Developing Client-side IP Call Recording Applications using Avaya Application Enablement Services

An Avaya DevConnect Developer Guide

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Overview

The ability to record calls is increasingly important in call center and other business communications environments. For example, it may be necessary to record calls to comply with legal requirements, to satisfy security concerns, for training purposes, for compliance purposes, for transaction verification, for publication as a Podcast, and for many other reasons.

Depending on the reason, recording may be initiated:

- manually, by one of the parties on the call or by a system administrator
- automatically, by a client application

In addition, it may be desirable to record calls with or without the knowledge of the active participants.

There are many methods available for recording calls, including packet sniffing, T1 DS0 monitoring, using an analog station, etc. However, this paper is only concerned with IP call recording methods where:

- The extension at which calls are to be recorded (the “target extension”) is managed by Avaya Communication Manager
- The calls involve up to six participants: the maximum number supported by Communication Manager
- The media streams to be recorded are handled by the client application
- The client application uses Avaya Application Enablement (AE) Services to connect to Communication Manager. In particular, the application uses the AE Services’ Device, Media, and Call Control (DMCC) service to access and control the media streams.

Three client-side IP call recording three methods are discussed, namely:

- Service Observing
- Single Step Conferencing
- Multiple Registrations

Which method is most suitable depends on the requirements for the application.

Note: AE Services also supports server-side call recording. However, this method does not provide the scalability or performance required by enterprise-level call recording applications, and is not covered here. For information about server-side call recording, see the AE Services Device, Media, and Call Control API Programmers Guide for the DMCC API (Java, .NET or XML) you are using.

Purpose

The main purpose of this paper is to describe and compare the available client-side IP call recording methods. The information can be used by analysts and developers to help them select which call recording method or methods best meet their requirements. In addition, the paper discusses resource consumption issues that should be considered when developing call recording applications using these methods.
Target Audience and Assumed Knowledge

This paper is primarily intended for developers who are familiar with IP telephony, and who wish to include call recording capabilities in their client applications. It would be useful to have a good working knowledge of:

- Avaya Communication Manager
- Avaya Application Enablement Services
- Developing applications using Application Enablement Services
- Device registration for first-party physical device and media control

A brief overview of these topics is given in the following sections for those readers who are unfamiliar with the underlying platform, services and concepts.

Section 1: Introduction to the Underlying Platforms and Services

Before we start looking at the client-side IP call recording methods, it would be useful to understand something of the underlying platform and services, namely:

- **Avaya Communication Manager**: the platform which manages the extensions at which calls are to be recorded and which provides the underlying call and media control capabilities
- **Avaya Application Enablement Services (AE Services)**, which provides connectivity between client applications and Avaya Communication Manager
- **The AE Services’ DMCC service** used by client applications to control media streams and record calls

This section also includes an overview of DMCC device registration, which is essential for enabling the media control used by each of the call recording methods.

Avaya Communication Manager

Communication Manager is Avaya’s flagship IP Telephony software platform. It contains robust call processing capabilities, advanced workforce productivity and mobility features, built-in conferencing and contact center applications, and support for a variety of wired and wireless end-user communications devices.

Communication Manager exposes a series of low-level, proprietary application programming interfaces (APIs). These APIs allow other software products to work with Communication Manager. With the addition of Avaya Application Enablement Services, the APIs also allow software developers to create their own client applications that interact with, and leverage the capabilities of, Avaya Communication Manager.

Avaya Application Enablement Services

Application Enablement (AE) Services is a server-based software application that provides connectivity between client applications and Avaya Communication Manager. AE Services incorporates a number of discrete services which provide high-level abstractions of the proprietary Communication Manager APIs. Using AE Services, software developers can create client applications written in the programming language or protocol of their choice.
For the client-side IP call recording methods described in this guide, AE Services is not in the media path (i.e. does not terminate or generate RTP). Rather, AE Services provides the signaling capabilities that allow client applications to manage the media.

The methods described in this paper use the AE Services’ Device, Media, and Call Control (DMCC) service to provide the media control necessary for recording calls. In addition, the methods make use of the TSAPI interface, either directly via the AE Services TSAPI service or via the JTAPI or DMCC services, to monitor extensions at which calls are to be recorded, to obtain information about calls and to provide other third-party call control functionality.

**AE Services’ Device, Media and Call Control Service**

The AE Services DMCC service provides access to Communication Manager’s device, media and basic third-party call control capabilities. In particular, the media control functionality allows applications to access voice stream RTP data for the purposes of recording or analysis, and to send RTP data as outgoing voice streams.

Depending on the programming language used, applications interface with the DMCC service using one of the following access methods:

- **DMCC Java API**: used by applications written in the Java programming language
- **DMCC .NET API**: used by applications written in the C#, Visual Basic or Visual C++ .NET programming languages
- **DMCC XML protocol description**: used by applications written in any programming language that supports the sending and receiving of XML data over a network connection. Applications that use this access method are typically written in C or C++.

Each access method has its own SDK containing the tools developers need to create DMCC applications.

**Section 2: Device Registration**

Device registration is an important aspect of each of the client-side, IP call recording methods described in this paper.

To be able to perform first-party device and media control at an extension, a client application must use the AE Services DMCC service to register itself as a “device” on Communication Manager. We’ll call a device that has been registered using the DMCC service, a “DMCC device”. When a client application registers itself as a DMCC device at an extension, it can act like an IP softphone to control and monitor physical aspects of the extension (button pushes, lamps, the display, etc.) or access and control the media streams at the extension.

For a client application to be able to control the media at an extension, and record calls at that extension, it must register itself as a DMCC device with the media mode set to “Client”. Client media mode indicates that the client application will handle the media streams from the DMCC device. For the purposes of this paper, we’ll call a DMCC device that has been registered in Client media mode a “recording device”. Note, however, that Client media mode DMCC devices can be used by applications for purposes other than call recording. Each of the call recording methods described in this paper uses recording devices, albeit in different ways.
Supported Extension Types

DMCC devices can only be registered at extensions that have been IP softphone-enabled on Communication Manager. The following types of extension can be softphone enabled:

• DCP
• Avaya H.323 IP

System Administrators can softphone-enable extensions using the Communication Manager Stations screen. See the Administrator Guide for Avaya Communication Manager for detailed information about softphone enablement.

Note: It is not possible to register a DMCC device against a SIP extension. In practice, this means that the Multiple Devices method cannot be used to record calls at SIP extensions. However, it is possible to record calls at SIP extensions using the Service Observing or Single Step Conferencing methods, provided the extension is at an Avaya SIP station, such as a 1600 or 9600 series telephone, that supports third-party call control.

Multiple Device Registration

Using Communication Manager release 5.0 or higher, it is possible to register up to three devices against an extension; using earlier releases, only one device can be registered.

Where multiple device registration is supported, the number of DMCC devices that can be registered against an extension is determined as follows:

• If there is no physical set and no Avaya IP softphone registered at the extension, the client application can register up to three DMCC devices.
• If there is a physical set or Avaya IP softphone registered at an extension, the client application can register up to two DMCC devices.
• If a physical set and Avaya IP softphone share control of an extension, the client application can register only one DMCC device.

The Multiple Registrations call recording method, that we will look at later, takes advantage of the multiple registrations capability to register a recording device against the actual extension at which calls are to be recorded.

Standalone Device Registration

Releases of Communication Manager earlier than 5.0 only allow one device to be registered against an extension. Client applications can only register one DMCC device against an extension, and that extension cannot have an associated physical set or Avaya IP softphone. Thus, if a DMCC device is registered against an extension, the extension cannot be used by an active party in a call. However, the DMCC device at the extension can be used by the client application to record calls at other extensions, as well shall see later.

Obviously, in releases of Communication Manager that do support multiple registrations, it is still possible that a DMCC device is the only device registered against an extension.

For the purposes of this paper, where a DMCC device is the only device registered against an extension, we'll call it a “standalone DMCC device”. Where a standalone DMCC device is used to record calls, we'll call it a “standalone recording device”.

Footnote: Where multiple device registration is supported, and a highly available call recording service is required, a client application can register two standalone recording devices at an extension.
The Service Observing and Single Step Conferencing call recording methods both use standalone recording devices. In each case, the client application registers a DMCC device against an extension that has been provisioned on Communication Manager specifically for call recording. The client application monitors or observes the extension at which it wants to record calls and, when it joins a call, adds the standalone recording device to the call as a participant. The client application can then access and record the media streams from the call, via the standalone recording device.

**Dependency Modes**

When a client application registers itself as a DMCC device, it must specify its dependency mode. The dependency mode determines which application or station controls the extension’s physical elements and media. The possible dependency modes are:

- **Main**
  Only one device can be registered at an extension with dependency mode Main. A station or application registered in this mode can originate and receive calls, can talk and listen, and block the transfer of talk capabilities to other devices registered at the extension. Physical sets, Avaya IP softphones and standalone DMCC devices are typically registered with dependency mode Main.

- **Independent**
  A device registered in this mode can originate and receive calls, and can talk and listen even if a Main device is not registered. This mode is not used for recording devices.

- **Dependent**
  A device can only be registered in this mode if a Main device has already been registered against the extension. Dependent devices can only listen, not talk. When using the Multiple Registrations method to record calls, a physical set or Avaya IP softphone is registered as the Main device against the target extension and the recording device as a Dependent device.

**Registering Recording Devices**

To register a DMCC device for client-side IP call recording, the client application:

- Has to be aware of the extensions against which it can be registered as a recording device. The extensions can either be provisioned on Communication Manager by the application itself using the System Management Service web service, or be pre-provisioned and the extension numbers supplied as parameters to the application.

- Gets the Device ID for the extension against which the recording device is to be registered. For standalone DMCC device registration, this is a softphone-enabled extension provisioned on Communication Manager specifically for call recording; for multiple device registration, it is the target extension itself.

- Defines the dependency mode of the recording device to be registered at the extension identified by the Device ID.

- Defines the media mode of the device. For the call recording methods discussed in this paper, the media mode is always set to “Client”.
• Specifies the RTP IP address and port number where media streams from the recording device are to be sent. Media resources, controlled by the client application, are located at this address to handle the media streams. Each media stream is an aggregation of the media from each of the participants in a call. Thus the media streams from the recording device allow all active participants to be recorded.

• Specifies the codec and, optionally, media encryption method to be used by the recording device. If a codec is not specified by the client application, Communication Manager uses the PCM codec. We’ll discuss the affect of codec selection on bandwidth consumption later in the paper when we look at resource issues.

Section 3: Introducing the Client-side IP Call Recording Methods

Three methods are available for client-side, IP call recording. Each method uses the AE Services DMCC service to provide the required media control, and the AE Services TSAPI service, either directly or via the JTAPI or DMCC service, to provide call information, call monitoring and third-party call control functionality. The three methods are:

• Service Observing: The application uses the AE Services DMCC service to register itself as a standalone recording device. The Service Observing feature is provisioned and activated on the device so that, when the target extension joins a call, the recording device is automatically added to the call. The application receives the call’s aggregated RTP media stream via the recording device and records the call.

• Single Step Conferencing: The application uses the AE Services DMCC service to register a pool of standalone recording devices. The application uses the AE Services TSAPI service to monitor the target extension for Established Call events. Whenever the extension joins a call, an Established Call event occurs which triggers the application to use the Single Step Conferencing method to add a recording device to the call. The application receives the call’s aggregated RTP media stream via the recoding device and records the call.

• Multiple Registrations: The application uses the AE Services DMCC service to register itself as a recording device at the target extension. When the target extension joins a call, the application automatically receives the call’s aggregated RTP media stream via the recording device and records the call. Information about the call is derived from the Established event that is generated when the target extension joins the call.

We’ll take a more detailed look at each of these call recording methods, and their features, in the sections that follow.

Section 4: Service Observing Method

Service Observing is primarily intended to allow external parties to listen in to calls in progress. It is typically used in call center environments for monitoring and training purposes. In this case, Service Observing is used to include a standalone recording device in calls.

The client application typically registers one standalone recording device for each extension at which it wants to record calls. This creates a one-to-one association between recording devices and target extensions.

Note: This method also supports a more fluid association where the application uses a pool of recording devices to observe and record calls at different target extensions at different times. Using a pool reduces the number of recording devices needed, but requires that the application to be more sophisticated and exposes the risk of running out of recording devices at busy times.
Using Service Observing to record calls at a target extension involves the following steps:

1. The client application uses the AE services DMCC service to register itself as a standalone recording device with dependency mode “Main” and media mode “Client”. During registration, the application also sets the RTP IP address and port number where it wants the aggregated media stream for the recording device to be sent, and the codec and encryption settings it wants to use.

2. Optionally, the recording device is provisioned with a Service Observing button. This is only necessary if the system has not been provisioned with Service Observing Feature Access Codes (FACs) or if you do not prefer not to use them (see step 3). Provisioning Service Observing buttons can be done directly by the Communication Manager System Administrator or by the client application using the AE Services System Management Service (SMS) Web Service.

3. The client application activates Service Observing on the recording device so that it observes the target extension. There are two ways of doing this:
   i. The client application calls the appropriate first-party device control method to programmatically “press” the Service Observing button on the recording device, and then “presses” a sequence of keypad buttons to dial the target extension. Once Service Observing is activated, the application can use the Service Observing button to toggle between Listen and Talk modes. This has the advantage that, in Talk mode, the application can use the recording device's RTP talk path to send a tone notifying participants that the call is being recorded. However, Service Observing Listen/Talk mode has the disadvantage of consuming an additional TDM timeslot to support the Talk capability: we will discuss the significance of this later when we look at resource consumption issues.
   ii. The client application dials one of the Service Observing Feature Access Codes (FACs) provisioned in step 2, followed by the target extension number. Three Service Observing FACs can be provisioned for a device:
      - **Service Observing Listen/Talk Access Code**: if this FAC is dialed, the recording device can listen and play messages to calls.
      - **Service Observing Listen Only Access Code**: if this FAC is dialed, the recording device can initially only listen to calls. However, a TDM timeslot is reserved for talking and the Service Observing button, if provisioned, can be used to toggle between listen and talk modes.
      - **No Talk Access Code**: if this FAC is dialed, the recording device can only listen to calls. It is not possible to change to talk mode. This has the advantage of not using a TDM timeslot to record calls, but does not allow the application to notify participants when calls are being recorded.

   A refinement to the above is to provision a speed dialing button on the recording device that the application invokes to dial the required FAC and, if desired, the target device extension.

4. Whenever the target extension joins a call, the recording device is added to the call. This is done automatically by Communication Manager and therefore does not have to be handled programmatically by the client application.

   **Note**: AE Services will not be able to add the recording device to the call if the maximum number of participants (six) or Service Observers (two) are already attached to the call.

5. Communication Manager sends the RTP media stream, representing the combined audio streams from the other call participants, to the RTP address specified when the recording device was registered in step 1. Media resources must be located at this address to handle the media streams, and the location must be controllable by the client application so that it can record the media streams.
6. Typically, the client application uses the AE Services’ TSAPI service, either directly or via the JTAPI or DMCC services, to monitor the target extension and to acquire information about calls, such as the calling party’s telephone number. The application can tag the recordings with this information so that they can subsequently be identified and retrieved. For example, to locate recordings of all calls from a particular customer in a particular week.

7. The client application records the RTP media stream.

Recording stops when instructed by the application or automatically when the target extension drops out of the call. Note that, using this method, it is only that part of the call involving the target extension that is recorded – the call may have started before the target extension joined or continue after it disconnects or holds, but these parts of the call will not be recorded.

Features of the Service Observing Method

- The Service Observing method is supported in all releases of AE Services and Communication Manager.
- The recording device is a participant in the call. Communication Manager supports up to six participants in a single call, which is effectively reduced by one for each recording device.
- Up to two Service Observers, and hence recording devices, are permitted in a call. Thus recording may be blocked if other extensions in the call are already being observed.

Note: Releases of Communication Manager prior to release 4.0 only allow one Service Observer in a call.

- Serving Observing can be used to record calls against any type of target extension managed by Communication Manager.
- The AE Services DMCC service is recommended for call monitoring (step 6) only if you are using AE Services Release 4.1 or higher. If you are using an earlier release of AE Services, you should use the TSAPI or JTAPI service.
- Service Observing does not change the display on the physical sets or IP softphones at the extensions involved in a call. Therefore, participants will be unaware that a call is being recorded unless the application explicitly sends a notification tone on the recording device’s Talk path.

Section 5: Single Step Conferencing Method

Single Step Conferencing provides an easy method for programmatically adding participants to existing calls. The underlying functionality is provided by the TSAPI service although the Single Step Conferencing method is also available through the JTAPI and DMCC services.

Single step conferencing is used to add a standalone recording device to a call.

Typically, the client application registers a pool of standalone recording devices. Whenever a target extension joins a call, a recording device from the pool is added to the call. Although it is not necessary to register a recording device for every target extension, the number of recording devices in the pool should be sufficient to support the maximum number of call recordings that may be needed at any one time.

Using Single Step Conferencing to record a call at an extension involves the following steps:
1. The client application uses the AE Services DMCC service to register a pool of standalone recording devices, each with dependency mode “Main” and media mode “Client”. During registration, the application also sets the RTP IP address and port number where it wants the media stream for the recording device to be sent, and the codec it codec and encryption settings it wants to use.

2. The client application uses the AE Services TSAPI service, either directly or via the JTAPI or DMCC services, to add a call control listener to monitor Established Call events at the target extension. The application may also monitor other call control events at the target extension, such as Held, Transferred and Connection Cleared, so that it can respond appropriately when these events occur.

3. When the target extension joins a call, an Established Call event occurs. This triggers the client application make a Single Step Conference Call request to add a recording device to the call.

When using the Single Step Conferencing method to add a recording device, its Participation Type can be set to Active or Silent:

- **Active Participation Type:** The recording device can listen and talk. This has the advantage of being able to send a tone notifying participants that the call is being recorded. However, it has the disadvantage of consuming an additional TDM timeslot.

- **Silent Participation Type:** The recording device can only listen in to the call. This has the advantage of not using a TDM timeslot to record the call, but does not allow the client application to notify participants that the call is being recorded.

4. Communication Manager sends the RTP media stream, representing the summed audio streams from the other call participants, to the RTP address specified when the recording device was registered in step 1. Media resources at this location handle the media streams.

5. Typically, the client application uses the AE Services’ TSAPI service, either directly or via the JTAPI or DMCC services, to acquire information about calls, such as the calling party's telephone number. The application can tag the recordings with this information so that they can subsequently be identified and retrieved.

6. The application records the RTP media stream.

Recording stops when instructed by the application, or automatically when the entire call ends. Thus, unless explicitly stopped by the client application, recording will continue after the target extension disconnects or holds for as long as other parties remain on the call. To stop recording when the target extension alone leaves the call, the client application must listen for the appropriate call events at the extension.

**Features of the Single Step Conferencing Method**

- The Single Step Conferencing method is supported in all releases of AE Services and Communication Manager.

- The recording device is an participant in the call. Communication Manager supports up to six participants in a single call, which is effectively reduced by one for each recording device.

- Single Step Conferencing can be used to record calls against any type of target extension that is managed by Communication Manager and can be monitored.

- The Single Step Conferencing method (step 3) is available via the DMCC service in AE Services Release 3.1 and higher. If you are using an earlier release of AE Services, you must use the TSAPI or JSAPI service for Single Step Conferencing.
• The AE Services DMCC service is recommended for call monitoring (steps 2 and 5) only if you are using AE Services Release 4.1 or higher. If you are using an earlier release of AE Services, you should use TSAPI or JSAPI for call monitoring.

• There may be a short delay (in the order of hundreds of milliseconds) between the target extension being established in a call and the start of recording. Information exchanged during this period will not be included in the recording. This is because of the round trip made by the Established Call event and Single Step Conference Call request.

• The client application is responsible for managing the pooled recording devices.

Section 6: Multiple Registrations Method

AE Services Release 4.1 and Communication Manager 5.0 introduced the ability to register up to three devices at a single, softphone-enabled extension. Typically, a physical set or Avaya IP softphone will already be registered as the Main device at the extension to allow the end user to make and receive calls. Client applications can register a second or third DMCC device to record calls.

Using the Multiple Registrations method to record calls at a target extension involves the following steps:

1. The client application uses the AE Services DMCC service to obtain a Device ID for the target extension.

2. The client application uses the Device ID to register a secondary or tertiary device against the target extension, with dependency mode “Dependent” and media mode “Client”. During registration, the application also sets the RTP IP address and port number where it wants the media stream for the recording device to be sent, and the codec and encryption settings it wants to use.

   Note: The application can only register a Dependent DMCC device if there is a Main device registered at the extension.

3. Whenever the target extension joins a call, Communication Manager sends the RTP media stream, representing the combined audio streams from all the call participants (including the Main device’s talk path) to the RTP address specified when the recording device was registered in step 2. Media resources at this location handle the media streams.

   Note: Dependent devices cannot talk. This has the advantage of not using a TDM timeslot to record calls, but does not allow the application to notify participants when calls are being recorded.

4. Typically, the client application uses the AE Services TSAPI service, either directly or via the JTAPI or DMCC services, to acquire information about calls which can then be used to store and retrieve recordings.

5. The application records the RTP media stream.

Recording stops when instructed by the application or automatically when the target extension drops out of the call. Note that by using this method, it is only that part of the call involving the target extension that is recorded – the call may continue after the target extension disconnects or holds, but this part of the call will not be recorded.

Features of the Multiple Registrations Method

• The Multiple Registrations method is only supported in AE Services Release 4.1 and higher, together with Communication Manager Release 5.0 or higher.

• Because this method does not require a standalone recording device to be added to calls, the six party limit in a call is not affected.
• Because client applications can only register recording devices at extensions that are softphone-enabled on Communication Manager’s Station form, the Multiple Registrations method is confined to recording calls at DCP and Avaya H.323 IP extensions.

• The Multiple Registrations method does not support the ability to talk in calls, therefore client applications cannot play tones to notify participants that a call is being recorded.

• The Multiple Registrations method supports the registration of a second recording device at a target extension, thereby providing a back-up should one recording fail.

• Depending on the configuration and provisioning, each registration can be through separate hardware and network paths, or overlapped, to achieve varying levels of high availability.

Section 7: Comparison of the Client-side, IP Call Recording Methods

The table below summarizes the features of each of the call recording methods described above, and is intended to help developers determine which method is most suited to their needs.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Service Observing</th>
<th>Single Step Conferencing</th>
<th>Multiple Registrations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum number of active participants in a recorded call</td>
<td>6 minus the number of recording devices, i.e. the absolute maximum is 5 with one recording device</td>
<td>6 minus the number of recording devices, i.e. the absolute maximum is 5 with one recording device</td>
<td>6</td>
</tr>
<tr>
<td>Allows notification message to be played to participants</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Additional TDM time slots consumed (assuming a single port network)</td>
<td>1 per recording device – Listen/Talk FAC 0 Listen Only FAC</td>
<td>1 per recording device – Active Participation 0 Silent Participation</td>
<td>0</td>
</tr>
<tr>
<td>Additional Media Processors consumed</td>
<td>1 per recording device</td>
<td>1 per recording device</td>
<td>1 per recording device</td>
</tr>
<tr>
<td>Association between target device and recording device</td>
<td>Typically one-to-one, but can be many-to-one</td>
<td>Typically many-to-one (or one-to-many)</td>
<td>One-to-one</td>
</tr>
<tr>
<td>Supported types of extension</td>
<td>All</td>
<td>All</td>
<td>DCP and Avaya H.323 IP Softphones</td>
</tr>
<tr>
<td>Available in AE Services / Communication Manager Releases</td>
<td>AE Services 3.0 and higher, Communication Manager 3.0 and higher</td>
<td>AE Services 3.0 and higher, Communication Manager 3.0 and higher</td>
<td>AE Services 4.1 and higher, Communication Manager 5.0 and higher</td>
</tr>
<tr>
<td>Records whole call or target extension participation only</td>
<td>Target extension participation only</td>
<td>Whole call, from when the target extension joins</td>
<td>Target extension participation only</td>
</tr>
<tr>
<td>Maximum number of recording devices in a call</td>
<td>2 Communication Manager 4.0 and higher 1 Earlier releases</td>
<td>6 minus number of active participants, i.e. the absolute maximum is 4, in a two party call</td>
<td>6 (one per participant)</td>
</tr>
<tr>
<td>Supports highly available call recording</td>
<td>No</td>
<td>Yes (but at cost of available active party slots in calls)</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 1: Comparison of Features of the Call Control Methods
Section 8: Resource Consumption Issues

When building applications, it is important for developers to consider how the inclusion of client-side call recording capabilities affects the consumption of valuable and potentially limited system resources. In this section we’ll look at resource consumption for the call recording methods described earlier, and at how good application design and system configuration can minimize resource consumption.

The main resources that we are concerned about in this section are:

- **Stations**: the number of stations, and hence extensions, available on a Communication Manager installation is limited by license.

- **TSAPI and DMCC licenses**: the call recording methods discussed in this paper use TSAPI and DMCC licenses.

- **TDM timeslots**: the number of TDM timeslots available on a Communication Manager installation is limited by cabinet.

- **IP Media Processors**: the number of IP media processor (MedPro) ports available on a Communication Manager installation is limited by license and hardware.

- **Bandwidth**: it is particularly important to preserve bandwidth when recording calls involving endpoints located in different network regions linked by wide-area networks (WANs). Bandwidth consumption is affected by the location of the recording device and by the codec it uses.

Developers need to be aware of how their implementation of client-side IP call recording affects the consumption of licensed and static resources, particularly as it could result in the need to purchase additional licenses or exhaust the TDM timeslots in a cabinet.

**Station License Consumption**

Service Observing and Single Step Conferencing both make use of standalone recording devices which are registered against extensions that have been provisioned on Communication Manager specifically for call recording purposes. Thus each recording device consumes one additional station license.

Service Observing typically has a one-to-one association between target extensions and recording devices, and therefore consumes a relatively large number of station licenses. Single Step Conferencing typically uses a pool of recording devices, and therefore potentially needs fewer station licenses, but exposes the possibility of running out of recording devices if a large number of recordings need to be made at the same time.

The Multiple Registrations method does not consume additional station licenses.

**DMCC and TSAPI License Consumption**

Various aspects of call recording use DMCC and TSAPI licenses, as follows:

- Each DMCC registration takes a DMCC license.
- Each TSAPI monitor takes a TSAPI license.
- Each Single Step Conference Call takes a TSAPI license.
- Each DMCC call control monitor takes a TSAPI license.
- Each JTAPI terminal monitor on an extension or call monitor takes a TSAPI license.
TDM Timeslot and MedPro License Consumption

To help understand how call recording affects the consumption of TDM timeslot and MedPro resources, we’ll start by taking a look at some possible call scenarios.

In the simplest case (Figure 1), a two-party call between IP endpoints can use direct IP media. The RTP media is sent directly between the IP endpoints on a call. No MedPro or TDM timeslot resources are reserved or used in Communication Manager.

The situation changes when there are more than two parties in a call and/or one or more of the endpoints is a TDM-only device, such as a DCP phone (Figure 2). In this scenario, the IP endpoints each use a MedPro resource to convert IP media to TDM media so that it can be shared with other call participants. In addition, to be able to exchange media, each endpoint in the call uses one TDM timeslot.
Calls involving only IP endpoints may also use TDM media (Figure 3). In fact, all calls start out in this mode and are converted to direct IP media when possible. The call participants, number of active parties, provisioning, and available transport (IP or TDM) all determine how a call’s media stream is handled and which calls are switched to direct IP. Switching from one media path to another through the use of IP (or SIP) signaling is often referred to as “shuffling”, and can be used to connect IP devices with calls that require TDM media resources, such as managed transfers to DCP-based extensions.
Figure 4 shows the effect of using the Service Observing or Single Step Conferencing methods to add a listen-only, standalone recording device to a call. Each recording device consumes an additional MedPro resource.

An additional TDM timeslot is consumed (Figure 5) if the recording device has been configured to listen and talk, i.e. for Service Observing when the Service Observing button, Listen/Talk FAC or Listen Only FAC is used; for Single Step Conferencing when the Participation Type is set to Active.
Note that, if the participants in a two-party call were both at IP endpoints potentially able to communicate using direct IP media, adding a recording device effectively causes the consumption of an additional MedPro and TDM timeslot resource for each endpoint.

The Multiple Registrations method consumes one additional MedPro resource for each recording device. Additional TDM timeslots are not consumed as the recording device is not able to talk.

**Recording Calls across Network Regions**

In the scenarios we have looked at so far, we have assumed that all the endpoints involved in a call are in the same Network Region. Additional bandwidth optimization and resource consumption considerations come into play when the participants and/or recording devices are located in different Network Regions.

**What is a Network Region?**

A Network Region is a collection of IP endpoints and switch IP interfaces interconnected by an IP network. For example, a university might have multiple campuses within a city, linked by a Wide Area Network (WAN), with all campuses served by the same Communication Manager installation. Communication Manager allows the university to define a Network Region for each campus, and associate each of their Control Local Area Network (CLAN) and IP media processor circuit packs with these regions. Conceptually, a Network Region can be thought of as a building with its own remote media gateway.

**Note:** Because DMCC devices are logical rather than physical entities, each of the DMCC devices registered at an extension can be configured to be in a different Network Region.

Because Network Regions are linked by WANs, which have a narrower bandwidth than is available on local networks, it becomes particularly important to minimize the bandwidth used to record calls when the devices involved are in different Network Regions.

In most cases, bandwidth and other resource optimization is handled automatically by Communication Manager. However, in some cases, the client application can play a role. Let’s take a look at a scenario that illustrates this.

**Cross Network Region Call Recording Scenario**

In this scenario we are using the Single Step Conferencing method to record a call between two parties whose extensions are located in different Network Regions, and that there are pools or recording devices available in both Network Regions. The call is an inbound trunk call from Network Region A that terminates at the remote extension in Network Region B. The issue for the application is whether it is more efficient to use a recording a device in Network Region A or Network Region B to record the call.

In fact the answer is always the same, regardless of whether the target is the extension in Network Region A or B, whether it is an IP or TDM extension, or whether or not the trunk and target extension are on the same switch – a recording device on the trunk (Network Region A) should be selected to minimize media traffic across the WAN.

**Codec Selection**

Another important consideration when recording calls involving endpoints in different Network Regions the choice of codec. A codec is an algorithm used to encode and decode audio media flowing from and to a device. When registering a recording device, the client application can specify the list of codecs it supports. If the client application does not specify a supported codec list, a default codec will be assumed.
Where media flows across a WAN it may be desirable to use a low bandwidth codec, which compresses the signal more aggressively. However, using a low bandwidth codec reduces audio quality, so selecting a suitable codec is a matter of compromise.

Fortunately, the client application does not have to determine the optimal codec as it is automatically selected by Communication Manager.

**Figure 6** shows an example of how Communication Manager determines which codec should be used for media flowing to and from a standalone recording device.

- The client application has specified a supported codec list for the recording device comprising the G.711A and G.729A codecs.
- Each Network Region has an IP codec list associated with it. Communication Manager determines which Network Region the recording device is in from CLAN it is registered against or from its IP address/CLAN mapping: in this case the recording device is in Network Region 3. The IP codec list for Network Region 3 comprises, in priority order, the G.729A, G.711A and G.711GU codecs.
- Communication Manager compares the Network Region and recording device codec lists and selects the highest priority match, which in this case is the G.729A codec.
Summary

In this paper we have looked at three methods available for including IP call recording in client-side applications. Each of the methods uses Avaya Application Enablement Services to record calls at extensions managed by Avaya Communication Manager.

As we have seen, each method has different features, advantages and limitations. Which method is best suited for providing call recording in a particular situation depends on many factors, such as the version of the platform and services against which the client will run, the need to provide high-availability, the types of extension at which calls are to be recorded, and the desirability of minimizing the consumption of limited resources.

Hopefully, you now have a good understanding of the available recording methods and the issues that affect how they should be implemented. You should be able to determine which method best satisfies your requirements for client-side, IP call recording.

Glossary of Terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
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<tbody>
<tr>
<td>AE Services</td>
<td>Application Enablement Services provides connectivity between client applications and Communication Manager. AE Services includes the DMCC and TSAPI services, both used in the client-side, IP call recording methods.</td>
</tr>
<tr>
<td>CLAN</td>
<td>Control Local Area Network. Depending on the system configuration, a single CLAN can provide registration and call control to IP endpoints in a single or multiple Network Regions.</td>
</tr>
<tr>
<td>Codec</td>
<td>A codec (coder/decoder) provides the means by which audio is compressed. Some of the codecs supported by Communication Manager include G.711, G.722, G.723, and G.729.</td>
</tr>
<tr>
<td>Communication Manager</td>
<td>Avaya Communication Manager is an open, scalable, highly reliable and secure IP telephony platform, which provides user and system management functionality, intelligent call routing, application integration and extensibility, and enterprise communications networking.</td>
</tr>
<tr>
<td>DCP</td>
<td>Digital Communication Protocol. DCP is a proprietary protocol used for call control signaling between Avaya Communication Manager and Avaya DCP telephones. DCP uses two call control signaling channels and two media channels time division multiplexed on a two or four wire interface.</td>
</tr>
<tr>
<td>DMCC Device</td>
<td>A “virtual” device registered on Communication Manager using the AE Services DMCC service. A DMCC device may be registered as a standalone IP endpoint or at the target extension. DMCC devices are used to provide first-party device and media control functionality.</td>
</tr>
<tr>
<td>DMCC service</td>
<td>Device, Media, and Call Control service - An AE Services service that provides device, media, and basic third-party call control functionality to client applications.</td>
</tr>
<tr>
<td>Extension</td>
<td>For the purposes of this paper, an extension is a Communication Manager station that has been provisioned with an extension number and other attributes so that calls can be made to and from it.</td>
</tr>
<tr>
<td>H.323</td>
<td>Protocol for providing audio-visual communication sessions on a packet network.</td>
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<tr>
<td>JTAPI</td>
<td>Java Telephony API. JTAPI is a Java-based, client-side interface to the TSAPI service resident on the Avaya Application Enablement (AE) Services server.</td>
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<td>MedPro</td>
<td>IP media processor used for voice processing. The IP media processor at sending location adjusts the audio stream.</td>
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<tr>
<td>Network Region</td>
<td>A collection of IP endpoints and switch IP interfaces interconnected by an IP network.</td>
</tr>
<tr>
<td>Recording Device</td>
<td>A DMCC device registered in client media mode for the purpose of recording calls. The recording device can be a standalone IP endpoint (Service Observing and Single Step Conferencing) or registered at the extension at which calls are to be recorded (Multiple Registrations).</td>
</tr>
<tr>
<td>RTP</td>
<td>Real-time Transport Protocol. RTP is a standardized packet format for delivering audio and video over a packet network.</td>
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<tr>
<td>SIP</td>
<td>Session Initiation Protocol.</td>
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<tr>
<td>Standalone recording</td>
<td>A DMCC device that has been registered at an extension that has no physical set or IP phone associated with it. Service Observing and Single Step Conferencing both use standalone recording devices.</td>
</tr>
<tr>
<td>Target Extension</td>
<td>The extension at which calls are to be recorded.</td>
</tr>
<tr>
<td>Target Device</td>
<td>The physical set (softphone or “hard” phone) registered at the target extension.</td>
</tr>
<tr>
<td>TDM</td>
<td>Time-division Multiplexing. TDM is a widely used method of combining multiple data streams in a single signal by separating the signal into many segments, each having a very short duration.</td>
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<tr>
<td>TSAPI</td>
<td>Telephony Service API: The API used by client applications to access Communication Manager's advanced third-party call control capabilities. Client applications can access the full range of TSAPI functionality via the AE Services TSAPI or JTAPI services, and basic TSAPI functionality via the AE Services DMCC service. In the call recording methods discussed in this paper, TSAPI is used to monitor extensions and devices, and to provide information about calls.</td>
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<tr>
<td>WAN</td>
<td>Wide Area Network.</td>
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### ABOUT DEVCONNECT

The DevConnect Program is a comprehensive set of innovative sales, support, marketing and services programs through which Avaya works with members to develop and promote their products and solutions that interoperate with Avaya solutions.

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