

Understanding How Inbound and Outbound Dial Peers are Matched on

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Voice – Understanding How Inbound and Outbound Dial Peers are Matched on Cisco IOS Platforms

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Introduction

The purpose of this document is to explain how inbound and outbound dial peers are matched to plain old telephone service (POTS) and Voice–Network call legs. This document assumes that the reader is familiar with the content of the following documents:

- Voice – Understanding Dial Peers and Call Legs on Cisco IOS Platforms
- Voice – Understanding Inbound and Outbound Dial Peers on Cisco IOS Platforms

Matching Inbound Dial Peers

Inbound Dial Peers Elements and Attributes

Three information elements sent in the call setup message and four configurable dial peer command attributes are used to match dial peers as follows:

- *Inbound* POTS dial peers are associated to incoming POTS call legs on the originating router/gateways
- *Inbound* Voice–Network dial peers are associated to incoming Voice–Network call legs of the terminating router/gateway. Examples of Voice–Network calls legs are Voice over IP (VoIP), Voice over Frame Relay (VoFR), Voice over ATM (VoATM), and Multimedia Mail over IP (MMoIP)

The four configurable Cisco IOS® dial peer attributes and corresponding call setup elements are shown below:

Dial Peer Attribute	Description	Call Setup Element (See Table Below)
<p>gwy(config-dial-peer)# incoming called-number <i>DNIS_string</i></p>	<p>This dial-peer command defines the called number destination or dialed number identification service (DNIS) string. When properly configured it uses the called number to match the incoming call leg to an inbound dial peer.</p>	<p>Called number (DNIS)</p>
<p>gwy(config-dial-peer)# answer-address <i>ANI_string</i></p>	<p>This dial-peer command defines the originating calling number or automatic number identification (ANI) string. When properly configured it uses the calling number to match the incoming call leg to an inbound dial peer.</p>	<p>Calling Number (ANI)</p>
<p>gwy(config-dial-peer)# destination-pattern <i>string</i></p>	<p>When matching inbound call legs, this command uses the calling number (originating or ANI string) to</p>	<p>Calling Number (ANI) for <i>inbound</i> or the Called number (DNIS) strings for outbound</p>

	match the incoming call leg to an inbound dial peer. Note: For outbound dial-peers, this command is matched against the called number or DNIS strings.	
gwy(config-dial-peer)# port port	This dial peer command defines the POTS voice port through which calls to this dial peer are placed.	Voice Port

The three call setup elements are:

Call Setup Element	Description
Called number (DNIS)	This is the call destination dial string and it is derived from the ISDN setup message or channel associated signaling (CAS) DNIS.
Calling Number (ANI)	This is a number string that represents the origin and it is derived from the ISDN setup message or CAS ANI. The ANI is also referred to as Calling Line Identification (CLID).
Voice Port	This represents the POTS physical voice port.

Inbound Dial Peers Matching Process

When the Cisco IOS router/gateway receives a call setup request, a dial-peer match is made for the incoming call to facilitate routing the call to different session applications. This is not digit-by-digit matching, rather the full digit string received in the setup request is used for matching against configured dial peers.

The router/gateway selects an *inbound* dial peer by matching the information elements in the setup message with the dial peer attributes. The router/gateway matches these items in the following order:

1. Called number (DNIS) with **incoming called-number**

First, the router/gateway attempts to match the called number of the call setup request with the configured **incoming called-number** of each dial-peer. Since call setups always include DNIS information, it is recommended to use the **incoming called-number** command for inbound dial peer matching. This attribute has matching priority over **answer-address** and **destination-pattern**.

2. Calling Number (ANI) with **answer-address**

If no match is found in step 1, the router/gateway attempts to match the calling number of call setup request with the **answer-address** of each dial-peers. This attribute may be useful in situations where you want to match calls based on the calling number (originating).

3. Calling Number (ANI) with **destination-pattern**

If no match is found in step 2, the router/gateway attempts to match the calling number of call setup request to the **destination-pattern** of each dial-peer. For more information about this, refer to the first bullet on the Dial Peer Additional Information section of this document.

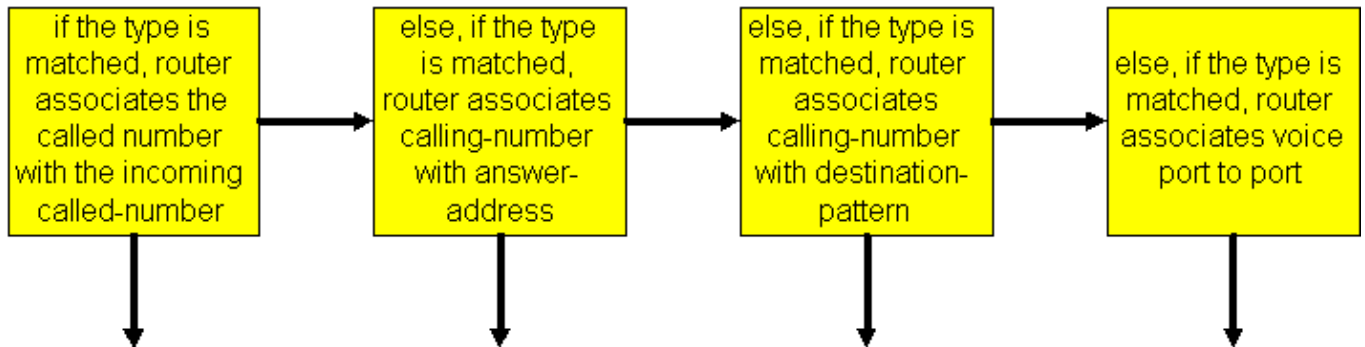
4. Voice-port (associated with the incoming call setup request) with configured dial peer **port** (applicable for inbound POTS call legs).

If no match is found in the step 3, the router/gateway attempts to match the configured dial-peer **port** to the voice-port associated with the incoming call. If multiple dial-peers have the same port configured, the dial-peer first added in the configuration is matched.

5. If no match is found in the above 4 steps, then default dial peer 0 (pid:0) is used.

Note: Step 4 is *not* applicable to voice/dial platforms such as AS5300, AS5350, AS5400, AS5800 and AS5850. If any one of first three steps are not used, then we match dial-peer 0 and the call is treated as a dial modem call. This means that customers can be getting modem tones as opposed to dial tone for inbound calls.

The previous selection process is displayed with the following diagram:



The Cisco IOS router/gateway matches only *one* of these conditions. It is not necessary for all the attributes to be configured in the dial-peer or that every attribute match the call setup information. Only one condition must be met for the router/gateway to select a dial-peer. The router/gateway stops searching as soon as one dial peer is matched.

The longest prefix matching criteria applies while each step is performed. At each step, if multiple matches are found, the one with the longest explicit match is chosen. The following example helps clarify this concept:

Assume the incoming called number (DNIS) is "81690". Dial peer 2 will be matched.

```

dial-peer voice 1 pots
  incoming called-number 8....
  direct-inward-dial
!

dial-peer voice 2 pots
  incoming called-number 816..
  direct-inward-dial

```

Note: For *inbound* dial peers, the **session target** command is ignored.

The Default Dial-Peer 0 peer_tag=0, pid:0

If no incoming dial-peer is matched by the router/gateway, the inbound call leg is automatically routed to a default dial peer (POTS or Voice-Network). This default dial peer is referred to as *dial-peer 0* or *pid:0*

Note: There is an exception to the previous statement. Cisco voice/dial platforms such as the AS53xx and AS5800, require that a configured *inbound* dial peer is matched for incoming POTS calls to be accepted as a voice call. If there is no *inbound* dial peer match, the call is treated and processed as a dialup (modem) call.

Dial-peer 0 (pid:0) has a default configuration that cannot be changed. The default *dial-peer 0* will fail to negotiate non-default capabilities, services, and/or applications such as:

- Non-default Voice-Network capabilities: **dtmf-relay**, **no vad**, so forth, and so on.
- Direct Inward Dial (DID)
- TCL Applications

Dial-peer 0 for inbound VoIP peers has the following configuration:

- any codec
- **ip precedence 0**
- **vad enabled**
- **no rsvp support**
- **fax-rate voice**

Dial-peer 0 (pid:0) for inbound POTS peers has the following configuration:

- no ivr application

For further explanation of this concept refer to the section: Case Study: Understanding Inbound Matching and Default Dial-Peer 0

Special Note on isdn overlap-receiving

There are implication on the inbound dial peer matching when **isdn overlap-receiving** is configured on ISDN interfaces. After every digit is received at the ISDN layer, dial peers are checked for matches. If a full match is made, the call is routed immediately (to the session app in this case) without waiting for additional digits. The 'T' terminator can be used to suspend this digit-by-digit matching and force the router/gateway to wait until all digits are received. The 'T' refers to the T302 interdigit timer at the ISDN level, configurable under the serial interface associated with the ISDN interface. ISDN also provides other mechanisms to indicate the end of digits, such as setting the Sending Complete IE (Information Element) in a Q.931 information messages.

Special Note on POTS Calls with Empty Calling Number Field

Assume the following configuration:

```
dial-peer voice 1 pots
  destination-pattern 9T
  port 1/0:1
```

Now, assume that an incoming call arrives with no calling number information and is matched with the above POTS dial peer based on the **destination-pattern 9T**. In this case, the Cisco IOS router/gateway will use the "9" digit as the calling number and forward the call to the corresponding device (Call Manager, IOS Gateway, etc). To eliminate this behavior of replacing the empty calling number field, create a dummy POTS dial peer with just the command **incoming called-number** configured. Since the **incoming called-number** statement has higher priority than **destination pattern** for inbound POTS matching, dial-peer voice 2 will be the POTS dial peer used.

```
dial-peer voice 1 pots
  destination-pattern 9T
  port 1/0:1
!
dial-peer voice 2 pots
  incoming called-number .
```

Matching Outbound Dial Peers

For matching *outbound* dial peers, the router/gateway uses the dial peer command **destination-pattern called_number**

- On POTS dial peers, the **port** command is then used to forward the call.
- On Voice-Network dial peers, the **session target** command is then used to forward the call.

Also, when matching outbound peers, there are two cases to consider: DID case and non-DID.

DID (Direct Inward Dial) Case

An incoming dial-peer configured with DID **direct-inward-dial** looks like the following:

```
dial-peer voice 1 pots
  incoming called-number 81690
  voice-port 0:D
  direct-inward-dial
```

On DID calls (also referred to as one-stage dialing), the setup message contains all the digits necessary to route the call and the router/gateway should not do subsequent digit collection. When the router/gateway searches for an outbound dial-peer, it uses the entire incoming dial string. This matching is by default variable-length. It is not done digit-by-digit because by DID definition, all digits have been received. The following example helps clarify this concept:

Assume the DID dial-string is "81690". In this case, the router will match dial peer 4 and forward the complete dial-string "81690".

```
dial-peer voice 3 voip
  destination-pattern 816
  session target ipv4:172.22.10.1
!
```

```
dial-peer voice 4 voip
 destination-pattern 81690
 session target ipv4:172.22.10.1
```

For more information on DID refer to: Voice – Understanding Direct-Inward-Dial (DID) on Cisco IOS Digital (T1/E1) Interfaces

Non-DID Case

This case is also referred to as two-stage dialing. If DID is not configured on the matched incoming dial-peer, the router/gateway enters the digit collection mode (digits are collected inband). Outbound dial peer matching is done on a digit-by-digit basis. Hence, the router/gateway checks for dial-peer matches after receiving each digit and then routes the call when a full match is made. The following examples help clarify this concept:

Assume the dial-string is "81690". Immediately after the router receives the digit "6" it will match dial peer 3 and route the call (forwarding only the digits "816").

```
dial-peer voice 3 voip
 destination-pattern 816
 session target ipv4:172.22.10.1
!
dial-peer voice 4 voip
 destination-pattern 81690
 session target ipv4:172.22.10.1
```

Now assume dial-peer 3 is configured for wild-card matching:

```
dial-peer voice 3 voip
 destination-pattern 816..
 session target ipv4:172.22.10.1
!
dial-peer voice 4 voip
 destination-pattern 81690
 session target ipv4:172.22.10.1
```

In this case, the longest-prefix rule will apply and dial peer 4 is matched for the outbound call leg.

Special Note on Variable-Length Dial Plans

There are situations where expected dial-strings do not have a set number of digits. In such cases, it is recommended to use variable-length dial-peers by configuring the "T" terminator on the dial peer **destination-pattern** command.

The "T" terminator forces the router/gateway to wait until the full dial-string is received. The router/gateway does this by:

- Waiting for a set interdigit timeout before routing the call.
- Routing the call once it receives the "#" termination character in the dial-string. For example, if you dialed "5551212#", the "#" would indicate to the router that you dialed all the digits and that all digits prior to the "#" should be used to match a dial-peer.

The following example helps clarify this concept.

Assume the router in this example receives from the network a call setup with dial-string "95551212". Dial

peer 2 will then forward to the PSTN the digits "5551212".

```
dial-peer voice 2 pots
  destination-pattern 9T
  port 2/0:23
```

Now, assume the dial-string from an inbound POTS interface is "81690".

```
dial-peer voice 3 voip
  destination-pattern 8T
  session target ipv4:172.22.10.1
!
dial-peer voice 4 voip
  destination-pattern 81690T
  session target ipv4:172.22.10.1
```

In this case, the longest-prefix rule will apply and dial peer 4 is matched for the outbound call leg.

Notes:

- The default interdigit timeout is set for 10 seconds. To modify this value, use the voice-port command **timeouts interdigit** *seconds*.
- Anytime the "T" is used it must be preceded by a "." or digits (".T" or "555T" for example). Using "T" on its own will cause the dial-peers to act improperly and will effect how calls are handled by the router.

Dial Peer Operational Status

A dial peer operational status must be *administratively up* and *valid* for it to be matched. To be considered operational, dial-peers must meet one of the following conditions: (There are others, but these are the main ones.)

- **Destination-pattern** is configured *and* a **voice-port** or **session target** is also configured.
- **Incoming called-number** is configured
- **Answer-address** is configured

For more information, refer to Voice – Understanding the Operational Status of Dial-Peers on Cisco IOS Platforms

Dial Peer Additional Information

The dial peer attribute **destination-pattern** has different behavior when applied to *inbound* or *outbound* call legs:

- For *inbound* dial peers, the **destination-pattern** is matched against the calling number (ANI string).
- For *outbound* dial peers, the **destination-pattern** is matched against called number (DNIS string).

Therefore, a dial-peer with the **destination-pattern** attribute may work for both *outbound* and *inbound* matching.

Case Study: Understanding Inbound Matching and Default Dial-Peer 0



Configurations

maui-gwy-04	maui-gwy-06
<pre> !-- <some output omitted> ! version 12.0 service timestamps debug datetime ! hostname maui-gwy-04 ! isdn switch-type primary-ni ! controller T1 0 framing esf clock source line primary linecode b8zs pri-group timeslots 1-24 ! voice-port 0:D ! !-- This dial-peer is used for inbound !-- DID calls. Dial-peer voice 1 pots incoming called-number 8.... direct-inward-dial ! dial-peer voice 3 voip destination-pattern 8.... DTMF-relay cisco-rtp session target ipv4:172.22.10.1 ! dial-peer voice 2 pots destination-pattern 9T port 0:D ! interface Ethernet0 ip address 172.22.10.2 255.255.255.0 no ip directed-broadcast ! interface Serial0:23 no ip address no ip directed-broadcast isdn switch-type primary-ni isdn incoming-voice modem fair-queue 64 256 0 no cdp enable </pre>	<pre> !-- <some output omitted> ! version 12.2 service timestamps debug datetime ! hostname maui-gwy-06 ! interface Ethernet0/0 ip address 172.22.10.1 255.255.255.0 half-duplex ! !-- FXS port voice-port 1/0/0 ! dial-peer voice 1 pots destination-pattern 81560 port 1/0/0 ! dial-peer voice 2 voip destination-pattern 9..... session target ipv4:172.22.10.2 DTMF-relay cisco-rtp </pre>

In this case study we use the following show and debug commands:

- **show call active voice {brief}** – This command displays the contents of the active call table, which shows all of the calls currently connected through the router. In our case, this command is useful to display dial-peers and capabilities associated to an active call.
- **debug voip ccapi inout** – This command is useful to troubleshoot end-to-end VoIP calls.

```

!--- Action: Call is placed from the PSTN through maui-gwy-04 and terminated on a
!--- FXS port of maui-gwy-06 (called number: "81560")
!--- Notes:
!--- 1)On maui-gwy-04 the incoming call is received on the POTS dial-peer 1 which
!--- is configured for DID.
!--- 2)On maui-gwy-06 no inbound VoIP dial-peer is matched and default dial-peer=0
!--- is used. Therefore, the DTMF-relay cisco-rtp negotiation fails.

!-----
!--- Output on maui-gwy-04 (Originating Gateway)
!-----

maui-gwy-04#show call active voice brief
!--- This information was captured on the call originating gateway
!--- once the call was placed and active.
!---
!--- <some output omitted>
!
<ID>: <start>hs.<index> +<connect> pid:<peer_id> <dir> <addr> <state>
  dur hh:mm:ss tx:<packets>/<bytes> rx:<packets>/<bytes> <state>
  IP <ip>:<udp> rtt:<time>ms pl:<play>/<gap>ms lost:<lost>/<early>/<late>
  delay:<last>/<min>/<max>ms <codec>
  Tele <int>: tx:<tot>/<v>/<fax>ms <codec> noise:<l> acom:<l> i/o:<l>/<l> dBm

!--- POTS (keyword Tele) dial-peer 1 is matched inbound (keyword Answer)
!--- This dial-peer was matched based on condition 1 of the Matching Inbound Dial
!--- Peers section of this document.
87 : 415666267hs.1 +107 pid:1 Answer active
  dur 00:00:20 tx:101/791 rx:100/3200
  Tele 0:D:93: tx:20600/2000/0ms g729r8 noise:-56 acom:0 i/o:-55/-70 dBm

!--- VoIP (keyword IP) dial-peer 3 is matched outbound (keyword Originate)
!--- This dial-peer was matched based on the destination-pattern command
87 : 415666268hs.1 +106 pid:3 Originate 81560 active
  dur 00:00:20 tx:100/2000 rx:101/1991
  IP 172.22.10.1:18160 rtt:2ms pl:1990/40ms lost:0/1/0 delay:69/69/70ms g729r8

maui-gwy-04#show call active voice
!--- <some output omitted>
!--- With the show call active voice command we can see that DTMF-relay cisco rtp
!--- was partially negotiated.
VOIP:
RemoteIPAddress=172.22.10.1
RemoteUDPPort=18160
RoundTripDelay=4 ms
SelectedQoS=best-effort
tx_DtmfRelay=cisco-rtp
SessionProtocol=cisco
SessionTarget=ipv4:172.22.10.1
VAD = enabled
CoderTypeRate=g729r8
CodecBytes=20
SignalingType=cas

!-----
!--- Output on maui-gwy-06 (Terminating Gateway)
!-----

```

```

maui-gwy-06#show call active voice brief
!--- This information was captured once the call was placed and active.
!---
!--- <some output omitted>
!--- Noticed that in this case, default VoIP(keyword IP) dial-peer 0 was matched
!--- inbound.
Total call-legs: 2
87 : 257583579hs.1 +105 pid:0 Answer active
dur 00:10:03 tx:1938/37069 rx:26591/531820
IP 172.22.10.2:18988 rtt:lms pl:528740/160ms lost:0/1/0 delay:50/50/70ms g729r8

87 : 257583580hs.1 +104 pid:1 Originate 81560 active
dur 00:10:05 tx:26648/532960 rx:1938/37069
Tele 1/0/0 (96): tx:605710/37690/0ms g729r8 noise:-46 acom:0 i/0:-46/-61 dBm

maui-gwy-06#show call active voice
!--- <some output committed>
!--- Notice that DTMF-relay cisco rtp was NOT negotiated on this end.
Total call-legs: 2
VOIP:
RemoteIPAddress=172.22.10.2
RoundTripDelay=2 ms
SelectedQoS=best-effort
tx DtmfRelay=inband-voice
FastConnect=FALSE
Separate H245 Connection=FALSE
H245 Tunneling=FALSE
SessionProtocol=cisco
VAD = enabled
CoderTypeRate=g729r8
CodecBytes=20
SignalingType=ext-signal

!--- Output from debug voip ccapi inout
!--- <Only relevant output has been captured>

!--- Inbound VoIP call leg is matched to default dial-peer 0
!--- In this case, notice that maui-gwy-06 did not received the calling number
!--- (ANI). Hence, voip dial-peer 2 was not matched based on condition 3 of the
!--- Matching Inbound Dial Peers section.

*Mar 30 19:30:35: cc_api_call_setup_ind (vdbPtr=0x620AA230, callInfo={called=81560,
called_oct3=0 calling=,calling_oct3=0x0,calling_oct3a=0x0,calling_xlated=false,
subscriber_type_str=Unknown, fde,peer_tag=0, prog_ind=0},callID=0x62343650)
*Mar 30 19:30:35: cc_api_call_setup_ind (vdbPtr=0x620AA230, callInfo={called=81560,
calling=, fd1 peer_tag=0}, callID=0x62343650)
*Mar 30 19:30:35: >>>>CCAPI handed cid 95 with tag 0 to app "DEFAULT"
.....

!--- Outbound POTS dial-peer 1 is matched.

*Mar 30 19:30:35: ssaSetupPeer cid(95) peer list: tag(1) called number (81560)
*Mar 30 19:30:35: ccCallSetupRequest (Inbound call = 0x5F, outbound peer =1, dest=,
params=0x621D4570 mode=0, *callID=0x621D48D8, prog_ind = 0)
*Mar 30 19:30:35: peer_tag=1

```

Now, to match the inbound VoIP dial-peer 2 on **maui-gwy-06** we add the following command:

```

maui-gwy-06#config t
Enter configuration commands, one per line. End with CNTL/Z.
maui-gwy-06(config)#dial-peer voice 2 voip
!--- This command uses the DNIS(called number)to match the inbound call leg
!--- to the dial-peer.

```

```
maui-gwy-06(config-dial-peer)#incoming called-number 8....
```

The following is a snapshot of **maui-gwy-06** configuration after additional configuration:

```
!--- <Some output omitted>
dial-peer voice 1 pots
 destination-pattern 81560
 port 1/0/0
!
dial-peer voice 2 voip
 incoming called-number 8....
 destination-pattern 9.....
 session target ipv4:172.22.10.2
 dtmf-relay cisco-rtp
!
```

```
!--- Action: Call is placed from the PSTN through maui-gwy-04 and terminated in an
!--- FXS port of maui-gwy-06 (called number: "81560")
!--- Notes:
!--- 1)On maui-gwy-04 the incoming call is received on the POTS dial-peer 1 which
!--- is configured for DID.
!--- 2)On maui-gwy-06, dial-peer 2 voip is matched inbound, dtmf-relay cisco-rtp
!--- is negotiated.
```

```
!-----
!--- Output on maui-gwy-06 (Terminating Gateway)
!-----
```

```
maui-gwy-06#show call active voice brief
```

```
!--- <some output omitted>
```

```
Total call-legs: 2
```

```
!-- Notice that in this case, the inbound VoIP call leg is matched to dial-peer 2 voip
```

```
8B : 258441268hs.1 +176 pid:2 Answer active
```

```
dur 00:01:01 tx:485/8768 rx:2809/56180
```

```
IP 172.22.10.2:16762 rtt:2ms pl:52970/120ms lost:0/1/0 delay:60/60/70ms g729r8
```

```
8B : 258441269hs.1 +175 pid:1 Originate 81560 active
```

```
dur 00:01:02 tx:2866/57320 rx:512/9289
```

```
Tele 1/0/0 (98): tx:64180/9640/0ms g729r8 noise:-46 acom:0 i/0:-46/-61 dBm
```

```
maui-gwy-06#show call active voice
```

```
!--- <some output omitted>
```

```
!--- Notice that dtmf-relay cisco rtp was successfully negotiated.
```

```
VOIP:
```

```
RemoteIPAddress=172.22.10.2
```

```
RoundTripDelay=1 ms
```

```
SelectedQoS=best-effort
```

```
tx DtmfRelay=cisco-rtp
```

```
FastConnect=FALSE
```

```
Separate H245 Connection=FALSE
```

```
H245 Tunneling=FALSE
```

```
SessionProtocol=cisco
```

```
SessionTarget=
```

```
VAD = enabled
```

```
CoderTypeRate=g729r8
```

```
CodecBytes=20
```

```
SignalingType=cas
```

Tools Information

For additional resources, refer to Cisco TAC Tools for Voice, Telephony and Messaging Technologies.

Related Information

Dial Peer Information

- **Voice – Understanding Dial Peers and Call Legs on Cisco IOS Platforms**
- **Voice – Understanding Inbound and Outbound Dial Peers on Cisco IOS Platforms**
- **Voice – Understanding the Operational Status of Dial–Peers on Cisco IOS Platforms**
- **Voice – Understanding Direct–Inward–Dial (DID) on Cisco IOS Digital (T1/E1) Interfaces**
- **Configuring Dial Plans, Dial Peers, and Digit Manipulation**

Related Voice Resources

- **VoIP – Understanding Codecs: Complexity, Support, MOS, and Negotiation**
 - **Voice, Telephony and Messaging**
 - **Voice and Telephony Technology Support Page**
 - **Voice and Telephony Product Support Page**
 - **Cisco Solutions Voice, Telephony and Messaging**
 - **Voice, Telephony and Messaging Top Issues**
 - **Field Notices**
 - **Voice, Telephony and Messaging Tac eLearning Solutions**
-

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Updated: Jun 26, 2002

Document ID: 14074
