Virtual Route Forwarding Design Guide for VRF-Aware Cisco Unified Communications Manager Express

This document provides an overview, a sample configuration, and other information for connecting and using Virtual Route Forwarding (VRF) with your network.

Contents

Introduction

Virtualization is a technique for hiding the physical characteristics of computing resources from the way in which other systems, applications, or end users interact with those resources. This includes making a single physical resource (such as a server, an operating system, an application, storage device, or network) appear to function as multiple logical resources; or it can include making multiple physical resources (such as storage devices or servers) appear as a single logical resource.

Virtual networks is a generic term that uses many different technologies to provide *virtualization*. Fundamentally, virtual networks all provide a mechanism to deploy what looks and operates like multiple networks, and are actually all using the same hardware and physical connectivity.

A distinction needs to be made among the types of virtualization and which layer this network virtualization occurs at:

- Physical (Layer 1)—A Time Division Multiplexer (TDM) provides a way to make a single physical connection look like many physical connections, while still maintaining separation.

- Datalink (Layer 2)—Frame Relay, Asynchronous Transfer Mode (ATM), and Ethernet switches are all examples of how a single physical link may provide multiple logical or virtual connections per physical connection.

- Network (Layer 3)—Routers are examples of how multiple sessions can be carried over a single connection using IP addresses as the identifier. Routers use IP addresses to direct the data to the correct destination. When an IP packet is received the destination address is looked up in a route table to determine the next hop to send the packet to. Normally all packets within a physical router use the same route table or global table.

Virtualization of Networks

If we needed IP networks that are isolated as they were used by different companies, departments, or organizations, we would normally deploy multiple IP networks made up of separate physical routers that were not connected to each other. They may still be using a shared Layer 2 or Layer 1 infrastructure, however at Layer 3 they are not connected and do not form a network.

Network virtualization allows a single physical router to have multiple route tables. The global table contains all IP interfaces that are not part of a specific virtual network and route tables are for each unique virtual network assigned to an IP interface.

In its basic form this allows a FastEthernet 0/0 IP interface to be in virtual network 10 and FastEthernet 0/1 IP interface to be in virtual network 20. Packets arriving on FastEthernet 0/0 are only forwarded to other interfaces in virtual network 10 and do not use FastEthernet 0/1, because it is not in its virtual network: virtual network 10 has no routing knowledge of other virtual networks.

Additional virtualization can be provided by allowing multiple virtual networks per physical connection. This is enabled by using Layer 2 logical connections. For a FastEthernet physical port, the use of multiple virtual LANs (VLANs) allows each VLAN to use a different virtual network.

Virtual Route Forward (VRF) is a technique which creates multiple virtual networks within a single network entity (Figure 1). In a single network component, multiple VRF resources create the isolation between virtual networks.

Figure 1   ***Virtual Route Forwarding***
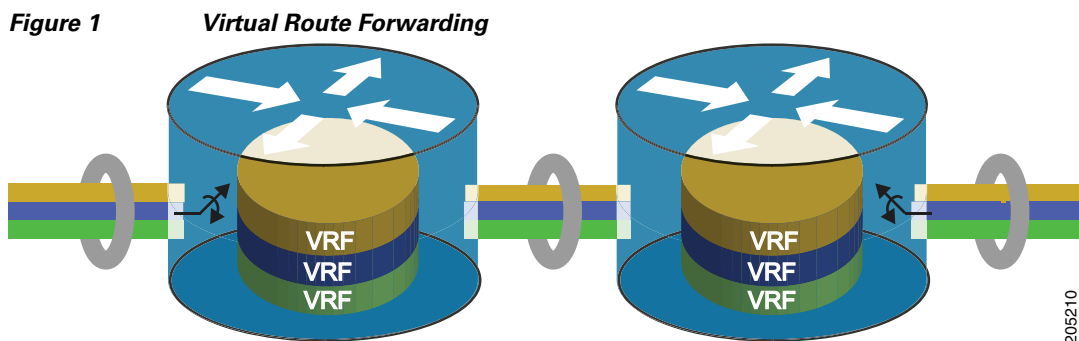
VRF implementations in Cisco Unified Communications Manager Express (Cisco Unified CME) include:

- Single voice network and multiple data networks, which consolidate voice communication into one logically partitioned network to separate voice and data communication on a converged multimedia network.

- Enable Cisco Unified CME on an MPLS provider edge router.

- Enable Cisco Unified CME on multiple CE (VRF Lite) routers.

- Multiple voice networks and multiple data networks, which share a Cisco Unified CME by multiple closed users group with different requirements. Check the feature restrictions for details; VRF does not support identical IP addresses or shared-lines.

Topology

With an increased adoption of IP communications, the data and voice networks co-exist. VLAN is the existing virtualization technique that is used to separate voice networks from data networks. However, in a case where a softphone from a PC (in a data VLAN) wants to talk to a hard-phone in a voice VLAN, the current solution is to allow routing between these two networks through a global routing table. As a result, it creates a potential security threat since the voice VLAN is now visible from the data network.

With the old TDM telephony model, these two were independent networks and have no visibility to each other. A customer talking to an agent on a voice network has no access to the data world of that agent. However, with IP communications, since both are on the same network, security is a significant concern.

Security can be improved by deploying virtualization at the network level. VRF technology can be used with the rules and policies so that each VRF network achieves the expected level of security. The system allow only the softphone application to talk to the hard-phone in a voice VRF, or allow different soft phones within data VRF resources to talk to each other, however, do not allow other applications to communicate with each other.

Figure 2 shows the traditional deployment of Cisco Unified CME, where multiple departments are connected to Cisco Unified CME for voice and data communication. In this deployment, we see both PSTN and WAN connectivity, allowing for interbranch communication through the WAN link. They can reach the rest of the world through the PSTN. In a real life deployment, we may not see that all the phones and PCs directly connected to Ethernet ports of the Cisco Unified CME router. There may be a lot of Ethernet switches in between the Cisco Unified CME and IP devices.

Whatever way the phones and computers are connected to the Cisco Unified CME router, the voice and data network is always separated by VLANs. Usually, all the IP phones are part of the voice VLAN and all other IP devices are in the regular data VLAN. IP phones are not accessible from the data network, although they may share the same physical layers. Virtualization is created through VLANs. To accommodate multiple departments, multiple VLANs are created for security purposes.

*Figure 2*   *Typical Deployment of Cisco Unified Communications Manager Express*
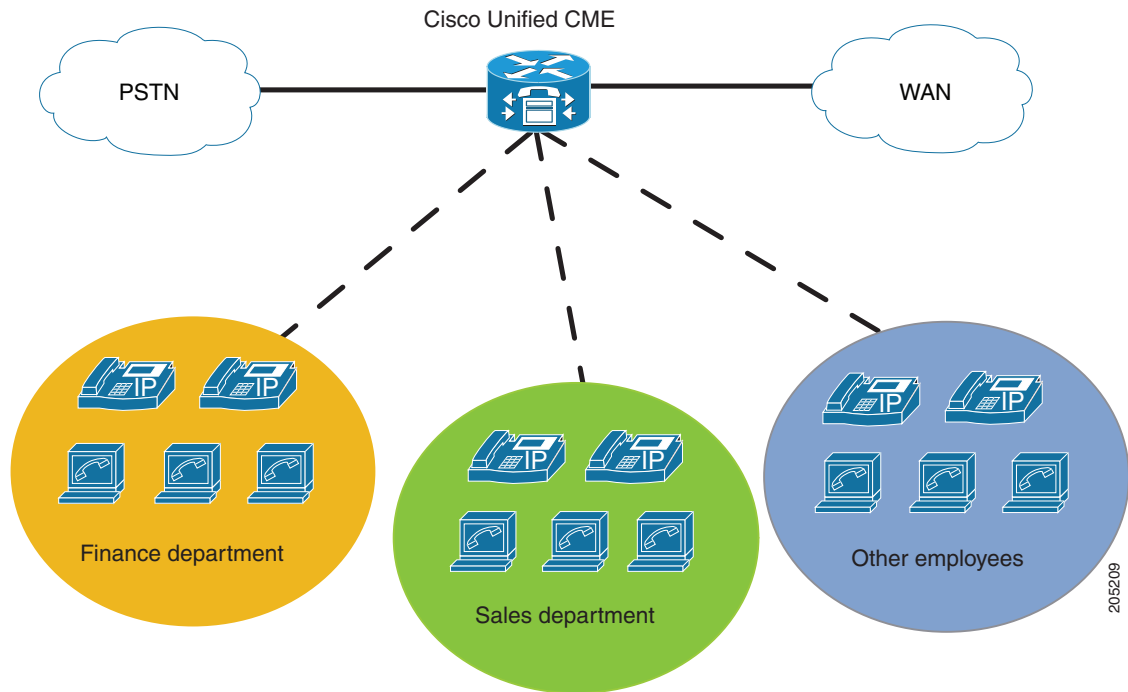
To explain the deployment scenario, we show the detail connectivity in Figure 3, where all the devices from "Finance" and "Sales" departments are connected directly to the Ethernet ports of the Cisco Unified CME. In Figure 3, there are 3 different VLANs:

- VLAN ID 201: Used for phones. All the IP phones belong to this VLAN, regardless of the department. That means that both the finance and sales departments have the same VLAN ID for phones.

- VLAN ID 202: Created to pass data within finance department.

- VLAN ID 203: Created to support data within sales department.

This is layer-2 virtualization. The limitations are:

- Softphones cannot communicate with IP phones, because they belong to different VLANS (data and voice VLANs, respectively).

- There is no separation of traffic when it flows towards the WAN link.

- This box cannot be shared by different organizations. For example, if this box is located in a superstore and then a bank wants to setup a small booth inside that superstore, the bank cannot use this box. The reason is security: there would be no separation between the networks.

***Figure 3***   ***Typical Deployment of Cisco Unified Communications Manager Express with VLAN***
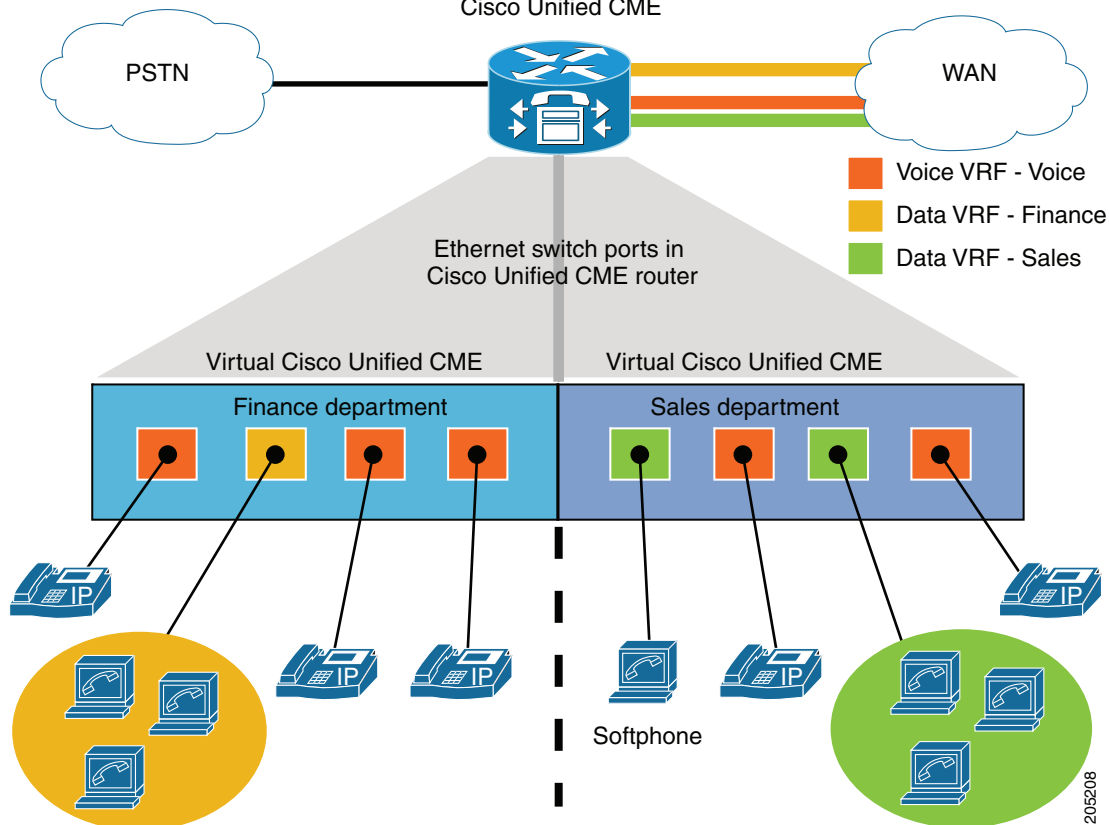
Separating the networks by creating separate VRF resources.

Now, in the same network, we can introduce Layer-3 virtualization by using Virtual Route Forward (VRF). With VRF the Cisco Unified CME can be virtually partitioned into multiple Cisco Unified CME routers. An example for this application is a single Cisco Unified CME being shared by both a supermarket and a Coffee shop/Bank in a campus, but as networks, they can not talk to each other except over a PSTN or through restricted route leaks.

Another example of the VRF in voice networks is to split Cisco Unified CME into different VRF networks, one for each department, such as finance, sales, HR, marketing, guest network, employees, and so on. The actual call processing rules can be applied by voice on a per VRF basis in this case.

Each of the virtual Cisco Unified CME routers handles the phones registered under that virtual Cisco Unified CME. Figure 4 shows two virtual Cisco Unified CME routers hosted in a single Cisco Unified CME platform. They work like independent Cisco Unified CME routers.

Figure 4 *Typical Deployment of Cisco Unified Communications Manager Express with VRF*
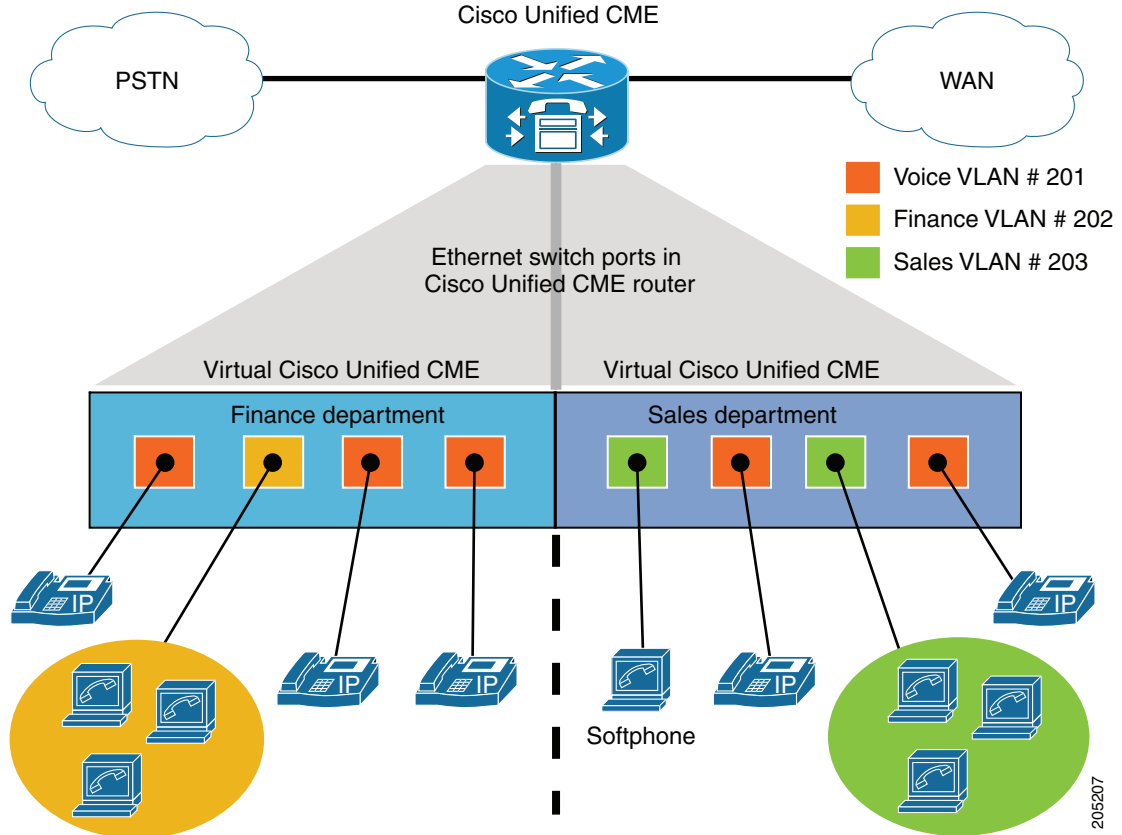
Separating the networks by creating separate VRF resources.

In this example, we have both data and voice together where:

• Finance Virtual — Cisco Unified CME has its own voice and data network (VRF: Finance)

• Sales Virtual — Cisco Unified CME has its own voice and data network (VRF: Sales)

• The Finance department has its own secured server, where only the Finance department can access those resources. Similarly, the Sales department has its own server, which is accessible to only the Sales department.

• Finance should not be able to access Sales servers/resources and vice versa.

• Both the Finance and Sales departments have IP telephones controlled by Cisco Unified CME. Those phones should be able to communicate among each other, including sharing the common voice gateways, voice mail servers, and so on. In Figure 4, the Finance department has 3 IP phones and few computers. The Sales department has 2 IP phones, softphones, and computers.

• Softphones from both data VRF resources (Finance and Sales) can communicate with IP phones.

A VRF is assigned to an interface. The devices behind this interface are all under a particular VRF and all phones behind this VRF interface can communicate with its server in the same VRF. In this case, the Cisco Unified CME router is the server. In a device with multiple interfaces, each of the interfaces can be assigned a VRF. The interfaces that are not assigned to a VRF use the global routing table as the default routing table (for example, the VRF table ID is 0).

Elements Description

Voice network virtualization adds VRF support for Cisco Unified CME, conferencing, transcoding, and so on. Enabling VRF-awareness in Cisco Unified CME and SRST (Survivable Remote Site Telephony) allows the SCCP phone or SIP IP phones associated with Cisco Unified CME or SRST to be assigned a VRF-ID. Cisco Unified CME IP phones and conferencing/transcoding/TRP (Media Termination Functionality) voice components can be assigned to the voice VRF. It also allows softphones in data VRF resources to communicate with hard phones in a voice VRF.

The overall components for Cisco Unified CME deployment include:

- SIP/SCCP phones under Cisco Unified CME
- Internal Xcoder/Conference/TRP (Media Termination Functionality)
- Hard/analog phone in a single voice VRF and a softphone in multiple data VRF resources

In this solution, we assume that the softphones (SCCP only) from PCs register through a data VRF. We also assume that all hard phones are registered through a voice VRF (a global and default VRF). Like softphones, the TAPI client from PCs also register to the SCCP server through a data VRF.

We recommend that you use a TRP device (controlled by a Cisco Unified CME server process, internal TRP) when interVRF communication needs to be done. For SCCP Cisco Unified CME, the TRP device handles media transmit functions for both media streams in order to flow through Cisco Unified CME. You must set correct VRF IDs for both media streams through this TRP functionality in the Cisco Unified CME router.

SIP Cisco Unified CME

The SIP layer is made VRF aware. Cisco IOS software supports single voice VRF for SIP, which is based on global voice VRF configuration.

SCCP Cisco Unified CME

Cisco Unified CME behaves like an independent Cisco Unified CME for each of the VRF endpoints. In Figure 5, endpoints shown in blue register and communicate with Cisco Unified CME, which is listening on a standard socket in the blue Cisco Unified CME address space. This is the same for other VRF resources —green endpoints send their registration and other communications to their advertised green Cisco Unified CME address.

Figure 5 **Different Components Register to Cisco Unified CME**
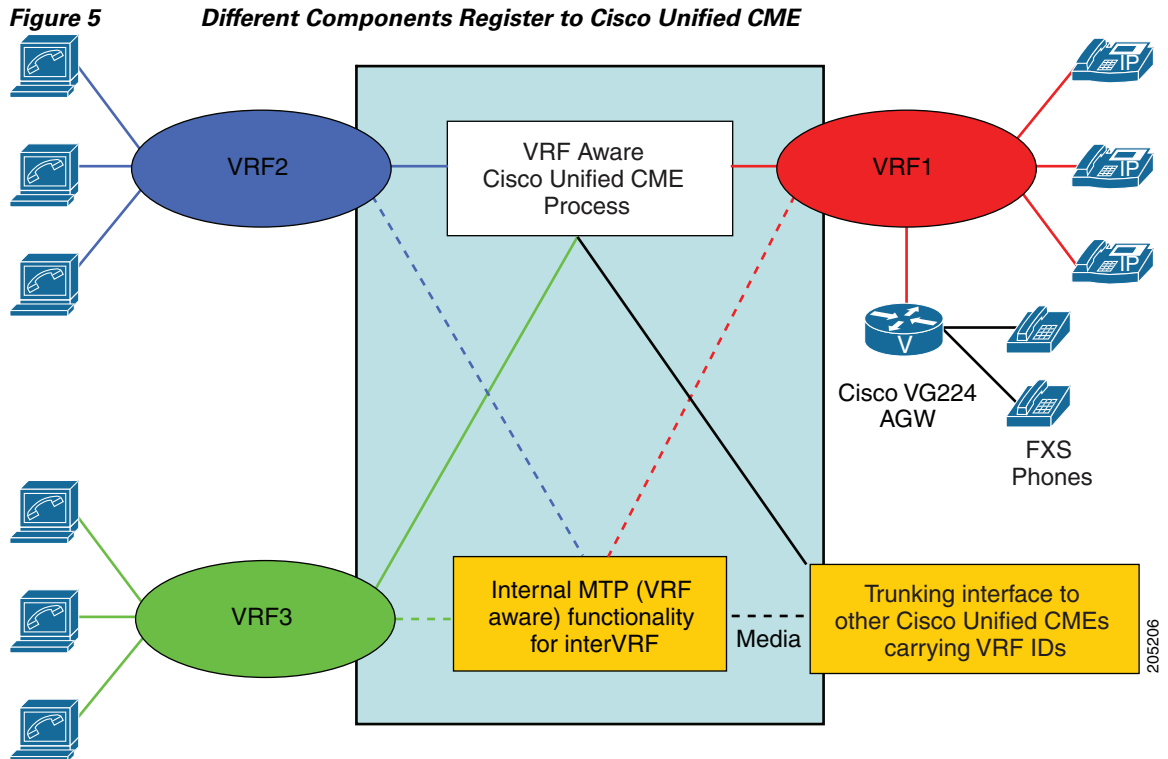
The endpoints themselves contact Cisco Unified CME as they did before. No software change is required on the endpoint itself. The Cisco Unified CME ephone server process is now be able to receive registration from different interfaces, (each representing a separate VRF) then to verify and accept the calls coming in from different VRFs.

In the case of SCCP Cisco Unified CME, the VRF ID information is configured for each ephone or a group of ephones, and configuration is used in the routing process. When a call is being routed, depending on the VRF of the outgoing interface, the VRF ID is set on that interface and the call is routed accordingly. The Cisco Unified CME server process determines the VRF of the outgoing interface and sets it accordingly. This applies to both inter and intraVRF form signaling.

For the SCCP Cisco Unified CME TAPI client, the VRF ID information is configured and verified when the TAPI client registers. Registration request for the phone or TAPI client from a different VRF interface other than configured will be rejected.

For media, in a SCCP Cisco Unified CME, two modes are supported. In one mode, media always flows between the endpoints. This is still true for inter-VRF communication, because each of these end devices is capable of reaching the other directly. The second mode is currently to force the media to go through the Cisco Unified CME router. This is achieved using the "TRP" configuration under ephone. This will continue to work for intraVRF media flow-through also without "TRP" configuration.

SCCP Controlled Analog Endpoints

Figure 5 also shows an analog voice gateway with an FXS interface to analog phones. The VGW (Cisco VG224) talks to Cisco Unified CME using SCCP. The media path between analog VGW and Cisco Unified CME is flow-through when a call goes through the H323/SIP trunk. If the call is between two SCCP endpoints, the path is directly between endpoints. For all practical purposes, the Cisco VG224 acts like an SCCP endpoint. All the phones map 1:1 between a voice port and the ephone. In order for VRF awareness to be extended to these phones, we assume that all the analog phones registering to Cisco

Unified CME through the Cisco VG224 are similar to hard ephones and are in the same VRF as hard phones. In order for interVRF calls between phones from analog phones behind analog VGW and data, VRF is the same as interVRF described earlier.

Configuring a Voice VRF

To configure a voice VRF, you must shutdown voice services on the gateway, assign a previously defined VPN VRF to the VoIP SPI, and then restart voice services.

This section describes the tasks required to configure VRF-aware voice gateways.

Note If a voice VRF is not configured, signaling and media packets are sent using the default routing table.

Prerequisites

Be sure to check the following prerequisites before configuring a voice VRF:

- To ensure there are no active calls on the voice gateway during a VRF change, you must shut down the voice gateway before you configure or make changes to a voice VRF.

- If your configuration uses address binding, use the **h323-gateway voip bind srcaddr** *ip-address* command to bind the gateway to an interface that belongs to the voice VRF.

- If the voice gateway configuration has H.323 RAS enabled, use the **h323-gateway voip interface** command to configure RAS on the interface that belongs to the voice VRF.

Restrictions

Restrictions for configuring VRF-aware H.323 and SIP are as follows:

- If the voice gateway configuration has H.323 RAS enabled, the gatekeeper must be accessible to the gateway in the configured voice VRF.

- When voice VRF is configured, the H.323 gateway and gatekeeper cannot communicate with each other if they are on the same router.

Voice VRF supports only the following call types:

- A single VRF for SIP-to-SIP calls

- A single VRF for H323-to-SIP calls

- A single VRF for H323-to-H323 calls

- A single VRF in IP-to-IP gateway calls with a gatekeeper involved, however the gatekeeper is not on the same router.

- A SIP SRST call

- A SCCP SRST call

- A SCCP Cisco Unified CME call

- A SIP Cisco Unified CME call

SUMMARY STEPS

1. **enable**

   2. **configure terminal**

   3. **ip vrf** *vrfname*

   4. **rd** *route-distinguisher*

   5. **route-target** {**import** | **export** | **both**} *route-target-ext-community*

   6. **exit**

   7. **voice service voip**

   8. **shutdown**

   9. **exit**

  10. **voice vrf** *vrfname*

  11. **voice service voip**

  12. **no shutdown**

  13. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> enable	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.
Step 3	**ip vrf** *vrfname* **Example:** Router(config)# ip vrf vrf1	Defines a Virtual Private Network (VPN) routing/forwarding (VRF) instance and enters VRF configuration mode. • *vrfname*—Identifier for the VRF.
Step 4	**rd** *route-distinguisher* **Example:** Router(config-vrf)# rd 1:1	Creates a routing and forwarding table for a VPN VRF. • *route-distinguisher*—Adds an 8-byte value to an IPv4 prefix to create a VPN IPv4 prefix.
Step 5	**route-target {import | export | both} route-target-ext-community** **Example:** Router(config-vrf)# route-target export 1:2	Creates a list of import or export route target communities for the specified VRF. • **import**—Imports routing information from the target VPN extended community. • **export**—Exports routing information to the target VPN extended community. • **both**—Imports both import and export routing information to the target VPN extended community. • *route-target-ext-community*—Adds the route-target extended community attributes to the VRF's list of import, export, or both (import and export) route-target extended communities.
Step 6	**exit** **Example:** Router(config-vrf)# exit	Exits VRF configuration mode.
Step 7	**voice service voip** **Example:** Router(config)# voice service voip	Enters voice-service configuration mode.
Step 8	**shutdown** **Example:** Router(config-voi-serv)# shutdown	Shuts down voice services.

Step 9	`exit`
	
	Example:
	`Router(config-voi-serv)# exit`
		Exits voice-service configuration mode.

Step 10	`voice vrf name`
	
	Example:
	`Router(config)# voice vrf vrf1`
		Assigns a predefined VRF to voice services.
		
		• *vrfname*—Identifier for the VRF.

Step 11	`voice service voip`
	
	Example:
	`Router(config)# voice service voip`
		Enters voice-service configuration mode.

Step 12	`no shutdown`
	
	Example:
	`Router(config-voi-serv)# no shutdown`
		Restarts voice services.

Step 13	`end`
	
	Example:
	`Router(config-voi-serv)# end`
		Returns to privileged EXEC mode.

Examples

```
!
ip vrf vrf1
 rd 1:1
 route-target export 1:2
 route-target import 1:2
!
voice vrf vrf1
!
voice service voip
!
```

Cisco IOS Global Configuration

The following example is part of a Cisco Unified CME/SRST configuration. There are two VRF resources, VPN801 and VPN802, defined for two groups of phones. Cisco Unified CME belongs to the third VRF and is named *ccm*.

VRF resources VPN801 and VPN802 import routes from and import routes to VRF ccm. VPN801 and VPN802 can access VRF ccm, but their routes are independent of each other.

The default voice VRF is ccm, where SIP phones must belong to and be registered with Cisco Unified CME.

Initially, phones belonging to VRF VPN801 and VPN802 register to Cisco Unified CME.

```
voice vrf ccm
ip vrf VPN801
 rd 801:1
 route-target export 801:1
 route-target import 1000:1
!
```

```
ip vrf VPN802
 rd 802:1
 route-target export 802:1
 route-target import 1000:1
!
ip vrf ccm
 rd 1000:1
 route-target export 1000:1
 route-target import 801:1
 route-target import 802:1
!
interface FastEthernet0/0
 no ip address
 duplex auto
 speed auto
!
interface FastEthernet0/0.801
 encapsulation dot1Q 801
 ip vrf forwarding VPN801
 ip address 21.22.21.1 255.255.255.0
 ip helper-address global 21.20.10.11
!
interface FastEthernet0/0.802
 encapsulation dot1Q 802
 ip vrf forwarding VPN802
 ip address 21.22.22.1 255.255.255.0
 ip helper-address 21.20.10.11
```

VoIP and POTS Dial Peers

The dial peers are a global resource and belongs to voice VRF, which are shared and accessible from any VRF. There is no need to specify a dial peer for an individual VRF.

The following example shows how to configure one outgoing ISDN PRI trunk, SIP trunk, and H.323 trunk to any service provider or another Cisco Unified CME.

```
dial-peer voice 2822 pots
 corlist outgoing PSTN-TRUNK
 destination-pattern 7....
 direct-inward-dial
 port 1/0/0:23
 forward-digits 4
!
dial-peer voice 2821 voip
 corlist outgoing SIP-TRUNK
 destination-pattern 8....
 voice-class codec 1
 session protocol sipv2
 session target ipv4:11.2.0.1
 dtmf-relay sip-notify
 no vad
!
dial-peer voice 1000 voip
 voice-class codec 1
!
dial-peer voice 2823 voip
 corlist outgoing H323-TRUBK
 destination-pattern 9....
 voice-class codec 1
 session target ipv4:11.2.0.1
!
dial-peer voice 28211 voip
```

```
 translation-profile incoming STRIP
 voice-class codec 1
 incoming called-number.%
 no vad
!
```

DHCP Configurations

The three ways to define DHCP address allocation are shown below. Duplicate IP addresses, even with VRF specified, are not supported.

1. With a global address allocation scheme, you must use the **no ip dhcp use vrf connected** command.

```
no ip dhcp use vrf connected
ip dhcp pool vcme1
   network 20.1.10.0 255.255.255.0
   option 150 ip 20.1.10.1
   default-router 20.1.10.1
   class vcme1
      address range 20.1.10.10 20.1.10.250
!
```

2. The following example shows how to assign addresses from VRF pool VPN801.

```
ip dhcp use vrf connected
!
ip dhcp pool vcme1
   vrf VPN801
   network 20.1.10.0 255.255.255.0
   option 150 ip 20.1.10.1
   default-router 20.1.10.1
   class vcme1
      address range 20.1.10.10 20.1.10.250
!
```

3. The following example show how to assign an address by an individual host. You must replace the first two hexadecimal digits of a host MAC address with **01**.

```
ip dhcp pool phone3
   host 20.2.10.11 255.0.0.0
   client-identifier 0100.0ed7.4ce6.3d
   default-router 20.2.10.1
   option 150 ip 20.2.10.1
!
```

Cisco Unified CME SCCP Phone Configuration

The following example shows how to define telephony-service with up to two VRF resources and two groups of phones.

```
telephony-service
 sdspfarm conference mute-on # mute-off #
 sdspfarm units 4
 sdspfarm transcode sessions 10
 sdspfarm tag 1 xcode101
 sdspfarm tag 2 conf103
 group  1 vrf VPN801
ip source-address 20.1.10.1 port 2000
  url directories http://20.1.10.1/localdirectory
 !
 group  2 vrf VPN802
```

```
 ip source-address 20.2.10.1 port 2000
 !
load 7960-7940 P00308000400
 load 7941 SCCP41.8-2-1S
 load 7970 SCCP70.8-3-1S
 max-ephones 52
 max-dn 192
 auto assign 100 to 167 type 7960
 auto assign 168 to 192 type anl
 calling-number initiator
 system message vcme 2821
 time-zone 5
 max-conferences 1 gain 6
 call-park system redirect
 call-forward pattern .T
 call-forward system redirecting-expanded
 moh music-on-hold.au
 web admin system name cisco secret 5 $1$3.ZT$q0g3MXmIP8doZmA7v1mXz.
 dn-webedit
 time-webedit
 transfer-system full-consult dss
 transfer-pattern 9.T
 secondary-dialtone 9
 directory last-name-first
 create cnf-files version-stamp 7960 Jan 15 2008 22:32:06
!
ephone-dn  1
 number 7483001
 description 7483001
 name 7483001
!
!ephone-dn  2
 number 7493001
 description 7493001
 name 7493001
!
!ephone  1
 description cme-2801 srst : Aug 27 2007 18:18:20
 mac-address 0012.8055.D2EE
 group phone 1
 button  1:1
!
!!ephone  2
 description cme-2801 srst : Aug 27 2007 18:18:20
 mac-address 000E.D710.9F4A
 group phone 2
 button  1:2
!
```

Cisco Unified CME SIP Phone Configuration

The following example shows SIP phone registration and definition. A SIP phone must belong to voice VRF. Otherwise, SIP phones do not register properly.

```
voice register global
 mode cme
 source-address 20.2.10.1 port 5060
 max-dn 192
 max-pool 48
 create profile sync 0111955967541377
!
voice register dn  5
```

```
 number 2002
 allow watch
 label vcme2
!
voice register pool  5
 id mac 0014.698C.5D9F
 type 7960
 number 1 dn 5
 presence call-list
 voice-class codec 1
 username xxxx password xxxx
 blf-speed-dial 2 2001 label "group2"
 blf-speed-dial 3 3001 label "group3"
 blf-speed-dial 4 1001 label "group1"
 blf-speed-dial 5 5001 label "group5"
!
```

CME Supplementary Services

These services are shared among groups of phones and you must specify a VRF for each service. Phones in VPN801 and VPN802 are controlled by the same set of parameters.

```
voice service voip
 allow-connections h323 to h323
 allow-connections h323 to sip
 allow-connections sip to h323
 allow-connections sip to sip
 supplementary-service h450.12
 h323
 sip
  registrar server expires max 3600 min 3600
```

VRF-Aware Configuration Example

Figure 6 shows a configuration topology for VRF-Aware SIP call flows on Cisco Unified CME.

Figure 6 **Topology for Cisco Unified CME**
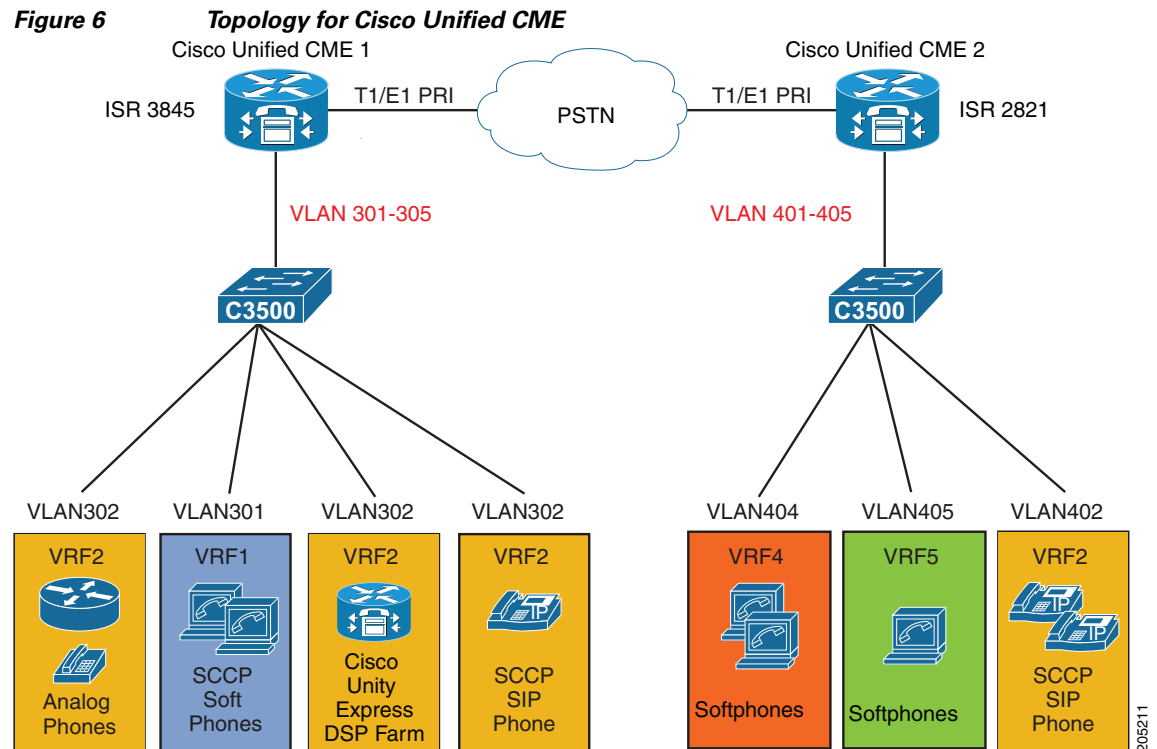
Configuring Cisco Unified CME 1

Here is the full configuration of the Cisco Unified CME 1 running on a Cisco ISR 3845 router:

```
!
version 12.4
no service timestamps debug uptime
no service timestamps log uptime
no service password-encryption
!
hostname Router
!
boot-start-marker
boot-end-marker
!
card type t1 3 1
logging message-counter syslog
no logging buffered
no logging console
enable password xxxx
!
no aaa new-model
clock timezone PST -8
clock summer-time pdt recurring
no network-clock-participate slot 3
!
dot11 syslog
```

```
ip source-route
ip auth-proxy max-nodata-conns 3
ip admission max-nodata-conns 3
ip cef
!
!
no ip dhcp use vrf connected
!
ip dhcp pool phone
   network 10.10.10.0 255.255.255.0
   default-router 10.10.10.1
   option 150 ip 10.10.10.1
!
ip dhcp pool vrf1
   network 10.1.10.0 255.255.255.0
   default-router 10.1.10.1
   option 150 ip 10.1.10.1
   class vrf1
      address range 10.1.10.10 10.1.10.250
!
ip dhcp pool vrf2
   network 10.2.10.0 255.255.255.0
   default-router 10.2.10.1
   option 150 ip 10.2.10.1
   class vrf2
      address range 10.2.10.10 10.2.10.250
!
ip dhcp pool vrf3
   network 10.3.10.0 255.255.255.0
   option 150 ip 10.3.10.1
   default-router 10.3.10.1
   class vrf3
      address range 10.3.10.10 10.3.10.250
!
ip dhcp pool vrf4
   network 10.4.10.0 255.255.255.0
   default-router 10.4.10.1
   option 150 ip 10.4.10.1
   class vrf4
      address range 10.4.10.10 10.4.10.250
!
ip dhcp pool vrf5
   network 10.5.10.0 255.255.255.0
   default-router 10.5.10.1
   option 150 ip 10.5.10.1
   class vrf5
      address range 10.5.10.10 10.5.10.250
!
ip dhcp pool subcme4
   network 11.4.10.0 255.255.255.0
   default-router 11.4.10.1
   option 150 ip 11.4.10.1
   class subcme4
      address range 11.4.10.10 11.4.10.250
!
ip dhcp pool subcme5
   network 11.5.10.0 255.255.255.0
   default-router 11.5.10.1
   option 150 ip 11.5.10.1
   class subcme5
      address range 11.5.10.10 11.5.10.250
!
ip dhcp pool subcme3
   network 11.3.10.0 255.255.255.0
```

```
                default-router 11.3.10.1
                option 150 ip 11.3.10.1
                class subcme3
                    address range 11.3.10.10 11.3.10.250
        !
        ip dhcp pool subcme2
                network 11.2.10.0 255.255.255.0
                default-router 11.2.10.1
                option 150 ip 11.2.10.1
                class subcme2
                    address range 11.2.10.10 11.2.10.250
        !
        ip dhcp pool subcme1
                network 11.1.10.0 255.255.255.0
                option 150 ip 11.1.10.1
                default-router 11.1.10.1
                class subcme1
                    address range 11.1.10.10 11.1.10.250
        !
        !
        ip dhcp class vrf1
        !
        ip dhcp class vrf2
        !
        ip dhcp class vrf3
        !
        ip dhcp class vrf4
        !
        ip dhcp class vrf5
        !
        ip dhcp class subcme4
        !
        ip dhcp class subcme5
        !
        ip dhcp class subcme3
        !
        ip dhcp class subcme2
        !
        ip dhcp class subcme1
        !
        ip vrf vrf1
         rd 100:1
         route-target export 100:1
         route-target import 100:1
        !
        ip vrf vrf2
         rd 100:2
         route-target export 100:2
         route-target import 100:2
        !
        ip vrf vrf3
         rd 100:3
         route-target export 100:3
         route-target import 100:3
        !
        ip vrf vrf4
         rd 100:4
         route-target export 100:4
         route-target import 100:4
        !
        ip vrf vrf5
         rd 100:5
         route-target export 100:5
         route-target import 100:5
```

```
!
no ipv6 cef
!
multilink bundle-name authenticated
!
!
!
!
!
!
ctl-client
voice-card 0
 dsp services dspfarm
!
voice-card 3
 no dspfarm
!
!
voice rtp send-recv
voice vrf vrf2
!
voice service voip
 allow-connections h323 to h323
 allow-connections h323 to sip
 allow-connections sip to h323
 allow-connections sip to sip
 supplementary-service h450.12
 h323
  h225 timeout keepalive
 sip
  registrar server expires max 3600 min 3600
!
!
voice class codec 1
 codec preference 1 g711ulaw
 codec preference 2 g711alaw
 codec preference 3 g729r8
!
!
!
!
!
!
!
!
!
!
!
!
voice register dn  10
 number 2098
!
voice register pool  10
 id mac 0017.E014.2473
 number 1 dn 10
 voice-class codec 1
!
!
voice translation-rule 1
 rule 1 /81098/ /1098/
 rule 2 /84099/ /4099/
 rule 3 /91098/ /1098/
 rule 4 /94099/ /4099/
```

```
 rule 5 /82099/ /2099/
 rule 6 /81098/ /1098/
 rule 7 /82098/ /2098/
!
!
voice translation-profile STRIP
 translate called 1
!
!
!
!
!
!
username xxxx password xxxx
archive
 log config
  hidekeys
!
!
!
!
!
controller T1 3/0
!
controller T1 3/1
!
ip ftp username Administrator
ip ftp password xxxx
!
class-map match-all L3-to-L2_VoIP-Cntrl
 match  dscp af31
class-map match-all L3-to-L2_VoIP-RTP
 match  dscp ef
class-map match-all SIP
 match protocol sip
class-map match-all RTP
 match protocol rtp
!
!
policy-map EthOut
 class RTP
policy-map output-L3-to-L2
 class L3-to-L2_VoIP-RTP
  set cos 5
 class L3-to-L2_VoIP-Cntrl
  set cos 3
!
!
!
!
!
interface Loopback5
 ip address 12.5.10.1 255.255.255.255
!
interface Loopback101
 ip vrf forwarding vrf1
 ip address 11.1.0.1 255.255.255.255
!
interface Loopback102
 ip vrf forwarding vrf2
 ip address 11.2.0.1 255.255.255.255
!
interface Loopback103
 ip vrf forwarding vrf3
```

```
 ip address 11.3.0.1 255.255.255.255
!
interface Loopback104
 ip vrf forwarding vrf4
 ip address 11.4.0.1 255.255.255.255
!
interface Loopback105
 ip vrf forwarding vrf5
 ip address 11.5.0.1 255.255.255.255
!
interface GigabitEthernet0/0
 no ip address
 duplex auto
 speed auto
 media-type rj45
 no keepalive
!
interface GigabitEthernet0/0.301
 encapsulation dot1Q 301
 ip vrf forwarding vrf1
ip address 10.1.10.1 255.255.255.0
!
interface GigabitEthernet0/0.302
 encapsulation dot1Q 302
 ip vrf forwarding vrf2
 ip address 10.2.10.1 255.255.255.0
!
interface GigabitEthernet0/0.303
 encapsulation dot1Q 303
 ip vrf forwarding vrf3
 ip address 10.3.10.1 255.255.255.0
!
interface GigabitEthernet0/0.304
 encapsulation dot1Q 304
 ip vrf forwarding vrf4
 ip address 10.4.10.1 255.255.255.0
!
interface GigabitEthernet0/0.305
 encapsulation dot1Q 305
 ip vrf forwarding vrf5
 ip address 10.5.10.1 255.255.255.0
!
interface GigabitEthernet0/1
 no ip address
 duplex auto
 speed auto
 media-type rj45
 no keepalive
!
interface GigabitEthernet0/1.101
 encapsulation dot1Q 101
 ip vrf forwarding vrf1
 ip address 11.1.10.1 255.255.255.0
!
interface GigabitEthernet0/1.102
 encapsulation dot1Q 102
 ip vrf forwarding vrf2
 ip address 11.2.10.1 255.255.255.0
!
interface GigabitEthernet0/1.103
 encapsulation dot1Q 103
 ip vrf forwarding vrf3
 ip address 11.3.10.1 255.255.255.0
!
```

```
interface GigabitEthernet0/1.104
 encapsulation dot1Q 104
 ip vrf forwarding vrf4
 ip address 11.4.10.1 255.255.255.0
!
interface GigabitEthernet0/1.105
 encapsulation dot1Q 105
 ip vrf forwarding vrf5
 ip address 11.5.10.1 255.255.255.0
!
interface FastEthernet0/1/0
!
interface FastEthernet0/1/1
!
interface FastEthernet0/1/2
!
interface FastEthernet0/1/3
!
interface Service-Engine1/0
 no ip address
 shutdown
!
interface Vlan1
 no ip address
!
router ospf 101 vrf vrf1
 log-adjacency-changes
 network 10.1.0.0 0.0.255.255 area 0
 network 11.1.0.1 0.0.0.0 area 0
 network 11.0.0.0 0.255.255.255 area 0
!
router ospf 102 vrf vrf2
 log-adjacency-changes
 network 10.2.0.0 0.0.255.255 area 0
 network 11.2.0.1 0.0.0.0 area 0
 network 11.0.0.0 0.255.255.255 area 0
!
router ospf 103 vrf vrf3
 log-adjacency-changes
 network 10.3.0.0 0.0.255.255 area 0
 network 11.3.0.1 0.0.0.0 area 0
 network 11.0.0.0 0.255.255.255 area 0
!
router ospf 104 vrf vrf4
 log-adjacency-changes
 network 10.4.0.0 0.0.255.255 area 0
 network 11.4.0.1 0.0.0.0 area 0
 network 11.0.0.0 0.255.255.255 area 0
!
router ospf 105 vrf vrf5
 log-adjacency-changes
 network 10.5.0.0 0.0.255.255 area 0
 network 11.5.0.1 0.0.0.0 area 0
 network 11.0.0.0 0.255.255.255 area 0
!
router ospf 109
 log-adjacency-changes
 network 11.9.0.0 0.0.255.255 area 0
!
router ospf 210
 log-adjacency-changes
 network 21.10.0.0 0.0.255.255 area 0
!
ip forward-protocol nd
```

```
ip http server
ip http authentication local
no ip http secure-server
ip http path flash:
!
!
!
access-list 101 permit ip host 10.1.10.251 any
access-list 102 permit ip host 21.10.10.6 any
access-list 103 permit ip any host 21.10.10.6
access-list 104 permit ip any host 12.5.10.1
access-list 105 permit ip host 12.5.10.1 any
!
!
!
!
!
!
control-plane
!
!
!
voice-port 0/0/0
!
voice-port 0/0/1
!
voice-port 0/0/2
!
voice-port 0/0/3
!
ccm-manager fax protocol cisco
!
mgcp fax t38 ecm
!
sccp local Loopback5
sccp ccm 12.5.10.1 identifier 2 version 4.1
sccp
!
sccp ccm group 2
 bind interface Loopback5
 associate ccm 2 priority 1
 associate profile 103 register conf103
 associate profile 101 register xcode101
!
dspfarm profile 101 transcode
 codec g711ulaw
 codec g711alaw
 codec g729ar8
 codec g729abr8
 codec g729r8
 maximum sessions 1
 associate application SCCP
!
dspfarm profile 103 conference
 codec g711ulaw
 codec g711alaw
 codec g729ar8
 codec g729abr8
 codec g729r8
 codec g729br8
 maximum sessions 1
 associate application SCCP
!
```

```
!
dial-peer voice 3845 voip
 destination-pattern 8....
 voice-class codec 1
 session protocol sipv2
 session target ipv4:20.2.10.1
 dtmf-relay rtp-nte
 no vad
!
dial-peer voice 3847 voip
 destination-pattern 9....
 voice-class codec 1
 session target ipv4:20.2.10.1
!
dial-peer voice 3851 voip
 destination-pattern 51022.....
 voice-class codec 1
 session target ipv4:20.2.10.1
 dtmf-relay h245-alphanumeric
!
dial-peer voice 3850 pots
 destination-pattern 51012.....
 direct-inward-dial
 forward-digits 10
!
!
gateway
 timer receive-rtp 1200
!
!
!
telephony-service
 sdspfarm conference mute-on # mute-off #
 sdspfarm units 4
 sdspfarm transcode sessions 10
 sdspfarm tag 1 xcode101
 sdspfarm tag 2 conf103
 group  1 vrf vrf1
  ip source-address 10.1.10.1 port 2000
 !
 group  2 vrf vrf2
  ip source-address 10.2.10.1 port 2000
 !
 group  3 vrf vrf3
  ip source-address 10.3.10.1 port 2000
 !
 group  4 vrf vrf4
  ip source-address 10.4.10.1 port 2000
 !
 group  5
  ip source-address 12.5.10.1 port 2000
 !
 conference hardware
 no auto-reg-ephone
 em logout 0:0 0:0 0:0
 max-ephones 240
 max-dn 480
 auto assign 1 to 100 type 7960
 auto assign 204 to 230
 calling-number initiator
 system message vcme3845
 load 7941 SCCP41.8-3-3-13S
 load 7970 SCCP70.8-3-3-13S
 time-zone 5
```

```
voicemail 7710
max-conferences 8 gain -6
call-forward pattern .T
call-forward system redirecting-expanded
moh music-on-hold.au
dn-webedit
time-webedit
transfer-system full-consult dss
transfer-pattern 9.T
secondary-dialtone 9
create cnf-files version-stamp Jan 01 2002 00:00:00
!
!
ephone-dn  186  dual-line
 number 3333
 conference ad-hoc
 preference 5
!
!
ephone-dn  187  dual-line
 number 3333
 conference ad-hoc
 preference 4
 no huntstop
!
!
ephone-dn  188  dual-line
 number 3333
 conference ad-hoc
 preference 3
 no huntstop
!
!
ephone-dn  189  dual-line
 number 3333
 conference ad-hoc
 preference 2
 no huntstop
!
!
ephone-dn  190  dual-line
 number 3333
 conference ad-hoc
 preference 1
 no huntstop
!
!
ephone-dn  231  dual-line
 number 2099
 label vrf2
 description 2099
 name 2099
!
!
ephone-dn  232  dual-line
 number 70098
 label vrf1
 description 70098
 name 70098
!
!
ephone-dn  233  dual-line
 number 3099
 label vrf3
```

```
 description 3099
 name 3099
 call-forward noan 7710 timeout 10
!
!
ephone  59
 device-security-mode none
!
!
!
ephone  231
 device-security-mode none
 mac-address 000B.5FC2.2C23
 group phone 2
 type 7960
 keep-conference
 button  1:231
!
!
ephone  232
 device-security-mode none
 mac-address 001A.A246.05AC
 group phone 1
 type 7941
 keep-conference
 button  1:232
!
!
ephone  233
 device-security-mode none
 mac-address 000E.D748.5DE3
 group phone 3
 type 7960
 keep-conference
 button  1:233
!
!
line con 0
 exec-timeout 0 0
line aux 0
line 66
 no activation-character
 no exec
 transport preferred none
 transport input all
 transport output pad telnet rlogin lapb-ta mop udptn v120
line vty 0 4
 password xxxx
 login
!
exception protocol ftp
exception dump 9.20.20.253
exception data-corruption buffer truncate
scheduler allocate 20000 1000
end

Router#
```

Configuring Cisco Unified CME 2

This is the full configuration of the Cisco Unified CME 2 running on a Cisco ISR 2821 router:

```
!
! Last configuration change at 22:45:41 pdt Mon Jun 9 2008
!
version 12.4
no service timestamps debug uptime
no service timestamps log uptime
no service password-encryption
!
hostname Router
!
boot-start-marker
boot-end-marker
!
logging message-counter syslog
no logging buffered
no logging console
enable password xxxx
!
no aaa new-model
clock timezone PST -8
clock summer-time pdt recurring
no network-clock-participate slot 1
!
voice-card 0
 no dspfarm
!
voice-card 1
!
ip source-route
!
!
ip cef
no ip dhcp use vrf connected
!
ip dhcp pool vrf1
   network 20.1.10.0 255.255.255.0
   default-router 20.1.10.1
   option 150 ip 20.1.10.1
   class vrf1
      address range 20.1.10.10 20.1.10.250
!
ip dhcp pool vrf2
   network 20.2.10.0 255.255.255.0
   default-router 20.2.10.1
   option 150 ip 20.2.10.1
   class vrf2
      address range 20.2.10.10 20.2.10.250
!
ip dhcp pool vrf3
   network 20.3.10.0 255.255.255.0
   option 150 ip 20.3.10.1
   default-router 20.3.10.1
   class vrf3
      address range 20.3.10.10 20.3.10.250
!
ip dhcp pool vrf4
   network 20.4.10.0 255.255.255.0
   default-router 20.4.10.1
   option 150 ip 20.4.10.1
   class vrf4
      address range 20.4.10.10 20.4.10.250
!
ip dhcp pool vrf5
   network 20.5.10.0 255.255.255.0
```

```
                 default-router 20.5.10.1
                 option 150 ip 20.5.10.1
                 class vrf5
                    address range 20.5.10.10 20.5.10.250
              !
              ip dhcp pool phone3
                 host 20.2.10.11 255.0.0.0
                 client-identifier 0100.0ed7.4ce6.3d
                 default-router 20.2.10.1
                 option 150 ip 20.2.10.1
              !
              ip dhcp pool phone4
                 host 20.3.10.11 255.0.0.0
                 client-identifier 0100.1280.55d3.cd
                 default-router 20.3.10.1
                 option 150 ip 20.3.10.1
              !
              ip dhcp pool subcme4
                 network 21.4.10.0 255.255.255.0
                 default-router 21.4.10.1
                 option 150 ip 21.4.10.1
                 class subcme4
                    address range 21.4.10.10 21.4.10.250
              !
              ip dhcp pool subcme5
                 network 21.5.10.0 255.255.255.0
                 default-router 21.5.10.1
                 option 150 ip 21.5.10.1
                 class subcme5
                    address range 21.5.10.10 21.5.10.250
              !
              ip dhcp pool subcme3
                 network 21.3.10.0 255.255.255.0
                 default-router 21.3.10.1
                 option 150 ip 21.3.10.1
                 class subcme3
                    address range 21.3.10.10 21.3.10.250
              !
              ip dhcp pool subcme2
                 network 21.2.10.0 255.255.255.0
                 default-router 21.2.10.1
                 option 150 ip 21.2.10.1
                 class subcme2
                    address range 21.2.10.10 21.2.10.250
              !
              ip dhcp pool subcme1
                 network 21.1.10.0 255.255.255.0
                 option 150 ip 21.1.10.1
                 default-router 21.1.10.1
                 class subcme1
                    address range 21.1.10.10 21.1.10.250
              !
              !
              ip dhcp class vrf1
              !
              ip dhcp class vrf2
              !
              ip dhcp class vrf3
              !
              ip dhcp class vrf4
              !
              ip dhcp class vrf5
              !
              ip dhcp class subcme4
```

```
!
ip dhcp class subcme5
!
ip dhcp class subcme3
!
ip dhcp class subcme2
!
ip dhcp class subcme1
!
ip vrf service
 rd 210:1
 route-target export 210:1
 route-target import 201:1
 route-target import 202:1
 route-target import 203:1
 route-target import 204:1
 route-target import 205:1
!
ip vrf vrf1
 rd 201:1
 route-target export 201:1
 route-target import 201:1
 route-target import 210:1
!
ip vrf vrf2
 rd 202:1
 route-target export 202:1
 route-target import 202:1
 route-target import 210:1
!
ip vrf vrf3
 rd 203:1
 route-target export 203:1
 route-target import 203:1
 route-target import 210:1
!
ip vrf vrf4
 rd 204:1
 route-target export 204:1
 route-target import 204:1
 route-target import 210:1
!
ip vrf vrf5
 rd 205:1
 route-target export 205:1
 route-target import 205:1
 route-target import 210:1
!
no ipv6 cef
multilink bundle-name authenticated
!
!
!
!
!
voice rtp send-recv
voice vrf vrf2
!
voice service voip
 allow-connections h323 to h323
 allow-connections h323 to sip
 allow-connections sip to h323
 allow-connections sip to sip
 supplementary-service h450.12
```

```
 h323
  h225 timeout keepalive
 sip
  registrar server expires max 3600 min 3600
!
!
voice class codec 1
 codec preference 1 g711ulaw
 codec preference 2 g711alaw
 codec preference 3 g729r8
!
!
!
!
!
archive
 log config
  hidekeys
!
!
controller T1 1/0/0
!
controller T1 1/0/1
!
ip ftp username Administrator
ip ftp password xxxx
!
!
interface Loopback201
 ip vrf forwarding vrf1
 ip address 21.1.0.1 255.255.255.255
!
interface Loopback202
 ip vrf forwarding vrf2
 ip address 21.2.0.1 255.255.255.255
!
interface Loopback203
 ip vrf forwarding vrf3
 ip address 21.3.0.1 255.255.255.255
!
interface Loopback204
 ip vrf forwarding vrf4
 ip address 21.4.0.1 255.255.255.255
!
interface Loopback205
 ip vrf forwarding vrf5
 ip address 21.5.0.1 255.255.255.255
!
interface GigabitEthernet0/0
 no ip address
 duplex auto
 speed auto
 no keepalive
!
interface GigabitEthernet0/0.301
 encapsulation dot1Q 401
 ip vrf forwarding vrf1
 ip address 20.1.10.1 255.255.255.0
!
interface GigabitEthernet0/0.302
 encapsulation dot1Q 402
 ip vrf forwarding vrf2
 ip address 20.2.10.1 255.255.255.0
!
```

```
interface GigabitEthernet0/0.303
 encapsulation dot1Q 403
 ip vrf forwarding vrf3
 ip address 20.3.10.1 255.255.255.0
!
interface GigabitEthernet0/0.304
 encapsulation dot1Q 404
 ip vrf forwarding vrf4
 ip address 20.4.10.1 255.255.255.0
!
interface GigabitEthernet0/0.305
 encapsulation dot1Q 405
 ip vrf forwarding vrf5
 ip address 20.5.10.1 255.255.255.0
!
interface GigabitEthernet0/1
 no ip address
 duplex auto
 speed auto
 no keepalive
!
interface GigabitEthernet0/1.101
 encapsulation dot1Q 201
 ip vrf forwarding vrf1
 ip address 21.1.10.1 255.255.255.0
!
interface GigabitEthernet0/1.102
 encapsulation dot1Q 202
 ip vrf forwarding vrf2
 ip address 21.2.10.1 255.255.255.0
!
interface GigabitEthernet0/1.103
 encapsulation dot1Q 203
 ip vrf forwarding vrf3
 ip address 21.3.10.1 255.255.255.0
!
interface GigabitEthernet0/1.104
 encapsulation dot1Q 204
 ip vrf forwarding vrf4
 ip address 21.4.10.1 255.255.255.0
!
interface GigabitEthernet0/1.105
 encapsulation dot1Q 205
 ip vrf forwarding vrf5
 ip address 21.5.10.1 255.255.255.0
!
interface GigabitEthernet0/1.209
 encapsulation dot1Q 209
 ip address 21.9.10.1 255.255.255.0
!
interface GigabitEthernet0/1.210
 encapsulation dot1Q 210
 ip vrf forwarding service
 ip address 21.10.10.1 255.255.255.0
!
router ospf 201 vrf vrf1
 log-adjacency-changes
 network 20.1.0.0 0.0.255.255 area 0
 network 21.1.0.1 0.0.0.0 area 0
 network 21.0.0.0 0.255.255.255 area 0
!
router ospf 202 vrf vrf2
 log-adjacency-changes
 network 20.2.0.0 0.0.255.255 area 0
```

```
 network 21.2.0.1 0.0.0.0 area 0
 network 21.0.0.0 0.255.255.255 area 0
!
router ospf 203 vrf vrf3
 log-adjacency-changes
 network 20.3.0.0 0.0.255.255 area 0
 network 21.3.0.1 0.0.0.0 area 0
 network 21.0.0.0 0.255.255.255 area 0
!
router ospf 204 vrf vrf4
 log-adjacency-changes
 network 20.4.0.0 0.0.255.255 area 0
 network 21.4.0.1 0.0.0.0 area 0
 network 21.0.0.0 0.255.255.255 area 0
!
router ospf 205 vrf vrf5
 log-adjacency-changes
 network 20.5.0.0 0.0.255.255 area 0
 network 21.5.0.1 0.0.0.0 area 0
 network 21.0.0.0 0.255.255.255 area 0
!
router ospf 210 vrf service
 log-adjacency-changes
 redistribute bgp 100 metric-type 1 subnets
 network 21.10.0.0 0.0.255.255 area 0
!
router ospf 209
 log-adjacency-changes
 network 21.9.0.0 0.0.255.255 area 0
!
router bgp 100
 no synchronization
 bgp router-id 28.21.0.0
 bgp log-neighbor-changes
 no auto-summary
 !
 address-family ipv4 vrf vrf5
  redistribute connected
  no synchronization
 exit-address-family
 !
 address-family ipv4 vrf vrf4
  redistribute connected
  no synchronization
 exit-address-family
 !
 address-family ipv4 vrf vrf3
  redistribute connected
  no synchronization
 exit-address-family
 !
 address-family ipv4 vrf vrf2
  redistribute connected
  no synchronization
 exit-address-family
 !
 address-family ipv4 vrf vrf1
  redistribute connected
  no synchronization
 exit-address-family
 !
 address-family ipv4 vrf service
  redistribute connected
  no synchronization
```

```
  exit-address-family
!
ip forward-protocol nd
ip route 223.255.254.254 255.255.255.255 2.8.0.1
!
!
ip http server
!
access-list 101 permit ip host 11.2.10.1 host 20.2.10.1
access-list 102 permit ip any host 223.255.254.254
access-list 103 permit ip any host 20.1.10.1
!
!
!
!
control-plane
!
!
!
ccm-manager fax protocol cisco
!
mgcp fax t38 ecm
!
!
dial-peer cor custom
 name PSTN
 name SIP
 name H323
!
!
dial-peer cor list PSTN-TRUNK
 member PSTN
!
dial-peer cor list SIP-TRUNK
 member SIP
!
dial-peer cor list H323-TRUBK
 member H323
!
dial-peer cor list user-sip
 member SIP
!
dial-peer cor list user-pstn
 member PSTN
!
dial-peer cor list user-h323
 member H323
!
!
dial-peer voice 2821 pots
 corlist outgoing PSTN-TRUNK
 destination-pattern 70007
 direct-inward-dial
 forward-digits 10
!
dial-peer voice 2822 pots
 corlist outgoing PSTN-TRUNK
 destination-pattern 70017
 direct-inward-dial
 forward-digits 10
!
dial-peer voice 2823 voip
 corlist outgoing H323-TRUBK
 destination-pattern 70008
```

```
 voice-class codec 1
 session target ipv4:11.2.10.1
 dtmf-relay h245-alphanumeric
!
dial-peer voice 2824 voip
 corlist outgoing H323-TRUBK
 destination-pattern 70018
 voice-class codec 1
 session target ipv4:11.2.10.1
 dtmf-relay h245-alphanumeric
!
dial-peer voice 282145 voip
 destination-pattern 70009
 voice-class codec 1
 session protocol sipv2
 session target ipv4:11.2.10.1
 dtmf-relay rtp-nte
 no vad
!
dial-peer voice 282146 voip
 destination-pattern 70019
 voice-class codec 1
 session protocol sipv2
 session target ipv4:11.2.10.1
 dtmf-relay rtp-nte
 no vad
!
!
presence
 presence call-list
 watcher all
!
gateway
 timer receive-rtp 1200
!
sip-ua
 presence enable
!
!
telephony-service
 sdspfarm conference mute-on # mute-off #
 sdspfarm units 4
 sdspfarm transcode sessions 10
 sdspfarm tag 1 xcode101
 sdspfarm tag 2 conf103
 group  1 vrf vrf1
  ip source-address 20.1.10.1 port 2000
 !
 group  2 vrf vrf2
  ip source-address 20.2.10.1 port 2000
  url directories http://20.2.10.1//localdirectory
 !
 group  3 vrf vrf3
  ip source-address 20.3.10.1 port 2000
  url directories http://20.3.10.1//localdirectory
 !
 group  4 vrf vrf4
  ip source-address 20.4.10.1 port 2000
 !
 group  5 vrf vrf5
  ip source-address 20.5.10.1 port 2000
 !
 conference hardware
 no auto-reg-ephone
```

```
 em logout 0:0 0:0 0:0
 max-ephones 52
 max-dn 192
 auto assign 100 to 167 type 7960
 auto assign 168 to 192 type anl
 calling-number initiator
 system message vcme 2821
 time-zone 5
 max-conferences 1 gain 6
 call-park system redirect
 call-forward pattern .T
 call-forward system redirecting-expanded
 moh music-on-hold.au
 dn-webedit
 time-webedit
 transfer-system full-consult dss
 transfer-pattern 9.T
 secondary-dialtone 9
 directory last-name-first
 create cnf-files version-stamp 7960 Jun 09 2008 22:45:03
!
!
ephone-template  2
 conference admin
 group phone 2
!
!
ephone-template  3
 conference admin
 group phone 3
!
!
ephone-dn  132  dual-line
 number 1001
 label vrf1
 name 1001
!
!
ephone-dn  152  dual-line
 number 2001
 label vrf2
 name dc lin
 allow watch
 call-forward busy 2002
 call-forward noan 3001 timeout 15
!
!
ephone-dn  153  dual-line
 number 3001
 label vrf3
 name dd lin
 allow watch
!
!
ephone-dn  186  dual-line
 number 3333
 conference ad-hoc
 preference 5
!
!
ephone-dn  187  dual-line
 number 3333
 conference ad-hoc
 preference 4
```

```
 no huntstop
!
!
ephone-dn  188  dual-line
 number 3333
 conference ad-hoc
 preference 3
 no huntstop
!
!
ephone-dn  189  dual-line
 number 3333
 conference ad-hoc
 preference 2
 no huntstop
!
!
ephone-dn  190  dual-line
 number 3099
 label vrf3
 description 3099
 name 3099
 conference ad-hoc
 preference 1
 no huntstop
!
!
ephone  132
 mac-address 0018.BA14.B129
 group phone 1
 type 7941
 button  1:132
!
!
!
ephone  152
 mac-address 000E.D74C.E63D
 ephone-template 2
 type 7960
 keep-conference endcall
 button  1:152
!
!
!
ephone  153
 video
 mac-address 0012.8055.D3CD
 ephone-template 3
 type 7970
 keep-conference endcall
 button  1:153
!
!
!
ephone  231
 mac-address 000B.5FC2.2C23
 group phone 1
 type 7940
 keep-conference
!
!
!
ephone  232
 mac-address 0017.95B0.44C7
```

```
 group phone 1
 type 7960
 keep-conference
!
!
!
ephone  233
 mac-address 000E.D748.5DE3
 group phone 3
 type 7960
 keep-conference
!
!
!
line con 0
 exec-timeout 0 0
line aux 0
line vty 0 4
 exec-timeout 0 0
 password xxxx
 login
!
exception protocol ftp
exception dump 9.20.20.253
exception data-corruption buffer truncate
scheduler allocate 20000 1000
end

Router#
```

Configuring Cisco Unity Express for Cisco Unified CME Voice Mail

The followings are required for defining Cisco Unity Express with VRF awareness Cisco Unified CME:

- Telnet is used to access Cisco Unity Express, not the "Service-Engine Service-Engine 1/0 session" which is for non-VRF awareness Cisco Unified CME commands. Access the Cisco Unity Express module for defining Cisco Unity Express users with "voice vrf vrf2" telnet 21.10.10.5 2066 /vrf vrf2

- One IP address is required for "interface service engine," used to assign the interface to "voice vrf."

The example is for configuring Cisco Unity Express for Cisco Unified CME Voice Mail.

```
voice vrf vrf2
....
ip vrf vrf2
 rd 100:2
 route-target export 100:2
 route-target import 100:2
.....
interface GigabitEthernet0/1.210
 encapsulation dot1Q 210
 ip address 21.10.10.2 255.255.255.0
!
......
interface Service-Engine1/0
 ip vrf forwarding vrf2
 ip address 21.10.10.5 255.255.255.0
 service-module ip address 21.10.10.6 255.255.255.0
 service-module ip default-gateway 21.10.10.2
!
......
line 66
 no activation-character
```

```
 no exec
 transport preferred none
 transport input all
 transport output pad telnet rlogin lapb-ta mop udptn v120
```

Configuring Cisco Unified CME and DSP Farm on the Same Box for Conference, Transcoder, and Media Termination Point

```
interface Loopback5
 ip address 12.5.10.1 255.255.255.255
!
......
sccp local Loopback5
sccp ccm 12.5.10.1 identifier 2 version 4.1
sccp
!
sccp ccm group 2
 bind interface Loopback5
 associate ccm 2 priority 1
 associate profile 103 register conf103
 associate profile 101 register xcode101
!
dspfarm profile 101 transcode
 codec g711ulaw
 codec g711alaw
 codec g729ar8
 codec g729abr8
 codec g729r8
 maximum sessions 1
 associate application SCCP
!
dspfarm profile 103 conference
 codec g711ulaw
 codec g711alaw
 codec g729ar8
 codec g729abr8
 codec g729r8
 codec g729br8
 maximum sessions 1
 associate application SCCP
.....
telephony-service
 sdspfarm conference mute-on # mute-off #
 sdspfarm units 4
 sdspfarm transcode sessions 10
 sdspfarm tag 1 xcode101
 sdspfarm tag 2 conf103
 group  1 vrf vrf1
  ip source-address 10.1.10.1 port 2000
 !
 group  2 vrf vrf2
  ip source-address 10.2.10.1 port 2000
 !
 group  3 vrf vrf3
  ip source-address 10.3.10.1 port 2000
 !
 group  4 vrf vrf4
  ip source-address 10.4.10.1 port 2000
 !
 group  5
  ip source-address 12.5.10.1 port 2000
 !
```

```
     conference hardware
     load 7941 SCCP41.8-3-3-13S
     load 7970 SCCP70.8-3-3-13S
     max-ephones 240
     max-dn 480
     auto assign 1 to 100 type 7960
     auto assign 204 to 230
     calling-number initiator
     system message vcme3845
     time-zone 5
     voicemail 7710
     max-conferences 8 gain -6
     call-forward pattern .T
     call-forward system redirecting-expanded
     moh music-on-hold.au
     web admin system name cisco secret 5 $1$SO4p$HfTwkOyOYAa8zU2pANKqg/
     dn-webedit
     time-webedit
     transfer-system full-consult dss
     transfer-pattern 9.T
     secondary-dialtone 9
     create cnf-files version-stamp 7960 Feb 16 2008 22:45:55
     !
```

Configuring Cisco Unified CME and DSP Farm on the Different Boxes for Conference, Transcoder, and Media Termination Point

There are no changes to defining the DSP farm. Do make sure that the DSP farm messages and flows are coming through the interface and subinterface defined as "voice VRF" interface and subinterface.

The following example has the DSP farm defined on another box.

```
interface FastEthernet0/0.202
 encapsulation dot1Q 202
 ip address 21.2.10.2 255.255.255.0
!
........
sccp local FastEthernet0/0.202
sccp ccm 20.2.10.1 identifier 2 version 4.0
sccp
!
sccp ccm group 2
 associate ccm 2 priority 1
 associate profile 103 register conf103
 associate profile 101 register xcode101
!
dspfarm profile 101 transcode
 codec g711ulaw
 codec g711alaw
 codec g729r8
 maximum sessions 1
 associate application SCCP
 shutdown
!
dspfarm profile 103 conference
 codec g711ulaw
 codec g711alaw
 codec g729ar8
 codec g729abr8
 codec g729r8
 codec g729br8
 maximum sessions 1
```

```
 associate application SCCP
!
```

Verification

This section shows configuration verification commands.

show ip vrf interface
```
router#show ip vrf interface
Interface   IP-Address   VRF     Protocol
Lo101       11.1.0.1     vcme1   up
Gi0/0.301   10.1.10.1    vcme1   up
Gi0/1.101   11.1.10.1    vcme1   up
Lo102       11.2.0.1     vcme2   up
Gi0/0.302   10.2.10.1    vcme2   up
Gi0/1.102   11.2.10.1    vcme2   up
Se1/0       21.10.10.5   vcme2   up
Lo103       11.3.0.1     vcme3   up
Gi0/0.303   10.3.10.1    vcme3   up
Gi0/1.103   11.3.10.1    vcme3   up
Lo104       11.4.0.1     vcme4   up
Gi0/0.304   10.4.10.1    vcme4   up
```

show ip vrf interface vcme2
```
router#show ip vrf interface vcme2
Interface   IP-Address   VRF     Protocol
Lo102       11.2.0.1     vcme2   up
Gi0/0.302   10.2.10.1    vcme2   up
Gi0/1.102   11.2.10.1    vcme2   up
Se1/0       21.10.10.5   vcme2   up
router#
```

show ip vrf detail Csco3845_1
```
router#show ip vrf detail
VRF vcme1; default RD 100:1; default VPNID <not set>
Interfaces:
Lo101 Gi0/0.301 Gi0/1.101
VRF Table ID = 1
Export VPN route-target communities
RT:100:1
Import VPN route-target communities
RT:100:1
No import route-map
No export route-map
VRF label distribution protocol: not configured
VRF label allocation mode: per-prefix
VRF vcme2; default RD 100:2; default VPNID <not set>
Interfaces:
Lo102 Gi0/0.302 Gi0/1.102
Se1/0
VRF Table ID = 2
Export VPN route-target communities
RT:100:2
Import VPN route-target communities
RT:100:2
No import route-map
```

show sccp all Csco3845_1
```
router#show sccp all
```

```
                    SCCP Admin State: UP
                    Gateway IP Address: 12.5.10.1, Port Number: 2000
                    IP Precedence: 5
                    User Masked Codec list: None
                    Call Manager: 12.5.10.1, Port Number: 2000
                    Priority: N/A, Version: 4.1, Identifier: 2
                    Trustpoint: N/A
                    Transcoding Oper State: ACTIVE - Cause Code: NONE
                    Active Call Manager: 12.5.10.1, Port Number: 2000
                    TCP Link Status: CONNECTED, Profile Identifier: 101
                    Reported Max Streams: 2, Reported Max OOS Streams: 0
                    Supported Codec: g711ulaw, Maximum Packetization Period: 30
                    Supported Codec: g711alaw, Maximum Packetization Period: 30
                    Supported Codec: g729ar8, Maximum Packetization Period: 60
                    Supported Codec: g729abr8, Maximum Packetization Period: 60
                    Supported Codec: g729r8, Maximum Packetization Period: 60
                    Supported Codec: rfc2833 dtmf, Maximum Packetization Period: 30
                    Supported Codec: rfc2833 pass-thru, Maximum Packetization Period: 30
                    Supported Codec: inband-dtmf to rfc2833 conversion, Maximum Packetization Period: 30
                    Conferencing Oper State: ACTIVE - Cause Code: NONE
                    --More--
```

show sccp connection Csco3845_1
```
router#show sccp connection
sess_id conn_id stype mode codec ripaddr rport sport
-1073676287 131075 conf sendrecv g711u 12.5.10.1 2000 18214
-1073676287 131074 conf sendrecv g711u 12.5.10.1 2000 19226
-1073676287 131073 conf sendrecv g711u 12.5.10.1 2000 18170
Total number of active session(s) 1, and connection(s) 3
6) show ip route vrf vcme2 Csco3845_1#show ip route vrf vcme2
Routing Table: vcme2
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route
Gateway of last resort is not set
O E2 223.255.254.0/24 [110/20] via 11.2.10.2, 18:31:10, GigabitEthernet0/1.102
21.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
C 21.10.10.0/24 is directly connected, Service-Engine1/0
O 21.2.0.1/32 [110/3] via 11.2.10.2, 18:31:10, GigabitEthernet0/1.102
O 21.2.10.0/24 [110/2] via 11.2.10.2, 18:31:10, GigabitEthernet0/1.102
20.0.0.0/24 is subnetted, 1 subnets
O 20.2.10.0 [110/3] via 11.2.10.2, 18:31:10, GigabitEthernet0/1.102
10.0.0.0/24 is subnetted, 1 subnets
C 10.2.10.0 is directly connected, GigabitEthernet0/0.302
11.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C 11.2.10.0/24 is directly connected, GigabitEthernet0/1.102
```

show ip ospf neighbor Csco3845_1
```
router#show ip ospf neighbor
Neighbor    ID Pri State Dead Time Address      Interface
21.10.10.1 1  FULL/DR   00:00:31  21.10.10.1  GigabitEthernet0/1.210
21.1.10.2 1   FULL/DR   00:00:39  11.9.10.2   GigabitEthernet0/1.109
21.4.10.2 1   FULL/DR   00:00:38  11.5.10.2   GigabitEthernet0/1.105
21.5.10.2 1   FULL/DR   00:00:38  11.4.10.2   GigabitEthernet0/1.104
21.9.10.2 1   FULL/DR   00:00:38  11.3.10.2   GigabitEthernet0/1.103
21.3.10.2 1   FULL/DR   00:00:39  11.2.10.2   GigabitEthernet0/1.102
21.2.10.2 1   FULL/DR   00:00:39  11.1.10.3   GigabitEthernet0/1.101 8)
show dspfarm dsp active Csco3845_1#show dspfarm dsp active
SLOT DSP VERSION STATUS CHNL USE TYPE RSC_ID BRIDGE_ID PKTS_TXED PKTS_RXED
```

```
0 2 22.3.0 UP 1 USED conf 2 0x7 34665 34658
0 2 22.3.0 UP 1 USED conf 2 0x9 34664 34651
0 2 22.3.0 UP 1 USED conf 2 0xB 34662 34640
Total number of DSPFARM DSP channel(s) 1
```

show voice dsp voice Csco3845_1
```
router#show voice dsp voice

DSP DSP DSPWARE CURR BOOT PAK TX/RX
TYPE NUM CH CODEC    VERSION   STATE STATE   RST AI VOICEPORT TS ABORT PACK COUNT
==== === == ======== ========== ===== ======= === == ========= == ===== ============
edsp 001 01 g729r8 p 0.1 IDLE 50/0/186.1
edsp 002 02 g729r8 p 0.1 IDLE 50/0/186.2
edsp 003 01 g729r8 p 0.1 IDLE 50/0/187.1
edsp 004 02 g729r8 p 0.1 IDLE 50/0/187.2
edsp 005 01 g729r8 p 0.1 IDLE 50/0/188.1
edsp 006 02 g729r8 p 0.1 IDLE 50/0/188.2
edsp 007 01 g711ulaw 0.1 busy 50/0/189.1
edsp 008 02 g729r8 p 0.1 IDLE 50/0/189.2
edsp 009 01 g711ulaw 0.1 busy 50/0/190.1
edsp 010 02 g711ulaw 0.1 busy 50/0/190.2
edsp 011 01 g729r8 p 0.1 IDLE 50/0/197.1
edsp 012 02 g729r8 p 0.1 IDLE 50/0/197.2
```

show telephony-service conference hardware detail Csco3845_1
```
router#show telephony-service conference hardware detail
Conference Type Active Max Peak Master MasterPhone Last
cur(initial)
===========================================================================================
3333 Ad-hoc 3 8 3 3099 3099 233 (233) 1098 1098
Conference parties (number:phone)
1098 1098:232
2099 2099:231
3099 3099:233
```

debug tftp events Csco3845_1#
```
TFTP: Looking for CTLSEP000ED7485DE3.tlv
TFTP: Looking for CTLSEP000ED7485DE3.tlv
```

debug tftp packets TFTP: Server request for port 50919, socket_id 0x71523394 for process 334
```
TFTP: read request from host 10.2.10.11(50919) via GigabitEthernet0/0.302
TFTP: Looking for CTLSEP000B5FC22C23.tlv
TFTP: Sending error 1 No such file
TFTP: Server request for port 49785, socket_id 0x71523394 for process 334
TFTP: read request from host 10.3.10.10(49785) via GigabitEthernet0/0.303
TFTP: Looking for CTLSEP000ED7485DE3.tlv
TFTP: Sending error 1 No such file
```

debug sccp message
```
Csco3845_1(config)#
SCCP operational state bring up is successful.
SCCP:send RegisterMessage, protocol_ver=0xA000000
SCCP:send IpPortMessage
SCCP:send MediaResourceNotification
SCCP:send RegisterMessage, protocol_ver=0xA000000
SCCP:send IpPortMessage
SCCP:send MediaResourceNotification
%SDSPFARM-6-REGISTER: mtp-1:xcode101 IP:12.5.10.1 Socket:1 DeviceType:MTP has registered.
%HWCONF-6-REGISTER: hwconf-2:conf103 IP:12.5.10.1 Socket:2 DeviceType:HW Conference has
registered.
SCCP:rcvd RegisterAckMessage
SCCP:keepaalive interval=30, agreed_sccp_ver=10
SCCP:send MediaResourceNotification
```

```
SCCP:send VersionReqMessage
SCCP:rcvd RegisterAckMessage
SCCP:keepaalive interval=30, agreed_sccp_ver=10
SCCP:send MediaResourceNotification
SCCP:send VersionReqMessage
SCCP:rcvd CapabilitiesReqMessage
SCCP:send CapabilitiesResMessage
SCCP:rcvd CapabilitiesReqMessage
SCCP:send CapabilitiesResMessage
SCCP:rcvd VersionMessage
VersionMsg Info:
version:
SCCP:rcvd VersionMessage
VersionMsg Info:
version:
```