



Avaya 8500 Communications Manager 4.0 to Cisco IOS Voice Gateway using SIP with T1-CAS

January 14, 2008

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Introduction

- This Application note provides basic call interoperability and documented steps and configurations necessary for SIP integration between Avaya S8500 to Cisco IOS Voice Gateway providing PSTN (T1 CAS) connectivity.
- The SIP protocol is used between Cisco IOS Voice gateway and Avaya S8500. The connection between Cisco IOS gateway and PSTN uses T1-CAS (E&M-immediate).
- Features tested include Basic call, Call Transfer supervised, Call Transfer blind, Call Forward (All, Busy and No Answer), Three-way Conference, DTMF tones between Avaya S8500 users and PSTN.
- The Cisco IOS Voice Gateway offers the advantage of providing connectivity between Avaya S8500 and PSTN by offering SIP to T1-CAS (robbed-bit signaling) inter-working functionality.
- The network topology diagram (Figure 1) shows the test setup for end-to-end interoperability with the Cisco IOS Voice Gateway connected to the Avaya S8500 (10/100baseT) and connected to the PSTN via T1-CAS (robbed-bit signaling).
- This Application Notes uses the C2432 IOS-voice-gateway, however other Cisco voice gateways are also an option to use since the voice gateway implementation does not depend on the platform. Below is a list of Cisco platforms capable of voice gateway functionality: Care must be taken when selecting a voice gateway platform depending on the capacity and capability required for the intended deployment.

[Cisco 1861 Integrated Services Router](#)

[Cisco IAD2430 Integrated Access Device](#)

[Cisco 2800 Series Integrated Services Routers](#)

[Cisco 3700 Series Multiservice Access Routers](#)

[Cisco 3800 Series Integrated Services Routers](#)

[Cisco AS5350XM Universal Gateway](#)

[Cisco AS5400XM Universal Gateway](#)

Network Topology

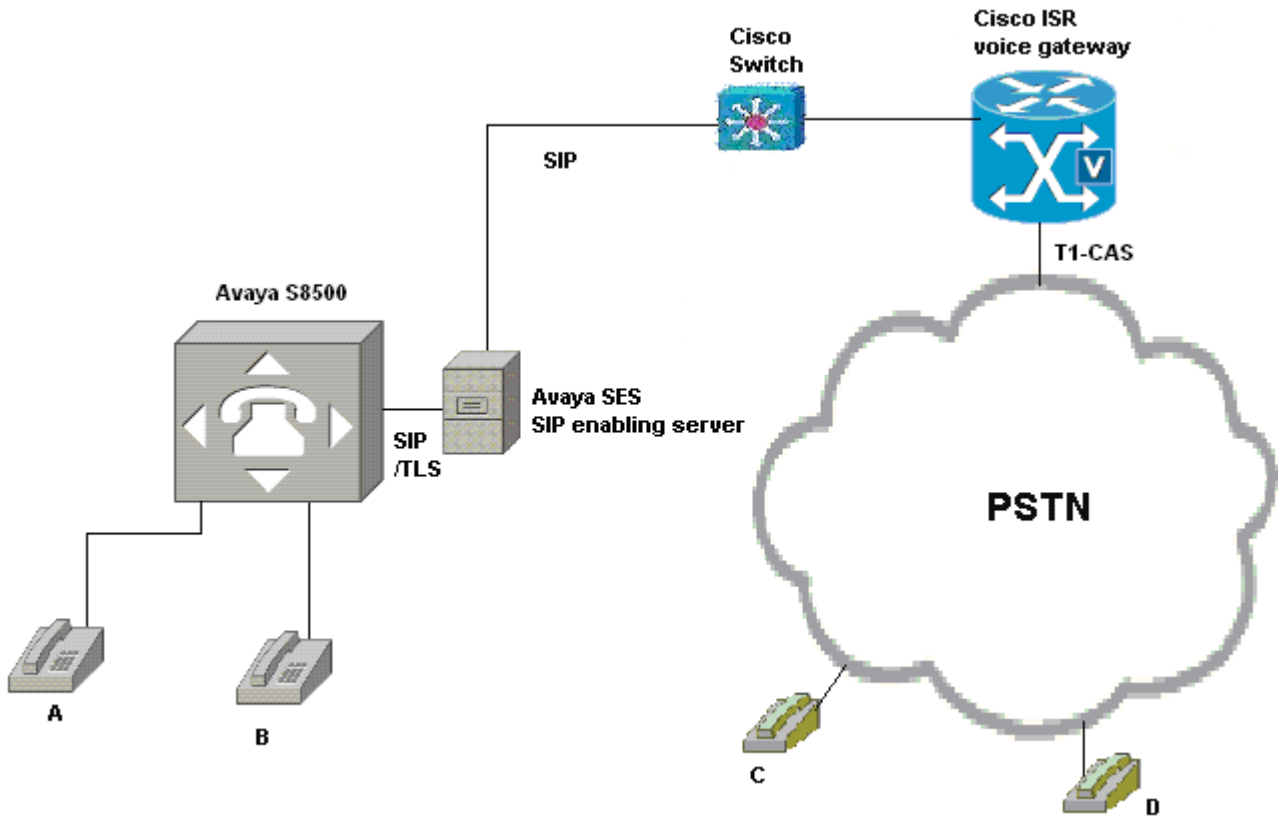


Figure 1. Network Topology



Limitations

- Cisco IOS gateway does not support SIP 181 message (call being forwarded) which causes SDP establishment failure during a call forward between PSTN phone and Avaya stations. PSTN user does not get ringback. This applies to Call Forwarding (all and busy) calls.
- Basic call using G.726A – 32K fails. Avaya rejects G.726 codec, even when the Avaya is set for G.726.

System Components

Hardware requirements

Cisco equipment

- Cisco 2432 (Cisco 3800 family routers)
- Cisco 3560 powered Ethernet switch

Avaya equipment

- Avaya S8500
- Avaya SIP Enablement Services (SES)
- TN2312BP IPSI
- TN799DP C-LAN
- TN2302AP IP Media Processor
- TN746B Analog
- TN2224B 2-wire Digital
- 2 - Digital stations 8410D

Software Requirements

- IOS Gateway: Cisco IOS Release – c2432: c2430-ik9o3s-mz.124-15.T1.bin
- Avaya S8500: Communication Manager 4.0
- Avaya SES: SES-4.0.0.0-033.6

Features

Features Supported

- G.711alaw, G.711ulaw, G.723 (5.3K and 6.3K), G.729(A and B)
- Call Transfer blind and Call Transfer Supervised
- Call Conference
- Call Forward All, please see limitations
- Call Forward No Reply
- Call Forward Busy, please see limitations
- DTMF (RFC2833)
- Digit Translation
- DTMF inband (G711)



Features Not Supported

- G726 codecs
- T1-CAS do not support Calling name/number and Connected name/number



Configuration

Avaya Configuration

Signaling group (in band DTMF).

The screenshot shows a configuration window for a signaling group. The window title is "change signaling-group 1". The main content area is titled "SIGNALING GROUP" and displays the following configuration details:

- Group Number: 1
- Group Type: sip
- Transport Method: tls
- Near-end Node Name:
- Far-end Node Name:
- Near-end Listen Port:
- Far-end Listen Port:
- Far-end Network Region:
- Far-end Domain:
- Bypass IF IP Threshold Exceeded?
- DTMF over IP:
- Direct IP-IP Audio Connections?
- IP Audio Hairpinning?
- Enable Layer 3 Test?
- Session Establishment Timer(min):



Signaling group (RFC 2833 DTMF)

File Edit View System Action Tools Window Help

change signaling-group 1 send (return) help (f5) cancel (esc) enter (f3) schedule (f9) next (f7) previous (f8) next form (f6)

1

SIGNALING GROUP

Group Number: 1 Group Type: sip Transport Method: tls

Near-end Node Name: Far-end Node Name:
Near-end Listen Port: Far-end Listen Port:
Far-end Network Region:
Far-end Domain:

Bypass If IP Threshold Exceeded? n

DTMF over IP: Direct IP-IP Audio Connections? y
IP Audio Hairpinning? y

Enable Layer 3 Test? n
Session Establishment Timer(min):

Trunk group – p1 of 3

File Edit View System Action Tools Window Help

change trunk-group 1 send (return) help (f5) cancel (esc) enter (f3) schedule (f9) next (f7) previous (f8) next form (f6)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21

TRUNK GROUP

Group Number: 1 Group Type: CDR Reports: y
Group Name: COR: TN: TAC:
Direction: Outgoing Display? n
Dial Access? n Night Service:
Queue Length:
Service Type: Auth Code? n

Signaling Group:
Number of Members:



Trunk group – p2 of 3

File Edit View System Action Tools Window Help

change trunk-group 1 send (return) help (F5) cancel (esc) enter (F3) schedule (F9) next (F7) previous (F8) next form (F6)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----

Group Type: sip

TRUNK PARAMETERS

Unicode Name?

Redirect On OPTIM Failure:

SCCAN?

Digital Loss Group:

Preferred Minimum Session Refresh Interval(sec):

Trunk group – p3 of 3

File Edit View System Action Tools Window Help

change trunk-group 1 send (return) help (F5) cancel (esc) enter (F3) schedule (F9) next (F7) previous (F8) next form (F6)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----

TRUNK FEATURES

ACA Assignment? Measured: Maintenance Tests?

Numbering Format: UUI Treatment:

Replace Unavailable Numbers?

Show ANSWERED BY on Display?



Node-names IP

The screenshot shows the 'IP NODE NAMES' configuration page in the Cisco SIP1 interface. The left sidebar contains a 'General' menu with options like 'Start GEDI', 'Add User', 'Change User Name', 'Remove User', 'Add Bridged Appearance', 'Browse Dial Ranges', 'Browse Stations', 'Browse Unused Ports', 'Find Unused Extension', and 'Print Button Labels'. The main content area displays a table of node names and their IP addresses.

Name	IP Address
avayasip1	172.20.212.254
clan1	172.20.212.253
clan1serverb	172.20.213.253
default	0.0.0.0
pipgw	172.20.192.102
medpro1	172.20.212.252
nortelcs1000	172.20.216.100
procr	172.20.212.200

(8 of 13 administered node-names were displayed)
 Use 'list node-names' command to see all the administered node-names
 Use 'change node-names ip xxx' to change a node-name 'xxx' or add a node-name

IP Network Region

The screenshot shows the 'IP NETWORK REGION' configuration page in the Cisco SIP1 interface. The left sidebar is the same as in the previous screenshot. The main content area displays various configuration parameters for Region 1.

Region: 1
 Location: 1 Authoritative Domain: lab.com
 Name: CiscoLAB

MEDIA PARAMETERS

Codec Set: 1 Intra-region IP-IP Direct Audio: no
 Inter-region IP-IP Direct Audio: no
 UDP Port Min: 2048 IP Audio Hairpinning?
 UDP Port Max: 3029

DIFFSERV/TOS PARAMETERS

Call Control PHB Value: 34 RTCP Reporting Enabled?
 Audio PHB Value: 46 RTCP MONITOR SERVER PARAMETERS
 Video PHB Value: 26 Use Default Server Parameters?

802.1P/Q PARAMETERS

Call Control 802.1p Priority: 7
 Audio 802.1p Priority: 6
 Video 802.1p Priority: 5

H.323 IP ENDPOINTS

H.323 Link Bounce Recovery?
 Idle Traffic Interval (sec): 20
 Keep-Alive Interval (sec): 5
 Keep-Alive Count: 5

AUDIO RESOURCE RESERVATION PARAMETERS

RSUP Enabled?



IP codec set

change ip-codec-set 1

1 2

IP Codec Set

Codec Set: 1

Audio Codec	Silence Suppression	Frames Per Pkt	Packet Size(ms)
1: G.711MU	<input type="checkbox"/>	<input type="checkbox"/>	20
2: G.711MU	<input type="checkbox"/>	<input type="checkbox"/>	
3: G.722-64K	<input type="checkbox"/>	<input type="checkbox"/>	
4: G.722.1-24K	<input type="checkbox"/>	<input type="checkbox"/>	
5: G.722.1-32K	<input type="checkbox"/>	<input type="checkbox"/>	
6: G.723-5.3K	<input type="checkbox"/>	<input type="checkbox"/>	
7: G.723-6.3K	<input type="checkbox"/>	<input type="checkbox"/>	
G.726A-32K	<input type="checkbox"/>	<input type="checkbox"/>	
G.729	<input type="checkbox"/>	<input type="checkbox"/>	
G.729A	<input type="checkbox"/>	<input type="checkbox"/>	
G.729B	<input type="checkbox"/>	<input type="checkbox"/>	

1: none
2:
3:

Uniform dialing plan

display uniform-dialplan 1

1 2

UNIFORM DIAL PLAN TABLE

Percent Full: 0

Matching Pattern	Len	Del	Insert Digits	Net Conv	Node Num
1	4	0	222	aar	n
1612	4	0	211	aar	n
1613	4	0	211	aar	n
18	4	0	211	aar	n
20	4	0	202	aar	n
2001	4	0	210	aar	n
2004	4	0	210	aar	n
2006	4	0	210	aar	n
2007	4	0	221	aar	n
21	4	0	202	aar	n
2101	4	0	216	aar	n
2102	4	0	216	aar	n
2106	4	0	204	aar	n
2107	4	0	204	aar	n
2117	4	0	214	aar	n
2118	4	0	214	aar	n



AAR analysis

display aar analysis 111

send (return) help (F5) cancel (esc) enter (F3) schedule (F9) next (F7) previous (F8) next form (F6)

1 2

Percent Full: 2

Dialed String	Total Min	Total Max	Route Pattern	Call Type	Node Num	ANI Reqd
2	7	7	999	aar		n
202	7	7	2	aar		n
203	7	7	3	aar		n
204	7	7	44	aar		n
207	7	7	99	aar		n
208	7	7	2	aar		n
210	7	7	10	aar		n
211	7	7	11	aar	1	n
213	7	7	13	aar		n
214	7	7	14	aar		n
216	7	7	16	aar		n
217	7	7	17	aar	3	n
221	7	7	11	aar	4	n
222	7	7	21	aar		n
224	7	7	99	aar		n

Route Pattern

display route-pattern 21

send (return) help (F5) cancel (esc) enter (F3) schedule (F9) next (F7) previous (F8) next form (F6)

1 2 3

Pattern Number: 21 Pattern Name: ISDN TIE

SCCAN? n Secure SIP? n

Grp No	FRL	NPA	Pfx Mrk	Hop Lmt	ToLL List	No. Del	Inserted Digits	DGTS	DCS/ IXC
1:	1	0					3		n user
2:									n user
3:									n user
4:									n user
5:									n user
6:									n user

BCC	VALUE	TSC	CA-TSC	ITC	BCIE	Service/Feature	PARM	No. Dgts	Numbering Format	LAR
0	1 2 M 4 W		Request							
1:	y	y	y	y	y	n	y	as-needed	bothept	unk-unk none
2:	y	y	y	y	y	n	n		rest	none
3:	y	y	y	y	y	n	n		rest	none
4:	y	y	y	y	y	n	n		rest	none
5:	y	y	y	y	y	n	n		rest	none
6:	y	y	y	y	y	n	n		rest	none



Avaya SIP Enablement Server

Server

Help Exit

Top

- Users
- Conferences
- Media Server Extensions
 - Emergency Contacts
- Hosts
 - List
 - Migrate Home/Edge
- Media Servers
 - Address Map Priorities
- Adjunct Systems
- Trusted Hosts
 - Services
- Server Configuration
- Certificate Management
 - IM logs
- Trace Logger
- Export/Import to ProVision

List Hosts

Status	Commands	Host	Type
up to date	Edit Map Go-To Test-Link Delete	172.20.212.254	home/edge

Force All
Migrate Home/Edge

Routing Entry

Help Exit

Top

- Users
- Conferences
- Media Server Extensions
 - Emergency Contacts
- Hosts
 - List
 - Migrate Home/Edge
- Media Servers
 - Address Map Priorities
- Adjunct Systems
- Trusted Hosts
 - Services
- Server Configuration
- Certificate Management
 - IM logs
- Trace Logger
- Export/Import to ProVision

Edit Host Map Entry

Name*

Pattern*

Replace URI

Fields marked * are required.



DN Map

Help
Exit

Top

- ▣ Users
- ▣ Conferences
- ▣ Media Server Extensions
 - Emergency Contacts
- ▣ Hosts
 - List
 - Migrate Home/Edge
- ▣ Media Servers
 - Address Map Priorities
- ▣ Adjunct Systems
- ▣ Trusted Hosts
 - Services
- ▣ Server Configuration
- ▣ Certificate Management
 - IM logs
- ▣ Trace Logger
- ▣ Export/Import to ProVision

List Host Address Map

Host 172.20.212.254

Commands	Name	Commands	Contact
Edit Delete	IP_IP_GW_233		
Edit Delete	IP_IP_GW_5000		
Edit Delete	IP_IP_GW_5001		
Edit Delete	IP_IP_GW_5010		
Add Another Map		Edit Delete	sip:\${user}@172.20.174.40:5060;transport=udp
Add Another Contact		Delete Group	
Edit Delete	CM-Polaris		
Add Another Map		Edit Delete	sip:\${user}@172.20.236.50:5060;transport=tcp
Add Another Contact		Delete Group	
Edit Delete	CCM-Mercury		
Add Another Map		Edit Delete	sip:\${user}@172.20.215.254:5060;transport=tcp
Add Another Contact		Delete Group	
Edit Delete	CCM5.0-Venus		
Add Another Map		Edit Delete	sip:\${user}@172.20.214.254:5060;transport=tcp
Add Another Contact		Delete Group	
Edit Delete	Nortel-cs1000		
Add Another Map		Edit Delete	sip:\${user}@172.20.216.100:5060;transport=udp
Add Another Contact		Delete Group	
Edit Delete	Avaya_SIP2		
Edit Delete	Avaya_SIP2_21XX		
Add Another Map		Edit Delete	sip:\${user}@172.20.213.254:5060;transport=tcp
Add Another Contact		Delete Group	
Add Map In New Group			

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IOS gateway trusted host

The screenshot shows the Cisco IOS Gateway configuration interface. On the left is a navigation menu with categories like Top, Users, Conferences, Media Server Extensions, Hosts, Media Servers, Adjunct Systems, Trusted Hosts, Services, Server Configuration, Certificate Management, Trace Logger, and Export/Import to Provision. The main content area is titled 'List Trusted Hosts' and contains a table with the following data:

Commands	IP Address	Trusted by Host	Comment
Edit Delete	172.20.174.40	172.20.212.254	Cecily-GW
Edit Delete	172.20.213.253	172.20.212.254	Avaya CM2
Edit Delete	172.20.213.254	172.20.212.254	Avaya SIP2
Edit Delete	172.20.214.254	172.20.212.254	CM-Venus
Edit Delete	172.20.215.254	172.20.212.254	CM-Mercury
Edit Delete	172.20.216.100	172.20.212.254	Nortel-cs1000
Edit Delete	172.20.228.254	172.20.212.254	IP_IP_GW
Edit Delete	172.20.236.50	172.20.212.254	CM-Polaris

Below the table is a link: [Add Another Trusted Host](#)

Cisco IOS configuration

Cisco 2432 voice gateway configuration

```
c2432-voice#sh ver
Cisco IOS Software, 2400 Software (C2430-IK9O3S-M), Version 12.4(15)T1, RELEASE
SOFTWARE (fc2)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2007 by Cisco Systems, Inc.
Compiled Wed 18-Jul-07 05:05 by prod_rel_team
```

ROM: System Bootstrap, Version 12.3(7r)T2, RELEASE SOFTWARE (fc1)

```
c2432-voice uptime is 1 week, 23 hours, 17 minutes
System returned to ROM by reload
System image file is "flash:c2430-ik9o3s-mz.124-15.T1.bin"
```

This product contains cryptographic features and is subject to United States and local country laws governing import, export, transfer and use. Delivery of Cisco cryptographic products does not imply third-party authority to import, export, distribute or use encryption. Importers, exporters, distributors and users are responsible for compliance with U.S. and local country laws. By using this product you agree to comply with applicable laws and regulations. If you are unable to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be found at:



<http://www.cisco.com/wwl/export/crypto/tool/stqrg.html>

If you require further assistance please contact us by sending email to export@cisco.com.

Cisco IAD2432 (R527x) processor (revision 4.1) with 119808K/11264K bytes of memory.

Processor board ID FHK1013F23V

R527x CPU at 225MHz, Implementation 40, Rev 3.1

1 On-Board Twenty-Four FXS Analog Voice Module V1.3

2 FastEthernet interfaces

42 Serial interfaces

2 Channelized E1/PRI ports

1 Virtual Private Network (VPN) Module

DRAM configuration is 64 bits wide with parity disabled.

63K bytes of non-volatile configuration memory.

System fpga version is 250027

System readonly fpga version is 250025

Option for system fpga is 'system'.

62720K bytes of ATA System CompactFlash (Read/Write)

Configuration register is 0x2102

=====

T1-CAS#sho run

Building configuration...

Current configuration : 2540 bytes

!

version 12.4

service timestamps debug datetime msec

service timestamps log datetime msec

no service password-encryption

!

hostname T1-CAS

!

boot-start-marker

boot system flash:c2430-ik9o3s-mz.124-15.T1.bin

boot-end-marker

!

card type t1 1

logging buffered 1000000

!

no aaa new-model

network-clock-participate T1 1/0

network-clock-participate T1 1/1

!

!

no ip domain lookup

!

!

multilink bundle-name authenticated

!

voice-card 0

!

!

voice rtp send-recv

!

voice service voip



```
allow-connections sip to sip1
sip2
  min-se 240
!
!
voice translation-rule 13
  rule 1 /2332/ /2008/
  rule 2 /2333/ /2007/
!
voice translation-rule 24
  rule 1 /70/ /41\1/
!
!
voice translation-profile rule15
  translate called 1
!
  voice translation-profile rule2
  translate called 2
!
!
archive
  log config
  hidekeys
!
!
controller T1 1/0
  mode cas
  framing esf
  linecode b8zs
ds0-group 0 timeslots 1-4 type e&m-immediate-start6
!
controller T1 1/1
  framing esf
  linecode b8zs
!
!
interface FastEthernet0/0
  no ip address
  shutdown
  duplex half
  speed 100
!
interface FastEthernet0/1
  ip address 172.20.174.40 255.255.255.0
  duplex auto
  speed auto
!
ip default-gateway 172.20.174.1
ip http server
```

¹ This enables VoIP-VoIP call connections.

² This will enter SIP configuration mode.

³ This defines a digit translation-rule set: rule 1 replaces the first occurrence of the number “2332” to “2008”; and rule 2 replaces the second occurrence of the number “2333” to “2007”

⁴ This individual rule translate the number that starts with “70” and replaces the first two digits with “41”, then copy the rest of the dialed digits.

⁵ The voice translation rules are applied to voice translation profile, which can then applied to dial peers.

⁶ This defines T1 channels for compressed voice calls and the CAS method by which the router connects to the PBX.



```
no ip http secure-server
!  
ip route 0.0.0.0 0.0.0.0 172.20.174.1
!  
!  
control-plane
!  
!  
voice-port 1/0:0
!  
!  
dial-peer voice 2000 pots
translation-profile incoming rule27
destination-pattern 20..
incoming called-number 70..8
supplementary-service pass-through
port 1/0:0
forward-digits all
!  
dial-peer voice 4100 voip
translation-profile incoming rule1
destination-pattern 41..
session protocol sipv2
session target ipv4:172.20.212.254
incoming called-number 23..
dtmf-relay rtp-nte9
supplementary-service pass-through
!  
!  
gateway
timer receive-rtp 1200
!  
sip-ua
no remote-party-id
!  
!  
line con 0
exec-timeout 0 0
password cisco
login
line aux 0
line vty 0 4
exec-timeout 0 0
password cisco
login
!  
end
```

Acronyms

Acronym	Definitions
codec	compressor/decompressor
PBX	Private Branch Exchange

⁷ This is where you can associate the voice translation profile to dial peers, whether it is VOIP or POTS.

⁸ This specifies a digit string that can be matched by an incoming call to associate the call with a dial peer.

⁹ This command is for testing DTMF RFC2833; removing this command will do DTMF in-band.



Acronym	Definitions
PSTN	Public Switched Telephone Network
IOS	Internetworking Operating System

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