

IP Telephony Advanced Troubleshooting

**2003 Cisco Canada
Technical Symposium**

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Session Objectives

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- Understand the functionality of call flows, from the perspective of Cisco CallManager **when all works well**
- understand the trace outputs and provide a troubleshooting methodology
- To be able to enable the debugs and provide the information requested by Cisco TAC in resolving your issues
- Understand Echo and steps to resolve Echo in IPT Networks

What You Should Know

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- **Understanding of IP Telephony architecture, concepts and configuration**
- **Experience with CCM configuration and operation**
- **Cisco IOS® GW configuration and operation**

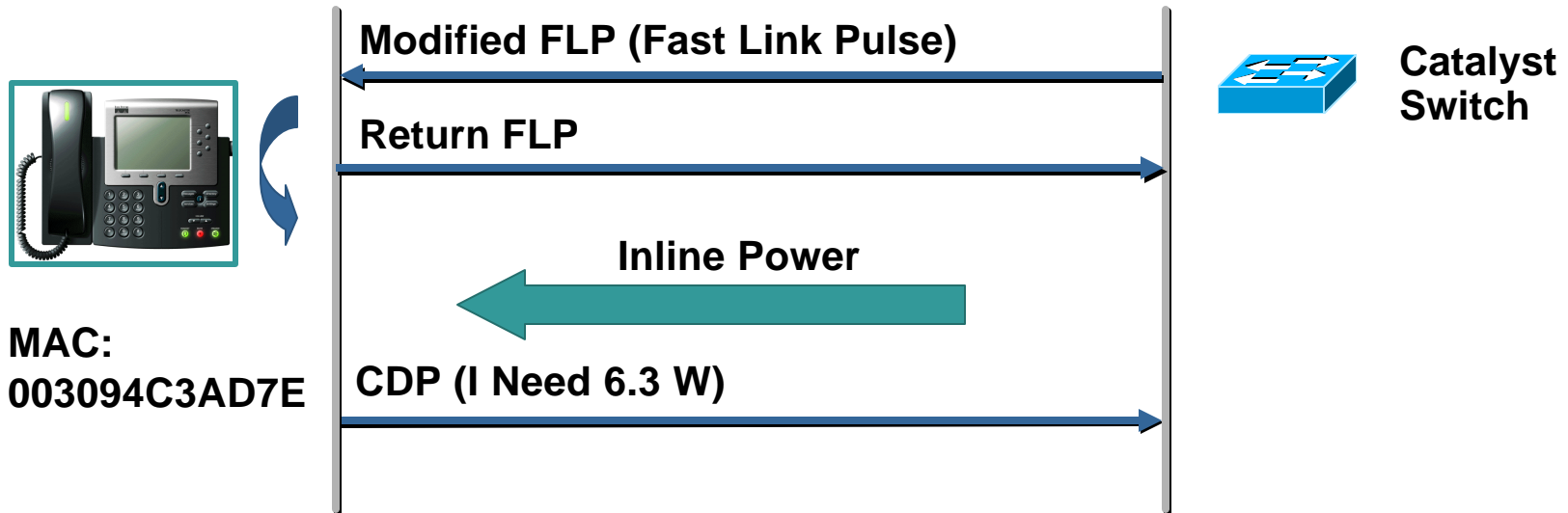
Agenda

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- **Phone Initialization**
- **Tools and Utilities to Configure, Monitor and Troubleshoot CCM**
- **IP Telephony Case Study and Troubleshooting Techniques**
- **Understand Echo and steps to resolve Echo in IPT Networks**

IP Phone Initialization—Inline Power

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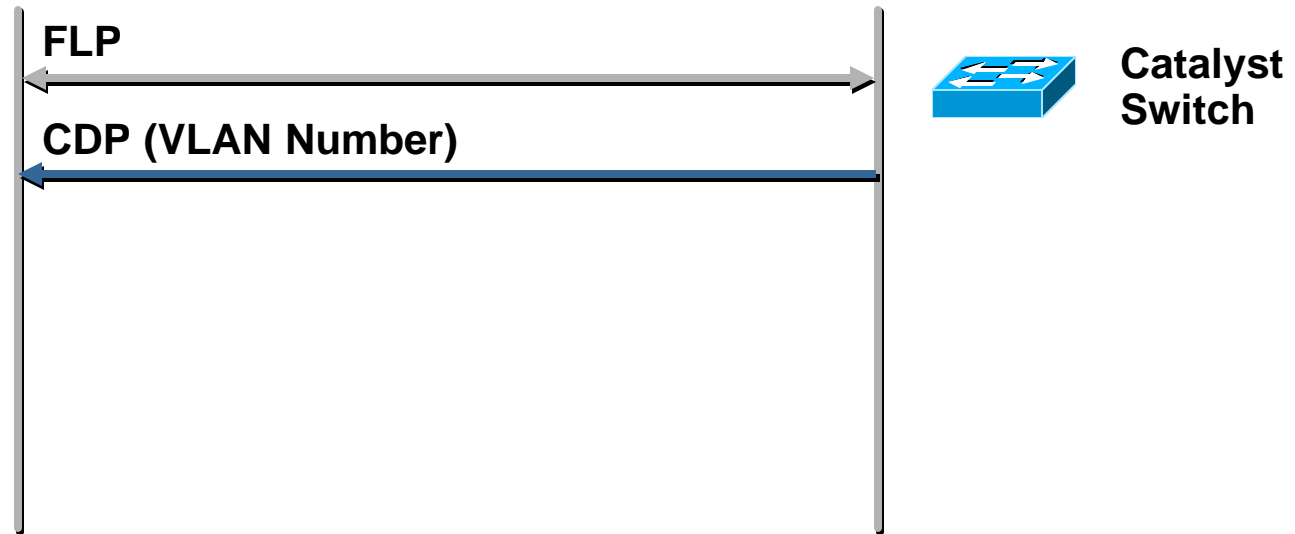
Phone: *Mute, Headset, Speaker Buttons Illuminated*

IP Phone Initialization—AUX VLAN

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MAC:
003094C3AD7E



Phone Displays: *Configuring VLAN*

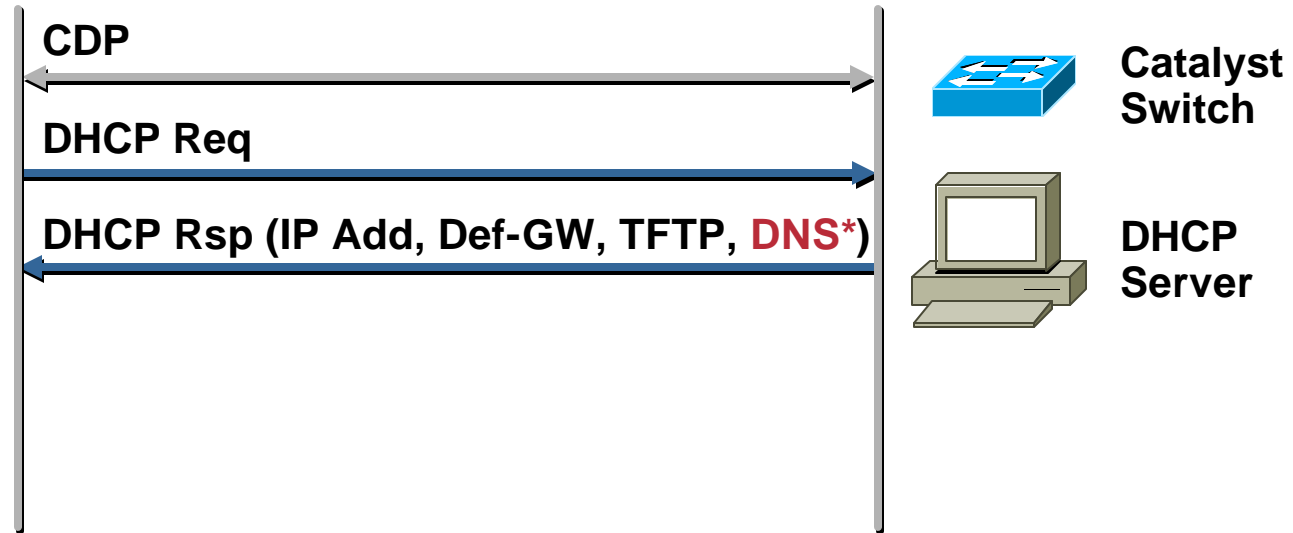
Check Settings: NetCfg->19 Operational VLAN ID

IP Phone Initialization—IP Configuration

Cisco.com



MAC:
003094C3AD7E



Phone Displays: *Configuring IP*

**DNS is Optional*

Check settings: NetCfg-> 1 DHCP Server

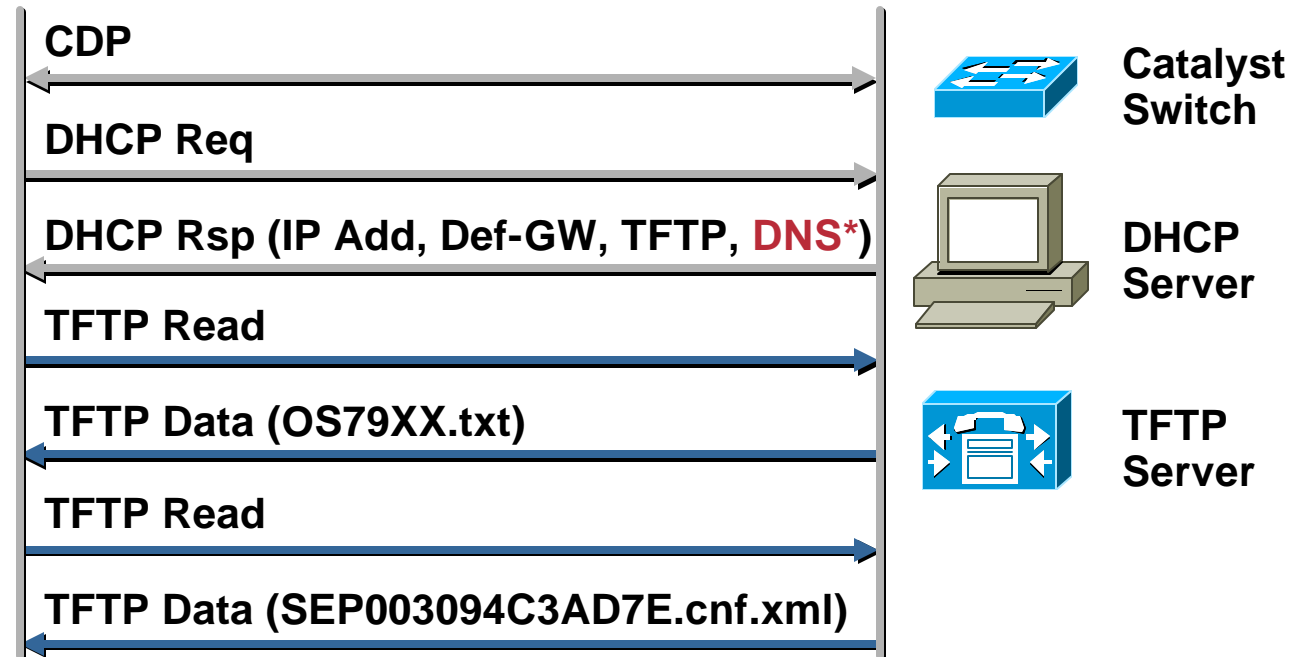
NetCfg-> 6 IP Address

IP Phone Initialization—TFTP

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MAC:
003094C3AD7E



Phone Displays: *Configuring IP*
Error Verifying Config Info
Check settings: NetCfg-> 8 TFTP Server

IP Phone Initialization TFTP Trace

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- TFTP traces provide more information on initialization process

```
TFTP|[opcode = 1] [Mode = octet] [thread count 0]| <CLID::StandAloneCluster>  
<NID::172.21.54.99><CT::3456:10.94.145.219:50953><IP::10.94.145.219>  
<DEV::SEP003094C25FCE.cnf.xml>
```

```
TFTP|file error[File Name or path not found 2]|<CLID::StandAloneCluster>  
<NID::172.21.54.99><CT::3456:10.94.145.219:50953><IP::10.94.145.219>  
<DEV::SEP003094C25FCE.cnf.xml>
```

- Note that the phone requests the configuration file

SEP0002FDAEFB9D.cnf.xml from the CallManager (version 3.1 and above)

Phone Loads in CallManager Releases prior to 3.1 request the File name:
SEP0002FDAEFB9D.cnf

3.0.12 will understand both file formats

- Files served by TFTP

Are located in c:\Program Files\Cisco\TFTPPath

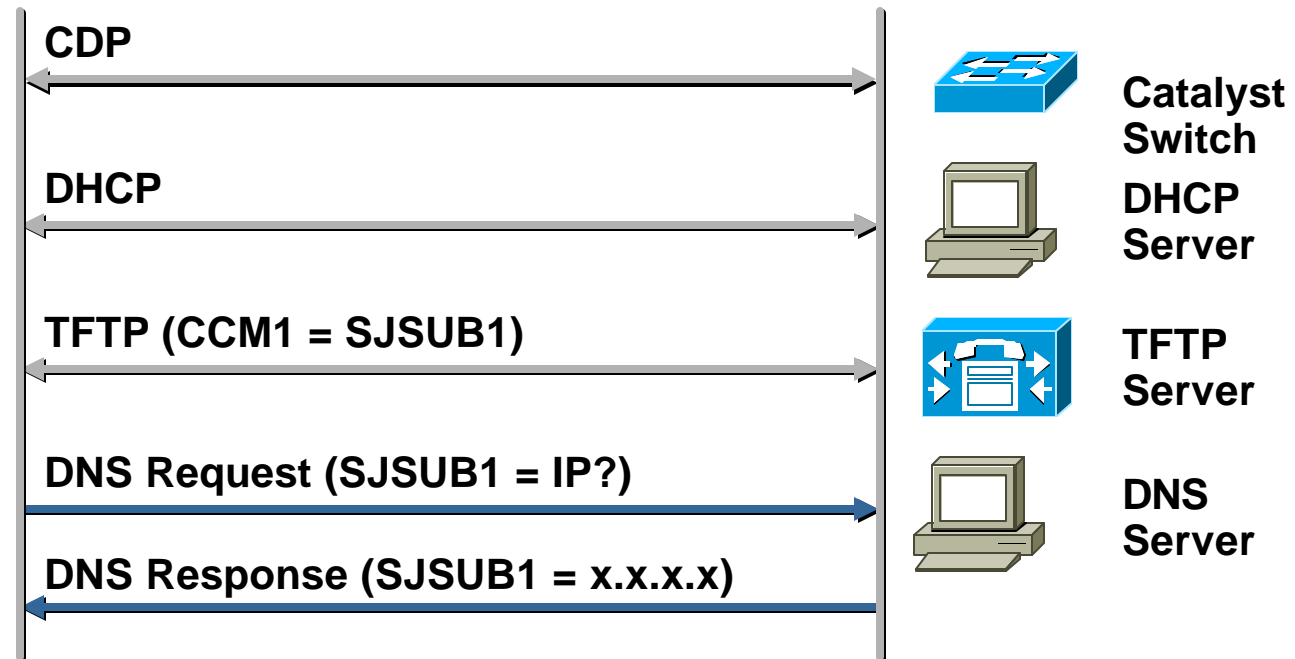
CCM 3.2: By default SEP.cnf.xml files cached in RAM and not written to disk

IP Phone Initialization—DNS

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MAC:
003094C3AD7E



Phone displays: *Configuring IP*

CallManager Name DNS Error

Defaulting CM to TFTP Server

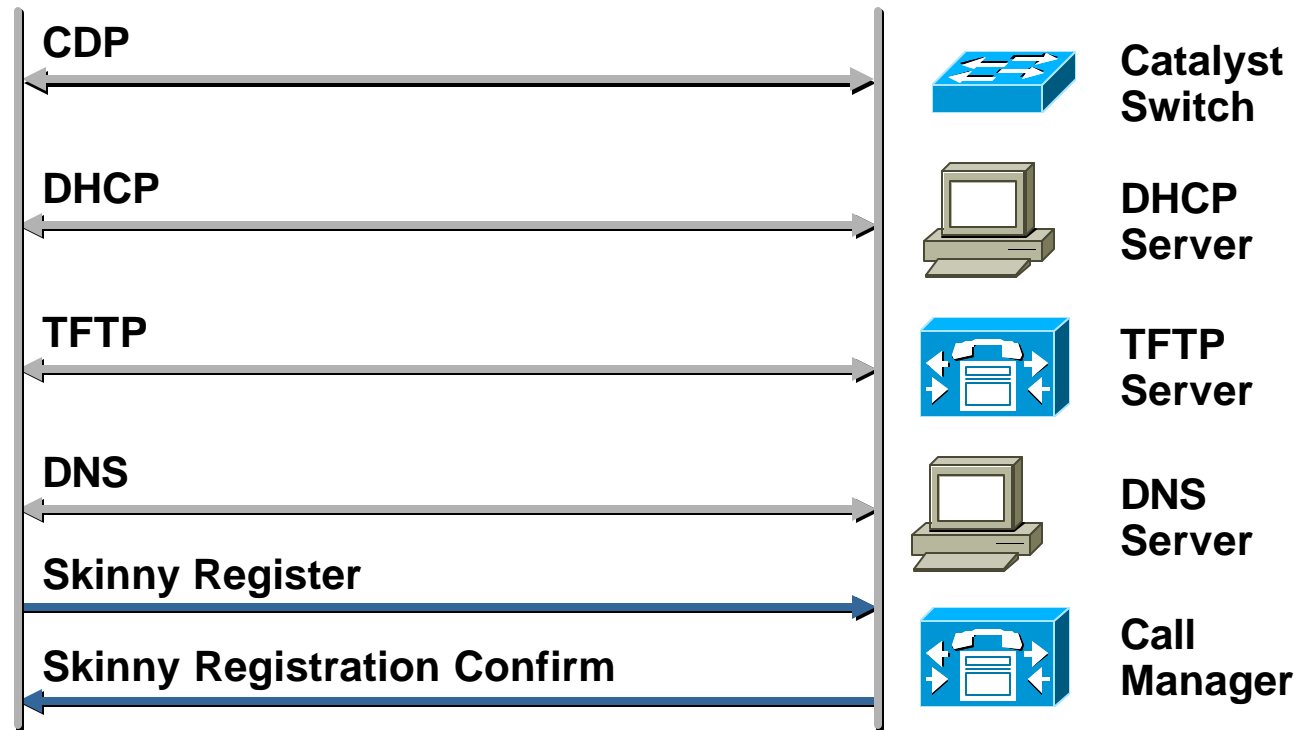
Check settings: NetCfg-> 14 DNS Server 1

IP Phone Initialization—CCM Registration

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MAC:
003094C3AD7E



Phone displays: *Configuring CM List*
Registration Rejected
Opening 10.1.1.1
CM Down, Features Disabled

Check settings: NetCfg-> 21 Call Manager 1

Post Initialization—The Sound of Success

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- **Re-order or fast busy is NOT a phone problem**
 - No route for dialed destination on CCM
 - No matching route patterns on GW
 - CODEC mismatch

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Tools and Utilities to Configure, Monitor and Troubleshoot on CallManager

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- **CCM administration**
- **Event log**
- **CCM serviceability**

Performance monitor

Trace configuration

CCM traces

Collection

Q931 translator

EventLog

- **Start-> Programs-> Administrative Tools -> Event Viewer -> Application Log**
- **EventLog is a Windows 2000 Server application that displays a log of Windows 2000 server and CCM**
- **Even if a service (including TFTP) can not read the database (where it gets trace configuration), it will add errors to the event log**

EventLog

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The screenshot shows the Windows Event Viewer application with the 'Application Log' selected, displaying 8,815 events. An 'Event Properties' dialog box is open, showing details for a specific event.

Event Properties Dialog Box:

- Event:**
 - Date: 4/24/2002
 - Time: 15:57
 - Type: Error
 - User: N/A
 - Computer: CM31PUB
 - Source: Cisco CallManager
 - Category: None
 - Event ID: 3
- Description:**

Error: DeviceTransientConnection - Transient connection attempt.
Connecting Port: 2000
Device name [Optional]:
Device IP address.: 10.17.168.108
Device type. [Optional]: 255
Reason Code [Optional]: 6
App ID: Cisco CallManager
- Data:** Bytes Words

Event Viewer Application:

- Tree:** Event Viewer (Local) > Application Log > Security Log
- Application Log:** 8,815 event(s)
- Table:**

Type	Date	Time	Source	Cal
Information	4/25/2002	6:54:48 AM	SceCli	Noi
Information	4/24/2002	4:11:47 PM	MSDTC	CM
Information	4/24/2002	4:11:47 PM	MSDTC Client	CM
Error	4/24/2002	4:01:32 PM	Cisco CallManager	Noi
Error	4/24/2002	4:01:08 PM	Cisco CallManager	Noi
Error	4/24/2002	3:57:06 PM	Cisco CallManager	Noi
Error	4/24/2002	3:57:01 PM	Cisco CallManager	Noi
Information	4/24/2002	3:48:34 PM	MSDTC Client	CM
Information	4/24/2002	3:48:34 PM	MSDTC	CM
Error	4/24/2002	3:25:43 PM	Cisco CallManager	Noi
Error	4/24/2002	3:22:33 PM	Cisco CallManager	Noi
Error	4/24/2002	3:22:28 PM	Cisco Tftp	Noi
Information	4/24/2002	1:47:43 PM	SceCli	Noi
Information	4/23/2002	9:23:37 PM	SceCli	Noi
Information	4/23/2002	5:09:32 AM	SceCli	Noi
Information	4/22/2002	12:58:27 PM	SceCli	Noi
Information	4/21/2002	8:21:21 PM	SceCli	Noi
Information	4/21/2002	3:28:16 AM	SceCli	Noi
Error	4/20/2002	1:46:53 PM	Cisco CTIManager	Noi

Enabling Tracing in Cisco CallManager

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- **For nearly all troubleshooting scenarios, you will need traces from the Cisco CallManager service; click the ‘Set Default’ button then change the trace level to either ‘Arbitrary’ or ‘Detailed’**
- **Arbitrary and Detailed are nearly identical, except Detailed shows KeepAlives and some additional digit analysis data**
- **CCM trace (a.k.a.: System diagnostic interface) files provide the greatest level of detail**

Trace Utility—Node, Service Selection

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The screenshot shows the Cisco CallManager Serviceability interface. At the top is a navigation bar with links: Alarm, Trace, Tools, Application, and Help. Below this is a header section with the Cisco CallManager Serviceability logo and the Cisco Systems logo. The main content area is titled "Trace Configuration".

On the left, there is a "Servers" table with two entries:

Servers
172.21.51.66
172.21.51.67

An annotation box with the text "Select the Node" points to the first server entry.

To the right of the servers table, the following information is displayed:

Current Service: New
Current Server: 172.21.51.66
Status: Ready

Below this, there is a section for "Configured Services" which contains a list box with the following items:

- Cisco CallManager
- Cisco CDR Insert
- Cisco CTIManager
- Cisco Database Layer Monitor
- Cisco IP Voice Media Streaming App
- Cisco Messaging Interface
- Cisco MOH Audio Translator
- Cisco RIS Data Collector

An annotation box with the text "Select the Service on Which Trace Needs to Be Enabled" points to the list box.

Enabling Tracing in Cisco CallManager

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Trace Configuration

Servers

Current Service: Cisco CallManager

Current Server: 172.21.51.229

Status : Ready

Click the Update Button
to Save the Settings

Update

SetDefault

Updates All
CallManagers in
this Cluster with
these Settings

[SDL Configuration](#)

Configured Services

Cisco CallManager

☒ Trace On

☒ Apply to All Nodes

Trace Filter Settings

Debug Trace Level

Detailed

☒ Cisco CallManager Trace Fields

☐ Enable H245 Message
Trace

☒ Enable CDR Trace

☒ Enable DT-24+/DE-30+
Trace

☒ Enable Analog Trunk
Trace

Trace Utility—Debug Trace Level

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- **Error**—Used for all traces generated in abnormal path; minimum amount of CPU cycles
- **Special**—Non-repetitive messages; ex. all system and device initialization messages
- **State transition**—Call processing events
- **Significant**—Media layer events
- **Arbitrary**—Used for debugging excluding keepalives
- **Detail**—Detailed debug information

Trace Utility—SDI Trace Format, raw

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```
ccm00000111.txt - Notepad
File Edit Format Help
03/20/2003 20:17:54.553 Cisco CallManager|StationInit: 51b7af4
OffHook. |<CLID::WWCCM1-Cluster><NID::CM-FL2><CT::1,100,95,1.1897913><IP::10.17.168.70><DEV::SEP0002FDAEFB9D>
03/20/2003 20:17:54.553 Cisco CallManager|StationD: 51b7af4 DisplayText text='
1000
'. |<CLID::WWCCM1-Cluster><NID::10.1.1.1><CT::1,100,95,1.1897913><IP::10.17.168.70><DEV::SEP0002FDAEFB9D>
03/20/2003 20:17:54.553 Cisco
CallManager|<CLID::WWCCM1-Cluster><NID::10.1.1.1><CT::1,100,95,1.1897913><MN::Directory
Number><MV: 1000><DEV::SEP0002FDAEFB9D>
03/20/2003 20:17:54.553 Cisco CallManager|CTI: RoutePatternToCtiGlobalCallID::findValue(): RP=1000:,
bRc=0, T=, #entries=0 |<CLID::WWCCM1-Cluster><NID::10.1.1.1>
03/20/2003 20:17:54.553 Cisco CallManager|CTI: RoutePatternToCtiCallOrigin::findValue() : RP=1000:,
bRc=0, T=, #entries=0 |<CLID::WWCCM1-Cluster><NID::10.1.1.1>
03/20/2003 20:17:54.553 Cisco CallManager|StationD: 51b7af4 SetLamp stimulus=9 (Line)
stimulusInstance=1
lampMode=2 (LampOn) |<CLID::WWCCM1-Cluster><NID::10.1.1.1><CT::1,100,95,1.1897913><IP::10.17.168.70><
DEV::SEP0002FDAEFB9D>
03/20/2003 20:17:54.553 Cisco CallManager|StationD: 51b7af4 DisplayPromptStatus timeOutValue=0
promptStatus='Enter number' lineInstance=1
callReference=50331661. |<CLID::WWCCM1-Cluster><NID::10.1.1.1><CT::1,100,95,1.1897913><IP::10.17.168.
70><DEV::SEP0002FDAEFB9D>
03/20/2003 20:17:54.553 Cisco CallManager|StationD: 51b7af4 SelectSoftKeys instance=1
reference=50331661 softKeySetIndex=4
```

Trace Utility— SDI Trace Format, detailed

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03/20/2003 20:17:54.553 Cisco CallManager |StationInit. 51b7af4 OffHook.|
<CLID::WWCCM1-Cluster> <NID::10.1.1.1> <CT::1,100,95,1.1897931>
<IP::10.17.168.70> <DEV::SEP0002FDAEFB9D>

Field Name	Example
Date	“03/20/2003”
Time	“20:17:54.553”
System	“Cisco CallManager”
Trace Text	“Trace/Event ID, Event Information”
Cluster ID (CLID)	“WWCCM1-Cluster”
Node ID (NID)	“10.1.1.1”
Correlation Tag (CT)	“1,100,95,1.1897931”
Source Device	“10.17.168.70, SEP0002FDAEFB9D”
Tag Mapping	“Destination Device Name, DN, Application defined Tags” Not used in this example

Device ID
a.k.a. TCP
Handle

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How Do We Find Information in these Huge Text Files?

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```

C:\WINNT\System32\cmd.exe
E:\>findstr "SEPABCDEFB8931F" ccm*.txt
ccm00000191.txt:04/22/2003 15:28:42.557 Cisco CallManager|StationInit: 830b438 K
eypadButton kpButton=7.|<CLID::CCM01-CLSTR01-Cluster><NID::10.0.32.65><CT::2,100
,95,1.80254893><IP::10.28.88.120><DEV::SEPABCDEFB8931F>
ccm00000191.txt:04/22/2003 15:28:47.635 Cisco CallManager|StationInit: 830b438 S
timulus stimulus=9(Line) stimulusInstance=1.|<CLID::CCM01-CLSTR01-Cluster><NID::
10.0.32.65><CT::2,100,95,1.80254923><IP::10.28.88.120><DEV::SEPABCDEFB8931F>
ccm00000191.txt:04/22/2003 15:28:47.635 Cisco CallManager|StationInit: 830b438 0
ffHook.|<CLID::CCM01-CLSTR01-Cluster><NID::10.0.32.65><CT::2,100,95,1.80254924><
IP::10.28.88.120><DEV::SEPABCDEFB8931F>
ccm00000191.txt:04/22/2003 15:28:47.635 Cisco CallManager|StationD: 830b438 S
etSpeakerMode speakermode=1(On).|<CLID::CCM01-CLSTR01-Cluster><NID::10.0.32.65><
CT::2,100,95,1.80254923><IP::10.28.88.120><DEV::SEPABCDEFB8931F>
ccm00000191.txt:04/22/2003 15:28:47.635 Cisco CallManager|StationD: 830b438 D
isplayText text=' 7024073709 '.|<CLID::CCM01-CLSTR01-Cluster><NID::10.0.32.65><CT::2,100,95,1.80254923><IP::10.28.88.120><DEV::SEPABCDEFB8931F>
ccm00000191.txt:04/22/2003 15:28:47.635 Cisco CallManager|StationD: 830b438 D
isplayText text=' 7024073709 '.|<CLID::CCM01-CLSTR01-Cluster><NID::10.0.32.65><CT::2,100,95,1.80254923><IP::10.28.88.120><DEV::SEPABCDEFB8931F>

```

Now We Know what the Device ID Is for that Phone and Can Chase All Traces Pertaining to that Phone Only; Scenarios of what to Look for Will Be More Obvious as We Review the Case Studies

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- **IP Telephony Case Study and Troubleshooting Techniques**
- **Understand Echo and steps to resolve Echo in IPT Networks**

Case Study: IP Phone to IP Phone Intra-Cluster (Successful Call)

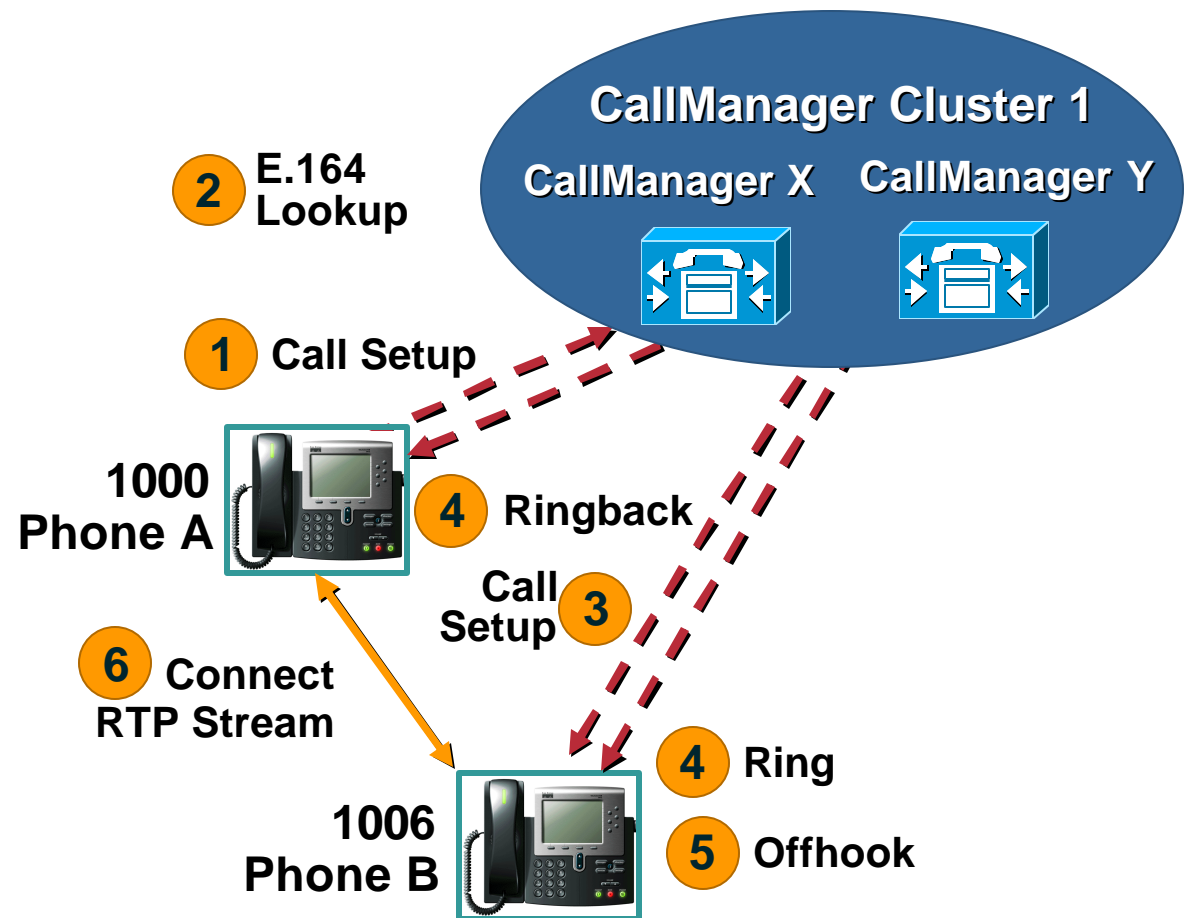
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- **IP phone to IP phone call flow within a cluster**
- **IP phone to IP phone call flow SCCP messages**
- **IP phone registration and call flow messages through the CCM traces**

IP-Phone to IP-Phone Call Flow

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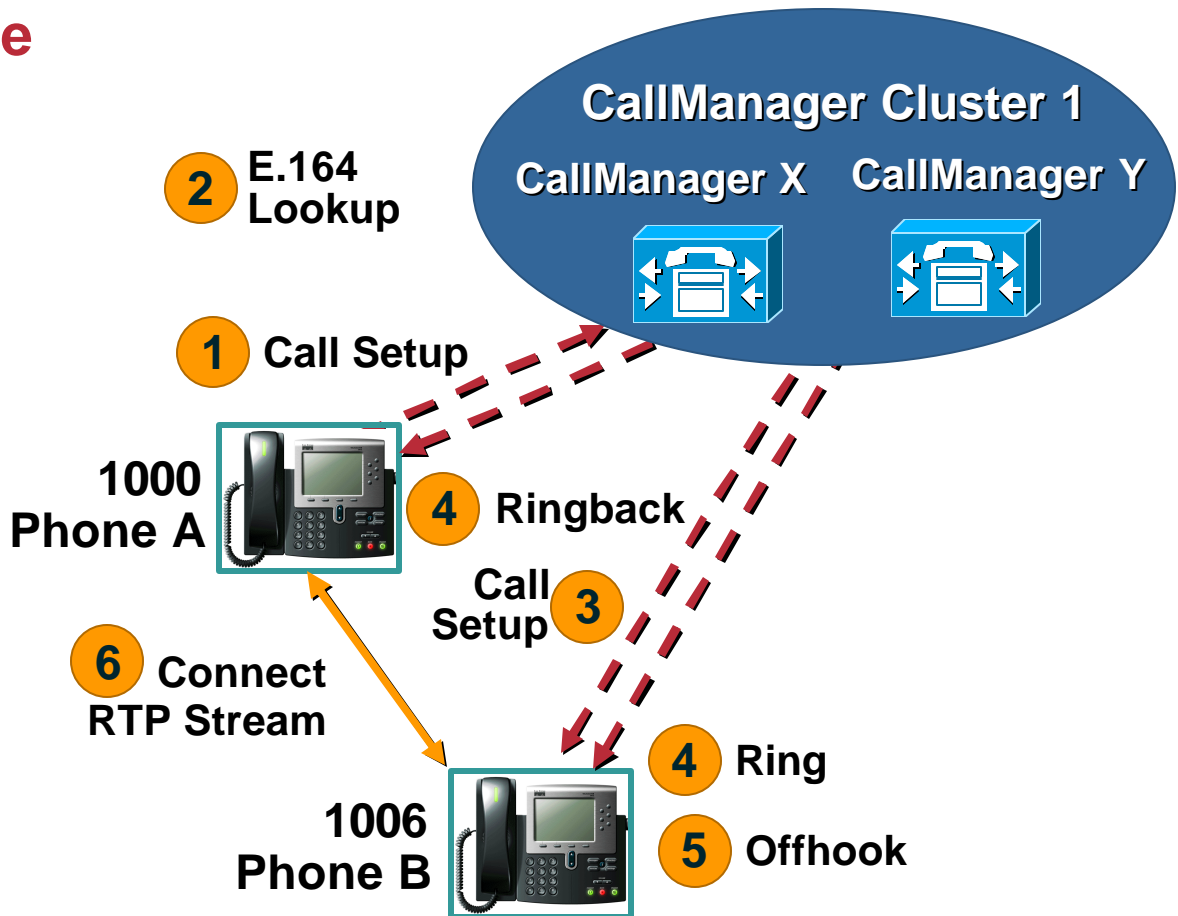
- Phone A is registered to CallManager X
- Phone B is registered to CallManager X
- Call is placed from Phone A (1000) to Phone B (1006)



IP-Phone to IP-Phone Call Flow

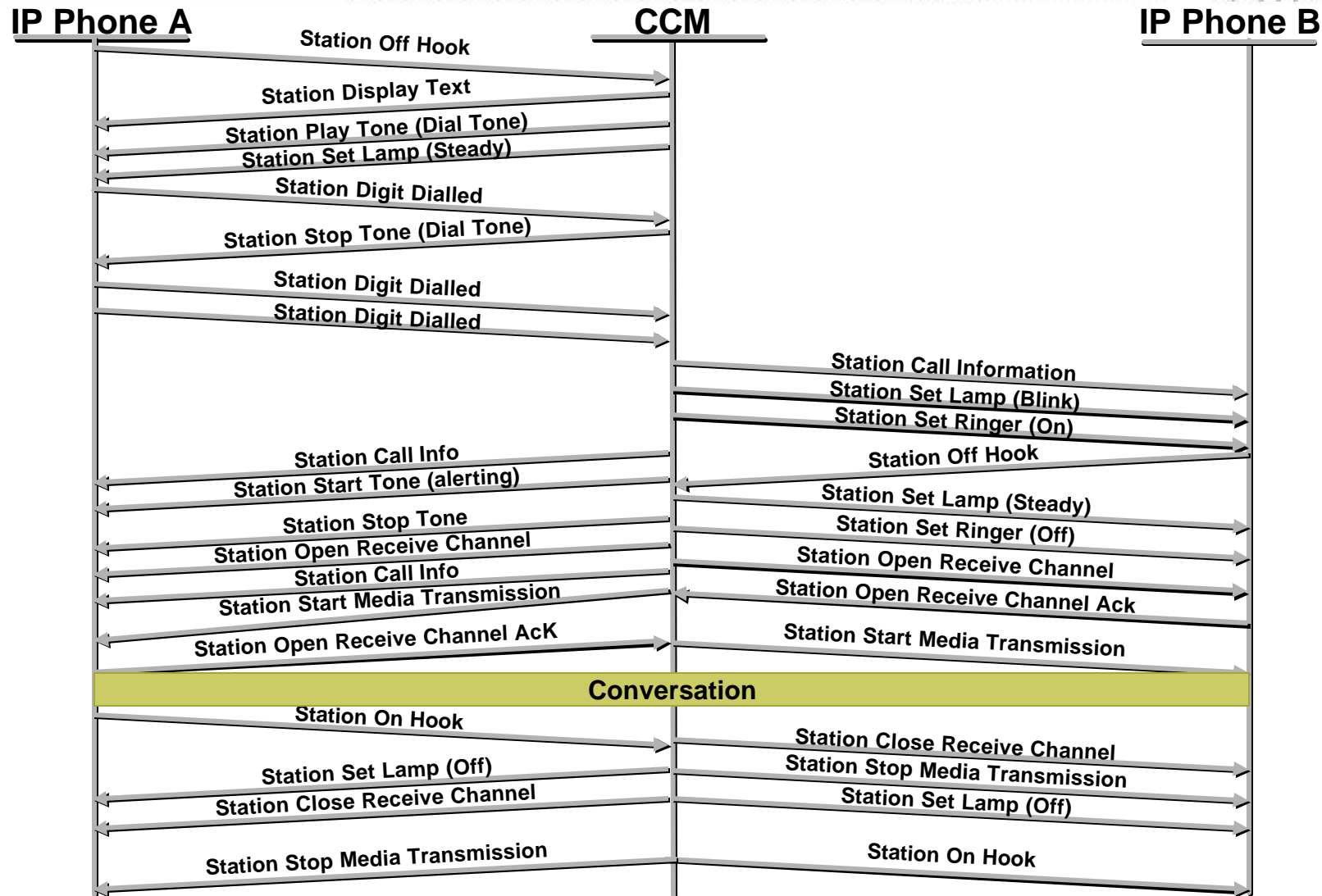
Cisco.com

- **Very important note**
- All traces were generated on CallManager X, since both phones are registered to it
- If phone B were registered to CallManager Y, we would have to collect traces from both servers



Simple Intra-Cluster Call Flow (SCCP)

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Intra Cluster Call Flow Trace— Phone Goes Off Hook

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- **Phone 1000 goes to OffHook**

03/20/2002 23:14:49.517 Cisco CallManager

|StationInit: 520443c OffHook.|

<CLID::WWCCM1-

Cluster><NID::172.21.51.216><CT::1,100,95,1.1243><IP::10.17.168.70><DEV::SEP0002FD
AEFB9D>

- **Header that is common to all the messages**

03/20/2002 23:14:49.517 Cisco CallManager

- **Trailer is common to all the messages to and from this phone**

<CLID::WWCCM1-

Cluster><NID::172.21.51.216><CT::1,100,95,1.1243><IP::10.17.168.70><DEV::SEP0002FD
AEFB9D>

- **Header and trailer messages will be omitted from now on to simplify the display**

- **The 520443c is unique ID for this phone**

- **StationInit indicates that CallManager received a TCP message from a skinny station**

Intra Cluster Call Flow Trace— SCCP Call States

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- | | |
|---------------------|---------------------------------|
| 1—Off Hook | 8—Hold |
| 2—On Hook | 9—Call Waiting |
| 3—Ring Out | 10—Call Transfer |
| 4—Ring In | 11—Call Park |
| 5—Connected | 12—Proceed |
| 6—Busy | 13—Call Remote Multiline |
| 7—Congestion | 14—Invalid Number |

Intra Cluster Call Flow Trace— Dialing Starts

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- User starts entering the digits—First digit '1' is dialed

|StationInit: 520443c KeypadButton kpButton=1.|

- CallManager stops sending the dial tone to the phone 1000 and collects the other digits entered through the keypad (We dialed 1006)

|StationD: 520443c StopTone.|

|StationD: 520443c SelectSoftKeys instance=1 reference=16777230 softKeySetIndex=6 validKeyMask=-1.|

|Digit analysis: match(fqcn="1000", cn="1000", pss="PA:Employee:CER", dd="1")|

|Digit analysis: potentialMatches=PotentialMatchesExist|

|StationInit: 520443c KeypadButton kpButton=0.|

|Digit analysis: match(fqcn="1000", cn="1000", pss="PA:Employee:CER", dd="10")|

|Digit analysis: potentialMatches=PotentialMatchesExist|

|StationInit: 520443c KeypadButton kpButton=0.|

|Digit analysis: match(fqcn="1000", cn="1000", pss="PA:Employee:CER", dd="100")|

|Digit analysis: potentialMatches=PotentialMatchesExist|

|StationInit: 520443c KeypadButton kpButton=6.|

|Digit analysis: match(fqcn="1000", cn="1000", pss="PA:Employee:CER", dd="1006")|

Intra Cluster Call Flow Trace— Digit Analysis

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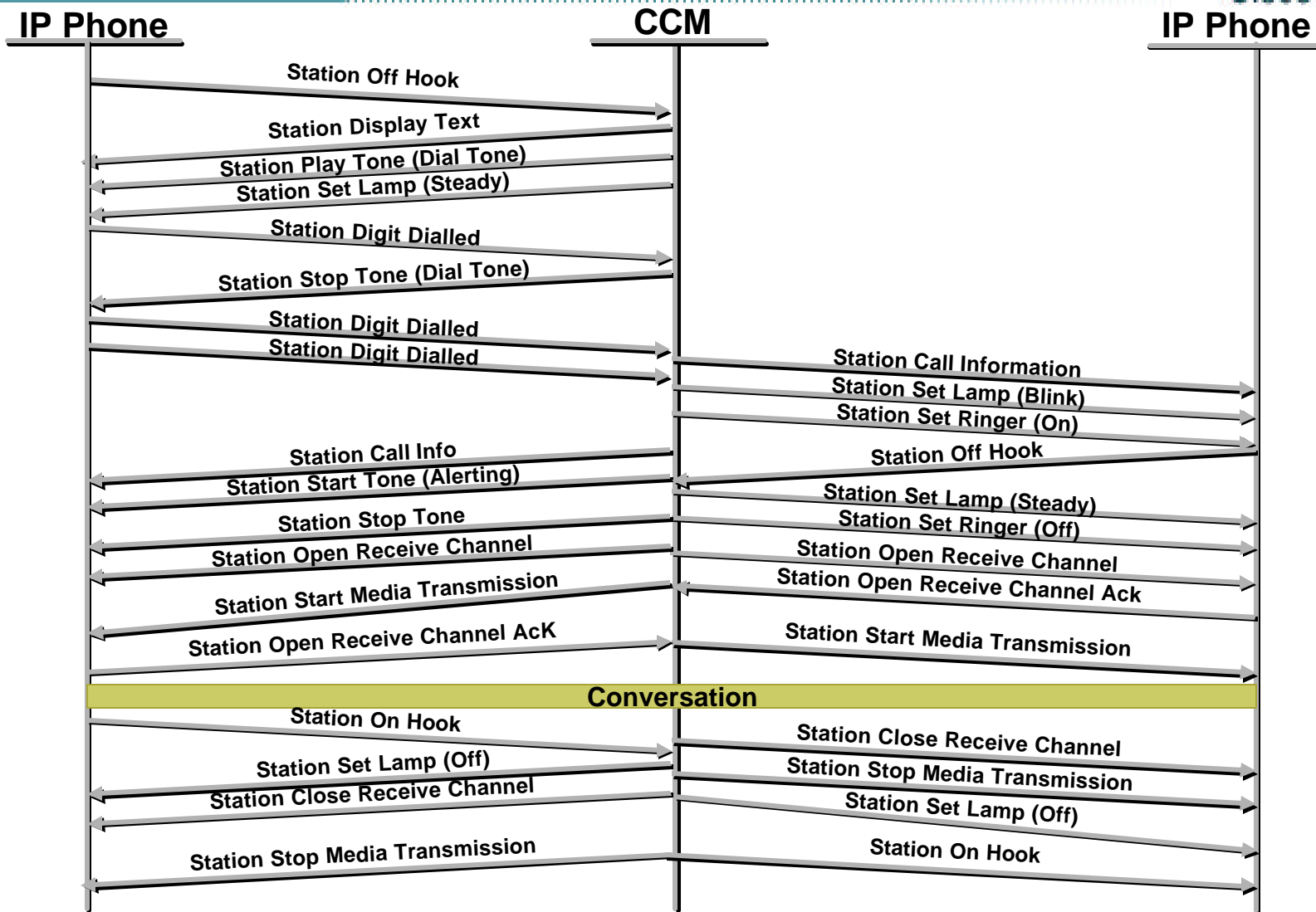
- A match was found: Here are the CallManager digit analysis results

```
|Digit analysis: analysis results|  
|PretransformCallingPartyNumber=1000  
|CallingPartyNumber=1000  
|DialingPartition=Employee  
|DialingPattern=1006  
|DialingRoutePatternRegularExpression=(1006)  
|DialingWhere=  
|PatternType=Enterprise  
|PotentialMatches=NoPotentialMatchesExist *  
|DialingSdlProcessId=(1,34,20)  
|PretransformDigitString=1006
```

*** NoPotentialMatchesExist Means that the Dialed String Is Not Partially Matching a Pattern within this Call's pss**

Simple Intra-Cluster Call Flow (SCCP)

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Troubleshooting Echo

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- **Echo Sources and Definition**
- **Eliminating Echo**
- **Tools and Methodology for Troubleshooting Echo**

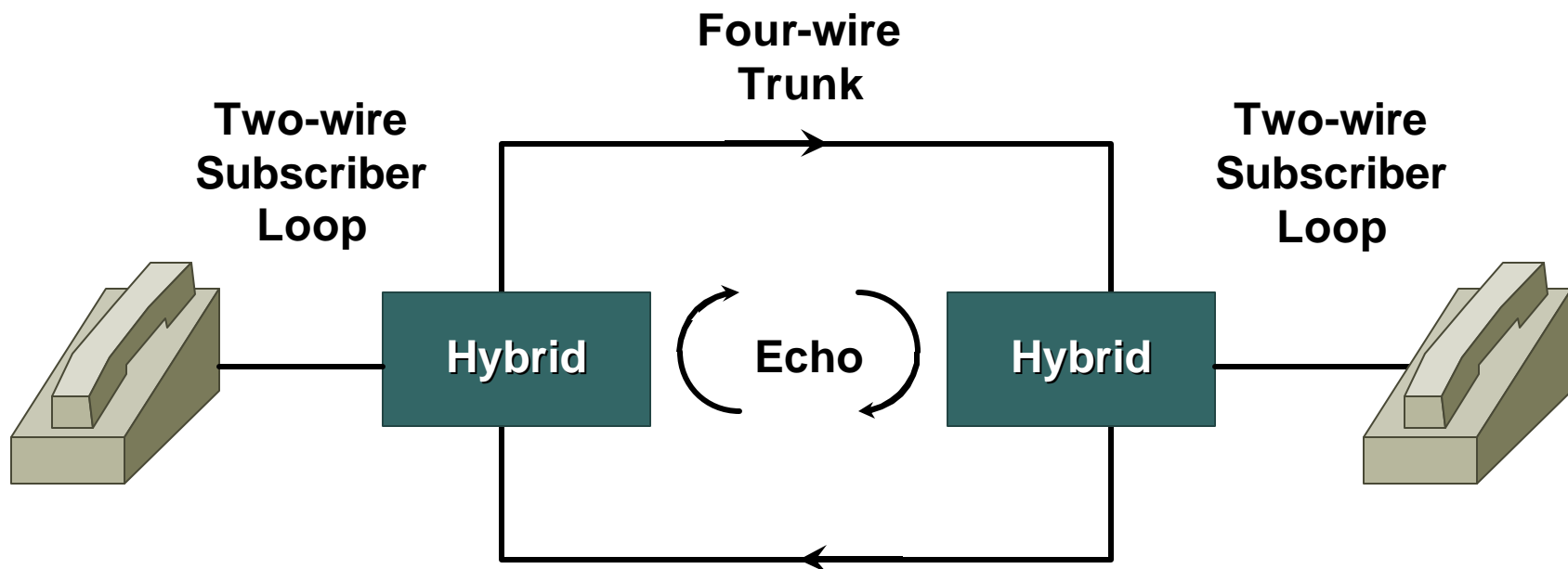
Echo—What Is Echo? What Is Echo?

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- **Objectionable reflected voice energy in speaker's receive path**
- **Function of signal strength and delay**
- **Why is echo prevalent in packet telephony?**

Sources of Echo: Hybrid Echo

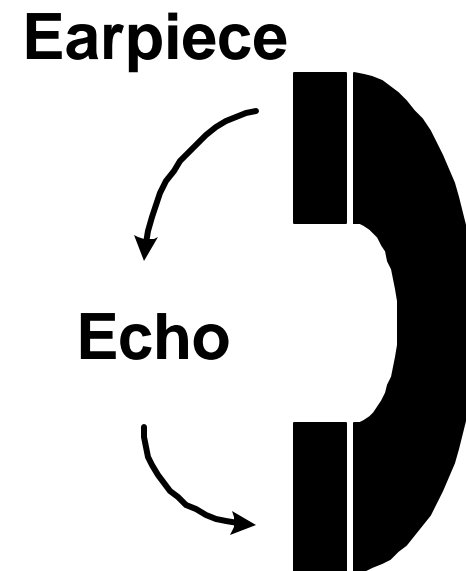
Cisco.com



Sources of Echo: Acoustic Echo

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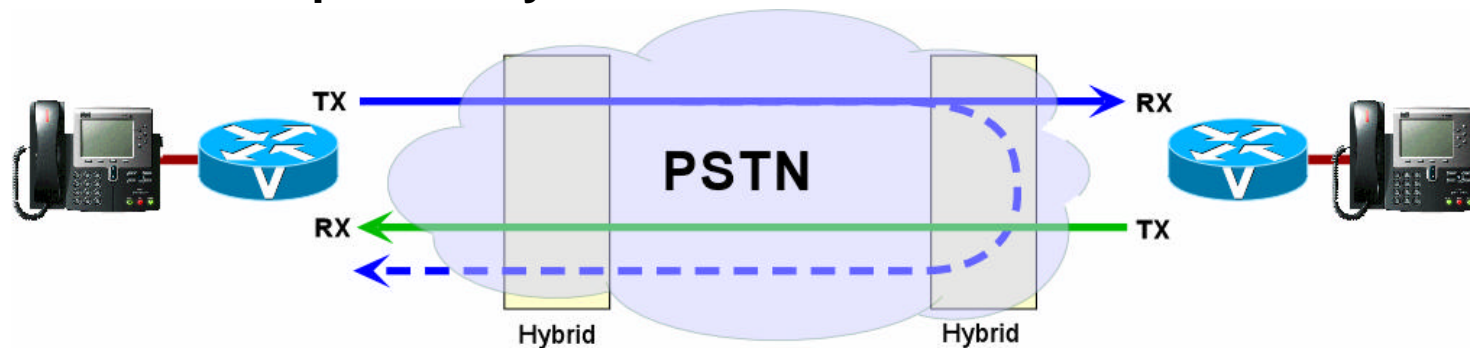
- **Poor acoustic isolation between the earpiece microphone and the microphone in handsets and hands-free devices introduce acoustic echo**



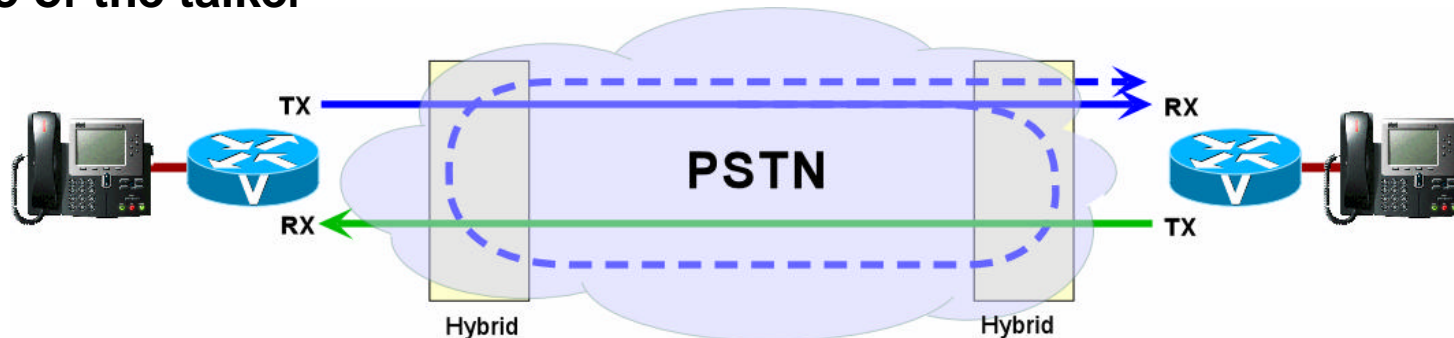
Types of Echo

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Talker Echo—The effect is the talker hears his/her own voice delayed by the total echo path delay time



Listener Echo—The effect is the person listening hears the talker and an echo of the talker



What Makes Echo a Problem?

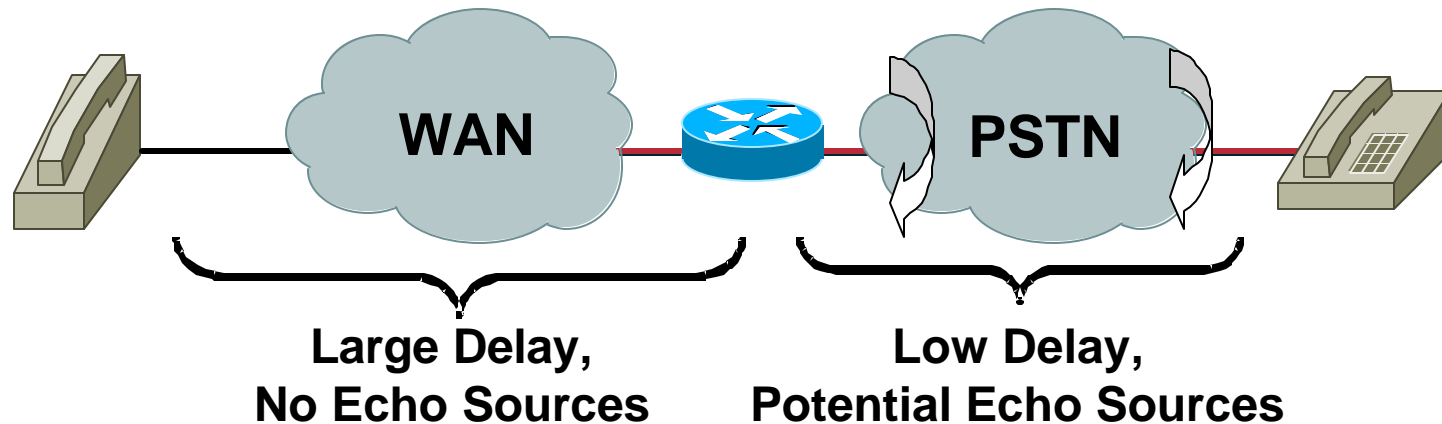
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For Echo to Be a Problem, All of the Following Conditions Must Exist:

- An **analog** leakage path between **analog** Tx and Rx paths
- Sufficient delay in echo return for echo to be perceived as annoying
(delays < 25ms are masked as sidetone)
- Sufficient echo amplitude to be perceived as annoying

The Impact of Packet Voice on Echo Perception

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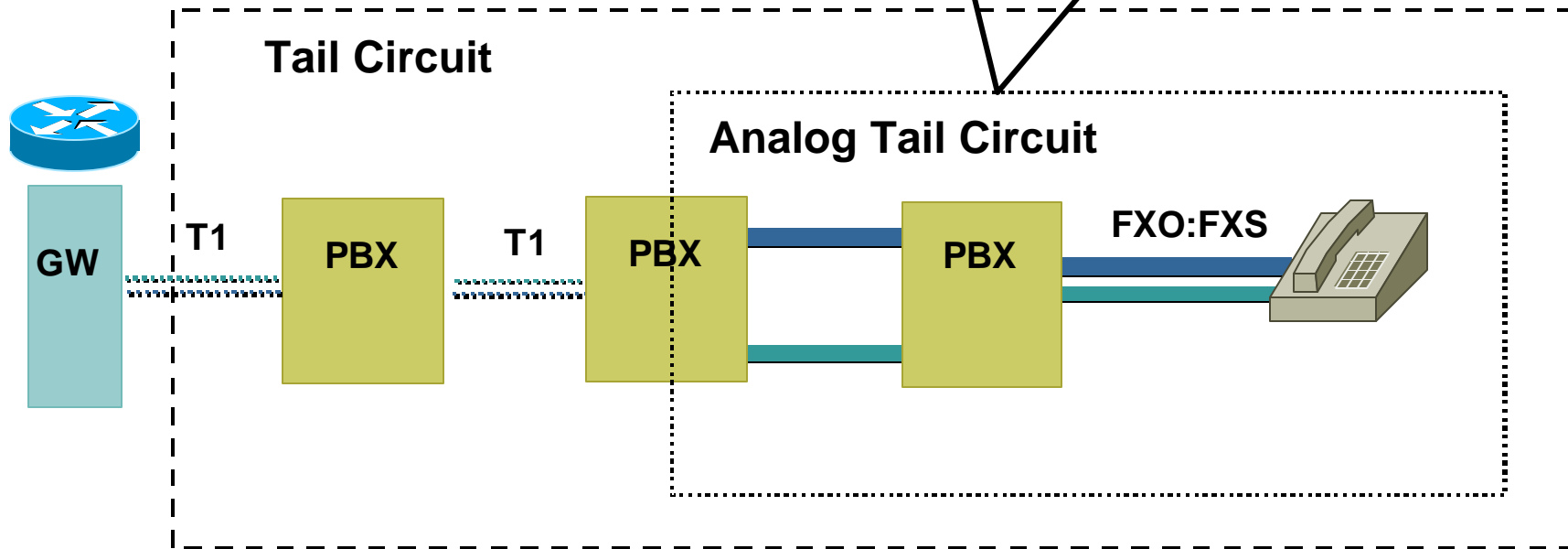


- The packet segment of the voice connection introduces large delay (typically > 30 ms in each direction)
- The introduction of delay causes echoes (from analog tail circuits) that are normally indistinguishable from side tone to become perceptible
- Because the delay introduced by packet voice is unavoidable, the voice gateways must prevent the echo

Example Topology of a Tail Circuit

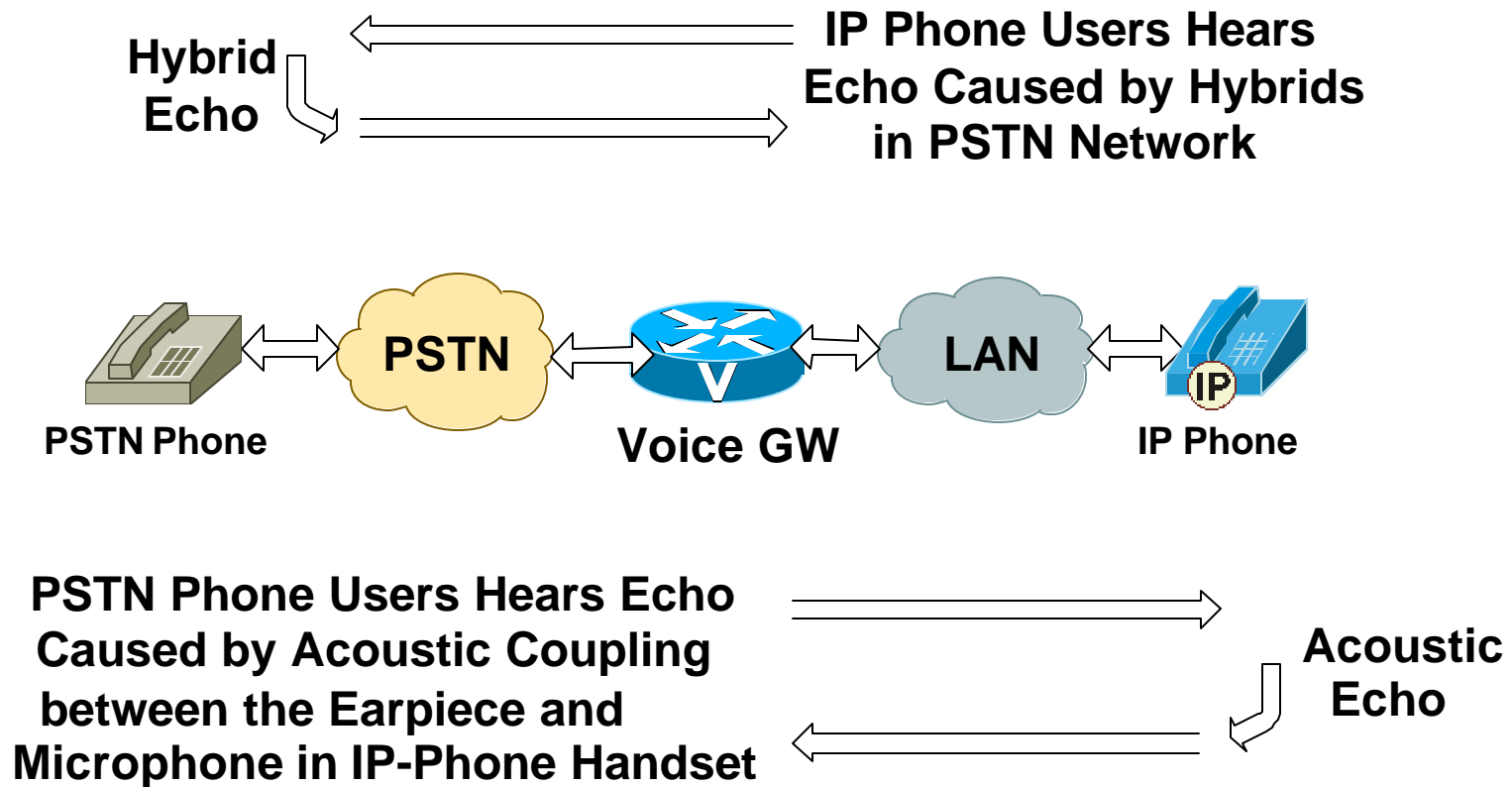
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Echoes Are Created in Analog Tail Circuits, They Do Not Form in Digital Call Legs



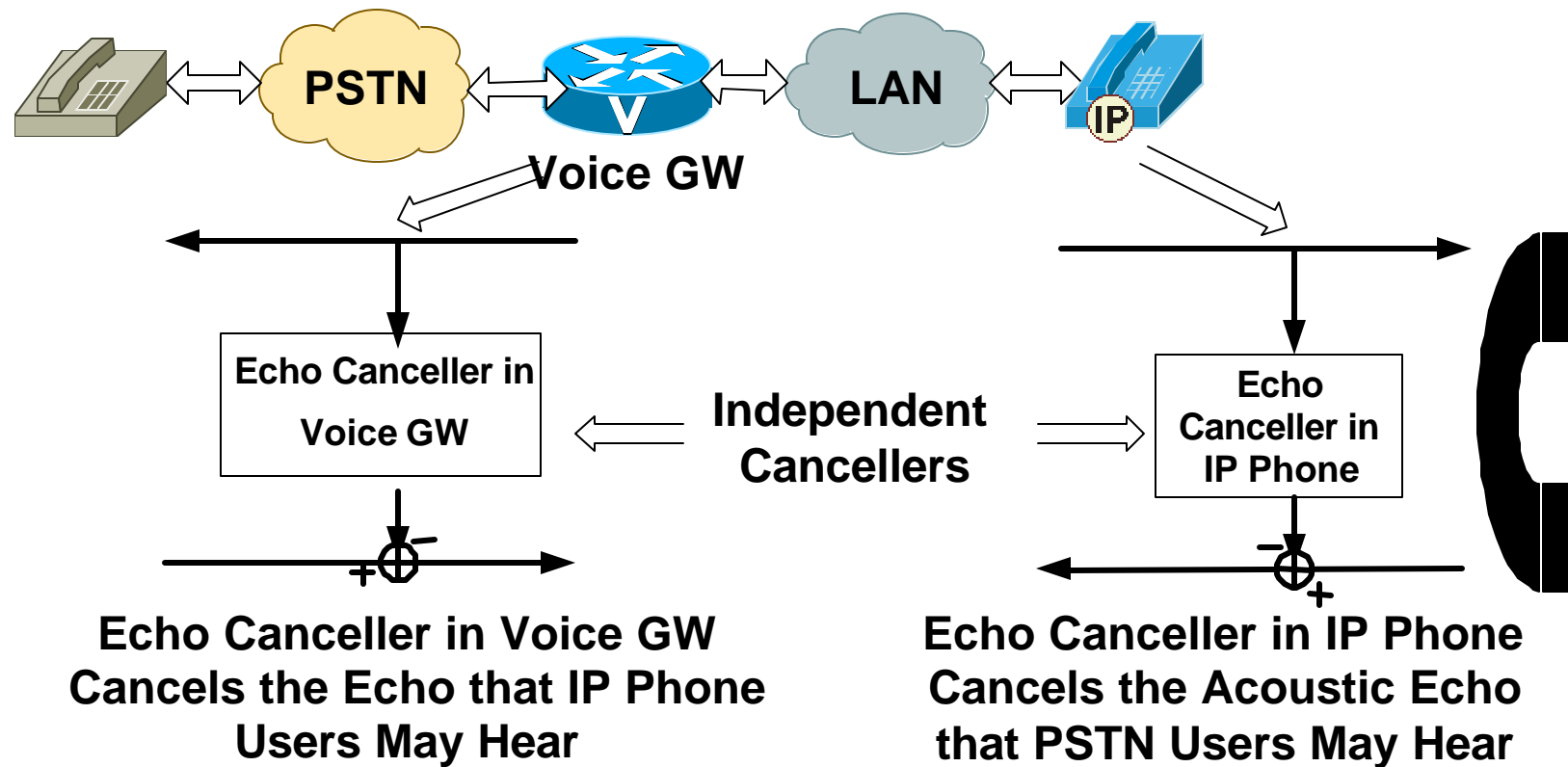
Echo in IP-PBX Environment

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Echo Cancellation in an IP-PBX Environment

Cisco.com



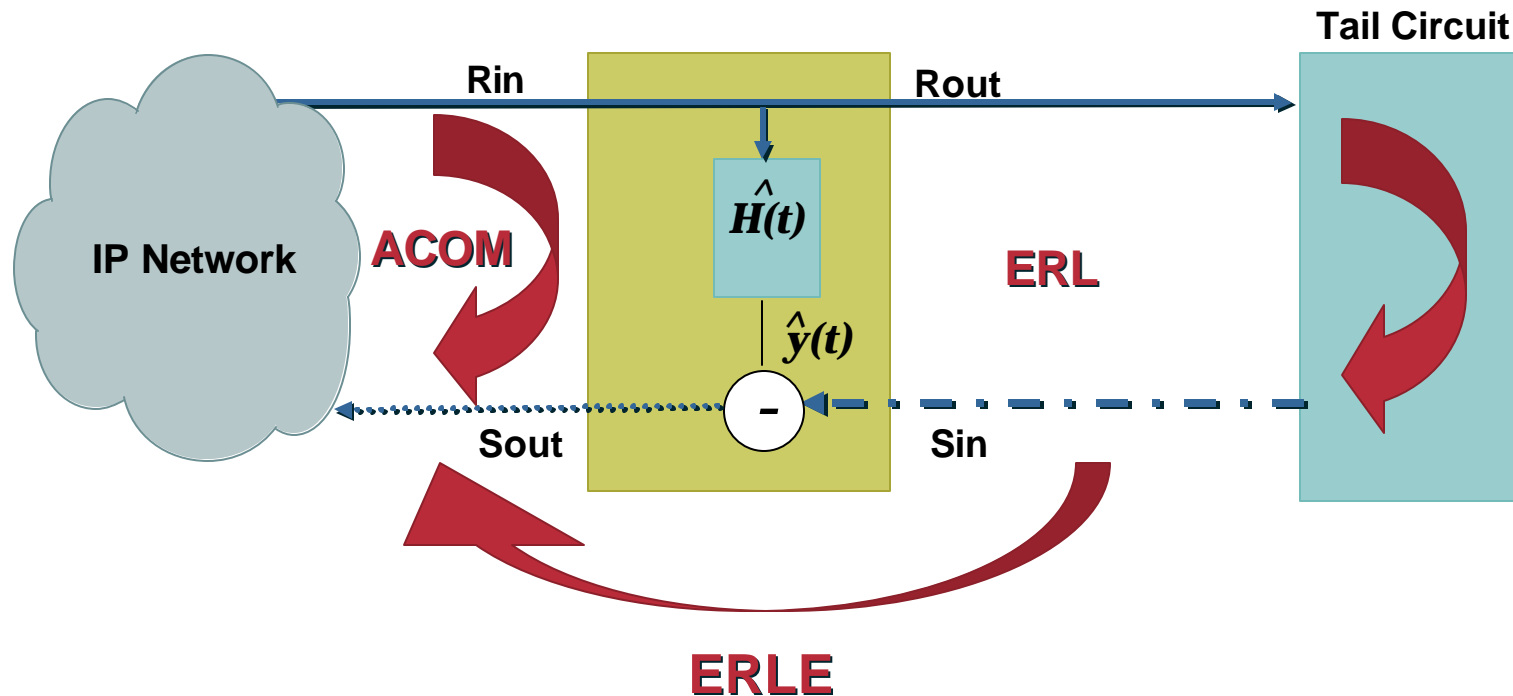
Troubleshooting Echo

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- **Echo Sources and Definition**
- **Eliminating Echo**
- **Tools and Methodology for Troubleshooting Echo**

Eliminating Echo—Terminology

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ERL = Echo Return Loss = $R_{out} - S_{in}$

ERLE = Echo Return Loss Enhanced = $R_{out} - S_{out}$

ACOM—Acombined = $R_{in} - S_{out}$

Eliminating Echo—Terminology

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- **Echo Cancel Coverage** is the amount of time the Echo Canceller will ‘Remember’ a signal that has been output; This parameter must be set to a value greater than the time it takes the echo to return back to the gateway

Characteristics of Conventional Echo Cancellers

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- The convergence rate depends on the properties of the reference (R_{in}) signal
- Silence and telephony signaling tones (DTMF, ringback, etc...) are poor reference signals and will not train the echo canceller significantly
- The convergence rate is inversely proportional to the duration of coverage provisioned
- Violation of the minimum assumed ERL prevents convergence due to falsely detecting doubletalk (when both parties talk at the same time)
- Adaptation during doubletalk will cause divergence

Characteristics of the dspware Echo Canceller before 12.2(13)T

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- Echo coverage is “provisionable” via CLI in 8 ms steps up to 32 ms; The greater the coverage provisioned, the slower the convergence rate
- Limitations of DSP MIPS and memory prohibit the expansion of coverage
- The minimum ERL is assumed to exceed 6 dB
- The EC does not perform well with echo environments that a) exceed 32ms in duration, b) are time varying (conferencing changes, acoustic echo), c) have an ERL < 6dB

Characteristics of the dspware Echo Suppressor

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- Can eliminate echo due to convergence times of echo canceller
- Echo Suppressors allow one way communication
voice-port cli: echo suppressor < # seconds >
- Must be disabled for modem communication
- Automatically disables during double talk
- Available in 12.2(8)T5 for NM-HDV and 12.2(11)T2 for most other voice interfaces (i.e. NM-2V)

Echo Cancellation Enhancements

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- Extends coverage to 64ms
- Allows required ERL drop from 6dB to 0 (via CLI)
- G.168 Complaint
- Much faster convergence time
- Echo suppressor not available (and is not needed) with ECAN Enhancements

cli: voice-card <slot>

codec complexity {high | medium} ecan-extended

Echo Cancellation Enhancements - Platform Support

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- **12.2(13)T adds support on NM-HDV, 7200/7500, ICS7750 MRP, High Complexity on 1700, High Complexity on MC3810**
- **12.2(15)ZJ and second release of 12.3T add additional platform support for NM-HDA and AIM-VOICE**
- **12.2(8)YH, 12.2(13)ZH, and the first release of 12.3T add medium complexity support for 1700**
- **12.3(1) adds support for medium complexity on MC3810.**
- **Second release of 12.3T adds support for High Complexity Analog and Medium Complexity digital on the Cat4k AGM.**

Troubleshooting Echo

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- **Echo Sources and Definition**
- **Eliminating Echo**
- **Tools and Methodology for Troubleshooting Echo**

Narrowing Your Focus

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- **First, find out what the exact symptoms of the echo problem are**
- **Every echo case is different and must be treated on a case-by-case basis**
- **Isolate the problem and try to find a scenario where the echo is reproducible**
- **There may be several different echo problems present—isolate each one and troubleshoot one at a time**

Questions to Ask

- **When does the echo occur?**
 - **Throughout call?**
 - **Only beginning of call?**
- **Does a single number (set of numbers) result in echo often?**
- **Which side hears the echo?**
- **Does the party hearing the echo hear themselves or the far end echoed?**

What to Collect?

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- Need to gather data while a call is experiencing echo
- Have users collect call-ING and call-ED numbers
- Need to produce 1004Hz tone and adjust dB levels (# or * dtmf buttons give a rough estimate if test gear is not available)
- PCM trace on PSTN tail-circuit producing the echo is very useful
- Sniffer trace
- 'show voice call x/y:z.ts' or 'show call active voice' → several iterations
- Check ERL—adjust input gain if necessary

Eliminating Echo

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So, How Do I Get Rid of Echo?

You need to make sure you give the echo canceller enough information to distinguish between echo and normal conversation; The only parameters you have control over are:

- **Input Level (Input Gain)**
- **Output Level (Output Attenuation)**
- **Echo Canceller Coverage**
- **Echo Suppressor (12.2(8)T5 and later)**
- **Enhanced Echo Canceller (12.2(13)T and later)**
- **Impedance**

Measuring Echo Using a 7960 IP Phone

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- To enable the tone generator, first unlock the phone by entering ****#** while the phone is idle; Wait at least 10 seconds before proceeding to the next step
- Type ****3** on the 7960/40 keypad while the phone is not on a call; This will enable the 'Tone' softkey for as long as this phone is registered to CallManager
- Place a call to the source of echo
- Once the call is established, hit the 'i' button twice; This will bring up the statistics for the call
- If the ****3** worked, you should have a 'Tone' softkey available; Press it and the phone will begin to generate a 1004 Hz tone at -15 dB
- The only way to stop the tone is to end the call
- Once the tone is being generated, keep the call up and then follow the procedures that follow to measure the dB levels

Measuring Echo in Cisco IOS

Cisco.com

- 1004Hz tone coming from IP Call Leg:
- Show voice call x/y:z.ts

```
vnt-3725-34a#sho voice call 1/0:23.23
```

```
1/0:23 23
```

```
vtsp level 0 state = S_CONNECT
```

```
callid 0x8003 B23 state S_TSP_CONNECT clld 99915506 cllg 41008
```

```
- snip -
```

```
***DSP LEVELS***
```

```
TDM Bus Levels(dBm0): Rx -15.5 from PBX/Phone, Tx -15.5 to PBX/Phone
```

```
TDM ACOM Levels(dBm0): +0.0, TDM ERL Level(dBm0): +0.0
```

```
TDM Bgd Levels(dBm0): -81.9, with activity being voice
```

Measuring Echo in Cisco IOS

Cisco.com

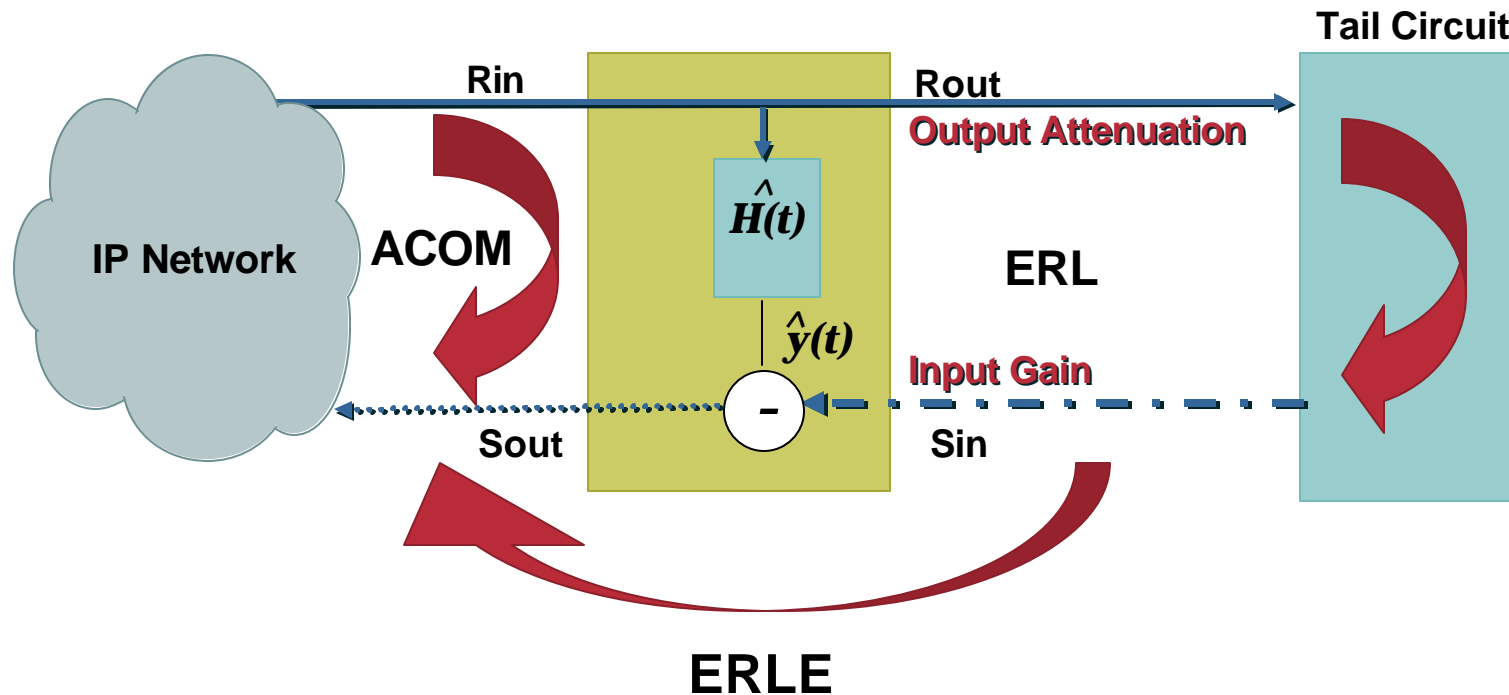
Use the Cisco IOS command 'show call active voice' to look at the input and output levels for your call; The following is a call to a loopback number that just echos back whatever we send with no attenuation

```
vdt1-3640-27a#sh call active voice
- snip -
OutSignalLevel=-15
InSignalLevel=-15
ERLLevel=25
- snip -
```

- The test tone is being output as -15 and is being looped back to us with 0dB loss, so it is coming back at -15 dB
- The ERL value here doesn't mean anything at this point since the ecan does not consider the input signal to be echo; The actual ERL is NOT really 25dB
- The OutSignalLevel shows the value of the level AFTER the output attenuation has been applied to the signal and InSignalLevel shows the level AFTER the input gain has been applied

Eliminating Echo

Cisco.com



- Perform dB level adjustment procedure; Remember:
Output Attenuation of a signal is performed **AFTER** the echo canceller has 'seen' the original output signal
Input Gain of a signal is performed **BEFORE** the echo canceller has 'seen' the echo

Measuring Echo in Cisco IOS

Cisco.com

If we configure 1 dB of attenuation in each direction as follows:

```
voice-port 1/1:23
  input gain -1
  output attenuation 1
```

The resulting levels are as follows:

```
vdt1-3640-27a#sh call active voice
- snip -
OutSignalLevel=-16    -15 dB minus 1 from output attenuation = -16
InSignalLevel=-17    -16 dB minus 1 from input gain = -17
ERLLevel=11
- snip -
```

- Notice the OutSignalLevel is -16 because we attenuated the -15 dB signal by 1 dB; The InSignalLevel is -17 dB due to the input gain of -1
- At this point our real ERL is 2dB, however the Echo Canceller still does not acknowledge the input signal as echo

Measuring Echo in Cisco IOS

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If we configure 2 dB of attenuation in each direction as follows:

```
voice-port 1/1:23
  input gain -2
  output attenuation 2
```

The resulting levels are as follows:

```
vdt1-3640-27a#sh call active voice
- snip -
OutSignalLevel=-17    -15 dB minus 2 from output attenuation = -17
InSignalLevel=-19    -17 dB minus 2 from input gain = -19
ERLLevel=4
-snip -
```

- Notice the OutSignalLevel is -17 because we attenuated the -15 dB signal by 2 dB; The InSignalLevel is -19 dB due to the input gain of -2
- Our expected ERL of 4dB is now correct
- The G.113 specification recommends a minimum ERL of 15 dB

Measuring Echo on the 6608

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- Same principles apply when troubleshooting echo on a 6608, however the commands are different
- From the CatOS prompt, type '**show port voice active <mod>/<port>**' to see the active calls on that port
- The 6608 does not show you input and output levels, however it does show the ERL and ACOM
- ERL and ACOM values are displayed as 10x the dB value, so a value of 61 is really 6.1 dB
- Echo cancel coverage is not configurable on the 6608; It is roughly equivalent to 32 ms in Cisco IOS
- The 6608 always has the echo suppressor enabled to reduce convergence echo

Adjusting Levels on Cisco CallManager

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- On Skinny/MGCP gateways, the input and output dB levels are adjusted from the CallManager administration web page
- The Output level is adjusted using the 'Audio Signal Adjustment from IP Network' menu; (Same as output attenuation, but positive values increase volume and negative values decrease volume)
- The Input level is adjusted using the 'Audio Signal Adjustment into IP Network' menu; (Same as input gain)
- **You must reset the gateway for the changes to take effect**

The screenshot displays the Cisco CallManager administration web page for configuring audio signal adjustments. The settings are as follows:

- FDL Channel***: ATT 54016
- Framing***: ESF
- Audio Signal Adjustment into IP Network***: Minus2db
- Audio Signal Adjustment from IP Network***: Minus2db
- Yellow Alarm***: Minus2db
- Zero Suppression***: Minus2db

The 'Audio Signal Adjustment from IP Network*' dropdown menu is open, showing a list of options: Minus4db, Minus3db, Minus2db (selected), Minus1db, NoDbPadding, Plus1db, Plus2db, Plus3db, Plus4db, Plus5db, and Plus6db. A 'Back to File' link is visible at the bottom right.

* indicates required
** applicable to DN
*** applicable to D
**** may be required to force ringback from some PBXs

Measuring Echo on the 6608

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Input Gain of -1 and Output Attenuation of 1

```
vdt1-Cat6k-PBX1> (enable) sh port voice active 4/8
```

```
Port 4/8 :
```

```
Channel #23:
```

Remote IP address	: 172.18.104.74
Remote UDP Port	: 24876
ACOM Level Current	: 45
Call State	: voice
Codec Type	: G711 ULAW PCM
Coder Type Rate	: 20
ERL Level	: 61
Voice Activity Detection	: disabled
Echo Cancellation	: enabled
Fax Transmit Duration (ms)	: 0
Hi Water Playout Delay	: 65
Low Water Playout Delay	: 64
Receive Bytes	: 373920
Receive Delay	: 64
Receive Packets	: 2337
Transmit Bytes	: 374240
Transmit Packets	: 2339
Tx Duration (ms)	: 42090
Voice Tx Duration (ms)	: 42090

Measuring Echo on the 6608

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Input Gain of -3 and Output Attenuation of 3

```
vdt1-Cat6k-PBX1> (enable) sh port voice active 4/8
```

```
Port 4/8 :
```

```
Channel #23:
```

Remote IP address	: 172.18.104.74
Remote UDP Port	: 28146
ACOM Level Current	: 370
Call State	: voice
Codec Type	: G711 ULAW PCM
Coder Type Rate	: 20
ERL Level	: 60
Voice Activity Detection	: disabled
Echo Cancellation	: enabled
Fax Transmit Duration (ms)	: 0
Hi Water Playout Delay	: 65
Low Water Playout Delay	: 64
Receive Bytes	: 315520
Receive Delay	: 64
Receive Packets	: 1972
Transmit Bytes	: 315680
Transmit Packets	: 1973
Tx Duration (ms)	: 37990
Voice Tx Duration (ms)	: 37990

Measuring Echo on the 6608

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Input Gain of -4 and Output Attenuation of 4

```
vdt1-Cat6k-PBX1> (enable) sh port voice active 4/8
```

```
Port 4/8 :
```

```
Channel #23:
```

Remote IP address	: 172.18.104.74
Remote UDP Port	: 24526
ACOM Level Current	: 349
Call State	: voice
Codec Type	: G711 ULAW PCM
Coder Type Rate	: 20
ERL Level	: 79
Voice Activity Detection	: disabled
Echo Cancellation	: enabled
Fax Transmit Duration (ms)	: 0
Hi Water Playout Delay	: 65
Low Water Playout Delay	: 64
Receive Bytes	: 503840
Receive Delay	: 64
Receive Packets	: 3149
Transmit Bytes	: 504160
Transmit Packets	: 3151
Tx Duration (ms)	: 62440
Voice Tx Duration (ms)	: 62440

Echo Cancellation Coverage

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- The echo canceller coverage time can be changed on IOS platforms using the **echo-cancel coverage** voice-port command

```
Router(config-voiceport)#echo-cancel coverage ?  
 16  16 milliseconds echo canceller coverage  
 24  24 milliseconds echo canceller coverage  
 32  32 milliseconds echo canceller coverage  
 64  64 milliseconds echo canceller coverage  
 8   8 milliseconds echo canceller coverage
```

- Echo canceller coverage is hard-coded to 32 ms on the 6608 gateway

Impedance Adjustment

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- Echo can also be caused by an impedance mismatch if both sides are not configured identically
- Default of 600r Ohm is consistent with most lines on the PSTN and PBX's

```
vnt-1760-32(config-voiceport)#impedance ?
```

```
600c      600 Ohms complex
```

```
600r      600 Ohms real
```

```
900c      900 Ohms complex
```

```
complex1  complex 1
```

```
complex2  complex 2
```

```
vnt-1760-32a#sho voice port 2/0 | inc Impedance
```

```
Impedance is set to 600r Ohm
```

Rules of Thumb

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- Echo on one end is typically generated at other end
- Introduced by 2 to 4 wire conversion in hybrid and impedance mismatch or via acoustic feedback
- **Bits don't leak—Echo is not introduced on digital links**
- **Must have sufficient ERL for ECANs to engage**
- Longer coverage yields longer convergence time—more so on legacy echo cancellers. Configure the coverage so that it is long enough to cover the worst-case for your environment, but no higher
- Use **3 on 7960/40 to use the built-in 1004 Hz tone generator
- # or * DTMF tones approximate 1004Hz @ 0dB tones
(on Analog phones if test gear isn't available)

Summary

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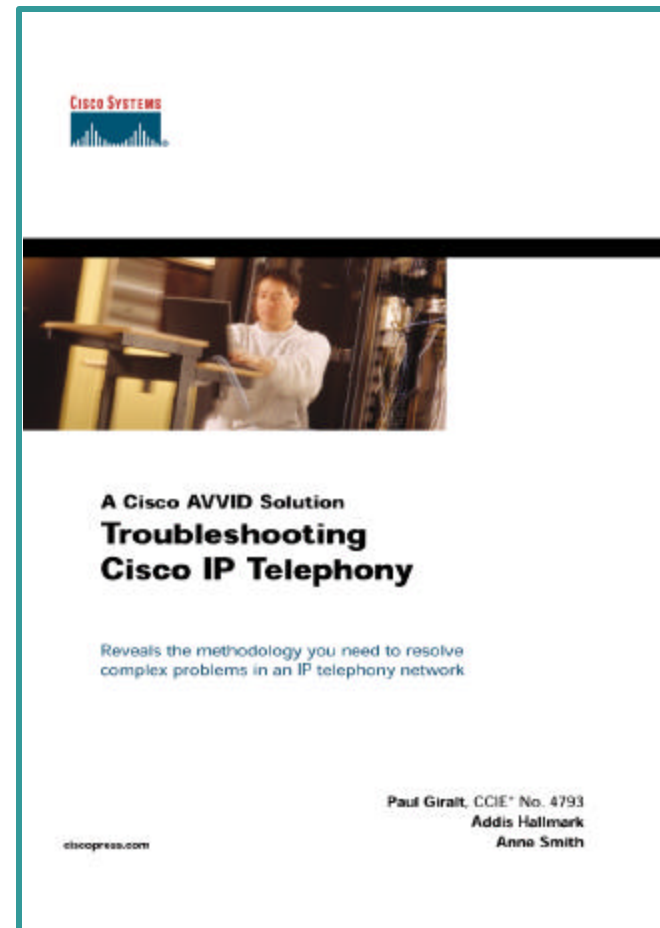
- Remember what is supposed to happen when there is no problem; simulate, re-create, stare and compare, etc...
- Traces are your friend!!!
- Assume that there is a perfectly logical explanation for the behavior you are investigating: 99% of the time, you'll be right
- For the remaining 1%, TAC will want to see the traces; be prepared to share the traces if need be
- Echo is the most common voice quality problem faced in the packet telephony networks. Proper analysis and methodical approach helps to resolve echo problems
- For further troubleshooting and information read the technical tips on Cisco TAC web site at <http://www.cisco.com/tac>

More Information

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- For more details on reading CCM traces, Troubleshooting Call Routing, and Echo, see here:

Troubleshooting Cisco IP Telephony
ISBN 1-58705-075-7



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