



# Avaya S8500 Communications Manager 2.1 to Cisco IOS Voice Gateway using E1 QSIG with H.323

October 30, 2007 Revision 3

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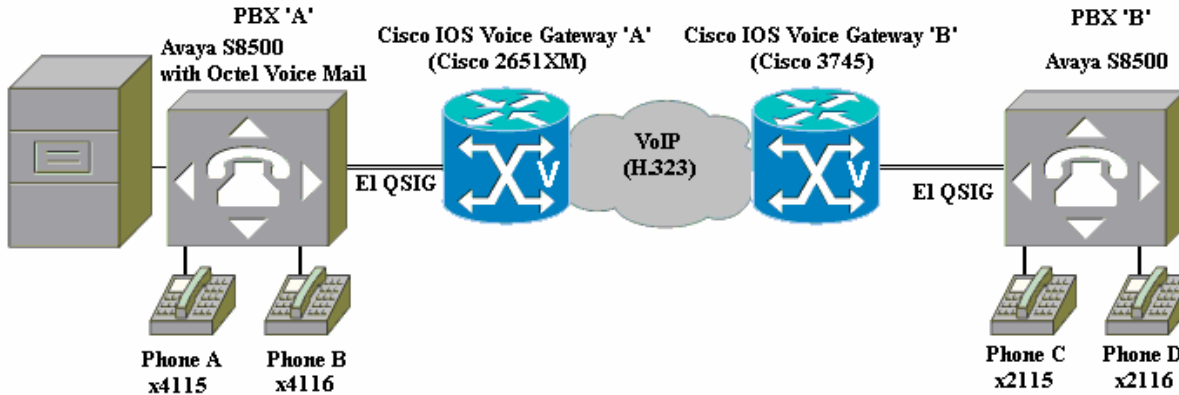
## Introduction

- Although specific gateway router models were used to validate its content, this application note also applies to all Cisco 1700/2600/3600/3700/2800/3800 series Cisco IOS voice gateways.
- This application note provides configuration guidelines for a toll-bypass network using Cisco IOS voice gateways to connect Avaya S8500 Communications Manager 2.1 PBXs. The PBXs are connected to the Cisco IOS voice gateways by E1 QSIG trunk circuits. The Cisco IOS voice gateways “extend” the E1 QSIG trunk circuits with VoIP, using the H.323 protocol.
- Two Avaya S8500 Communications Manager 2.1 PBXs were connected via E1 QSIG trunk to two Cisco IOS voice gateways. The voice gateways were connected via IP over Ethernet, and configured for VoIP using H.323. End-to-end calls were placed between the PBXs to exercise and test basic calls as well as QSIG supplementary services such as MWI, call hold, call transfer, call conference, and call forward.
- Using the Avaya PBX configurations and Cisco IOS voice gateway configurations in this application note, successful toll bypass integration was achieved. This includes basic call, call transfer, call conference, and call forward, call hold, and MWI, with some limitations on Caller ID features during transfer, forward, and conference scenarios. These limitations are detailed in the following sections and all were found to be inherent to the Avaya PBXs. Thus, H.323 toll bypass introduced no new restrictions to the available features or performance.



## Network Topology

Figure 1. Network Topology or Test Setup



## System Components

### Hardware Requirements

- (2) Cisco IOS voice gateways with E1 VWICs (voice/WAN interface cards)
- (2) Avaya S8500s
- (4) Avaya digital station telephones

### Software Requirements

- Avaya PBXs: Communications Manager Release 2.1
- Cisco IOS voice gateways: Cisco IOS Release Version 12.4(1.8)T or later.

### Features

- Basic Call (ENBLOC and Overlap)
- Call Transfer: Supervised Local Transfer
- Call Transfer: Supervised Network/External Transfer
- Call Conference: Local
- Call Conference: Network/External
- Call Forward: Local
- Call Forward: Network/External
- Call Hold
- MWI



## Limitations

- CONNECTED NUMBER is supported in lieu of CALLED (ALERTING) NUMBER. This is inherent to the PBXs and also occurs with the PBXs connected directly via an E1 QSIG trunk.
- On Supervised Transfers, the original CALLING NAME and CALLING NUMBER are displayed on the final destination only after the transfer was complete. This is inherent to the PBXs and also occurs with the PBXs connected directly via a E1 QSIG trunk.
- On Conference Calls accomplished by an external call followed by a local conference (e.g., originate call from 'C' to 'A', and conference from 'A' to 'B'), the Connected Name/Number are not updated on the original digital extension when the conferencing extension drops out. The original call is still displayed (e.g., 'A' Name/Number displayed on 'C'). This is inherent to the PBXs and also occurs with the PBXs connected directly via a E1 QSIG trunk.
- On Conference Calls accomplished by an external call followed by an external conference (e.g., originate from 'C' to 'A', and conference from 'A' to 'D' or originate from 'C' to 'A', and conference from 'C' to 'B'), the Calling Name/Number are not passed to the remaining conferee when the conferencing extension drops out. The conferencing extension's Name/Number are displayed, or no name/number are displayed. This is inherent to the PBXs and also occurs with the PBXs connected directly via a E1 QSIG trunk.
- On Conference Calls accomplished by an external call followed by an external conference (e.g., originate from 'C' to 'A', and conference from 'A' to 'D' or originate from 'C' to 'A', and conference from 'C' to 'B'), the Connected Name/Number are not updated on the original calling extension when a conferee drops out. In cases where the conferencing extension drops, the conferencing extension's Name/Number are displayed on the originating extension. In cases where the originating extension is the conferencing extension, and another extension drops, there is no Connected Name/Number on the original/conferencing extension. Rather, the trunk number as defined in the originating phone's PBX is displayed. This is inherent to the PBXs and also occurs with the PBXs connected directly via a E1 QSIG trunk.
- On Conference Calls accomplished by a local call followed by a network/external conference (e.g., originate call from 'A' to 'B', and conference from 'B' to 'C'), the Calling Name/Number are not passed to the remaining conferee ('C') when the conferencing extension ('B') drops out. The conferencing extension's information is still displayed (e.g., 'B' Name/Number displayed on 'C'). This is inherent to the PBXs and also occurs with the PBXs connected directly via a E1 QSIG trunk.
- On Forwarded Calls, the original Calling Number is not passed to the final destination extension. This is inherent to the PBXs and also occurs with the PBXs connected directly via a E1 QSIG trunk.
- On Forwarded Calls, the forwarding Called Number is not passed to the final destination extension. This is inherent to the PBXs and also occurs with the PBXs connected directly via a E1 QSIG trunk.
- On Forwarded Calls, the final destination Connected Number is not updated at the originating extension. This is inherent to the PBXs and also occurs with the PBXs connected directly via a E1 QSIG trunk.
- On Forwarded Calls involving an external call followed by an external forward (e.g., originate from 'C' to 'B' and forward from 'B' to 'D'), the forwarding Called Name is not passed to the final destination extension. This is inherent to the PBXs and also occurs with the PBXs connected directly via an E1 QSIG trunk.
- On Forwarded Calls involving an external call followed by an external forward (e.g., originate from 'C' to 'B' and forward from 'B' to 'D'), the final destination Connected Name is not passed to the originating extension. Rather, the forwarding extension's name is still displayed. This is inherent to the PBXs and also occurs with the PBXs connected directly via an E1 QSIG trunk.





Figure 3. AAR Analysis screenshot

```
display aar analysis 0 Page 1 of 2
```

AAR DIGIT ANALYSIS TABLE Percent Full: 1

Dialled String	Total		Route Pattern	Call Type	Node Num	ANI Reqd
	Min	Max				
2	7	7	999	aar		n
222	7	7	21	aar		n
224	7	7	99	aar		n
225	7	7	4	aar		n
226	7	7	13	aar		n
227	7	7	21	aar		n
3	7	7	999	aar		n
4	4	4	39	aar		n
5	7	7	999	aar		n
6	7	7	999	aar		n
7	7	7	999	aar		n
8	7	7	999	aar		n
9	7	7	999	aar		n
						n
						n

[ CANCEL ] [ REFRESH ] [ ] [ ] [ HELP ] [ GO TO PAGE ] [ NEXT PAGE ] [ PREV PAGE ]



Figure 4. Designated Route Pattern (21) screenshot

```

display route-pattern 21                                     Page 1 of 3
      Pattern Number: 21  Pattern Name: ISDN TIE
                        Secure SIP? n
  Grp FRL NPA Pfx Hop Toll No.  Inserted      DCS/  IXC
  No   Mrk Lmt List Del  Digits      QSIG  Intw
1: 6   0                3                n    user
2:                3                n    user
3:                3                n    user
4:                3                n    user
5:                3                n    user
6:                3                n    user

  BCC VALUE  TSC  CA-TSC  ITC BCIE Service/Feature BAND  No. Numbering  LAR
  0 1 2 3 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
  
```





Figure 6. Signaling Group (6) screenshot

```
status signaling-group 6
STATUS SIGNALING GROUP

Group ID: 6                               Active NCA-TSC Count: 0
Group Type: isdn-pri                       Active CA-TSC Count: 0
Signaling Type: facility associated signaling
Group State: in-service

Primary D-Channel

Port: 01A1416                            Level 3 State: in-service

Secondary D-Channel

Port:                                     Level 3 State: no-link

Command: 
```

CANCEL [ ] [ ] [ ] [ ] HELP [ ] [ ] [ ]



Figure 7. DS1 Board screenshot

```
display ds1 1a14
DS1 CIRCUIT PACK
Location: 01A14                               Name: E1 QSIG
Bit Rate: 2.048                               Line Coding: hdb3
Signaling Mode: isdn-pri
Connect: pbx                                  Interface: peer-master
TN-C7 Long Timers? n                          Peer Protocol: Q-SIG
Interworking Message: PROGRESS                 Side: a
Interface Companding: alaw                     CRC? n
Idle Code: 11111111                           Channel Numbering: sequential
DCP/Analog Bearer Capability: 3.1kHz
T303 Timer(sec): 4
Slip Detection? n                             Near-end CSU Type: other
Echo Cancellation? n
```

Command:

CANCEL     HELP



Figure 8. Trunks Status screenshot

```
status trunk 6

                                TRUNK GROUP STATUS

Member      Port      Service State      Mtce Connected Ports
              Busy

0006/001    01A1401    in-service/idle     no
0006/002    01A1402    in-service/idle     no
0006/003    01A1403    in-service/idle     no
0006/004    01A1404    in-service/idle     no
0006/005    01A1405    in-service/idle     no
0006/006    01A1406    in-service/idle     no
0006/007    01A1407    in-service/idle     no
0006/008    01A1408    in-service/idle     no
0006/009    01A1409    in-service/idle     no
0006/010    01A1410    in-service/idle     no

Command successfully completed
Command:

CANCEL      [ ]      [ ]      [ ]      HELP      [ ]      [ ]      [ ]
```



## Configuring the Avaya S8500 Communications Manager 2.1: Switch 2

Figure 9. Uniform Dial Plan screenshot

```
display uniform-dialplan 0 Page 1 of 2
```

UNIFORM DIAL PLAN TABLE Percent Full: 0

Matching Pattern	Len	Del	Insert Digits	Net	Conv	Node Num	Matching Pattern	Len	Del	Insert Digits	Net	Conv	Node Num
2	4	0	222	aar	n								n
26	4	0	222	aar	n								n
3	4	0	222	aar	n								n
40	4	0	226	aar	n								n
411	4	0	227	aar	n								n
415	4	0	226	aar	n								n
42	4	0	226	aar	n								n
43	4	0	214	aar	n								n
45	4	0	223	aar	n								n
5003	4	0	213	aar	n								n
5004	4	0	213	aar	n								n
5008	4	0	223	aar	n								n
5050	4	0	225	aar	n								n
60	4	0	226	aar	n								n
					n								n
					n								n

[ CANCEL ] [ REFRESH ] [ ] [ ] [ HELP ] [ GO TO PAGE ] [ NEXT PAGE ] [ PREV PAGE ]



Figure 10. AAR Analysis screenshot

```
display aar analysis 0 Page 1 of 2
```

AAR DIGIT ANALYSIS TABLE Percent Full: 1

Dialled String	Total		Route Pattern	Call Type	Node Num	ANI Reqd
	Min	Max				
2	7	7	999	aar		n
213	7	7	99	aar		n
214	7	7	14	aar		n
222	7	7	99	aar		n
223	7	7	14	aar		n
225	7	7	21	aar		n
226	7	7	26	aar		n
227	7	7	21	aar		n
3	7	7	999	aar		n
4	7	7	999	aar		n
5	7	7	999	aar		n
6	7	7	999	aar		n
7	7	7	999	aar		n
8	7	7	999	aar		n
9	7	7	999	aar		n

[ CANCEL ] [ REFRESH ] [ ] [ ] [ HELP ] [ GO TO PAGE ] [ NEXT PAGE ] [ PREV PAGE ]



Figure 11. Designated Route Pattern (21) screenshot

```

display route-pattern 21                                     Page 1 of 3
      Pattern Number: 21  Pattern Name: ISDN NODE 1
                        Secure SIP? n
  Grp FRL NPA Pfx Hop Toll No.  Inserted      DCS/  IXC
  No   Mrk Lmt List Del  Digits      QSIG  Intw
1: 6   0                3                n    user
2:                3                n    user
3:                3                n    user
4:                3                n    user
5:                3                n    user
6:                3                n    user

  BCC VALUE  TSC  CA-TSC  ITC BCIE Service/Feature BAND  No. Numbering  LAR
  0 1 2 3 4 W      Request      Subaddress  Dgts Format
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
  
```



Figure 12. Route Patterns screenshot

```
list route-pattern
```

Route Pat	Name/Trk		FRL	Hop Lmt	IXC	ROUTE PATTERNS					TSC	CA-TSC Request	ITC	Service/Feature
	Pref	Grp				0	1	2	3	4				
13	1	1	0		user	Y	Y	Y	Y	Y	n	Y	as-needed	rest
14	1	14	0		user	Y	Y	Y	Y	Y	n	Y	as-needed	both
21	ISDN	NODE	1		user	Y	Y	Y	Y	Y	n	Y	as-needed	both
26	TLS				user	Y	Y	Y	Y	Y	n	Y	as-needed	both
99	CCS	Sever	2		user	Y	Y	Y	Y	Y	n	Y	as-needed	both
213	1	1	0		user	Y	Y	Y	Y	Y	n	Y	none	rest

Command successfully completed

Command: █

CANCEL █ █ █ █ HELP █ █ █



Figure 13. Signaling Group (6) screenshot

```
status signaling-group 6
STATUS SIGNALING GROUP

Group ID: 6                               Active NCA-TSC Count: 0
Group Type: isdn-pri                       Active CA-TSC Count: 0
Signaling Type: facility associated signaling
Group State: in-service

Primary D-Channel

Port: 01A1416                               Level 3 State: in-service

Secondary D-Channel

Port:                                       Level 3 State: no-link

Command: 
```

CANCEL     HELP



Figure 14. DS1 Board screenshot

```
display ds1 1a14
DS1 CIRCUIT PACK
Location: 01A14                               Name: E1QSIG
Bit Rate: 2.048                               Line Coding: hdb3
Signaling Mode: isdn-pri
Connect: pbx                                  Interface: peer-slave
TN-C7 Long Timers? n                          Peer Protocol: Q-SIG
Interworking Message: PROGRESS                 Side: b
Interface Companding: alaw                     CRC? n
Idle Code: 11111111                           Channel Numbering: sequential
DCP/Analog Bearer Capability: 3.1kHz
T303 Timer(sec): 4
Slip Detection? n                             Near-end CSU Type: other
Echo Cancellation? n
```

Command:

CANCEL [ ] [ ] [ ] [ ] HELP [ ] [ ] [ ]



Figure 15. Trunks Status screenshot

```
status trunk 6

                                TRUNK GROUP STATUS

Member      Port      Service State      Mtce Connected Ports
              Busy

0006/001    01A1401    in-service/idle     no
0006/002    01A1402    in-service/idle     no
0006/003    01A1403    in-service/idle     no
0006/004    01A1404    in-service/idle     no
0006/005    01A1405    in-service/idle     no
0006/006    01A1406    in-service/idle     no
0006/007    01A1407    in-service/idle     no
0006/008    01A1408    in-service/idle     no
0006/009    01A1409    in-service/idle     no
0006/010    01A1410    in-service/idle     no

Command successfully completed
Command:

CANCEL      [ ]      [ ]      [ ]      HELP      [ ]      [ ]      [ ]
```



## Configuring the Cisco IOS Voice Gateway 'A' (Cisco 2651XM)

2651XM\_West#sho ver

Cisco IOS Software, C2600 Software (C2600-IPVOICE-M), Version 12.4(1.8)T, INTERI  
M SOFTWARE

Technical Support: <http://www.cisco.com/techsupport>

Copyright (c) 1986-2005 by Cisco Systems, Inc.

Compiled Thu 05-May-05 06:32 by kellmill

ROM: System Bootstrap, Version 12.2(8r) [cmong 8r], RELEASE SOFTWARE (fc1)

2651XM\_West uptime is 57 minutes

System returned to ROM by reload

System image file is "flash:c2600-ipvoice-mz.124-1.8.T"

Cisco 2651XM (MPC860P) processor (revision 0x300) with 125770K/5302K bytes of memory.

Processor board ID JAE0817EK5Z (1672255744)

M860 processor: part number 5, mask 2

2 FastEthernet interfaces

31 Serial interfaces

2 Channelized E1/PRI ports

32K bytes of NVRAM.

49152K bytes of processor board System flash (Read/Write)

Configuration register is 0x2102



```
2651XM_West#sho run
```

```
Building configuration...
```

```
Current configuration : 1879 bytes
```

```
!
```

```
version 12.4
```

```
service timestamps debug datetime msec
```

```
service timestamps log datetime msec
```

```
no service password-encryption
```

```
!
```

```
hostname 2651XM_West
```

```
!
```

```
boot-start-marker
```

```
boot system flash
```

```
boot-end-marker
```

```
!
```

```
!
```

```
no aaa new-model
```

```
!
```

```
resource policy
```

```
!
```

```
no network-clock-participate slot 1
```

```
no network-clock-participate wic 0
```



```
voice-card 1
!
ip subnet-zero
ip cef
!
!
no ip dhcp use vrf connected
!
!
no ip domain lookup
isdn switch-type primary-qsig
!
!
voice service voip
h323
!
voice class codec 1
codec preference 1 g729r8
codec preference 2 g711ulaw
codec preference 3 g711alaw
!
!
!
controller E1 1/0
framing NO-CRC4
pri-group timeslots 1-31
description ECN-4
!
controller E1 1/1
```



```
!  
interface FastEthernet0/0  
ip address 172.20.4.7 255.255.255.0  
duplex auto  
speed auto  
!  
interface FastEthernet0/1  
no ip address  
shutdown  
duplex auto  
speed auto  
!  
interface Serial1/0:15  
description D-channel for ECN-4  
no ip address  
no logging event link-status  
isdn switch-type primary-qsig  
isdn overlap-receiving  
isdn incoming-voice voice  
isdn send-alerting  
isdn bchan-number-order ascending  
isdn sending-complete  
no cdp enable  
!  
ip classless  
ip route 0.0.0.0 0.0.0.0 FastEthernet0/0  
!  
ip http server  
!
```



```
control-plane
!
voice-port 1/0:15
description voice port for ECN-4
!
!
dial-peer voice 323 voip
destination-pattern 2...
session target ipv4:172.20.4.9
!
dial-peer voice 1015 pots
destination-pattern 4...
direct-inward-dial
port 1/0:15
forward-digits all
!
dial-peer voice 519 voip
shutdown
destination-pattern 6...
session protocol sipv2
session target ipv4:172.20.4.9
supplementary-service pass-through
!
dial-peer voice 5050 pots
destination-pattern 5050
direct-inward-dial
port 1/0:15
forward-digits all
!
```



```
line con 0
line aux 0
line vty 0 4
exec-timeout 0 0
password cisco
login
transport input telnet
!
!
end
```

2651XM\_West#sho isdn stat

Global ISDN Switchtype = primary-qsig

ISDN Serial1/0:15 interface

dsl 0, interface ISDN Switchtype = primary-qsig

\*\*\*\* Slave side configuration \*\*\*\*

Layer 1 Status:

ACTIVE

Layer 2 Status:

TEI = 0, Ces = 1, SAPI = 0, State = MULTIPLE\_FRAME\_ESTABLISHED

Layer 3 Status:

0 Active Layer 3 Call(s)

Active dsl 0 CCBs = 0

The Free Channel Mask: 0xFFFF7FFF

Number of L2 Discards = 0, L2 Session ID = 1

Total Allocated ISDN CCBs = 0

2651XM\_West#



## Configuring the Cisco IOS Voice Gateway 'B' (Cisco 3745)

3745\_West#sho ver

Cisco IOS Software, 3700 Software (C3745-IPVOICE-M), Version 12.4(1.8)T, INTERIM  
SOFTWARE

Technical Support: <http://www.cisco.com/techsupport>

Copyright (c) 1986-2005 by Cisco Systems, Inc.

Compiled Thu 05-May-05 02:04 by kellmill

ROM: System Bootstrap, Version 12.2(8r)T2, RELEASE SOFTWARE (fc1)

3745\_West uptime is 33 minutes

System returned to ROM by reload

System image file is "flash:c3745-ipvoice-mz.124-1.8.T"

Cisco 3745 (R7000) processor (revision 2.0) with 110592K/20480K bytes of memory.

Processor board ID JMX0813L0Z3

R7000 CPU at 350MHz, Implementation 39, Rev 3.3, 256KB L2, 2048KB L3 Cache

2 FastEthernet interfaces

31 Serial interfaces

4 Channelized E1/PRI ports

2 Voice FXS interfaces

DRAM configuration is 64 bits wide with parity disabled.

151K bytes of NVRAM.

31168K bytes of ATA System CompactFlash (Read/Write)

Configuration register is 0x2102



```
3745_West#sho run
```

```
Building configuration...
```

```
Current configuration : 2044 bytes
```

```
!
```

```
version 12.4
```

```
service timestamps debug datetime msec
```

```
service timestamps log datetime msec
```

```
no service password-encryption
```

```
!
```

```
hostname 3745_West
```

```
!
```

```
boot-start-marker
```

```
boot system flash
```

```
boot-end-marker
```

```
!
```

```
card type e1 1 1
```

```
logging buffered 5000000 debugging
```

```
!
```

```
no aaa new-model
```

```
!
```

```
resource policy
```

```
!
```

```
no network-clock-participate slot 1
```

```
ip subnet-zero
```

```
ip cef
```

```
!
```

```
!
```



```
no ip dhcp use vrf connected
!
!
no ip domain lookup
isdn switch-type primary-qsig
voice-card 1
dspfarm
!
!
!
voice call carrier capacity active
!
voice service voip
h323
!
!
voice class codec 1
codec preference 2 g711ulaw
codec preference 3 g711alaw
!
!
controller E1 1/0
framing NO-CRC4
pri-group timeslots 1-31
description ECN10
!
controller E1 1/1
!
controller E1 1/2
```



```
!  
controller E1 1/3  
  
!  
!  
!  
  
interface FastEthernet0/0  
  
ip address 172.20.4.9 255.255.255.0  
  
duplex auto  
  
speed auto  
  
!  
  
interface FastEthernet0/1  
  
no ip address  
  
shutdown  
  
duplex auto  
  
speed auto  
  
!  
  
interface Serial1/0:15  
  
description D-channel for ECN10  
  
no ip address  
  
no logging event link-status  
  
isdn switch-type primary-qsig  
  
isdn overlap-receiving  
  
isdn protocol-emulate network  
  
isdn incoming-voice voice  
  
isdn send-alerting  
  
isdn sending-complete  
  
no cdp enable  
  
!  
  
router eigrp 10
```



```
network 172.20.0.0
no auto-summary
!
ip classless
ip route 0.0.0.0 0.0.0.0 FastEthernet0/0
!
ip http server
!
!
control-plane
!
voice-port 1/0:15
description voice port for ECN10
!
voice-port 3/0/0
!
voice-port 3/0/1
!
!
dial-peer cor custom
!
dial-peer voice 323 voip
destination-pattern 4...
session target ipv4:172.20.4.7
!
dial-peer voice 1015 pots
destination-pattern 2...
direct-inward-dial
port 1/0:15
```



```
forward-digits all
!
dial-peer voice 519 voip
shutdown
destination-pattern 3...
session protocol sipv2
session target ipv4:172.20.4.7
supplementary-service pass-through
!
dial-peer voice 5050 voip
destination-pattern 5050
session target ipv4:172.20.4.7
!
!
line con 0
line aux 0
line vty 0 4
exec-timeout 0 0
password cisco
login
transport input telnet
!
!
end
```



3745\_West#sho isdn stat

Global ISDN Switchtype = primary-qsig

ISDN Serial1/0:15 interface

\*\*\*\*\* Network side configuration \*\*\*\*\*

dsl 0, interface ISDN Switchtype = primary-qsig

\*\*\*\* Master side configuration \*\*\*\*

Layer 1 Status:

ACTIVE

Layer 2 Status:

TEI = 0, Ces = 1, SAPI = 0, State = MULTIPLE\_FRAME\_ESTABLISHED

Layer 3 Status:

0 Active Layer 3 Call(s)

Active dsl 0 CCBs = 0

The Free Channel Mask: 0xFFFF7FFF

Number of L2 Discards = 0, L2 Session ID = 1

Total Allocated ISDN CCBs = 0

3745\_West#





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