done in the `MrfH248Control` MO. The VRRP IP address of the core signaling VR is resolved by different mechanisms, as described in [General Description](#) on page 5. MTAS IP address-specific entries are added automatically in the Linux OS routing table when the `MrfH248Control` MO is configured.

**Note:** The core signaling VLAN is created in the virtualized infrastructure by a cloud manager. VLAN tagging is not performed by the vMRF application.

shows the details of the core signaling network.

Table 9 Core Signaling Network Details in vMRF

Traffic	Protocol	Source	Source Port	Destination	Destination Port	Direction	Transport Protocol	IP Version
Signaling	H.248	vMRF VM	2944 (configurable)	MTAS	2944 (configurable)	bidirectional	SCTP	IPv4

### 7.2.3 Core Media Network Connectivity

[Figure 7](#) shows vMRF connected to the IMS core media network.

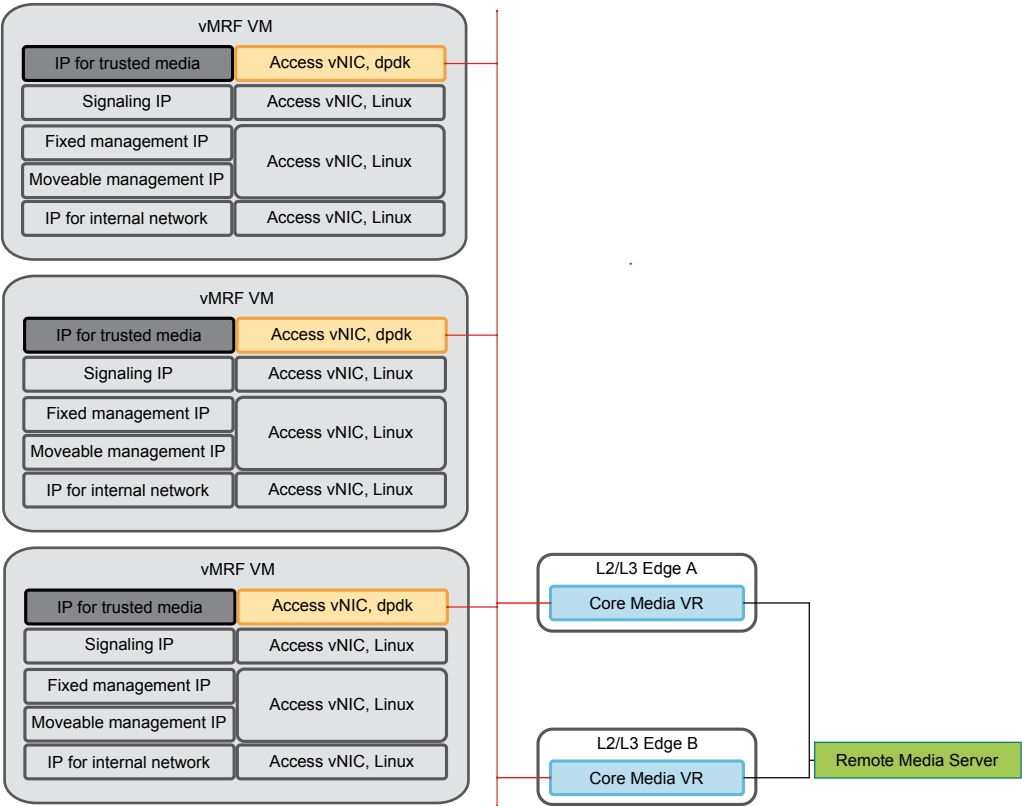


Figure 7 Core Media Network Connectivity in vMRF

Each VM has one access vNIC connected to a subnet used for media communication in core network. Both IPv4 and IPv6 are supported in this network.

There is a core media VR in the L2/L3 routers for communication with routers in the core media network. All VMs are connected to the core media VRs over the core media VLAN. All VMs can be configured to communicate with the remote media server end points over the core network. The VRRP IP address of the core media VR is configured in the `MrfNextHop` MO. Multiple next hops are supported for router load sharing.

**Note:** The core media VLAN is created in the virtualized infrastructure by a cloud manager. VLAN tagging is not performed by the vMRF application.

Table 10 shows the details of the core media network.



Table 10 Core Media Network Details in vMRF

Traffic	Protocol	Source	Source Port	Destination	Destination Port	Direction	Transport Protocol	IP Version
Audio	RTP, RTCP	remote media server	negotiated in SDP  derived through latching	vMRF	1024–65535	bidirectional	UDP	IPv4 or IPv6

Direct connections are required in data center. There must be no NAT configured in data center virtual routers.