Troubleshooting IP Telephony Networks - Case Studies

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Session Objectives

- Analysis and troubleshoot some real world problems
- Understand how to trace the call flow of a call from the call manager traces and identify the important information
- Understand how to use various built-in and external troubleshooting tools to assist in data gathering and analysis
- Use collected data to find root cause of some real-world problems

What You Should Know

- Cisco CallManager configuration and operation
- Cisco IOS® voice gateway configuration and operation
- Use of Network Sniffer
- Basic understanding of:
  - Skinny Client Control Protocol (SCCP)
  - H.323

Agenda

- Introduction
- Company Network Overview
- Case Study 1: Dropped Call
- Case Study 2: Intermittent voice quality issue

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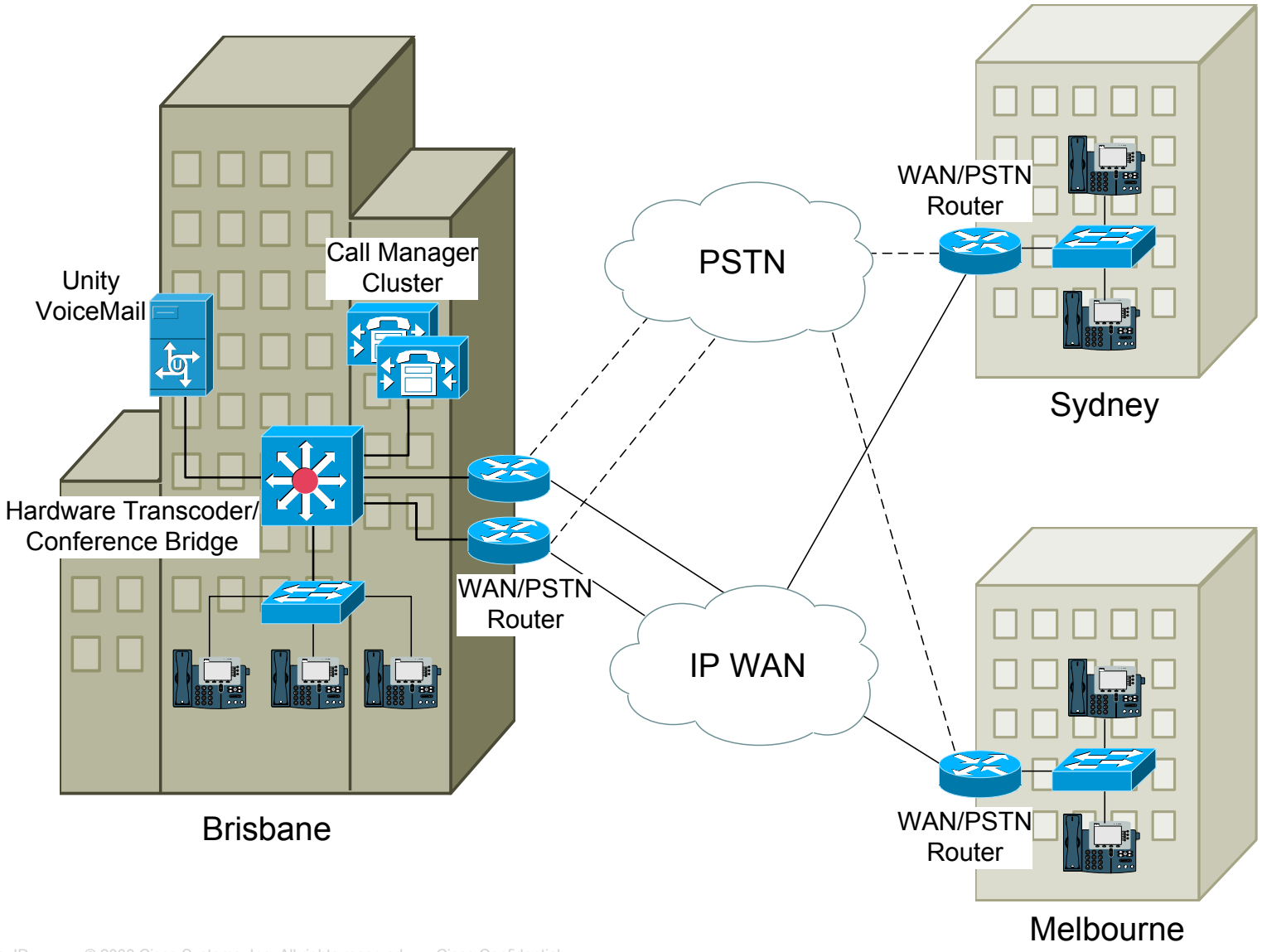
Company Network Overview



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Case Study 1: Dropped Call

"Hello Pete, need your help! A user has reported that while she was on the phone with a customer, the call dropped for no reason"

Questions to Ask

Questions to Ask About
"A User's Call Was Dropped"

- Who was the user?
  Simon Barker
- What is the directory number on their phone?
  2303
- What is the MAC address of their phone?
  SEP0002FD3BAF0B
- What time did the dropped call occur?
  Around 03:07 p.m. on August 10

Questions to Ask (Contd..)

- Who was the user speaking on the call that was dropped (internal vs. external)?
  - External; Phone number 0401252111
- Was the call inbound or outbound?
  - Inbound
- What was the duration of the call?
  - About two minutes before the call was dropped

Problem Description

Formulate a Problem Description

Simon Barker received a call around 03:07 p.m. on August 10, 2006 from 0401252111.

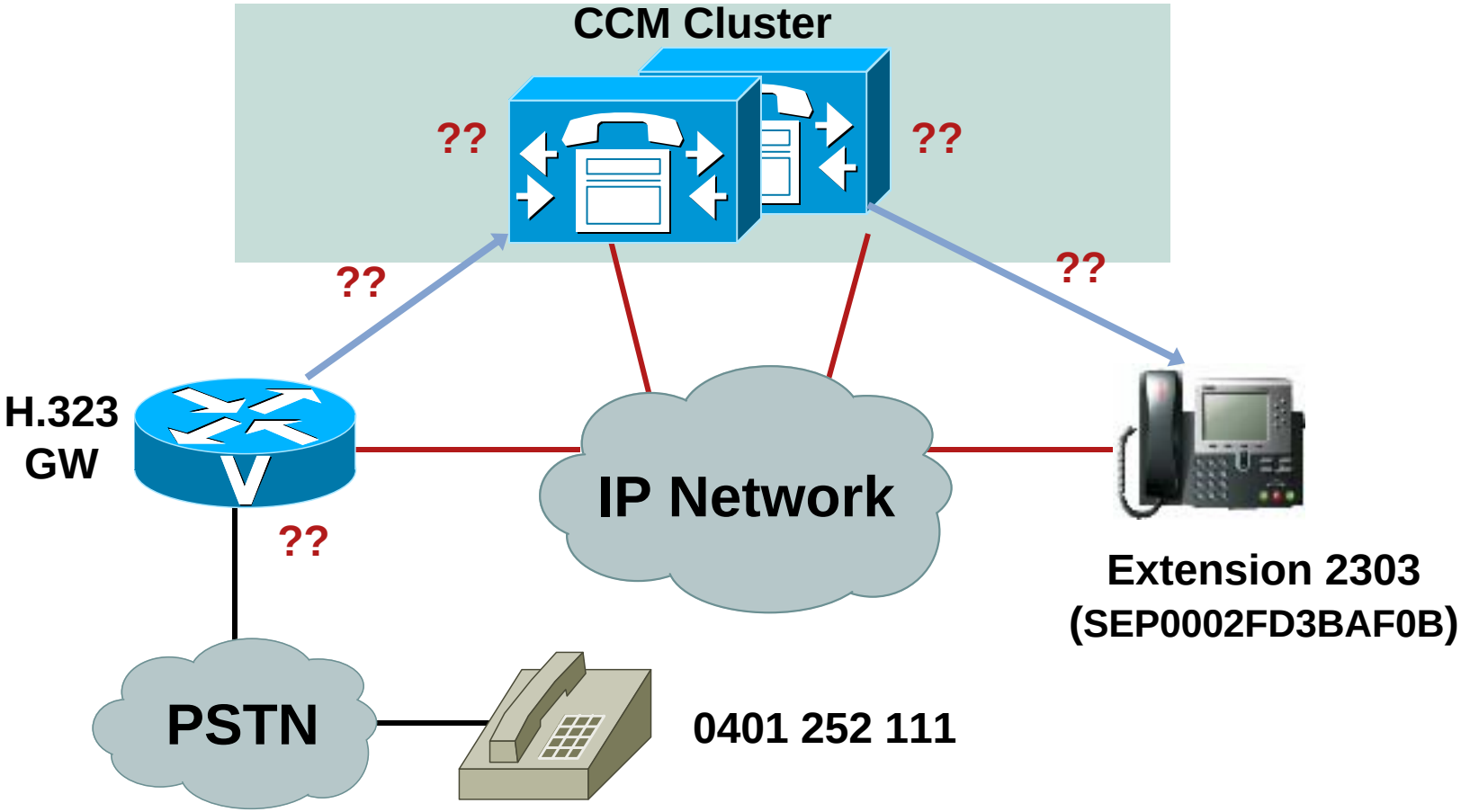
He received the call on extension 2303 on the phone identified as SEP0002FD3BAF0B.

About two minutes into the call, the call was dropped.

Action Plan

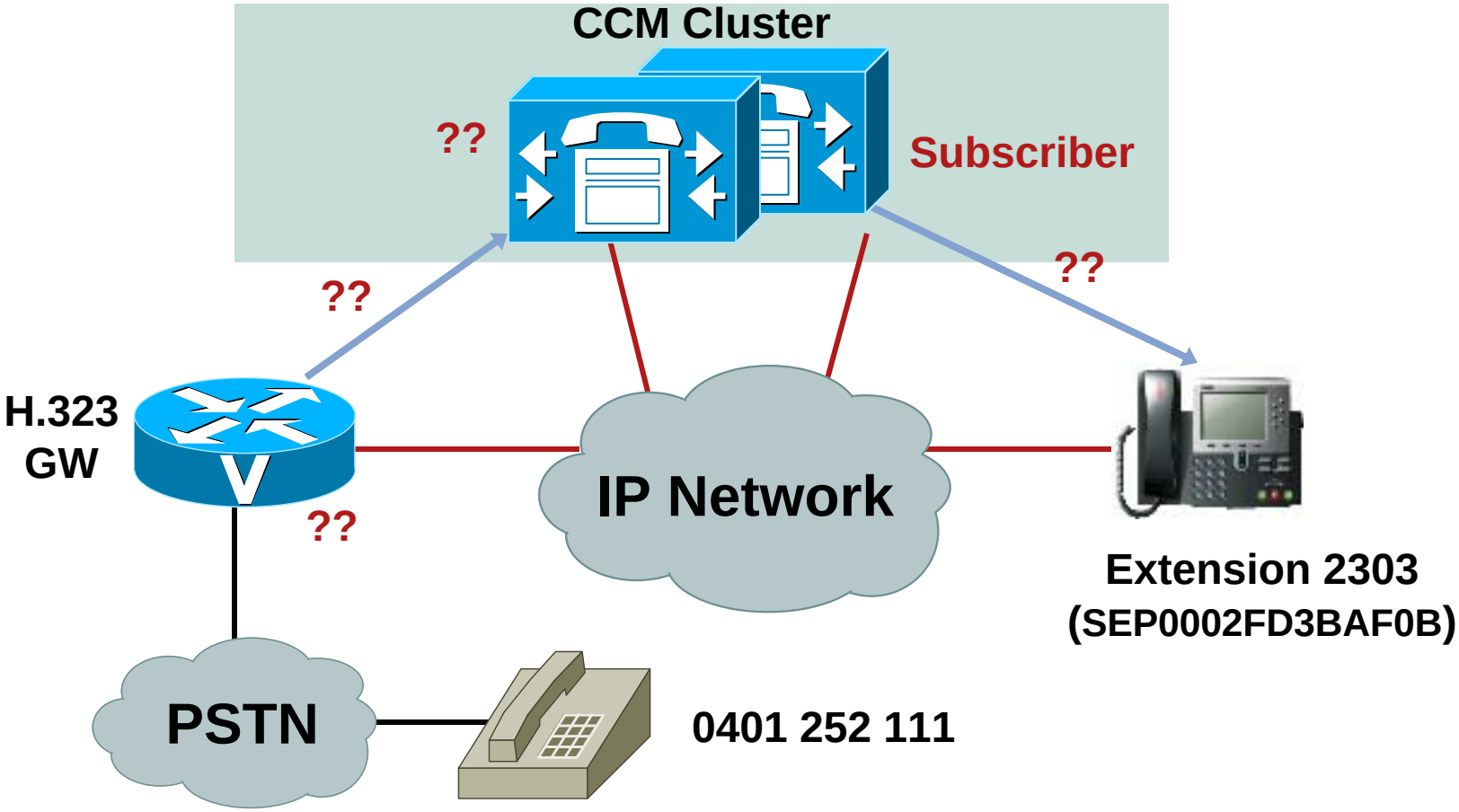
- **Identify and complete the call flow diagram**
- **Locate the disconnect reason**
- **Determine the device sending the disconnect.**
- **Investigate the root cause of the disconnect**

Call Flow Diagram



Phone Registration

Call Flow Diagram



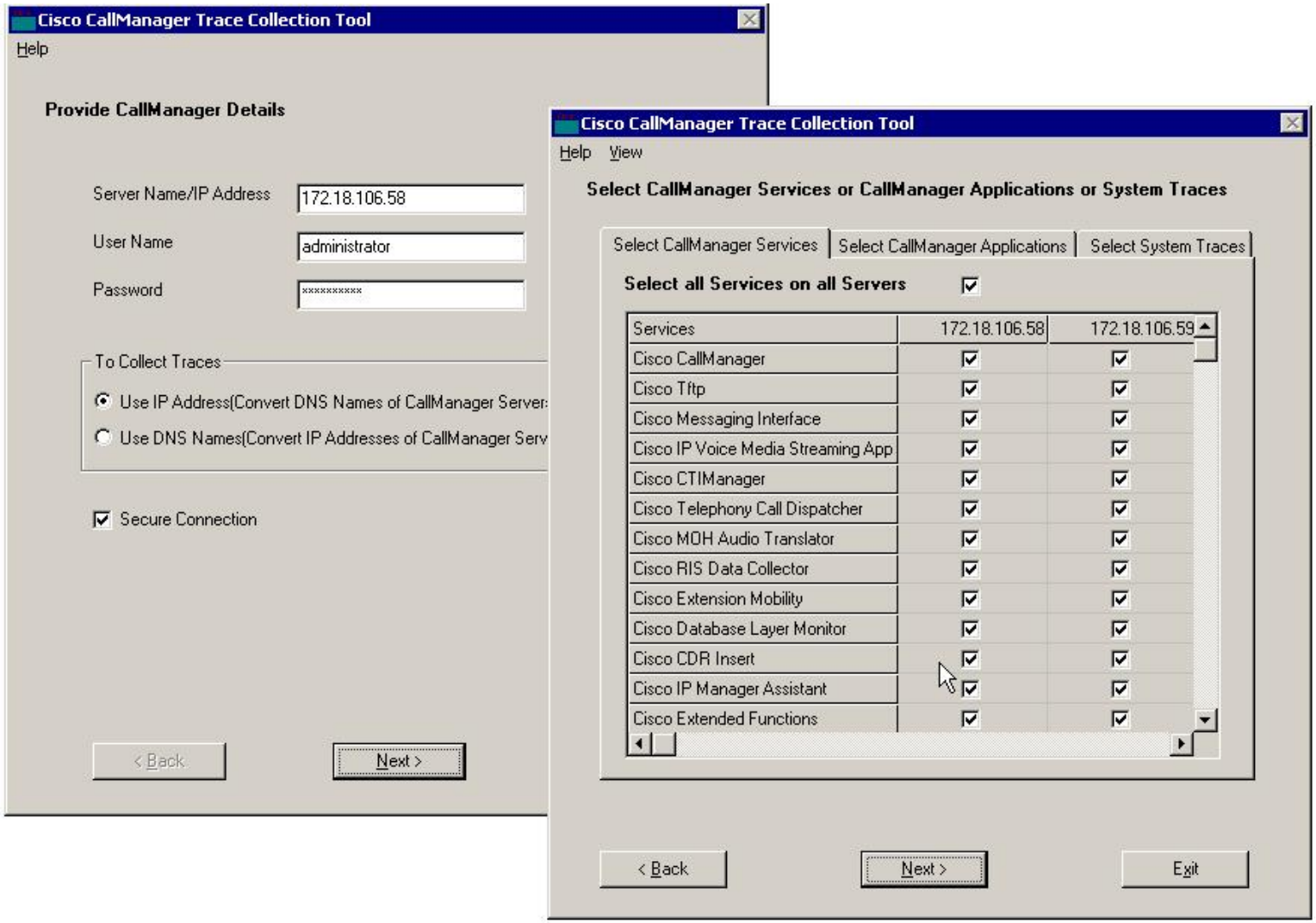
Trace Collection Tool

Various Ways to Collect Trace Files:

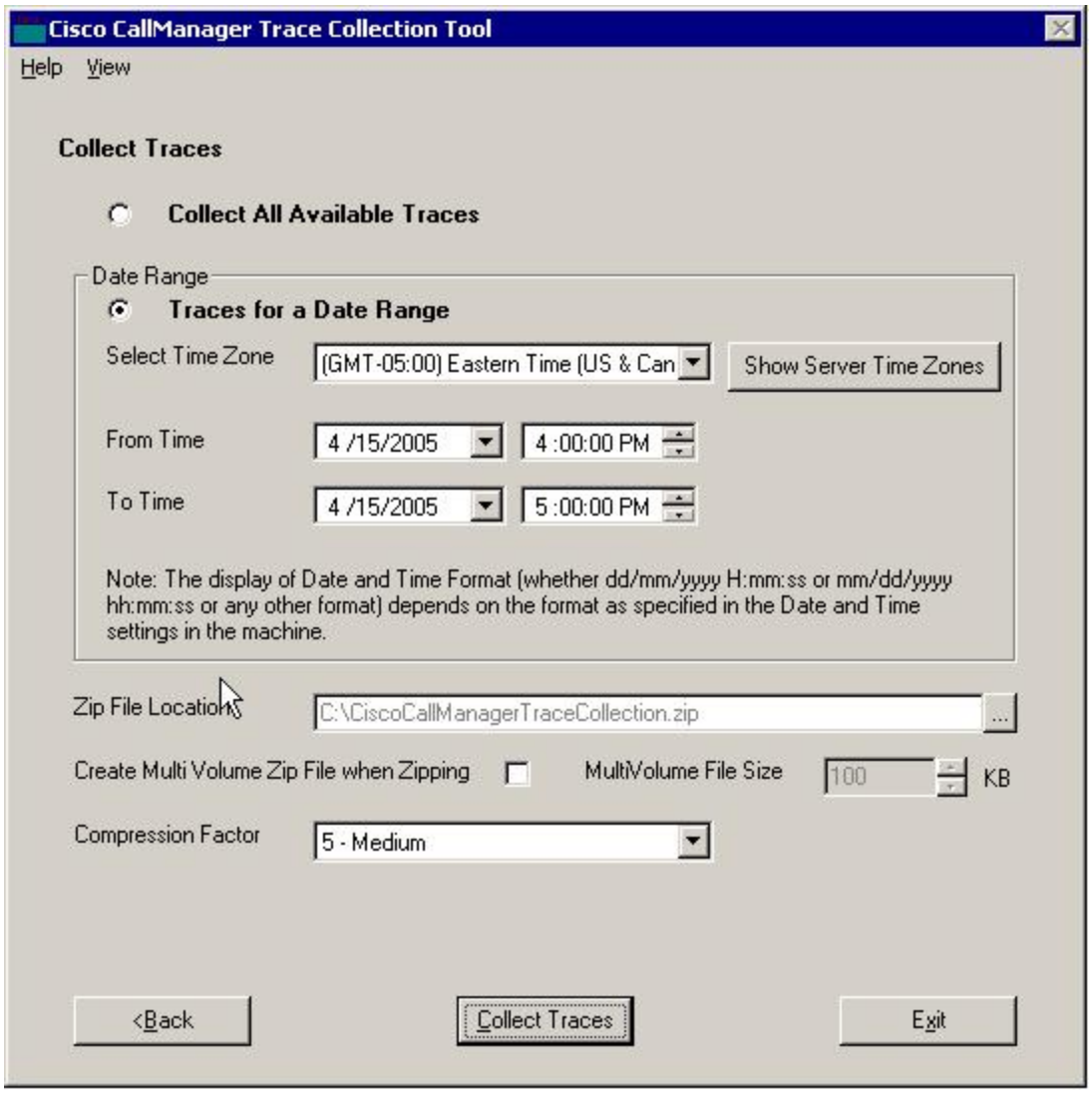
- Map a share to the server
- Use the Trace Collection Tool introduced in Cisco CallManager 4.0

  Download from **Cisco CallManager Administration > Applications > Plugins**

Trace Collection Tool



Trace Collection Tool



- **Time/Date Range**
- **Zip Compression**

Finding the Dropped Call

How Do We Find This Call in the Trace Files? Our Three Options Are:

- Search for everything that happened on device SEP0002FD3BAF0B at the time of the problem
- Search for calls to extension 2303
- Search for calls from 0401252111

Finding the Dropped Call

- We will be searching through the Cisco CallManager CCM (SDI) trace files

  Located in C:\Program Files\Cisco\Trace\CCM

- We will use SDL trace files to help us correlate some of the information in the CCM trace files

  Located in C:\Program Files\Cisco\Trace\SDL\CCM

Example - SCCP Trace Data

SCCP Trace Data in a CCM Trace

08/08/2006 09:37:31.240 CCM|StationInit: (0002129) OffHook.|
<CLID::StandAloneCluster><NID::10.66.88.11><CT::2,100,124,1.348485>
<IP::10.66.6.204><DEV::SEP0002FD3BAF0B>

Field Name	Description
Date and Time	Date and Time the event occurred
SCCP Message Direction	StationInit = SCCP Device → Cisco CallManager StationD = Cisco CallManager → SCCP Device
TCP Handle	Unique identifier for a device registered to a Cisco CallManager
SCCP Message Data	SCCP message and all data fields sent as part of that message
XML Trace Data	Extra data used by some tools that you should ignore

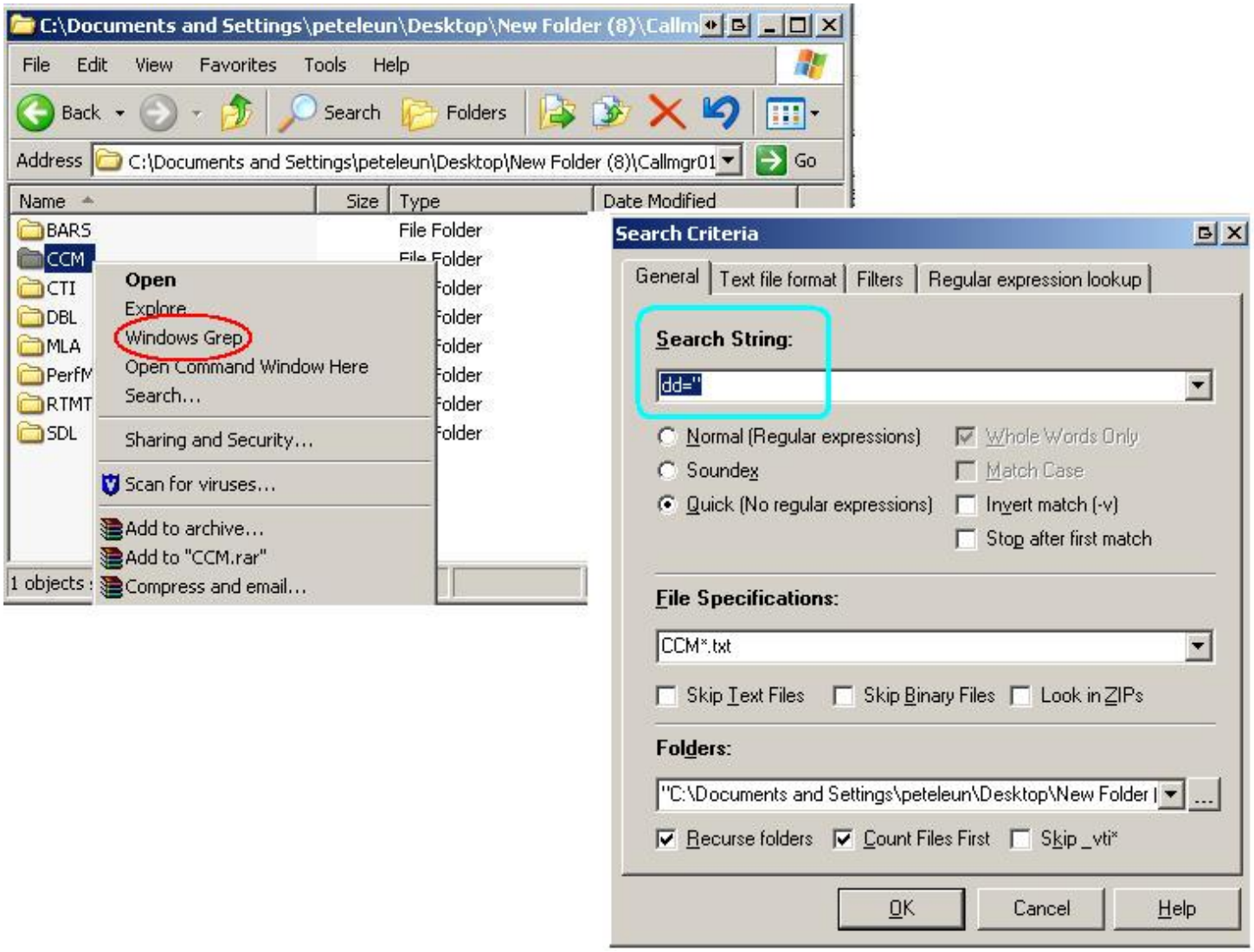
Device Name to TCP Handle

Correlating a Device Name to TCP Handle
TCP Handle tells us the event of phone

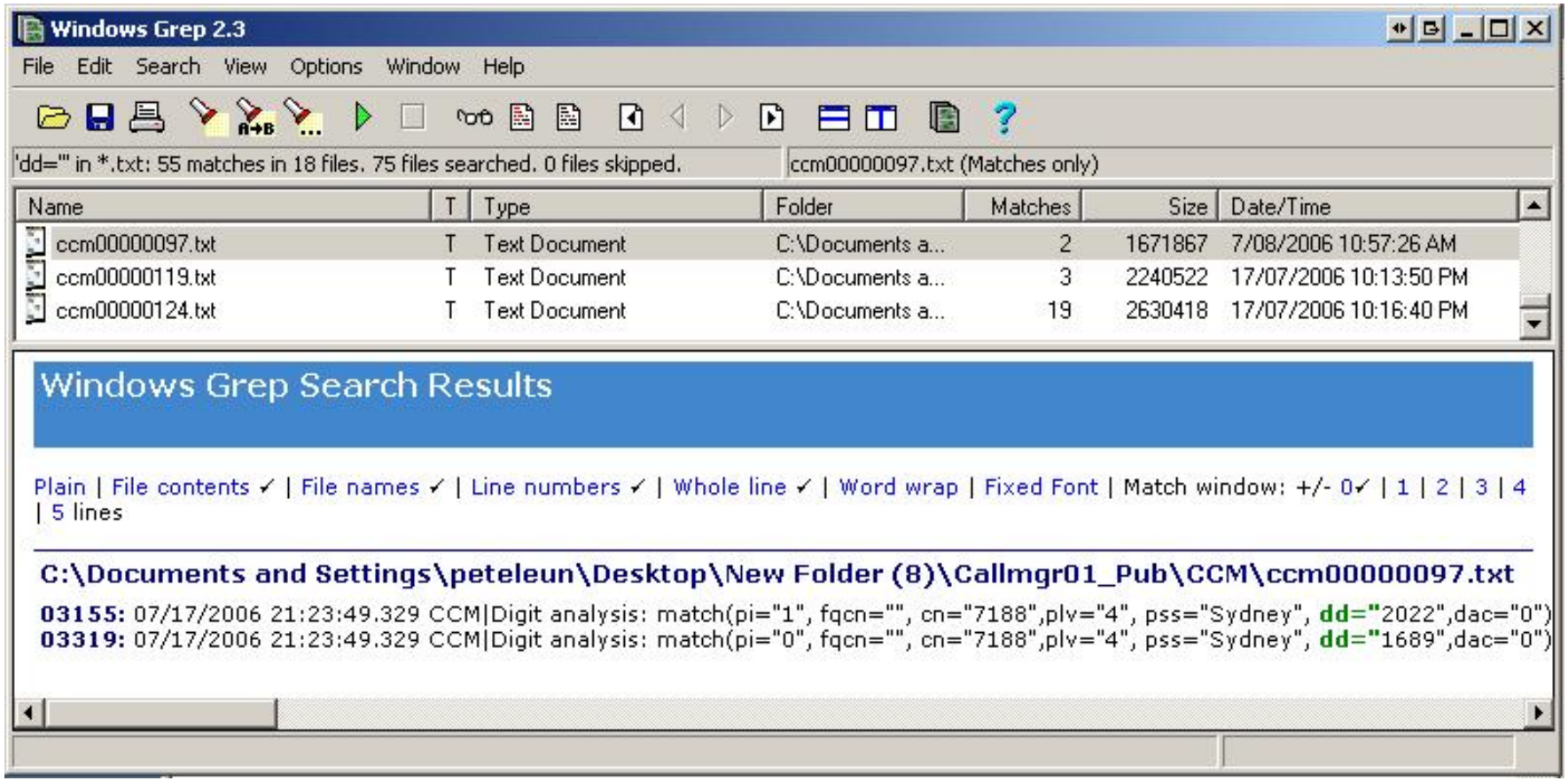
- Only way to do this reliably is by finding a KeepAlive from the phone in the trace

***Must select "Enable Keep Alive Trace" checkbox in CCM Trace Configuration for CCM 4.1(3) and later for Keepalives to appear in the CCM Traces**

Searching Tool - Wingrep

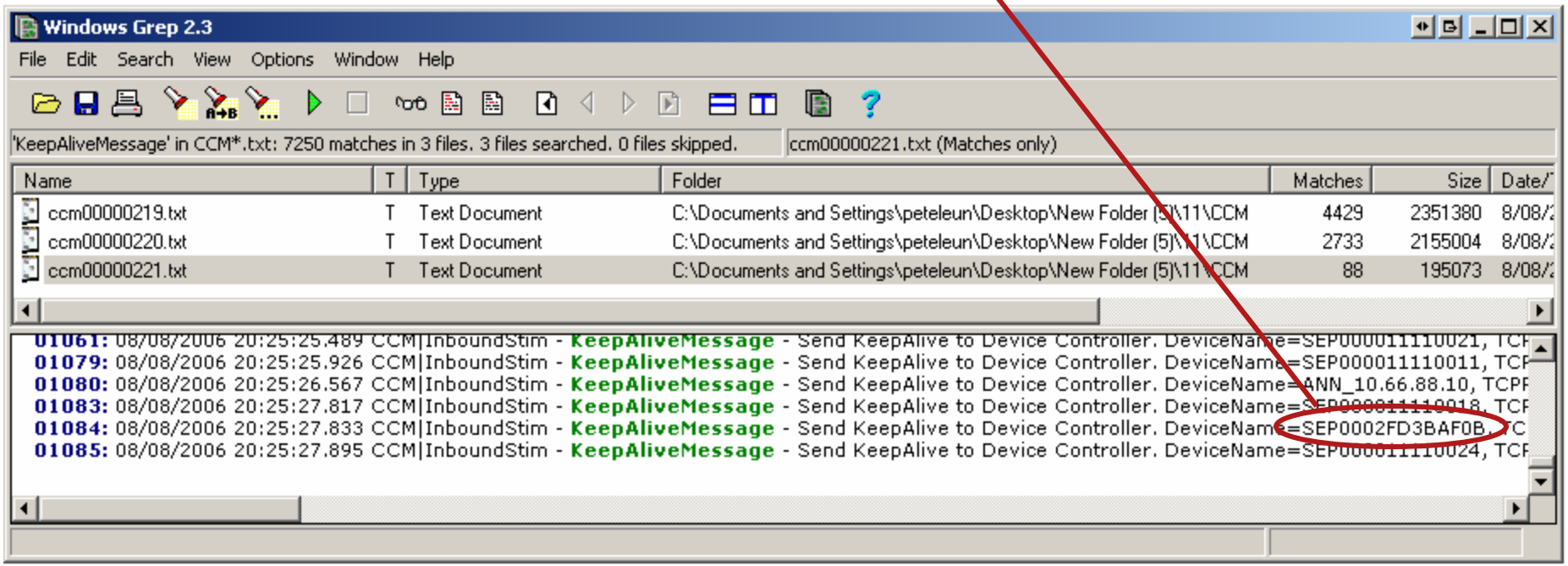


Wingrep Output



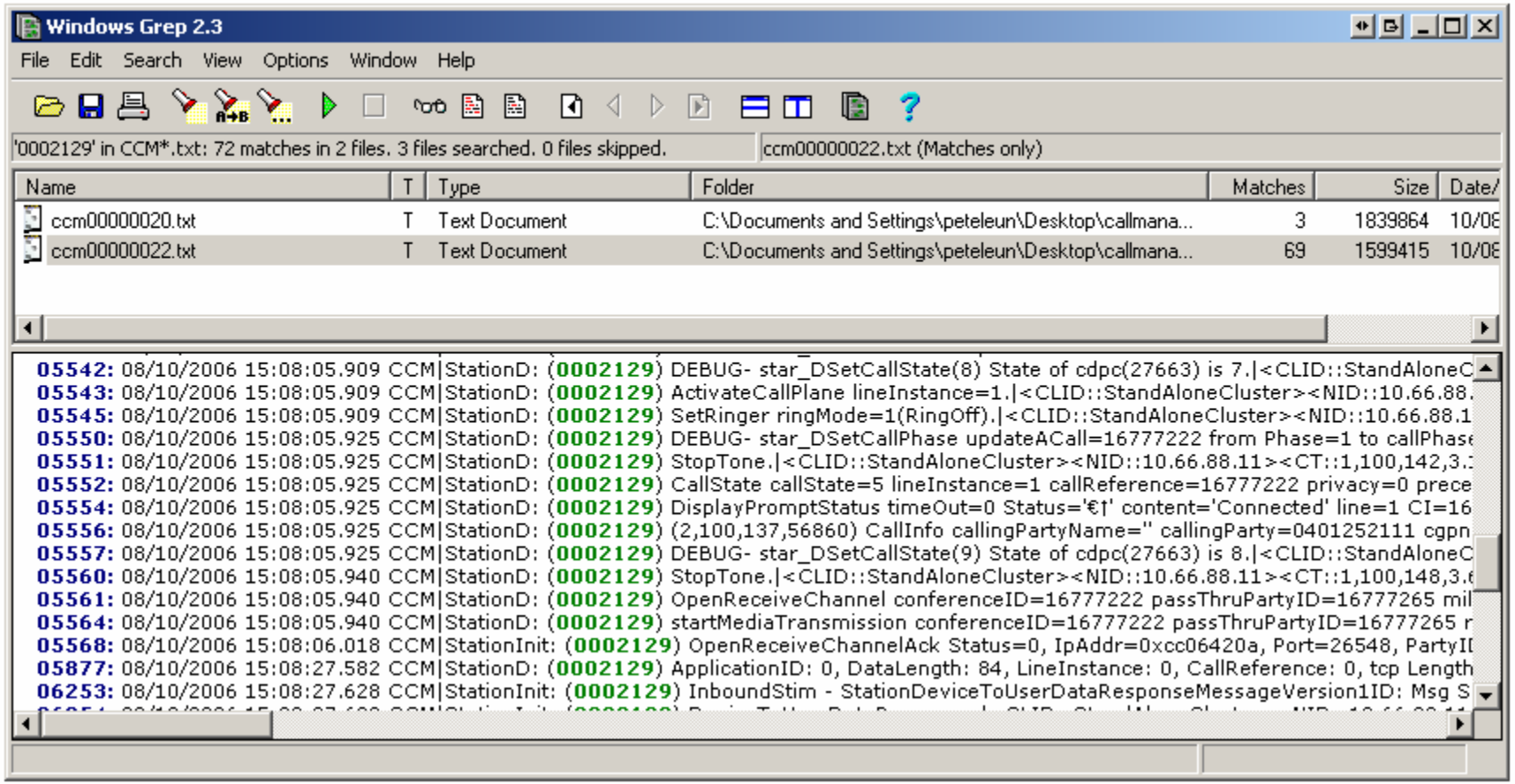
Determine the TCP Handle for Simon's Phone

- 08/08/2006 20:25:27.833 CCM|InboundStim - KeepAliveMessage - Send KeepAlive to Device Controller. DeviceName=SEP0002FD3BAF0B, TCPPid = [2.100.137.56860], IPAddr=10.66.6.204, Port=0, Device Controller=[2,123,2129]



TCP Handle Information Gathering

- Use TCP Handle to determine activities of Simon's Phone around the time of the problem



CallInfo information from CCM trace

Inbound Call
Extension 2303
Calling Party = 0401252111
At 15:08 p.m. on August 10, 2006

08/10/2006 15:08:05.925 CCM|StationD: (0002129) (2,100,137,56860) CallInfo

callingParty=0401252111

calledParty=2303

originalCalledParty=2303

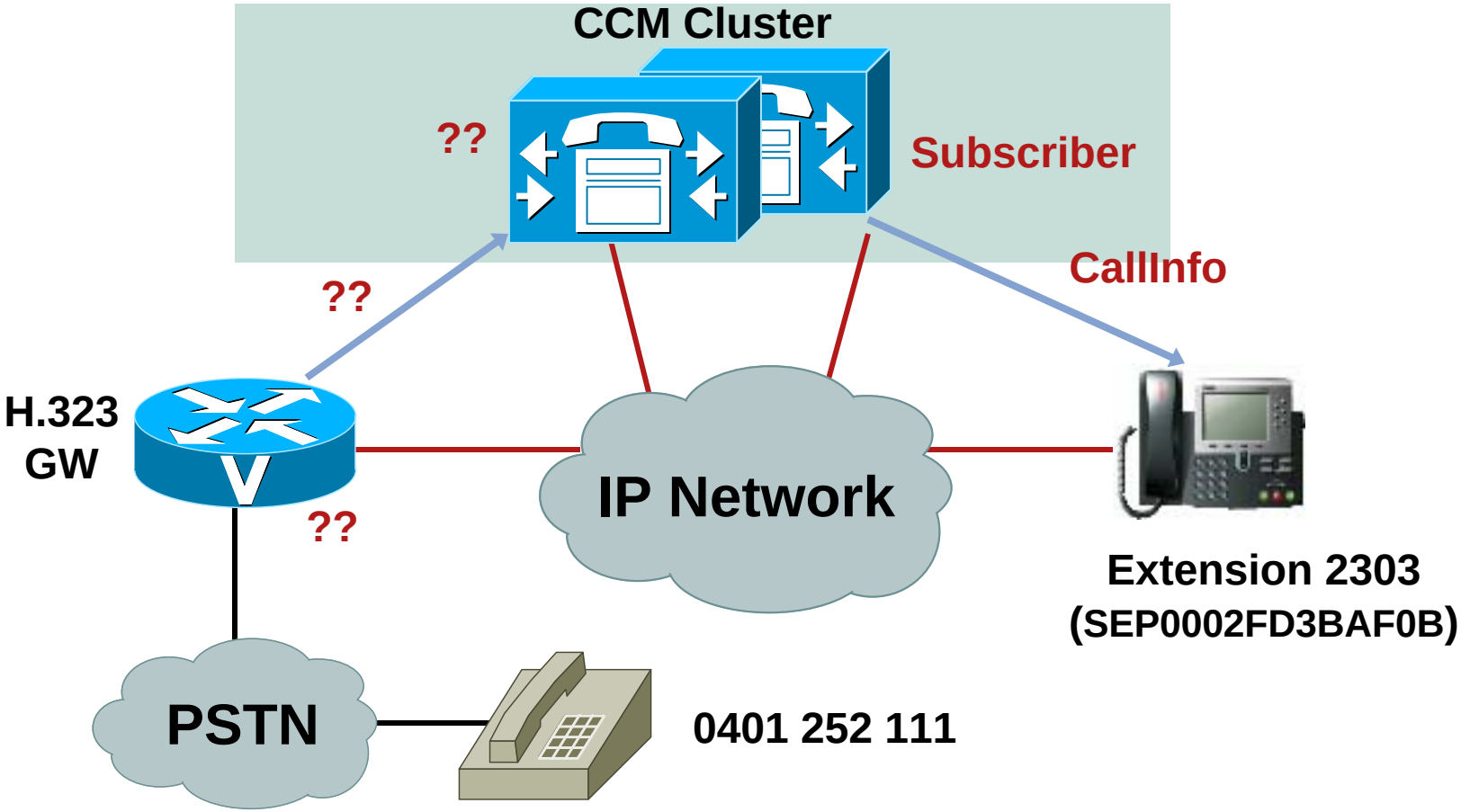
lastRedirectingParty=2303

callType=1(InBound)

lineInstance=1

callReference=16777222

Call Flow Diagram



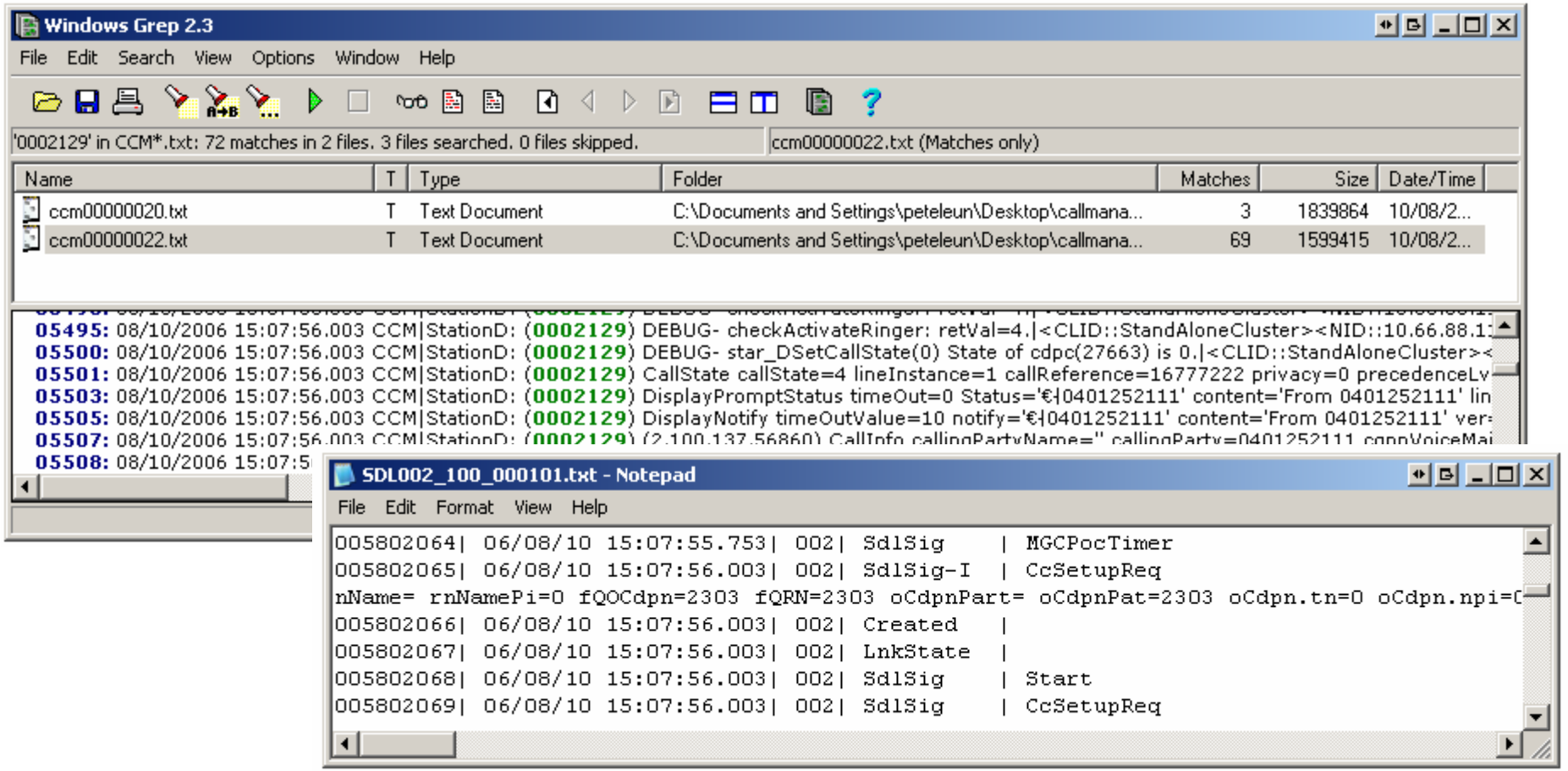
Finding Originating Device

Where Did This Call Come from?

- Look immediately above the first messages sent to the phone in relation to this call to see if there is an inbound gateway call
- If you do not see the Digit Analysis results for this call in the trace file, the call must have originated from some other node in the cluster
- Use the SDL trace to help you find which server in the cluster (node) the call originated on

Finding Originating Node

Searching SDL Trace to Find Originating Node



SDL Trace File Definitions

SDL Trace Line Example:

005802065| 06/08/10 15:07:56.003| 002| SdlSig-I | CcSetupReq
| idle | LineControl(2,100,50,2129) | Cdcc(1,100,23,3)

Field Name	Description
Line Number	Line number continuously incremented across files
Date and Time	Date and time the event occurred
Node ID	The node ID for the server where this trace is written
SDL Operation	Indicates if the signal is local to the server (SdlSig), inbound from another node in the cluster (SdlSig-I), or out to another node in the cluster(SdlSig-O)
SDL Signal Name	The signal that is being sent from source process to destination process
Destination Process State	Current state machine state of the destination process
Destination Process	The name and process ID of the destination process
Source Process	The name and process ID of the source process

SDL Trace File Definitions

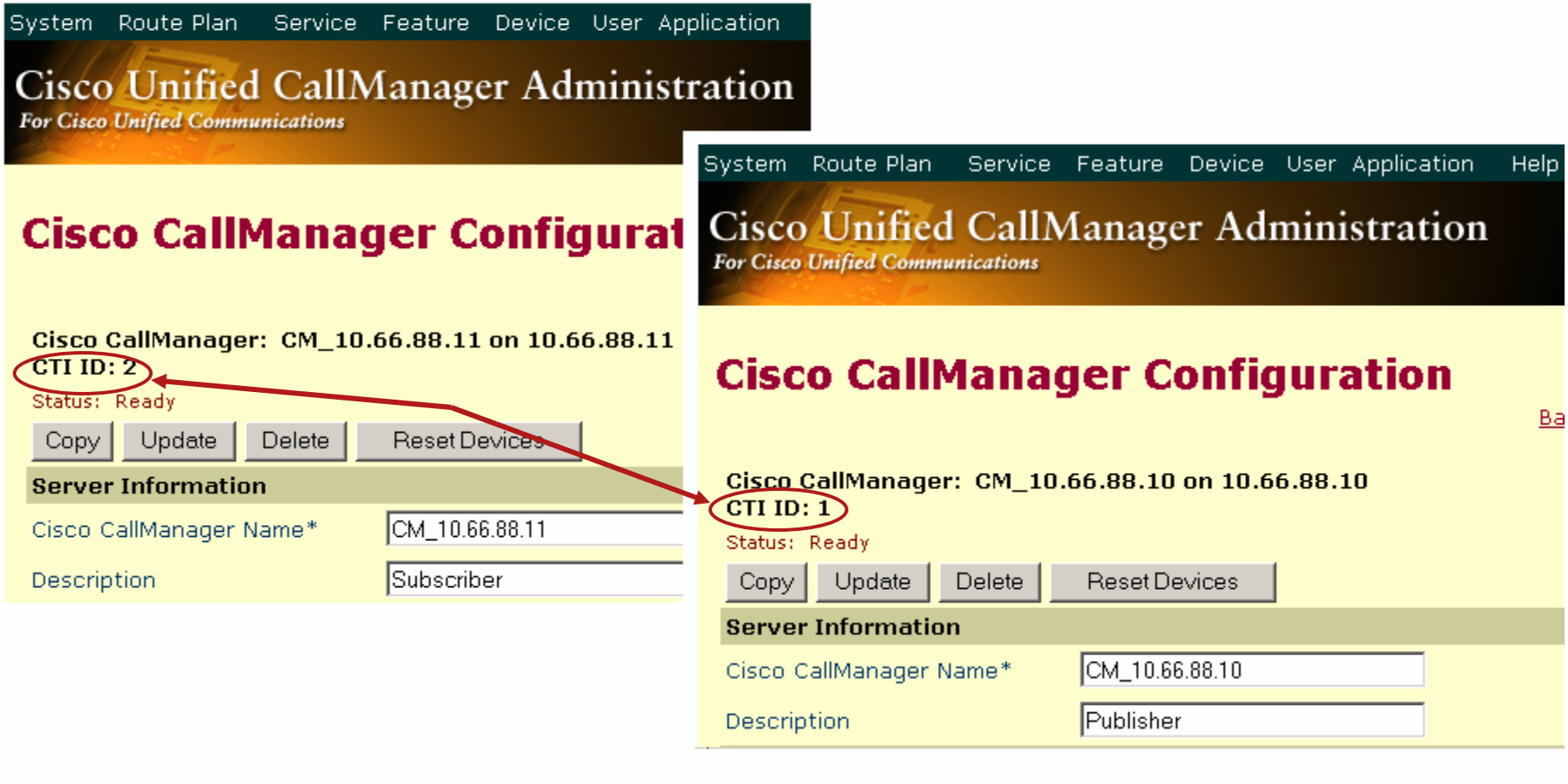
What Does Cdcc(1,100,23,3) Mean?

Cdcc(Node ID, Application ID, PID, PInstance)

Field Name	Description
Node ID	Node in the cluster where this process exists
Application ID	100 = Cisco CallManager, 200 = CTIManager
Process ID	In this case 23 means Cdcc; process IDs are assigned at runtime and will not be the same from one Cisco CallManager restart to another
Process Instance	The instance ID of this process; in this case this is the 3rd Cdcc process that has been created

Finding SDL Node ID

Node ID Is Found Under
System > Cisco CallManager



Finding Originating Node

Going Back to the SDL Trace Line

005802065| 06/08/10 15:07:56.003| 002| SdlSig-I | CcSetupReq
| idle | LineControl(2,100,50,2129) | Cdcc(1,100,23,18)

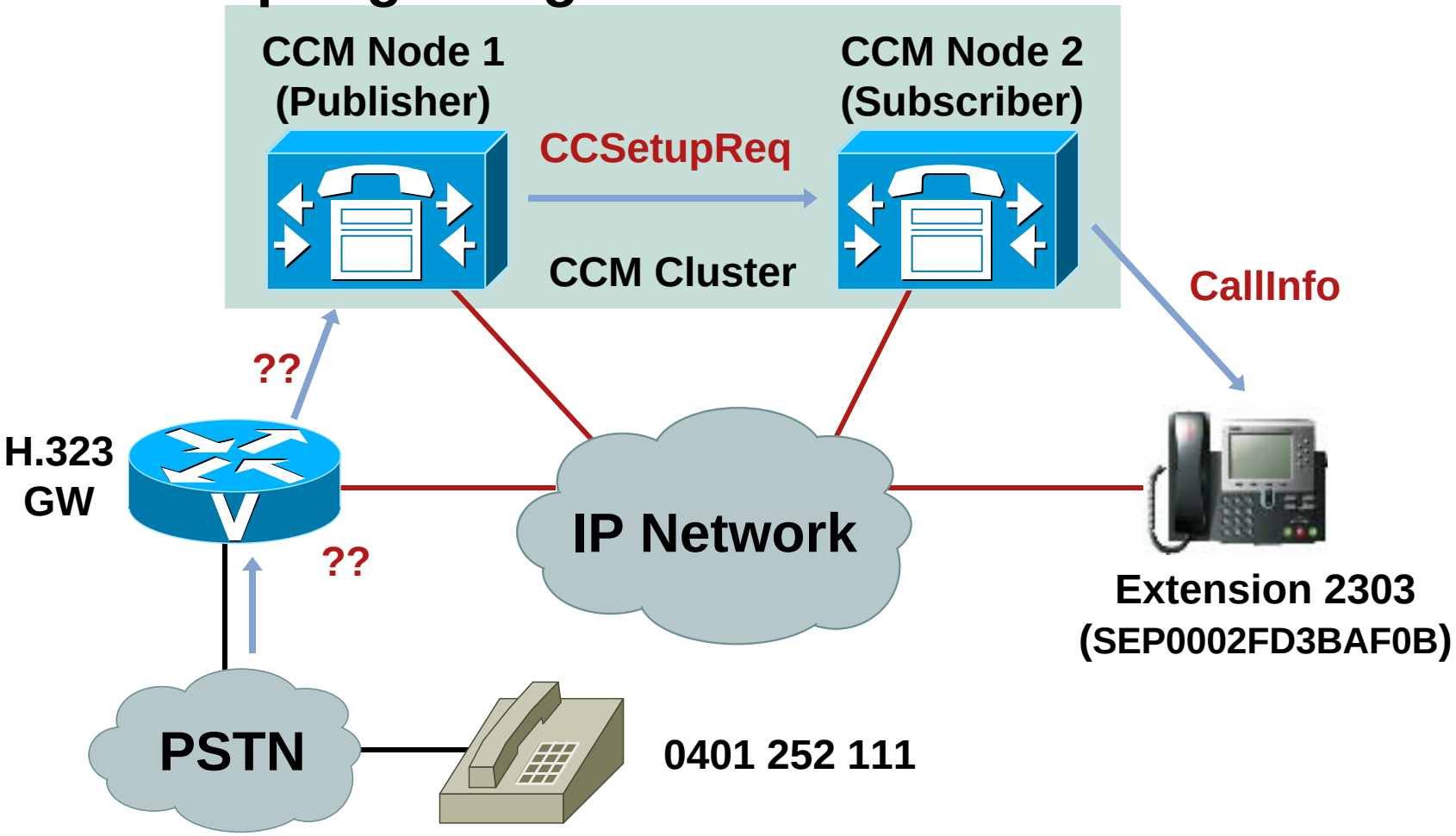
- This means the call originated on Node 1
- Look in the SDL trace on Node 1
  to find the matching trace line

000004494| 06/08/10 15:07:56.002| 001| SdlSig-O | CcSetupReq
| NotApplicable_RemoteSignal | LineControl(2,100,50,2129) | Cdcc(1,100,23,3)

- So now look in CCM trace at 06/08/10 15:07:56.003 on Node 1 (Publisher)

Call Setup

Call Setup Signaling



Found Digit Analysis Results

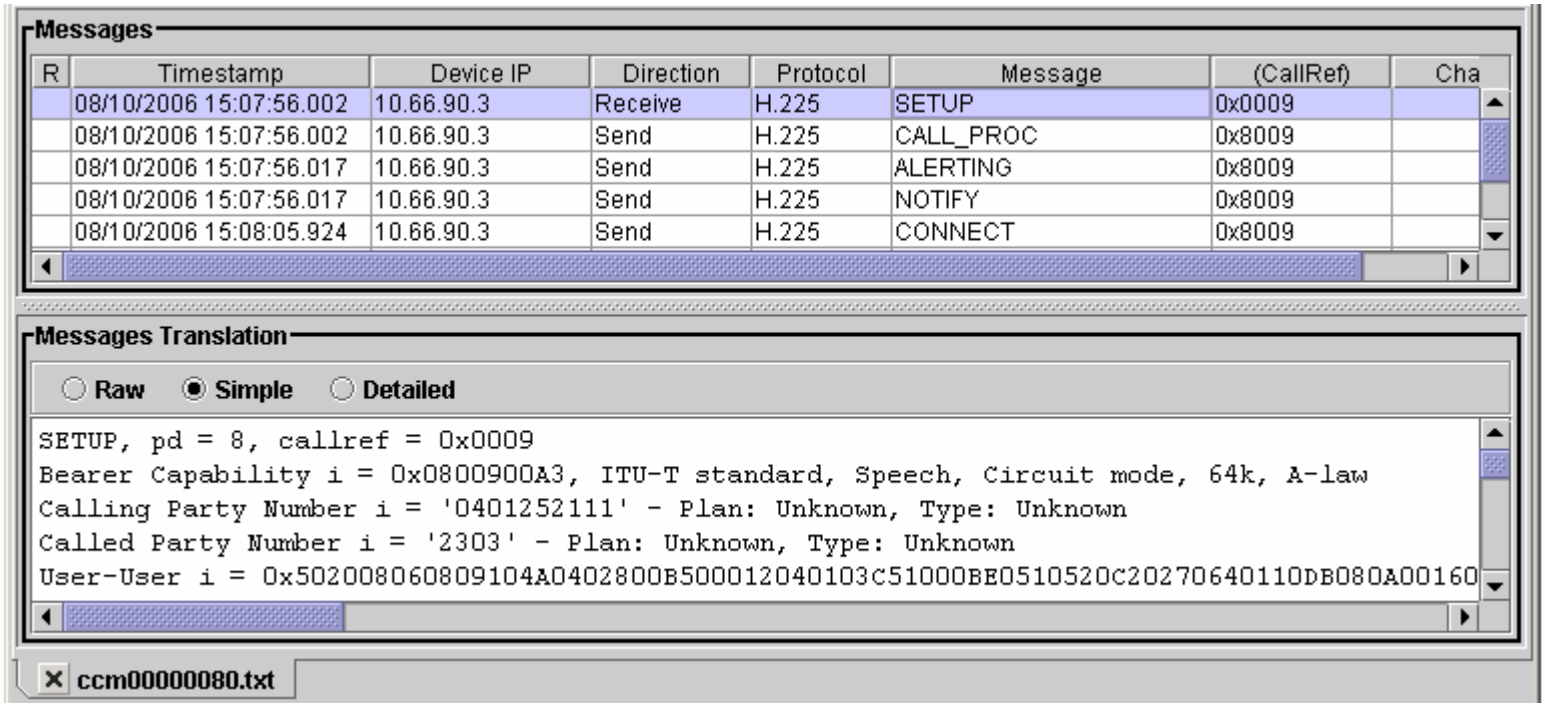
CCM Trace at 08/10/2006 15:07:56.002

08/10/2006 15:07:56.002 CCM|Digit analysis: analysis results
|PretransformCallingPartyNumber=0401252111
|CallingPartyNumber=0401252111
|DialingPartition=
|DialingPattern=2303
|FullyQualifiedCalledPartyNumber=2303
..
..
..
|VoiceMailPilotNumber=
|AlertingName=
|RouteBlockFlag=RouteThisPattern

Found Originating SETUP

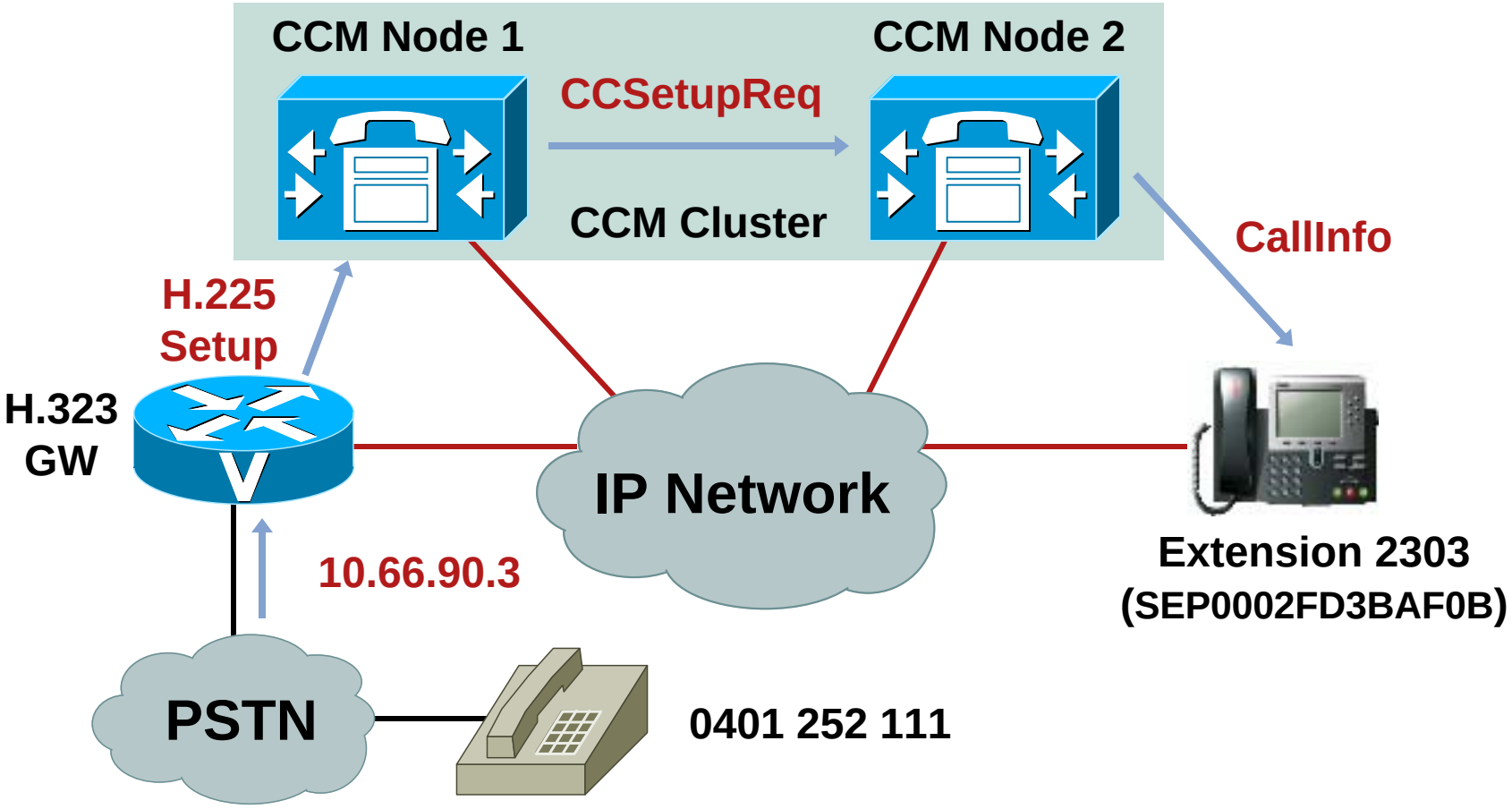
Look Just Before the Digit Analysis Match and You See:

08/10/2006 15:07:56.002 CCM|In Message -- H225SetupMsg -- Protocol= H225Protocol
08/10/2006 15:07:56.002 CCM|Ie - H225BearerCapabilityIe -- IEData= 04 03 80 90 A3
08/10/2006 15:07:56.002 CCM|Ie - H225CallingPartyIe -- IEData= 6C 0B 80 30 34 30 31 32 35 32 31 31 31
08/10/2006 15:07:56.002 CCM|Ie - Q931CalledPartyIe -- IEData= 70 05 80 32 33 30 33



Call Setup

Call Setup Signaling



Call Disconnected at Gateway

Filter the Call by Call Reference to See All Messages About This Call

R	Timestamp	Device IP	Direction	Protocol	Message	(CallRef)	Chann
	08/10/2006 15:07:56.002	10.66.90.3	Receive	H.225	SETUP	0x0009	
	08/10/2006 15:07:56.002	10.66.90.3	Send	H.225	CALL_PROC	0x8009	
	08/10/2006 15:07:56.017	10.66.90.3	Send	H.225	ALERTING	0x8009	
	08/10/2006 15:07:56.017	10.66.90.3	Send	H.225	NOTIFY	0x8009	
	08/10/2006 15:08:05.924	10.66.90.3	Send	H.225	CONNECT	0x8009	
	08/10/2006 15:08:05.924	10.66.90.3	Send	H.225	NOTIFY	0x8009	
	08/10/2006 15:09:21.144	10.66.90.3	Send	H.225	RELEASE_COMP	0x8009	
	08/10/2006 15:09:27.426	10.66.90.3	Receive	H.225	RELEASE_COMP	0x0009	

- Call was originated at 15:07:56.002 and connected at 15:08:05.924
- Call was disconnected at 15:09:21.144
- Click on RELEASE_COMP message for details

```
RELEASE_COMP, pd = 8, callref = 0x8009
Cause i = 0x0800A9 - Temporary failure
User-User i = 0x50250806080910 4A02101100BE0510520C20270640110DB08001C0AF0650790220B902FA0
```

- Now we know Cisco CallManager sent a Disconnect with a cause code of Temporary Failure at 15:09:21.144—but why?

Call Dropped on IP Phone

Go Back to the IP Phone to See What Happened from the User's Perspective

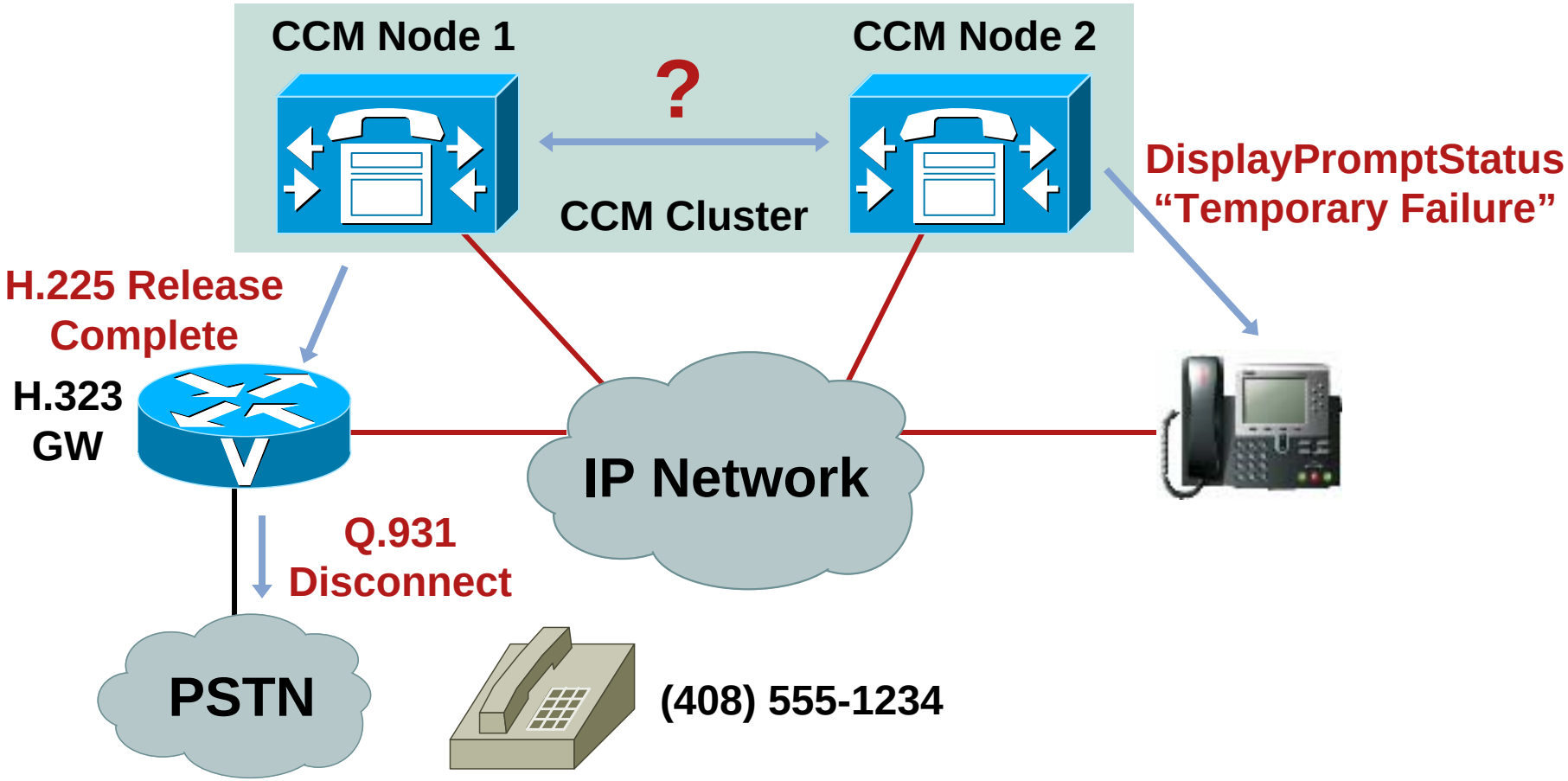
R	Timestamp	Device IP	Direction	Protocol	Message	(CallRef)	Ch
	08/10/2006 15:08:05.940	10.66.88.11		SCCP	startMediaTransmission	16777222	
	08/10/2006 15:08:06.018	10.66.88.11	Receive	SCCP	OpenReceiveChannelAck	16777222	
	08/10/2006 15:08:27.582	10.66.88.11		SCCP	ApplicationID:	16777222	
	08/10/2006 15:08:27.628	10.66.88.11		SCCP	InboundStim	16777222	
	08/10/2006 15:08:27.628	10.66.88.11	Receive	SCCP	DeviceToUserDataRespon...	16777222	
	08/10/2006 15:08:37.629	10.66.88.11		SCCP	DEBUG-	16777222	
	08/10/2006 15:08:37.629	10.66.88.11	Send	SCCP	DisplayPromptStatus	16777222	

- Media streams for the call established at 15:08:05.940
- Cisco CallManager sends a DisplayPromptStatus message at 15:08:37.629; click on DisplayPromptStatus to see what the message sent to the phone was

08/10/2006 15:08:37.629 CCM|StationD: (0002129) DisplayPromptStatus timeOut=0 Status='€#' content='Temporary failure' line=1 CI=16777222

Call Disconnected

Call Being Disconnected



SDL Link OOS

What Happened Between Node 1 and Node 2?

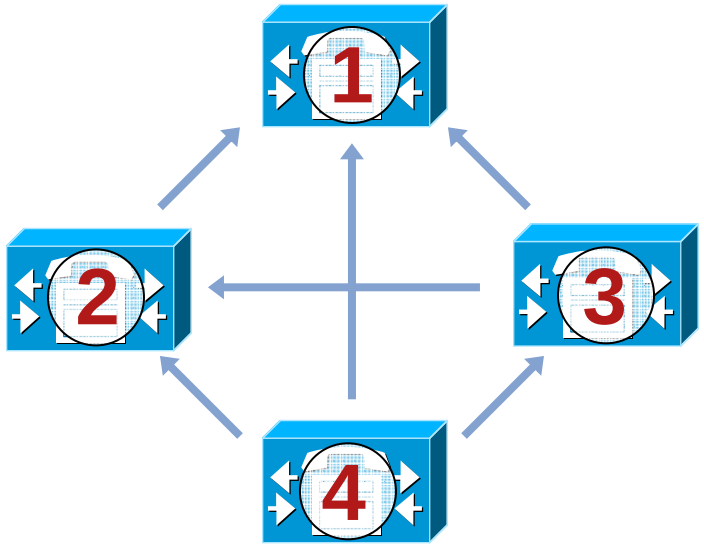
- Look at the CCM trace on Node 2 right before Cisco CallManager tells the phone about the failure at 15:08:37.629

08/10/2006 15:08:37.629 CCM|SdllinkOOS nodeId = 1, appId = 100
08/10/2006 15:08:37.629 CCM|SDLLinkOOS - SDL link to remote application out of service.
Local node ID:2 Local Application ID.:100
Remote IP address of remote application:10.66.88.10
RemoteNodeID:1 Remote application ID.:100

SDL Links

What Is an SDL Link?

- Fully meshed TCP connections between all nodes in a Cisco CallManager cluster
- Each server establishes a TCP connection to other nodes with a lower node ID than itself on port 8002



SDL Link OOS

Why Would an SDL Link Go Out of Service?

- IP Connectivity Issues
  - Duplex Mismatch between CCM NIC and switch
  - Router or Switch failure between CCM nodes
  - Cabling Issues
  - Network Congestion
- Cisco CallManager Restart
- Cisco CallManager unable to keep up with signals being sent across SDL Link
  - Overloaded Cisco CallManager node
  - High CPU due to other process on the system
  - High Disk I/O
  - Low Memory (causing memory to swap to/from disk)

CMProcMon

Check for Resource Constraints on Node 1

- CMProcMon runs every two seconds which acts like an internal KeepAlive mechanism to ensure the SDL Signal Router is still processing signals
- Before the SDL Link OOS, you can see things are working properly:

```
15:06:43.672 CCM|CMProcMon - ------Entered Router Verification
15:06:45.672 CCM|CMProcMon - ------Entered Router Verification
15:06:47.672 CCM|CMProcMon - ------Entered Router Verification
15:06:49.672 CCM|CMProcMon - ------Entered Router Verification
15:06:51.672 CCM|CMProcMon - ------Entered Router Verification
```

Dropped Call

- After 15:08:15, big gap appear:

```
15:08:09.783 CCM|CMProcMon - ------Entered Router Verification
15:08:11.783 CCM|CMProcMon - ------Entered Router Verification
15:08:13.783 CCM|CMProcMon - ------Entered Router Verification
15:08:15.799 CCM|CMProcMon - ------Entered Router Verification
15:09:06.175 CCM|CMProcMon - ------Entered Router Verification
15:09:13.082 CCM|CMProcMon - ------Entered Router Verification
```

Look for problems between 15:08:15 and 15:09:06

So most likely reason for SDL link OOS is a resource constraint on the Node 1 - lack of CPU, memory, or disk I/O

Dropped Call: Summary

We Know the Call Was Dropped Because an SDL Link Went Out of Service due to a Resource Issue on Cisco CallManager; What Can We Do About It?

- Monitor resources on Cisco CallManager using Performance Monitor
- Check for any applications or services installed that are not certified for use on Cisco CallManager
- Check for any administrative activity on the server at the time of the problem

Finding Resource Problem

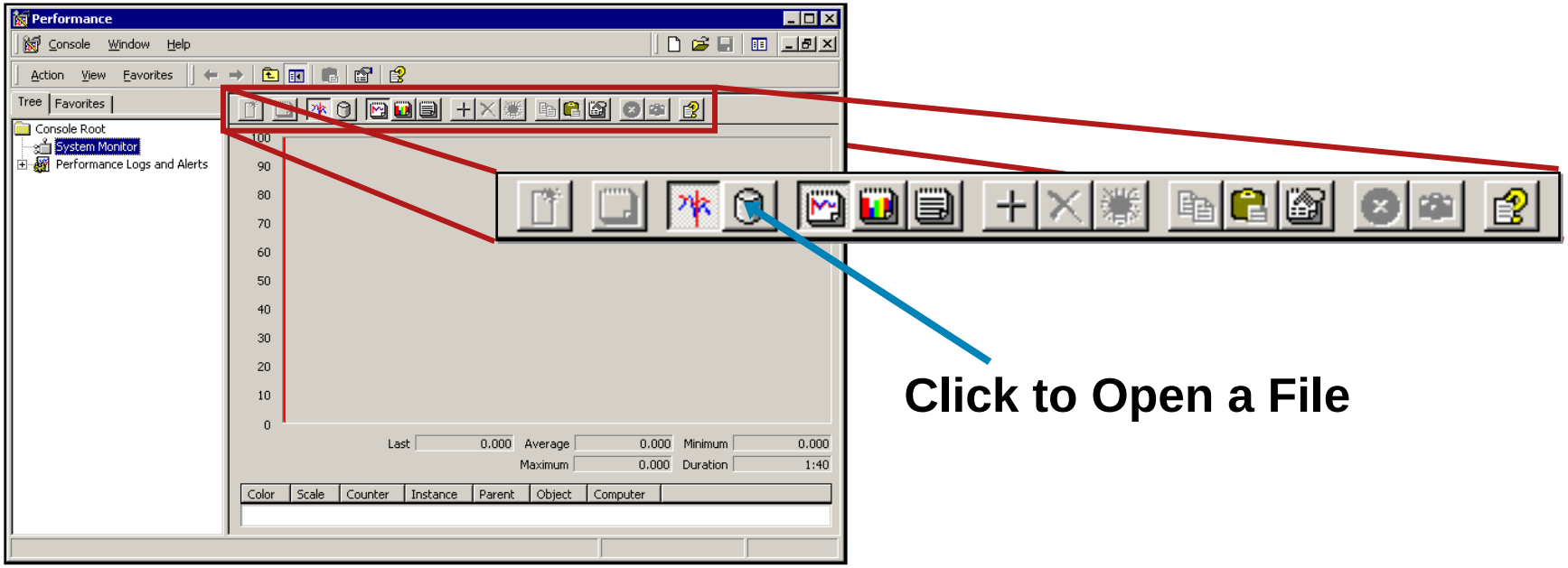
- Cisco CallManager 4.x and later automatically keep logs of CPU and memory statistics
- To view reports, go to **Cisco CallManager Serviceability > Tools > Serviceability Reports Archive**

Performance Statistics

- All data used to generate reports is stored in

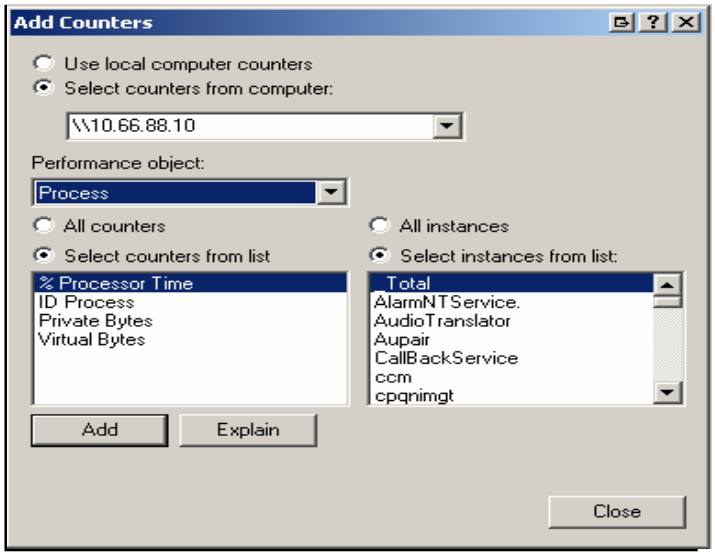
  C:\Program Files\Common Files\Cisco\Logs\RTMTLoggeron the Publisher

- Data is stored in CSV format
- Can be read by Excel or Microsoft Performance

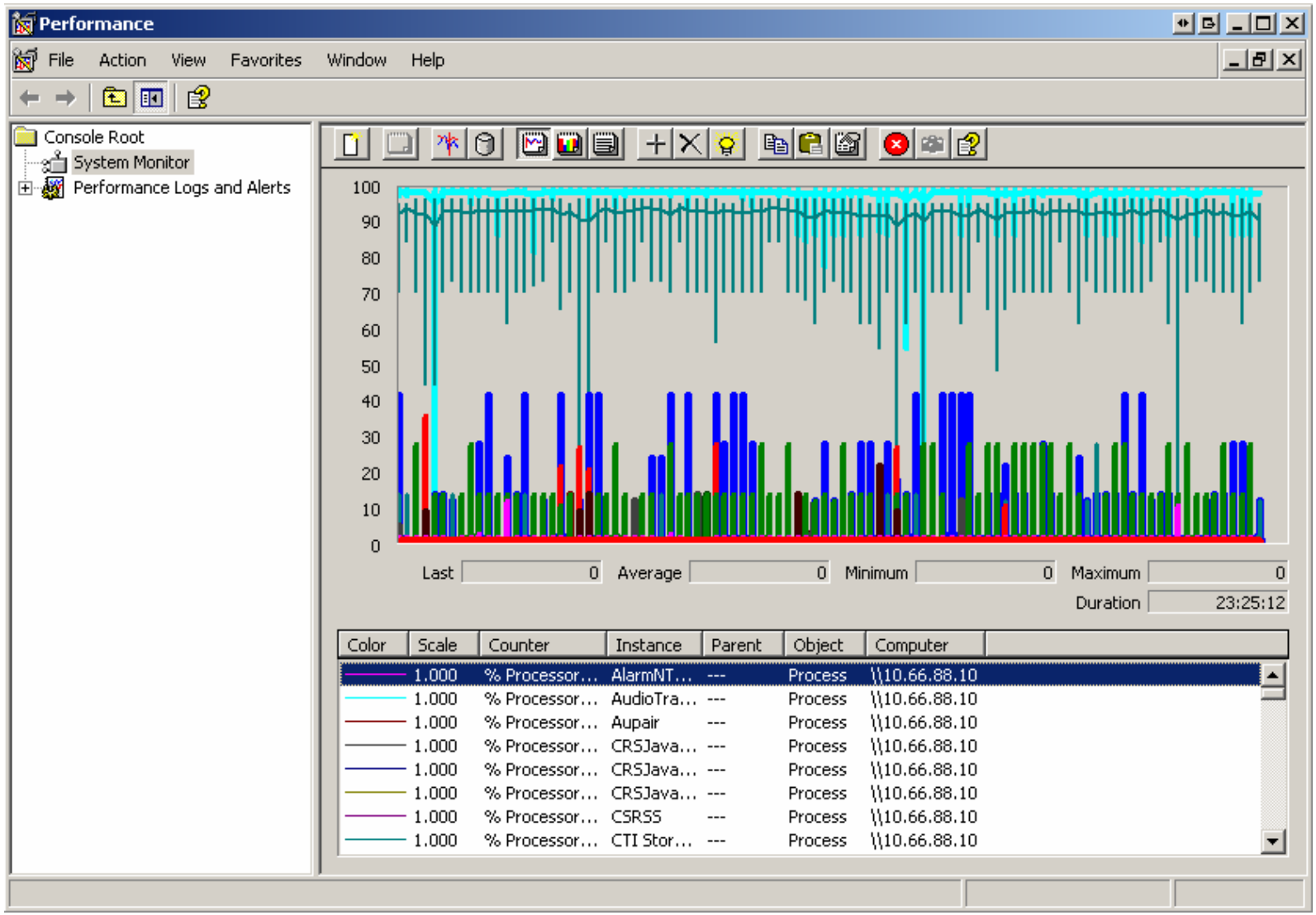


Per Process Statistics

- Per-process CPU and Memory statistics are stored in the files named: **PerfMonLog_10.66.88.10_08_10_2006_00_00.csv**
- Each file has the Server IP Address and Date in the name
- Once the file is open, click the  button
- Select ‘All Instances’ for the ‘% Processor Time’ counter
- Click the  button
- Click the  button

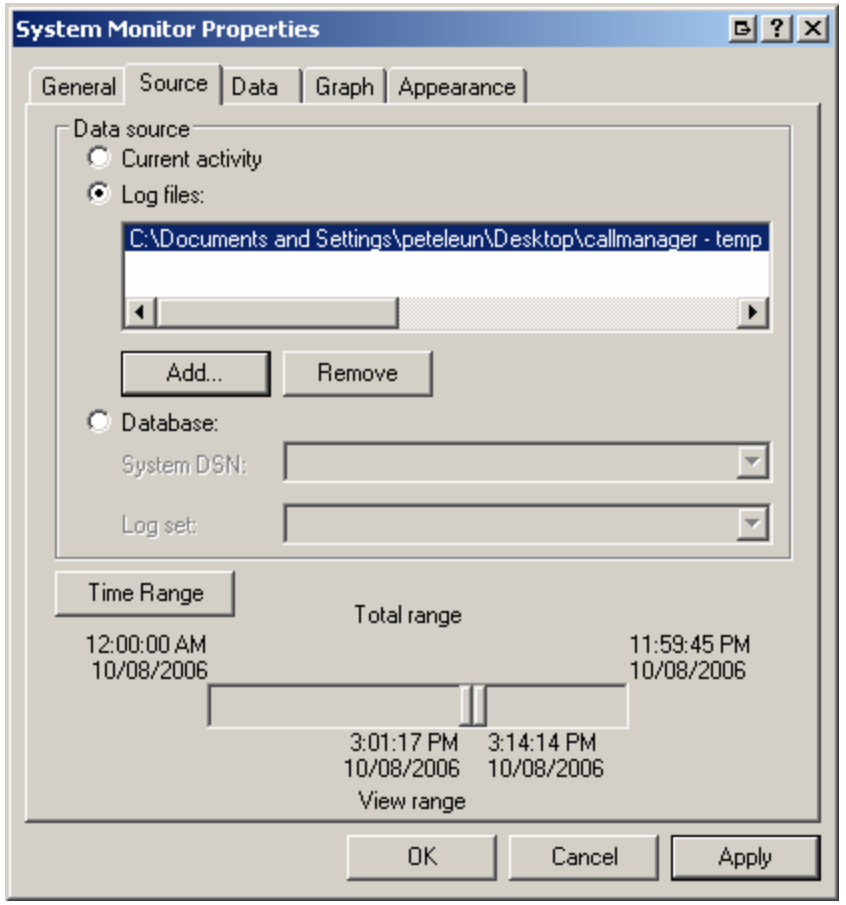


Per Process Statistics



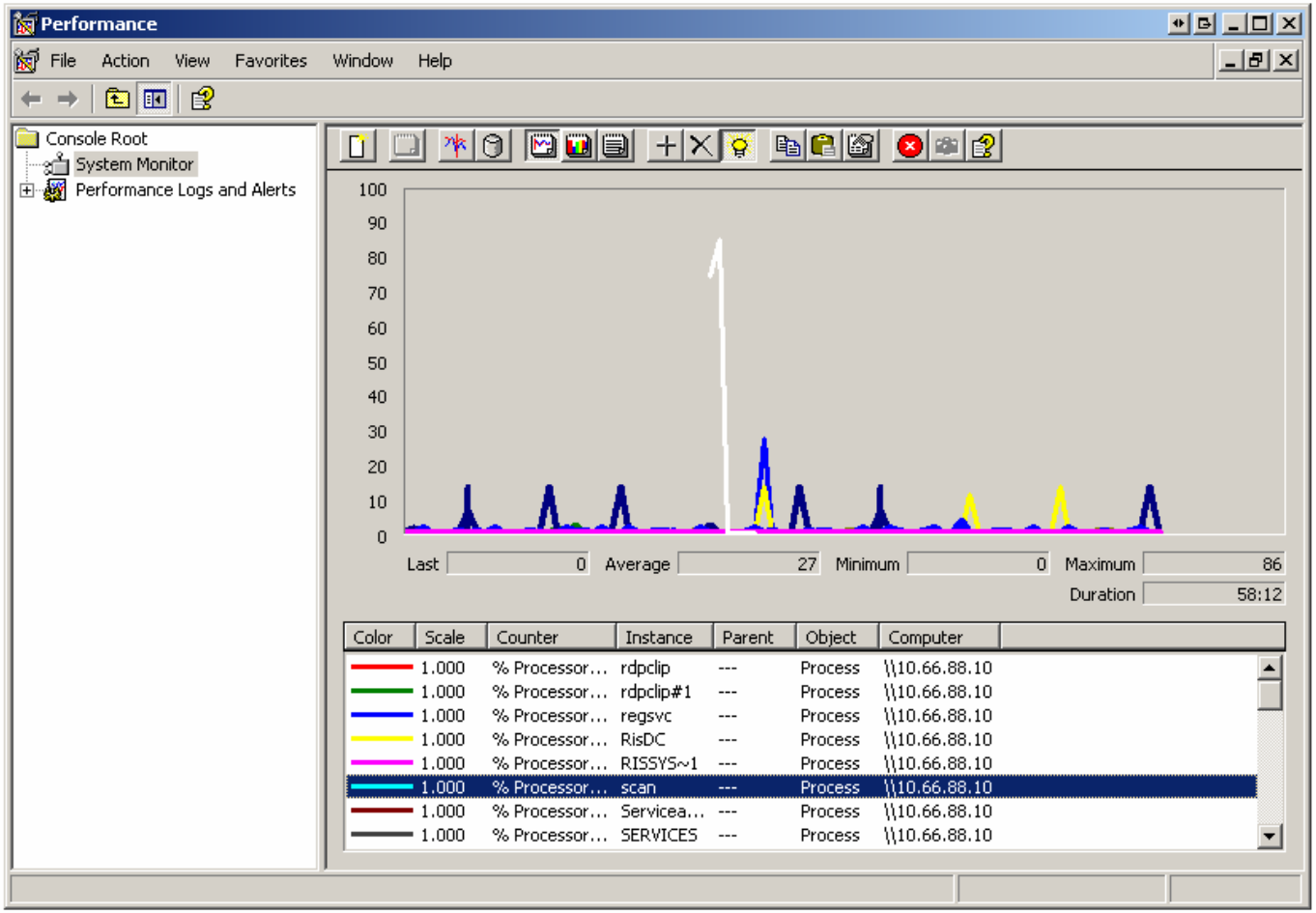
Per Process Statistics

- Click the “Properties” Button (
- Select the “Source” Tab
- Adjust the “Time range” slider at the bottom to narrow down the range to the time you had a problem
- Click “OK”



Per Process Statistics

Click the “Highlight” Button, Then Scroll Through the List Until the Spike on the Graph Is Highlighted



Conclusion

- Using SDL and SDI traces determine the actual flow of the call
- Identify why component in the flow was causing the disconnect
- Using Logs on the call manager to determine the root cause of the CPU problem

Agenda

- Introduction
- Company Overview
- Case Study 1: Dropped Call
- Case Study 2: Intermittent voice quality issue

Problem 2 – Voice quality

"Hello Peter, need your help again! This time the users in Melbourne are reporting poor voice quality intermittently. It seems very random. "

"What should I do??"

Problem Description

- What type of calls are experiencing the problem? - phone to phone? (same site? Different site?)
  - Gateway to phones?
  - When is it happening?
  - Can the problem be reproduced?
  - How often is it happening?
  - Who is hearing the bad audio? (One-way? Both ways?)

Problem Update

- Only happen for calls between Brisbane and Melbourne.
- Sometimes audio is bad for the whole call and sometimes part of the call.
- Hanging up and reconnecting the call doesn't seem to fix the problem.
- User normally tries again after awhile and the problem is gone

Common Voice Quality issues

- Voice quality issue is mostly caused by network related issues.
- But I don’t have any user reports of issues with data traffic??
  - Voice traffic more sensitive to network problems
  - Voice path vs data path

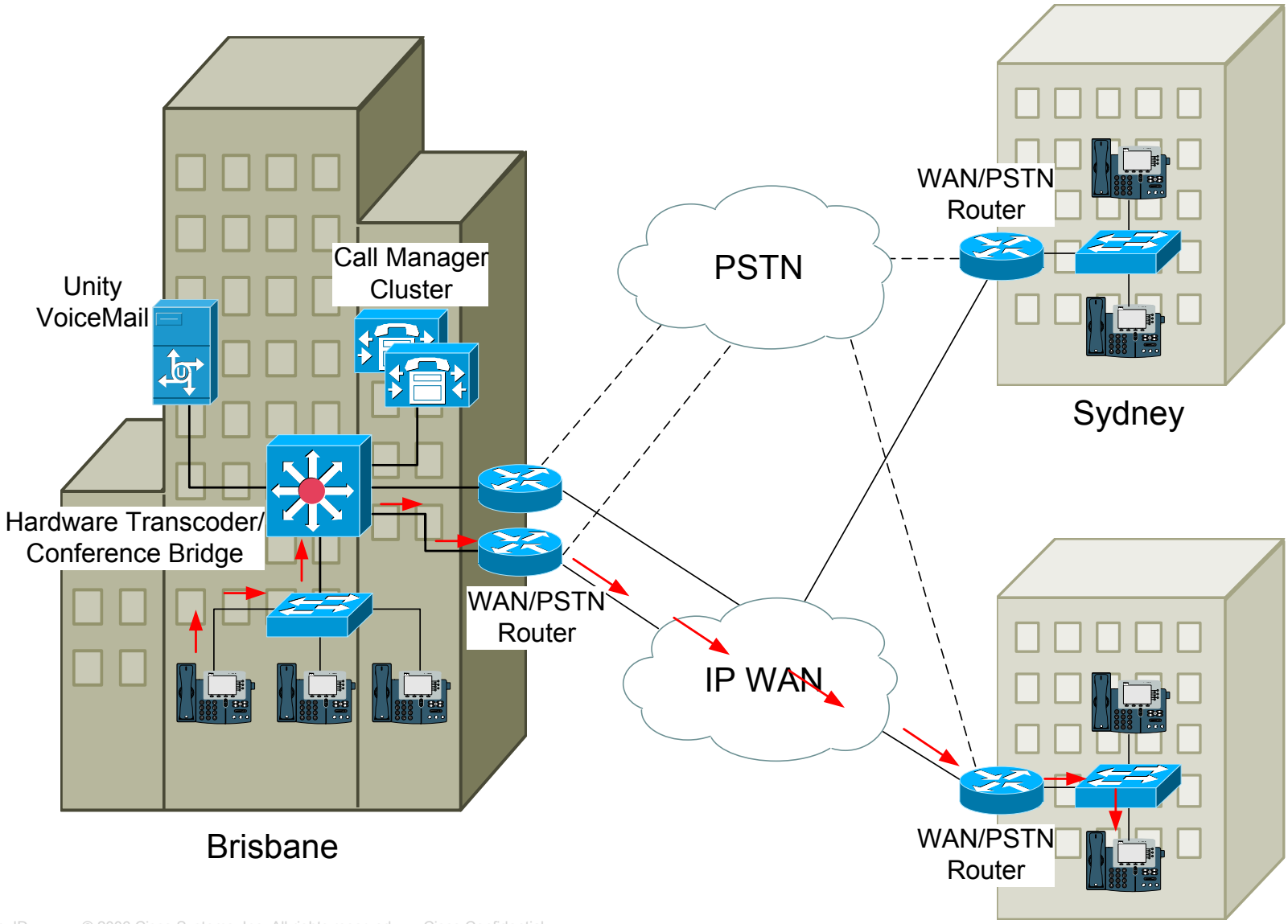
What to collect?

- Call manager traces
- Sniffer traces
- Ensure network path is clean (clear counter on all devices and monitor)
- Confirm phone setting is correct (incorrect settings, e.g location)
- Pattern to the problem (time of day? Location?)

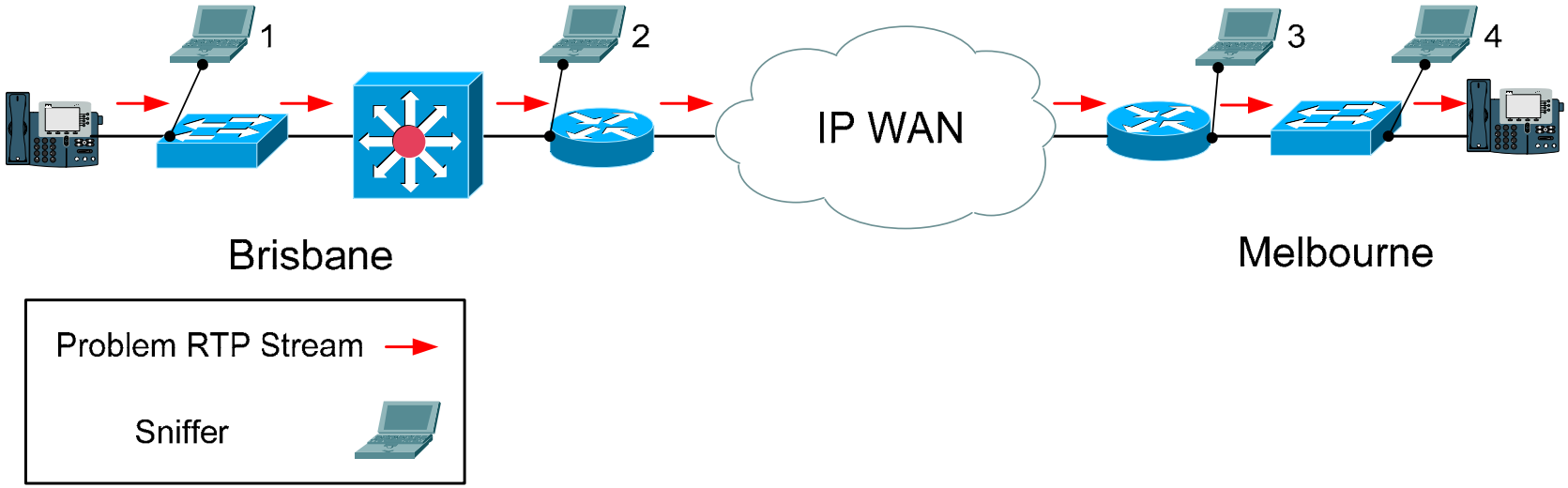
Ring Ring

“Hi Pete, a user has just reported the problem. As previously reported, the user is Melbourne is experiencing the poor audio.”

Call Flow Diagram



Simplified Call Flow Diagram

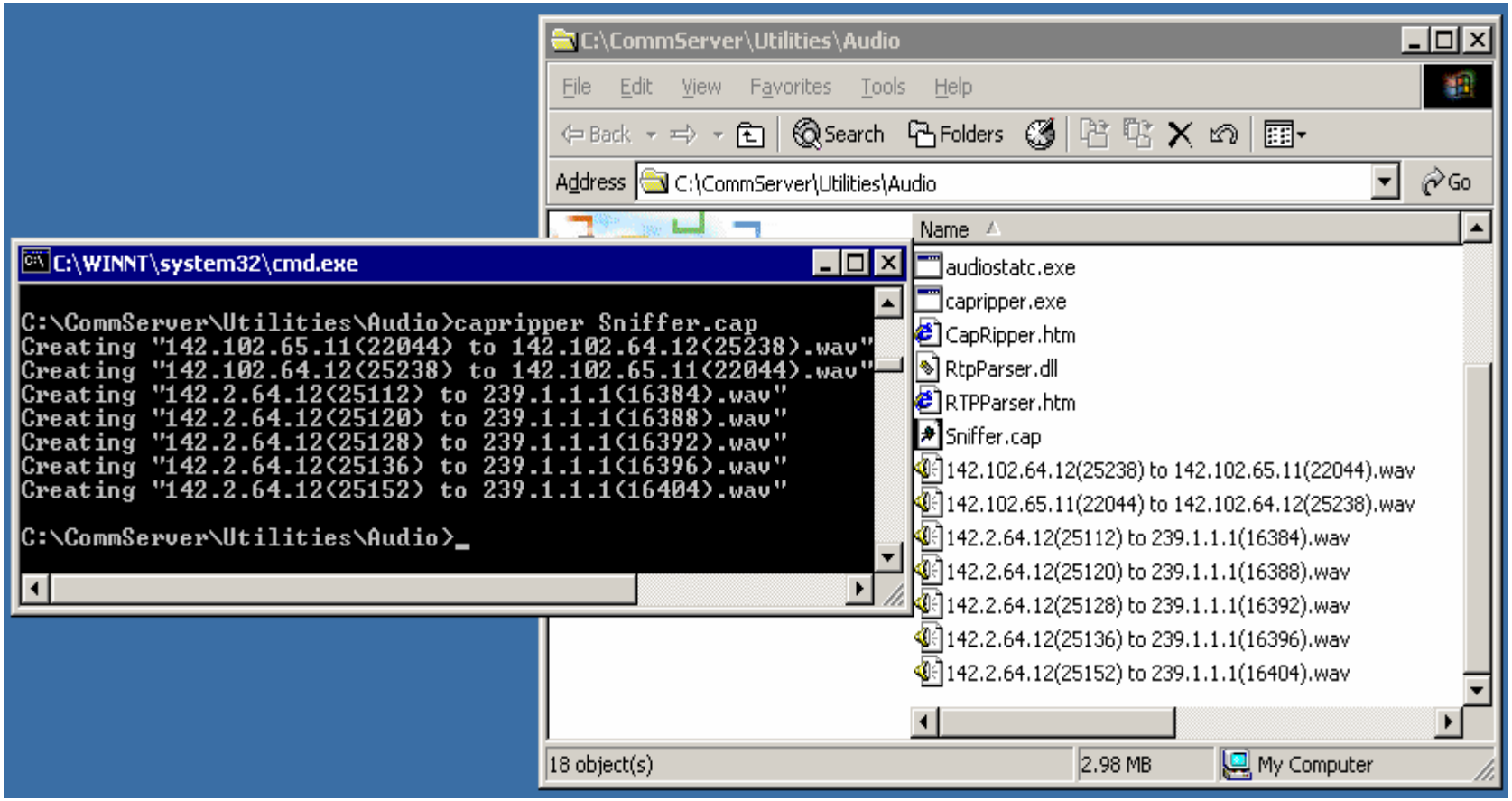


Tools Break - Extracting Audio Stream

- Capripper
- Ethereal
- RTPPlay

Capripper

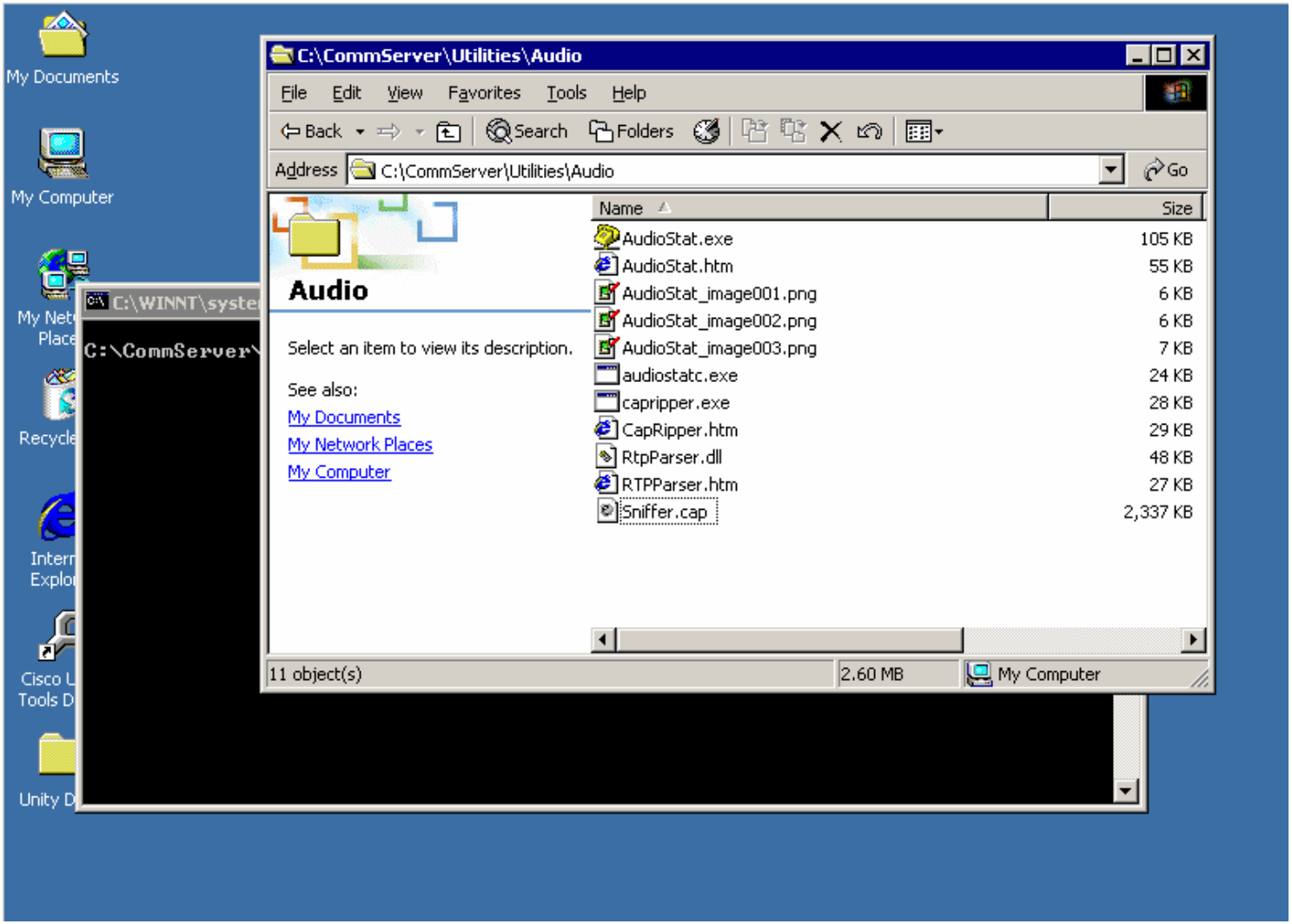
- **C:\CommServer\Utilities\Audio**
- **Installed by default on Unity server**



Capripper

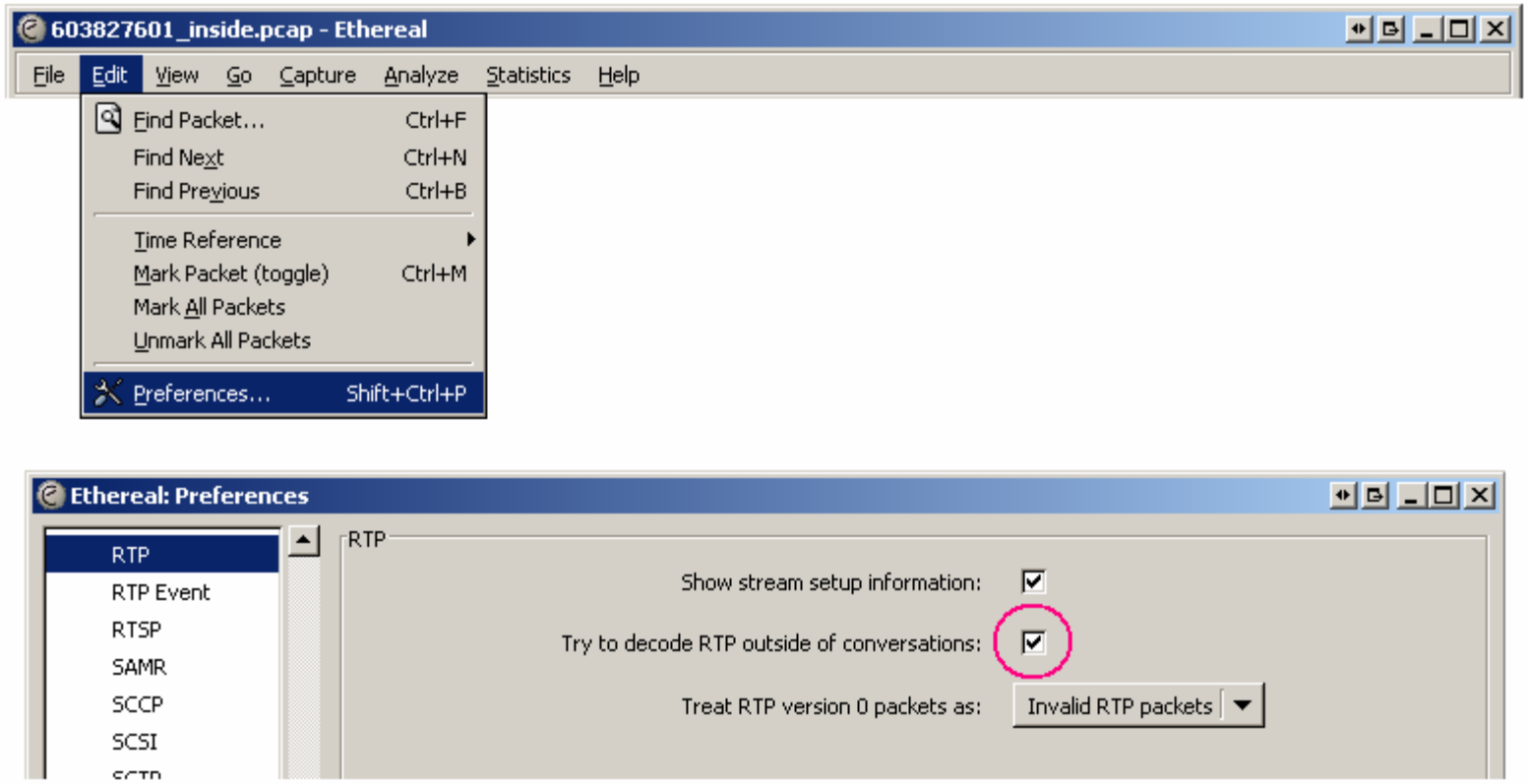
- C:\CommServer\Utilities\Audio>capripper
- Usage: capripper [-d numBytes] [-o offset] [-s] [filename]
- Options:
- -d number of bytes to dump
- -o offset in bytes to start extracting data (NetMon only)
- -s display summary information about RTP packets

Capripper Demo



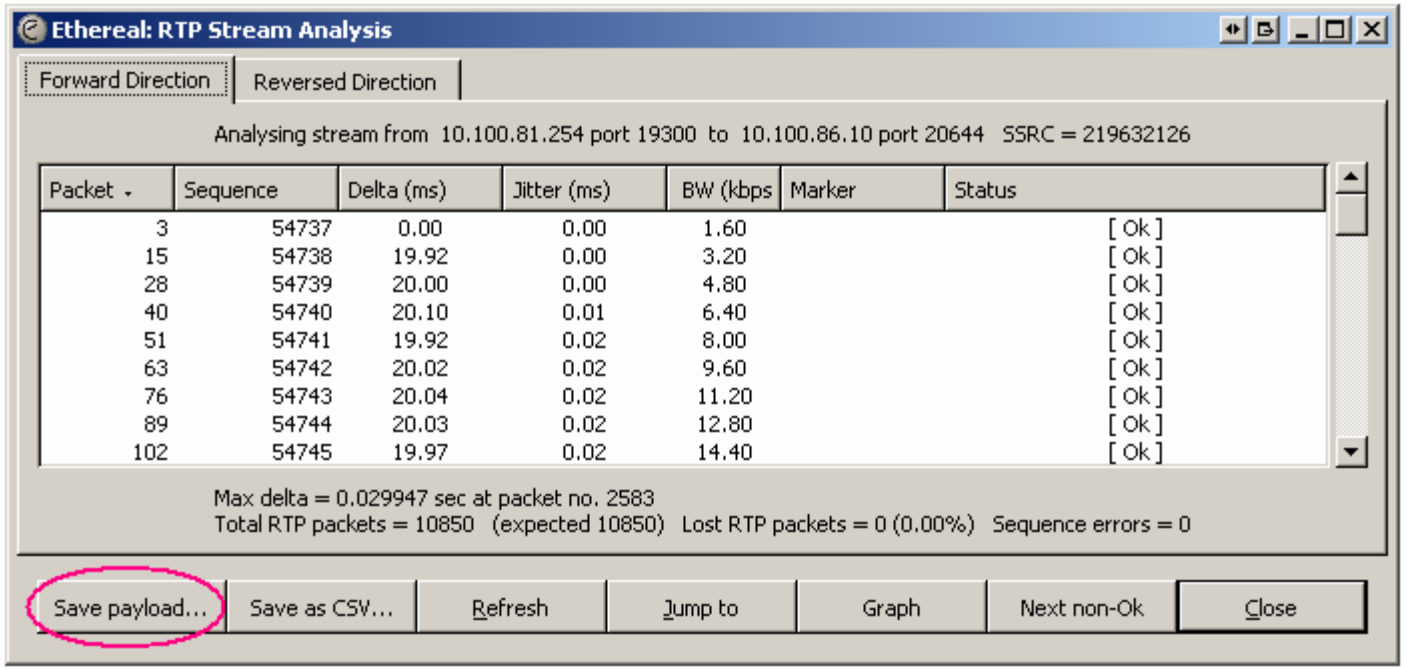
Ethereal - Sniffer Trace Analysis

- Check “Try To decode RTP outside of conversations”



Sniffer - Ethereal

- Statistics -> RTP -> Stream Analysis…



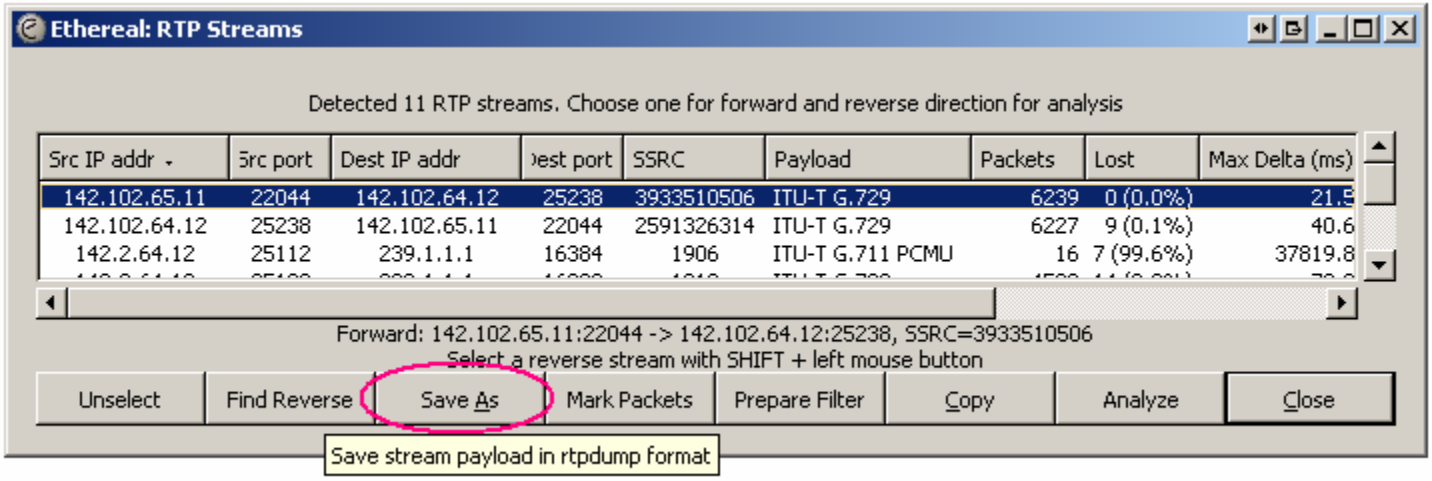
RTPPlay

- C:\rtpplay>rtpplay ?
- Usage: rtpplay [-v] [-T] [-p profile] [-f file] [-b begin time] [-e end time] destination/port[/ttl]
- -T uses the arrival time of packets
- -f rtpdump file name
- Destination/port
- Example rtpplay -T -f stream1 10.66.90.3/16542

RTPPlay

- RTPPlay works with files in rtpdump format
- Use Ethereal to extract the problem stream

  “Statistics -> RTP -> Show All Streams…”



How to playback the stream using RTPPlay

1. Get a call up from an IP phone to the device you wish to send the stream (phone or gateway)
2. Browse to the initiating phone and check the stream statistic and located the opened port of the receiving device
3. Unplug the initiating phone
4. Run RTPplay and send the stream to the IP/Port found in step 2

Video Example of RTPplay

Voice Quality Problems – Samples on CCO

- http://www.cisco.com/en/US/tech/tk652/tk698/technologies_white_paper09186a00801545e4.shtml

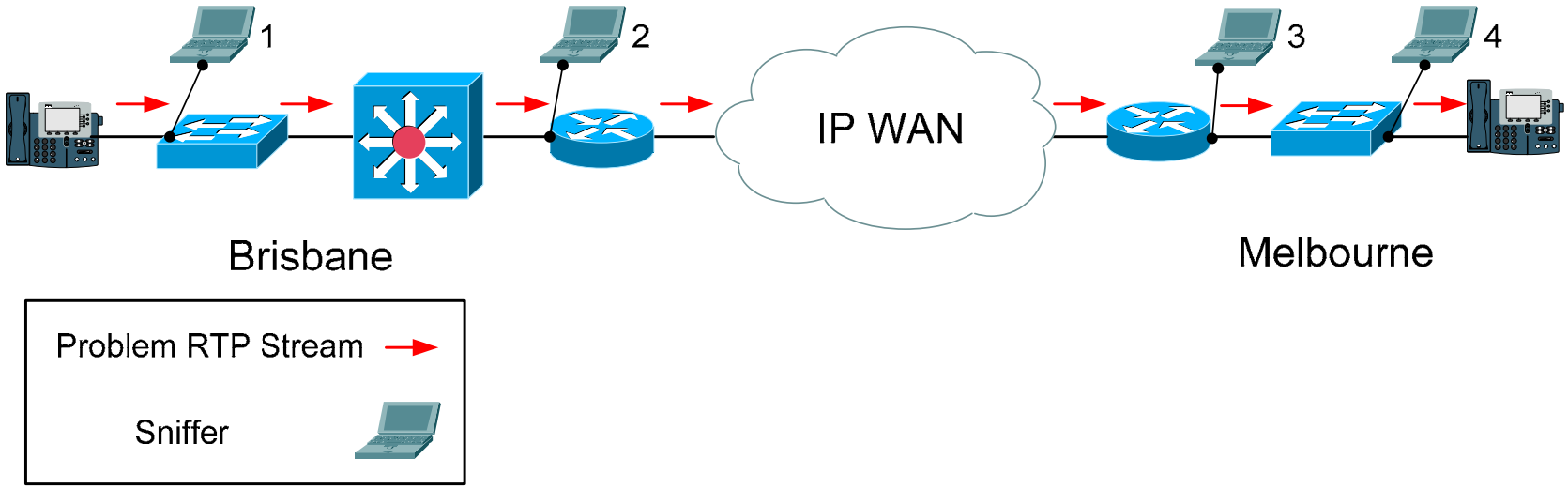
Clicking

Symptom—Clicking is an external sound similar to a knock that is inserted usually at intervals.

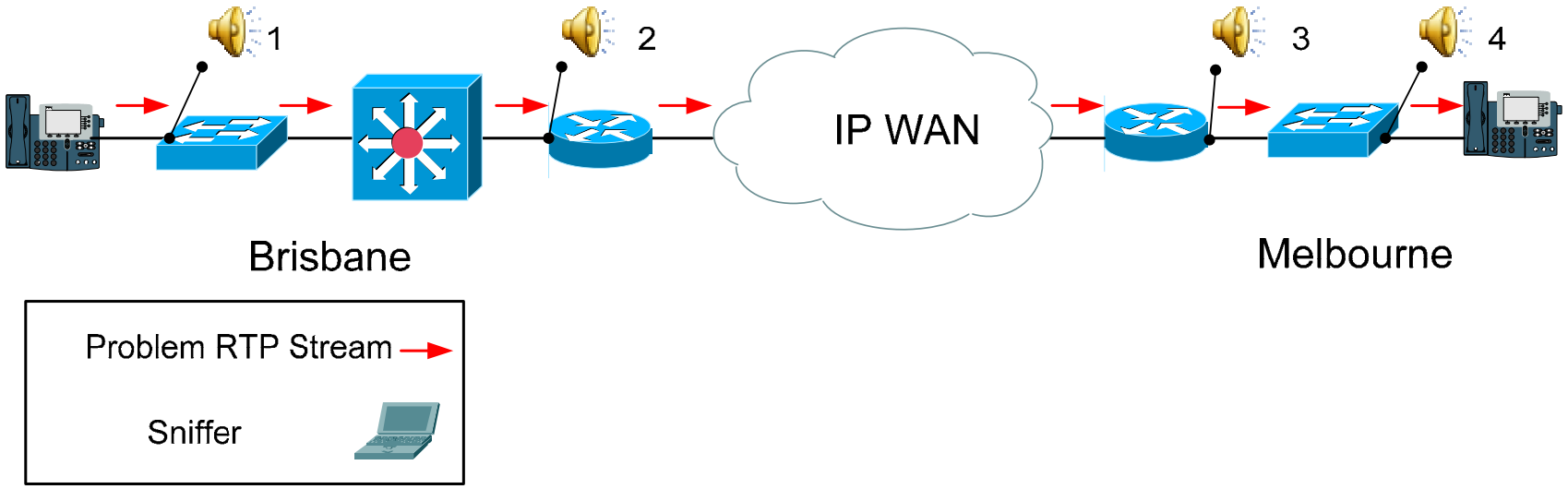
Cause—A common cause is clock slips or other digital errors.

Clicking Symptom Recording	Control Recording without the Symptom	Clicking Snippet Recording
		

Back to our problem - Call Flow Diagram



RTP Quality Capture



Queuing Configuration

- class-map match-any signal
- match ip dscp cs3
- match ip dscp af31
- class-map match-all voice
- match ip dscp ef
- !
- policy-map Melbourne
- class voice
- priority 100
- class signal
- bandwidth 10
- class class-default
- fair-queue

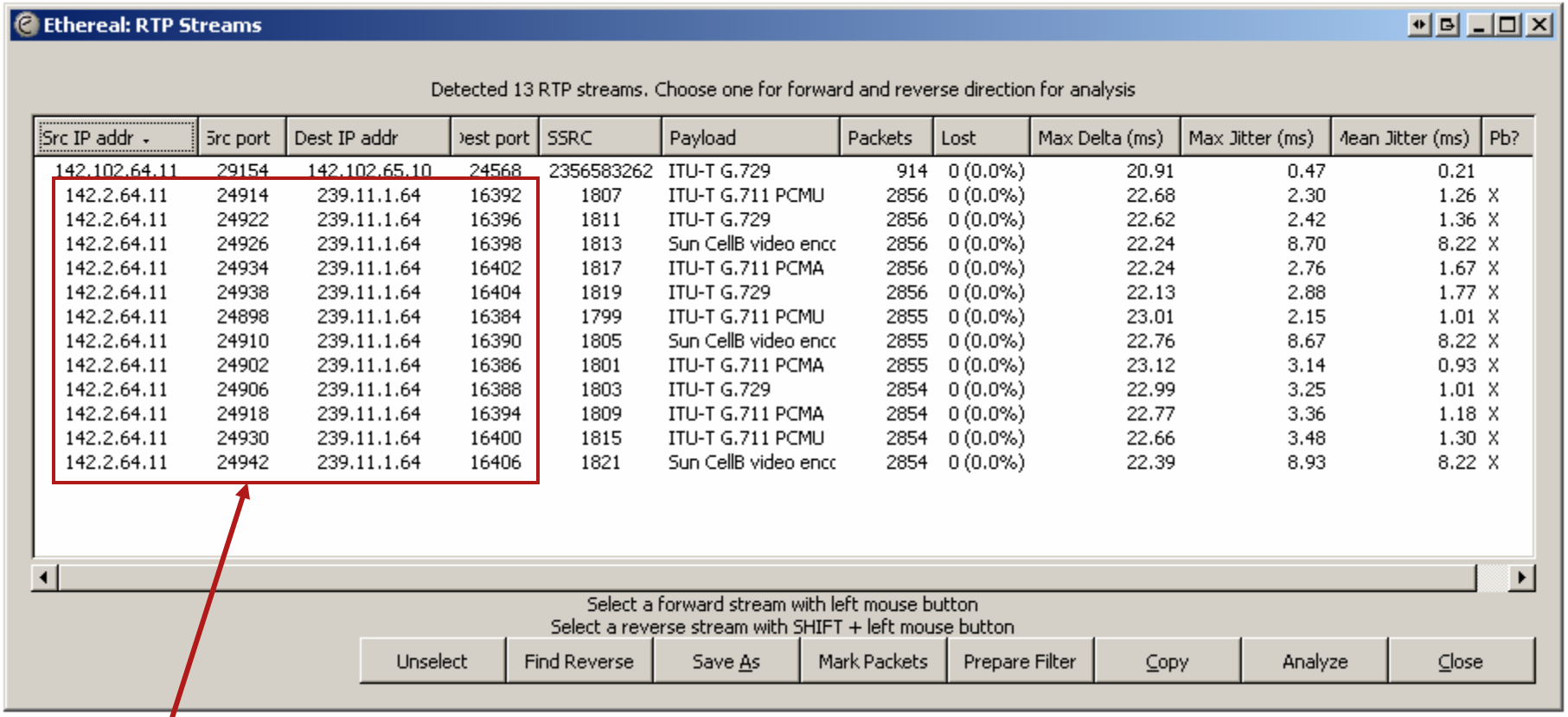
Queuing Statistics

- Rack02R1#show policy-map interface serial0/0
- Class-map: voice (match-any)
- 9217 packets, 2244988 bytes
- 30 second offered rate 231000 bps, drop rate 203000 bps
- Match: ip dscp ef (46)
- 9217 packets, 2244988 bytes
- 30 second rate 231000 bps
- Queueing
- Strict Priority
- Output Queue: Conversation 264
- Bandwidth 128 (kbps) Burst 3200 (Bytes)
- (pkts matched/bytes matched) 9217/2244988
- (total drops/bytes drops) 6110/2041220

Why are there Packet drops?

- Check configuration router configuration to ensure we are matching the correct traffic
- Confirm Call Manager Location settings
- Debug on the router with different access list to track the unknown traffic
- Sniffer trace capture all trace going into the router (wait! We have this already)

Sniffer trace revisit



Hold on! What's this?

MOH Settings

Multicast Audio Source Information

☑ Enable Multicast Audio Sources on this MOH Server

Base Multicast IP Address: 239.11.1.64

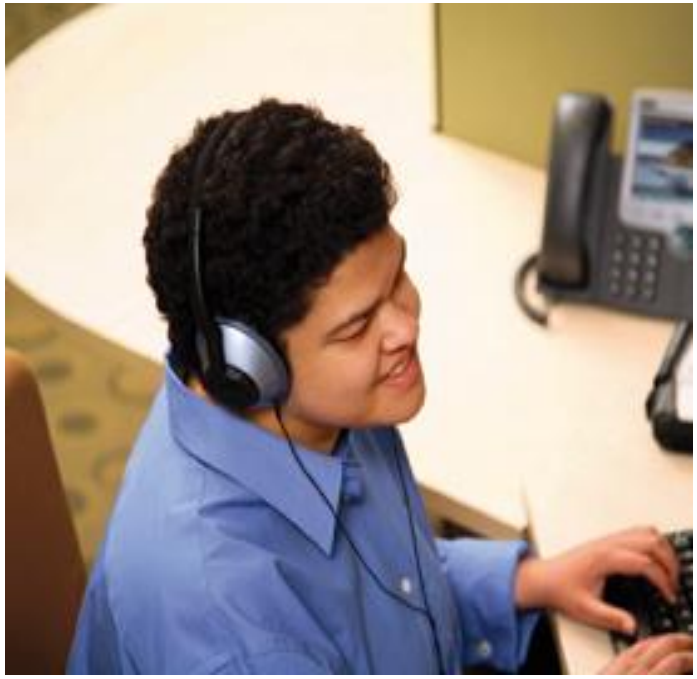
Base Multicast Port Number: 16384 (Even numbers only)

Increment Multicast on: ◉ Port Number ○ IP Address

Selected Multicast Audio Sources

No.	Audio Source Name	Max Hops
1	SampleAudioSource	5
2	Sales	2
3	Marketing	2

Parameter Name	Parameter Value
Supported MOH Codecs*	711 mulaw 711 alaw 729 Annex A



SRND Reference to Multicast MOH Setup

- From Solution Reference Network Design 4.x
- http://www.cisco.com/en/US/products/sw/voicesw/ps556/products_implementation_design_guide_chapter09186a00806e8c28.html#wp1043734

- “IP network routers route multicast based on IP addresses, not port numbers. “

Summary

- Identify Call Manager Call Flow
- Trace Reading Tools
- Sniffer Capture Decoding Tools
- Sound Quality Analysis

Q and A