



# Configuring an Anonymous Device Gatekeeper with Cisco CallManager Versions 3.3 and 4.1

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## Introduction

This document explains how to set up an anonymous device gatekeeper with use of a Cisco CallManager 4.1 or 3.3 server. It requires the use of a Cisco IOS® Software router to act as a gatekeeper and a Cisco IOS router to act as an H.323 gateway. The primary focus of this document is on how to configure the Cisco CallManager 4.1 or 3.3 server to use a gatekeeper. After you finish this configuration, you can make calls in either direction with Call Admission Control (CAC) between an IP phone registered to the Cisco CallManager 4.1 or 3.3 server and an analog phone attached to the Cisco IOS gateway.

## Prerequisites

### Requirements

Before you attempt this configuration, ensure that you meet these requirements:

- You have a sample network with a Cisco CallManager server.
- You have an IP phone (model 7910, 7940, or 7960).
- You have a Cisco IOS gateway with an Foreign Exchange Station (FXS) port.
- You have an analog phone that is attached to the FXS port on the Cisco IOS gateway.
- You have a Cisco IOS router with an image that supports H.323 gatekeeper functionality.
- All devices can ping each other.
- The IP phone can call the analog phone with two-way voice capability.
- The analog phone can call the IP phone with two-way voice capability.

**Note:** For more information, see the [Network Diagram](#) in this document.

### Components Used

The information in this document is based on these software and hardware versions:

- Cisco IOS router that acts as an H.323 VoIP gateway and runs Cisco IOS Software Release 12.2(11)T
- Cisco IOS router that acts as an H.323 VoIP gatekeeper and runs Cisco IOS Software Release 12.2(15)T
- Cisco CallManager server that runs 4.1(.091) or 3.3(3)sr4a
- 7960 IP Phone

- Generic analog phone

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, make sure that you understand the potential impact of any command.

## Conventions

For more information on document conventions, refer to the [Cisco Technical Tips Conventions](#).

## Background Theory

An anonymous device gatekeeper handles call-route decisions for the Cisco IOS gateways and Cisco CallManager gateways that are registered to it. This means that the Cisco CallManager servers in the cluster do not need to know about every other gateway in the network. Instead, their route patterns or VoIP dial peers are configured to point to the anonymous device gatekeeper. The anonymous device gatekeeper keeps track of the dial plan for the network. Refer to the document [Understanding Cisco IOS Gatekeeper Call Routing](#) for additional information on this subject.

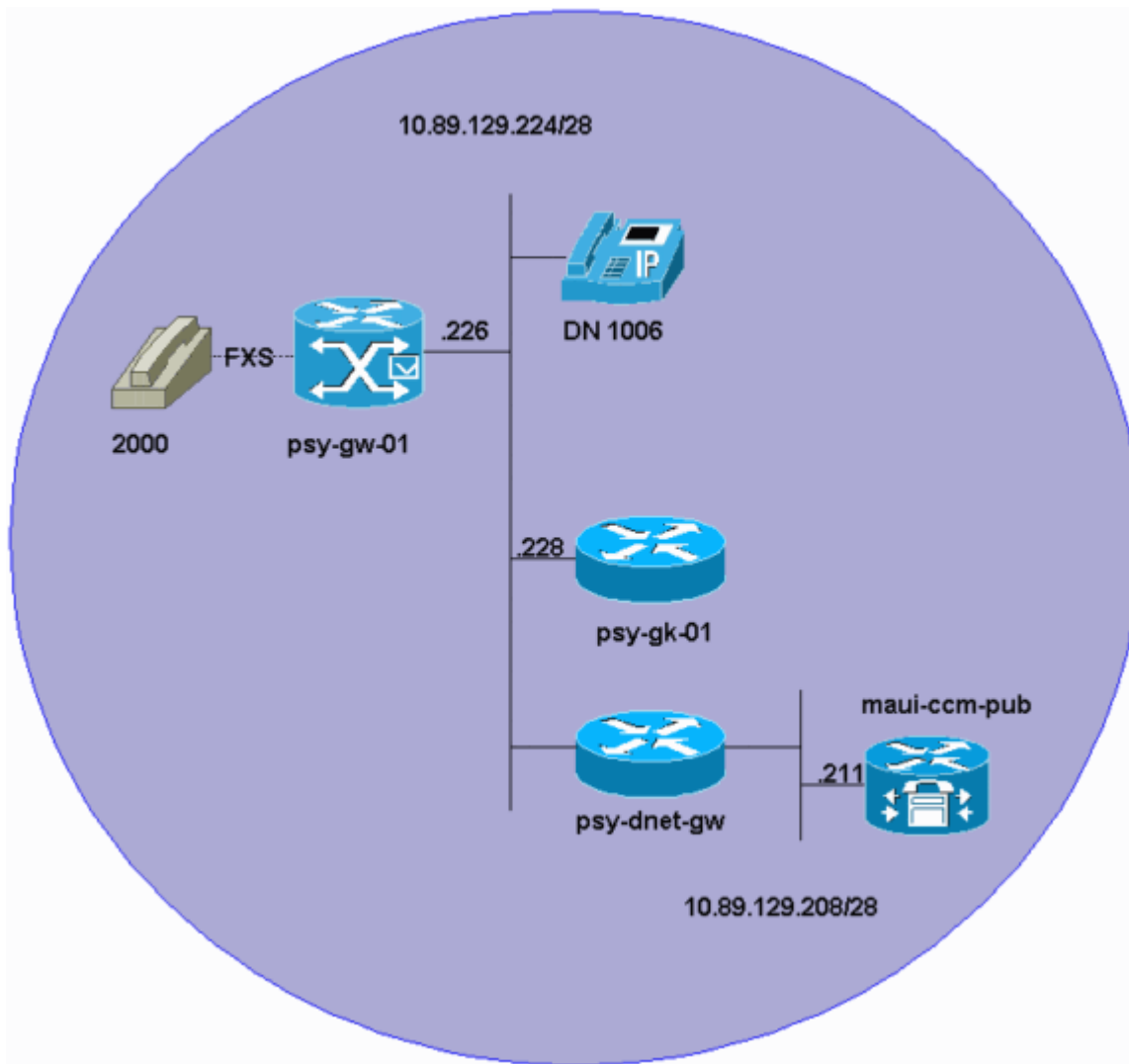
Networks used to learn internetwork skills typically use the configuration presented in this document. The concepts and commands are the same ones that you encounter in a live environment. The primary difference is that this scenario does not have a WAN connection for VoIP traffic that benefits from CAC.

**Note:** In Cisco CallManager 4.1 and 3.3, trunks replace all previously configured intercluster trunk devices. An H.225 trunk device represents a logical route to the wholesale network. Previously configured anonymous devices with H.225 protocol migrate to H.225 trunks with gatekeeper control. Previously configured anonymous devices with intercluster protocol migrate to intercluster trunks with gatekeeper control. Previously configured intercluster gateways migrate to intercluster trunks without gatekeeper control.

The successful implementation of CAC requires a well thought-out network design and CAC overlay that corresponds to it. A complete explanation of how to design and implement a CAC solution—which includes all of the available options to implement CAC on Cisco IOS gateways and gatekeepers—is beyond the scope of this document. There are several good resources available on [Cisco.com](#) to help you understand and implement CAC with Cisco IOS Software-based gateways and gatekeepers. Search for *gatekeeper* on [Cisco.com](#). You can then filter your search with additional words, such as *troubleshooting* or *understanding*. You can also limit the scope of your search to Products and Services or Technical Support (content written by Technical Support only).

## Network Diagram

This document uses this network setup:



## Configure the Cisco CallManager Gatekeeper Parameters

This section explains how to create an instance of an anonymous device gatekeeper in Cisco CallManager.

### Step-by-Step Instructions

1. Choose **Device > Gatekeeper**.

The Find and List Gatekeeper Configuration window displays.

2. In the upper, right corner of the window, click the **Add a New Gatekeeper** link.

The Gatekeeper Configuration window displays.

**Note:** If a gatekeeper already exists, you may want to delete it and start over. This ensures that you start with the default values for any parameters that this section does not specifically mention.

3. Enter these parameters:

Parameter	Setting
<b>Host Name/IP Address</b>	Enter the IP address or host name of the gatekeeper in this required field. You can register multiple gatekeepers for each Cisco CallManager cluster. In this case, it is <b>10.89.129.228</b> .
<b>Description</b>	Enter a descriptive name for the gatekeeper. In this case, it is <b>psy-gk-01</b> .
<b>Enable Device</b>	Ensure that the check box for this field is checked. This allows you to register this gatekeeper with Cisco CallManager. By default, this check box remains checked.

The parameter page appears as shown:

System Route Plan Service Feature Device User Application Help

Cisco CallManager Administration  
For Cisco IP Telephony Solutions

CISCO SYSTEMS

**Gatekeeper Configuration**

[Add a New Gatekeeper](#)  
[Back to Find/List Gatekeepers](#)

Gatekeeper: New

Status :Ready

Insert

**Gatekeeper Information**

Host Name/IP Address\*

Description

Registration Request Time To Live\*

Registration Retry Timeout\*

Enable Device

\* indicates required item

4. Click **Insert** or **Update**, as indicated.

## Configure the H.225 Trunk Parameters

This section explains how to configure an H.225 trunk device that represents a logical route to the

wholesale network.

## Step-by-Step Instructions

1. Choose **Device > Trunk**.
2. Choose **Add a New Trunk**.
3. In the Trunk type field, click the drop-down arrow and choose **H.225 Trunk (Gatekeeper Controlled)**.
4. In the Device Protocol field, click the drop-down arrow and choose **H.225**, as shown here:

The screenshot shows the Cisco CallManager Administration interface. At the top, there is a navigation menu with options: System, Route Plan, Service, Feature, Device, User, Application, and Help. Below this is the page title 'Cisco CallManager Administration For Cisco IP Telephony Solutions' and the Cisco Systems logo. The main heading is 'Add a New Trunk'. Underneath, it says 'Select the type of Trunk you would like to create:'. There are two dropdown menus: 'Trunk type\*' is set to 'H.225 Trunk (Gatekeeper Controlled)' and 'Device Protocol\*' is set to 'H.225'. A 'Next' button is positioned below the 'Device Protocol' dropdown. A red asterisk note states '\* indicates required item'.

5. For Cisco CallManager 4.1, complete these steps.

**Note:** For Cisco CallManager 3.3, move on to Step 6.

- a. Leave the other fields set to their defaults, and click **Next**.

The Trunk Configuration window appears.

- b. Enter these parameters:

Parameter	Setting
Device Name	Enter a unique identifier for the trunk.

	In this case, it is <b>h225_trk</b> .
<b>Description</b>	Enter a descriptive name for the trunk.
<b>Device Pool</b>	Choose the appropriate device pool for the trunk. In this case, it is <b>Default</b> .
<b>Gatekeeper Name</b>	Choose the gatekeeper IP address that controls this trunk. In this case, it is <b>10.89.129.228</b> .
<b>Terminal Type</b>	Choose <b>Gateway</b> .
<b>Technology Prefix</b>	Enter <b>1#*</b> in this field.
<b>Zone</b>	Enter the appropriate zone. In this case, the zone used is <b>horse</b> .

The parameter page appears as shown:

System		Route Plan		Service		Feature		Device		User Application		Help	
Cisco CallManager Administration											Cisco Systems		
<b>Trunk Configuration</b>											<a href="#">Add a New Trunk</a> <a href="#">Back to Find/List Trunk</a> <a href="#">Dependency Records</a>		
<b>Product: H.225 Trunk (Gatekeeper Controlled)</b> <b>Device Protocol: H.225</b> Status: Ready													
<input type="button" value="Update"/> <input type="button" value="Delete"/> <input type="button" value="Reset Trunk"/>													
<b>Device Information</b>													
Device Name*		h225_yk											
Description		h225_yk											
Device Pool*		Default											
Media Resource Group List		< None >											
Location		< None >											
AAR Group		< None >											
<input type="checkbox"/> Media Termination Point Required <input checked="" type="checkbox"/> Retry Video Call as Audio <input checked="" type="checkbox"/> Wait for Far End H.245 Terminal Capability Set													
<b>Call Routing Information</b>													
<b>Inbound Calls</b>													
Significant Digits*		All											
Calling Search Space		< None >											
AAR Calling Search Space		< None >											
Prefix DN													
<input checked="" type="checkbox"/> Redirecting Number IE Delivery - Inbound <input type="checkbox"/> Enable Inbound FastStart													
<b>Outbound Calls</b>													
Calling Party Selection*		Originator											
Calling Line ID Presentation*		Default											
Called party IE number type unknown*		Cisco CallManager											
Calling party IE number type unknown*		Cisco CallManager											
Called Numbering Plan*		Cisco CallManager											
Calling Numbering Plan*		Cisco CallManager											
Caller ID DN													
<input checked="" type="checkbox"/> Display IE Delivery <input type="checkbox"/> Redirecting Number IE Delivery - Outbound <input type="checkbox"/> Enable Outbound FastStart													
Codec For Outbound FastStart*		G711 u-law 54K											
<b>Gatekeeper Information</b>													
Gatekeeper Name*		10.88.128.228											
Terminal Type*		Gateway											
Technology Prefix		1#											
Zone		horse											
<b>Multilevel Precedence and Preemption (MLPP) Information</b>													
MLPP Domain													
MLPP Indication		Not available on this device											
MLPP Preemption		Not available on this device											
* indicates required item													
<a href="#">Back to Find/List Trunk</a>													

c. Skip Step 6 and move on to Step 7.

6. For Cisco CallManager 3.3, enter the parameters listed in this table.

**Note:** The only difference between Cisco CallManager 4.x and 3.3 in this regard is the addition of the parameters **Calling Party Selection** and **Calling Line ID Presentation**.

Parameter	Setting
<b>Device Name</b>	Enter a unique identifier for the trunk. In this case, it is <b>h225_trk</b> .
<b>Description</b>	Enter a descriptive name for the trunk.
<b>Device Pool</b>	Choose the appropriate device pool for the trunk. In this case, it is <b>Default</b> .
<b>Calling Party Selection</b>	Choose <b>Originator</b> .
<b>Calling Line ID Presentation</b>	Choose <b>Default</b> .
<b>Gatekeeper Name</b>	Choose the gatekeeper IP address that controls this trunk. In this case, it is <b>10.89.129.228</b> .
<b>Terminal Type</b>	Choose <b>Gateway</b> .
<b>Technology Prefix</b>	Enter <b>1#*</b> in this field.
<b>Zone</b>	Enter the appropriate zone. In this case, the zone used is <b>horse</b> .

7. Click **Update**, and click **Reset Trunk**.

## Change the Route Pattern to Use the Cisco CallManager Gatekeeper

This section explains how to point a route pattern at a gatekeeper (which, in this case, is the anonymous device gatekeeper) rather than at a gateway or route list.

### Step-by-Step Instructions

1. Choose **Route Plan > Route/Hunt > Route Pattern**.
2. Click **Find**.
3. Click the Route Pattern that you have configured to route calls to the analog phone.

In this case, it is the route pattern for extension 2000.

4. In the Gateway/Route List field, click the drop-down arrow and choose **h225\_trk**.

This is the trunk you just created.

**Note:** If your previous configuration allowed calls from your IP phone to your analog phone (as mentioned in the [Requirements](#) section of this document), you should not need to make any further changes. Set the remainder of the parameters for the route pattern, as shown in this window, to values that are known to work for the scenario of this document:

The screenshot displays the Cisco CallManager Administration web interface for configuring a route pattern. The page title is "Route Pattern Configuration" and the route pattern is "2XXX". The status is "Ready". A note states: "Any update to this Route Pattern automatically resets the associated gateway or Route List". There are buttons for "Copy", "Update", and "Delete".

**Pattern Definition**

- Route Pattern\*: 2XXX
- Partition: < None >
- Description:
- Numbering Plan\*: North American Numbering Plan
- Route Filter: < None >
- MLPP Precedence: Default
- Gateway or Route List\*: h225\_tnk (Edit)
- Route Option:
  - Route this pattern
  - Block this pattern (Dropdown: -- Not Selected --)
- Provide Outside Dial Tone
- Allow Overlap Sending
- Urgent Priority
- Require Forced Authorization Code
  - Authorization Level: 0
- Require Client Matter Code

**Calling Party Transformations**

- Use Calling Party's External Phone Number Mask
- Calling Party Transform Mask:
- Prefix Digits (Outgoing Calls):
- Calling Line ID Presentation: Default
- Calling Name Presentation: Default

**Connected Party Transformations**

- Connected Line ID Presentation: Default
- Connected Name Presentation: Default

**Called Party Transformations**

- Discard Digits: < None >
- Called Party Transform Mask:
- Prefix Digits (Outgoing Calls):

**ISDN Network-Specific Facilities Information Element**

- Carrier Identification Code:
- Network Service Protocol: -- Not Selected --
- Network Service: -- Not Selected --
- Service Parameter Name: < Not Exist >
- Service Parameter Value:

\* indicates required item.

5. Click **Update**.

## Configure the Gatekeeper Parameters

This section explains how to configure the Cisco IOS gatekeeper parameters required for CAC.

Use this configuration for the Cisco gatekeeper:

```

!
!
gatekeeper
zone local horse maui-onions.com 10.89.129.228
zone prefix horse 2* gw-priority 10 10.89.129.211
zone prefix horse 2* gw-priority 0 10.89.129.226
gw-type-prefix 1#* default-technology
bandwidth total zone horse 256
no shutdown
!
!
```

### Notes for This Configuration

- The gatekeeper controls the zone named horse. This is why it is configured as a local zone. The IP address is a local address that is used as the source address for CAC IP packets from the gatekeeper.
- The zone prefix commands for the horse zone are the dial plan for this zone. This is how the gatekeeper associates dialed numbers with the correct zone.

A priority of 1 or higher indicates that a gateway is a viable path to route calls to the prefix configured. A priority of 0 indicates that a gateway is not a viable path to route calls to the prefix configured.

A complete explanation of how gatekeepers make route decisions is beyond the scope of this document. Refer to the document [Understanding Cisco IOS Gatekeeper Call Routing](#) for more information on how gatekeepers make call-route decisions.

- In this scenario, you do not prepend technology prefixes to the dialed digits when the calls are routed to the gatekeeper. This is why the gatekeeper requires the **gw-type-prefix 1#\* default-technology** command and the Cisco IOS gateway requires the **h323-gateway voip tech-prefix 1#** command as well as the **Technology Prefix 1#\*** parameter on the Cisco CallManager gatekeeper configuration. If you neglect to meet these configuration requirements, calls do not complete successfully.
- This zone has a total bandwidth capacity of 256 kbps.

**Note:** There are two versions of the command to set the bandwidth for a zone, which depends on the version of Cisco IOS Software you run on the gatekeeper. The command versions are **bandwidth total zone** and **zone bw**.

## Configure the Gateway Parameters

This section explains how to configure the Cisco IOS gateway parameters required for CAC.

Use this configuration for the Cisco gateway:

```
!
```

```

interface Ethernet0/0
 ip address 10.89.129.226 255.255.255.240
 full-duplex
 h323-gateway voip interface
 h323-gateway voip id horse ipaddr 10.89.129.228 1719
 h323-gateway voip h323-id psy-voice-01@maui-onions.com
 h323-gateway voip tech-prefix 1#
 h323-gateway voip bind srcaddr 10.89.129.226
 !
 voice-port 1/0/0
 !
 voice-port 1/0/1
 !
 dial-peer voice 1 pots
 destination-pattern 2000
 port 1/0/1
 !
 dial-peer voice 2 voip
 destination-pattern 1...
 session target ras
 !
 gateway
 !

```

## Notes for This Configuration

- In this scenario, you do not prepend technology prefixes to the dialed digits when the calls are routed to the gatekeeper. This is why the Cisco IOS gateway requires the command **h323-gateway voip tech-prefix 1#** and the gatekeeper requires the command **gw-type-prefix 1#\* default-technology** as well as the **Technology Prefix 1#\*** parameter on the Cisco CallManager gatekeeper configuration. If you neglect to meet these configuration requirements, calls do not complete successfully.
- You must include the **gateway** command. The other parameters that you can apply under the **gateway** command are optional.
- The **session target ras** command on the gateway causes it to route calls to 1006 (the Directory Number [DN] of the IP phone) to the gatekeeper with the `destination-pattern 1...` wildcard.
- The **h323-gateway voip h323-id** command provides a unique identifier for this gateway that appears in the **show gatekeeper endpoints** command on the gatekeeper.
- The voice port 1/0 in the Cisco IOS gateway is an FXS port. The destination pattern (2000) under POTS dial peer registers as an E.164 (ITU-T) ID with the gatekeeper. You can see this in the output of the **show gatekeeper endpoints** command on the gatekeeper.

## Verify

This section provides some of the basic commands available to verify that your gatekeeper configuration works properly. There are several other documents on [Cisco.com](http://www.cisco.com) that explain how to verify and troubleshoot gatekeeper configurations in greater detail. See the [Related Information](#) section of this document for more information.

**Note:** Certain **show** commands are supported by the [Output Interpreter Tool](#) ( [registered](#) customers only) , which allows you to view an analysis of **show** command output.

## Use the show gatekeeper endpoints Command

Use the **show gatekeeper endpoints** command on the gatekeeper to verify that the two gateways (Cisco CallManager server and the Cisco IOS gateway router) have registered.

```
psy-gk-01# show gatekeeper endpoints
                        GATEKEEPER ENDPOINT REGISTRATION
                        =====
CallSignalAddr  Port  RASSignalAddr  Port  Zone Name          Type    Flags
-----
10.89.129.211   3152  10.89.129.211  1494  horse              VOIP-GW
      H323-ID: h225_trk_1
10.89.129.226   1720  10.89.129.226  51534 horse              VOIP-GW
      E164-ID: 2000
      H323-ID: psy-gw-01@maui-onions.com
Total number of active registrations = 2
```

Parameter	Description
<b>E164-ID: 2000</b>	This is the destination pattern on POTS dial peer 1 on the Cisco IOS gateway router.  <b>Note:</b> In this case, this is an FXS port, so it connects to an end station (which, in this case, is the analog phone shown in the <a href="#">Network Diagram</a> ).  dial-peer voice 1 pots destination-pattern 2000 port 1/0/1
<b>H323-ID: psy-gw-01</b>	This is the h.323-id parameter on the Fast Ethernet interface of the Cisco IOS gateway router.  h323-gateway voip h323-id <b>psy-gw-01</b>
<b>H323-ID: h225_trk_1</b>	This is the H.225 trunk that is configured in the Cisco CallManager server.

## Use the show gateway Command on the Cisco IOS Gateway to Verify Its Registration Status

Use the **show gateway** command on the Cisco IOS gateway to verify that the gateway has registered with the gatekeeper.

```
psy-gw-01# show gateway
H.323 ITU-T Version: 4.0   H323 Stack Version: 0.1
Gateway psy-gw-01@maui-onions.com is registered to Gatekeeper horse

Alias list (CLI configured)
```

```
H323-ID psy-gw-01@maui-onions.com
E164-ID 2000
Alias list (last RCF)
H323-ID psy-gw-01@maui-onions.com
E164-ID 2000
```

```
H323 resource thresholding is Disabled
```

This output shows that the Cisco IOS gateway has registered with the gatekeeper.

## Make Calls in Both Directions to Verify Connectivity

You must try to make calls in both directions to ensure that your dial plan is correct and that the gatekeeper functions for calls that either phone initiates.

1. Call the IP phone from the analog phone.

You should successfully establish a call and have two-way voice communication.

Even if you cannot make the call successfully, proceed to Step 2.

2. Call the analog phone from the IP phone.

You should successfully establish a call and have two-way voice communication.

If you can successfully make calls in both directions, proceed to the next section, [Use the \*\*show gatekeeper calls\*\* Command to Verify That CAC Is Working](#), to verify that the calls you make use CAC.

If you only have one-way voice communication, see the [Related Information](#) section for links to other documents on how to troubleshoot one-way voice issues. After you have resolved the one-way voice problem, proceed to the section [Use the \*\*show gatekeeper calls\*\* Command to Verify That CAC Is Working](#).

If you cannot place a call in either direction, or in both directions, see the [Troubleshoot](#) section of this document.

## Use the **show gatekeeper calls** Command to Verify That CAC Is Working

This section helps you to verify that the calls you make use CAC.

1. Make a call from the analog phone (2000) to the IP phone (1006) and leave both phones off hook.
2. Issue the **show gatekeeper calls** command to view an active call.

```
psy-gk-01# show gatekeeper calls
Total number of active calls = 1.
GATEKEEPER CALL INFO
=====
LocalCallID Age(secs) BW
35-24077 14 128(Kbps)
Endpt(s): Alias E.164Addr
```

```

src EP: psy-gw-01@maui-onions 2000
CallSignalAddr Port RASSignalAddr Port
10.89.129.226 1720 10.89.129.226 51534
Endpt(s): Alias E.164Addr
dst EP: h225_trk_1 1006
CallSignalAddr Port RASSignalAddr Port
10.89.129.211 3821 10.89.129.211 1494

```

This output shows that CAC is active for this call. Boldface text shows the source and destination DNs (1006 and 2000).

3. Make a call from the IP phone (1006) to the analog phone (2000) and leave both phones off hook.
4. Issue the **show gatekeeper calls** command to view an active call.

```

psy-gk-01# show gatekeeper calls
Total number of active calls = 1.
                        GATEKEEPER CALL INFO
                        =====
LocalCallID                Age(secs)   BW
36-32986                    8           16(Kbps)
  Endpt(s): Alias          E.164Addr
    src EP: h225_trk_1      1006
      CallSignalAddr Port RASSignalAddr Port
      10.89.129.211 3821 10.89.129.211 1494
  Endpt(s): Alias          E.164Addr
    dst EP: psy-gw-01       2000
      CallSignalAddr Port RASSignalAddr Port
      10.89.129.226 1720 10.89.129.226 51534

```

This output shows that CAC is active for this call. Boldface text shows the source and destination DNs (1006 and 2000).

## Reduce the Zone Bandwidth Parameter to Block All Calls

If you want to perform a final, conclusive test that CAC is operational, reduce the zone bandwidth parameter to less than 128. Based on the output from the **show gatekeeper calls** command, 128 is the bandwidth that the calls use. (This is shown in the section [Use the show gatekeeper calls Command to Verify That CAC Is Working.](#))

1. Shut down the gatekeeper.

```

psy-gk-01(config)# gatekeeper
psy-gk-01(config-gk)# shutdown

```

2. Issue the command to reduce the zone bandwidth.

```

psy-gk-01(config-gk)# bandwidth total zone horse 64

```

3. Bring the gatekeeper online again.

```

psy-gk-01(config-gk)# no shutdown

```

You should get an immediate reorder tone after you dial the fourth digit of either DN. If you do

not get a reorder tone and the call goes through, you may not have changed the route pattern on the Cisco CallManager server to point to the H.225 trunk (h225\_trk). Verify this setting. You should also verify that you made the change to the zone bandwidth parameter.

4. Remember to change the zone bandwidth back to a value that allows the calls to proceed.

## Troubleshoot

This section provides information you can use to troubleshoot your configuration.

### Troubleshoot the Gatekeeper Configuration

Complete these steps to troubleshoot your configuration:

1. If your gateways do not register with the gatekeeper and you have verified that all your configuration commands are correct, refer to the document [Troubleshooting Gatekeeper Registration Issues](#).
2. If your gateways register with the gatekeeper and you cannot place calls in either or in both directions:
  - o Verify that you have the zone prefix commands for your DNs on the gatekeeper.
  - o Verify that the zone bandwidth is not set below 128.
  - o Stop and restart the Cisco CallManager service on the server.
  - o Shut down the gatekeeper and restart it.
  - o Switch your Cisco CallManager route pattern back to the gateway that you used to verify the [Requirements](#) for this document. Ensure that you can place calls in both directions without CAC. If you cannot place calls with your original gateway, you need to resolve the problem before you can successfully test CAC.

There are several other documents available on [Cisco.com](#) that explain how to verify and troubleshoot gatekeeper configurations in greater detail. See the [Related Information](#) section for more information.

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Voice & Video: IP Phone Services for End Users
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## Related Information

- [Understanding H.323 Gatekeepers](#)
- [Troubleshooting and Understanding Cisco Gatekeeper Bandwidth Management](#)
- [Understanding Cisco IOS Gatekeeper Call Routing](#)
- [Troubleshooting Gatekeeper Registration Issues](#)

- [Troubleshooting Gatekeeper Endpoint Call Admission Issues](#)
- [Configuring Basic Gatekeeper Call Admission Control](#)
- [Troubleshooting One Way Voice Issues](#)
- [Voice Technology Support](#)
- [Voice and IP Communications Product Support](#)
- [Voice, Telephony and Messaging TAC eLearning Solutions](#)
- **Recommended Reading:** [Troubleshooting Cisco IP Telephony](#) 
- [Technical Support - Cisco Systems](#)

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