CHAPTER 7

Trunks

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Cisco Unified Communications Manager (Unified CM) supports several different types of IP trunks for connectivity with external devices:

- H.225 (H.323)
- SIP
- Intercluster trunks

Only SIP trunks and SIP intercluster trunks can support IPv6. This chapter describes the new IPv6 features and capabilities of these trunks. For information on the general capabilities and functions of Unified CM trunks, refer to the *Cisco Unified Communications Solution Reference Network Design (SRND)*, available at http://www.cisco.com/go/ucsrnd.

There are several possible configurations for Unified CM SIP trunks. This chapter focuses on the following recommended configurations for IPv6 SIP trunks:

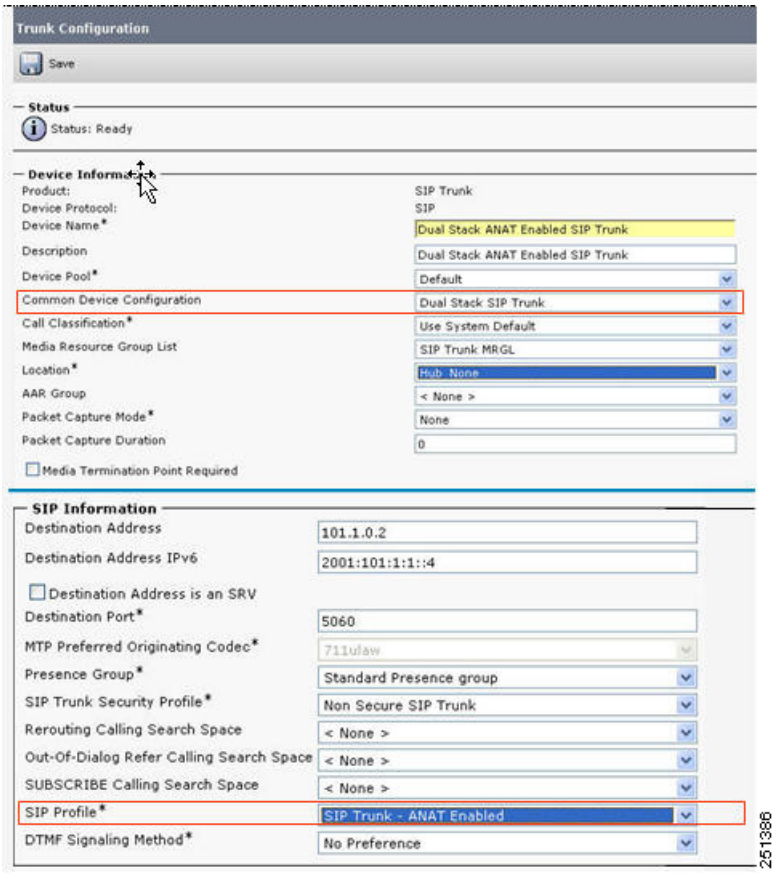
- Inbound and outbound SIP Early Offer trunk calls
- Inbound and outbound SIP Early Offer trunk calls with Alternative Network Address Types (ANAT) enabled
- Inbound and outbound SIP Delayed Offer trunk calls
- Inbound and outbound SIP Delayed Offer trunk calls with ANAT enabled

Configuring IPv6 SIP Trunks

To configure SIP trunks to gateways and Unified CM SIP intercluster trunks, select **Devices** > **Trunks** > **SIP Trunk** in Unified CM Administration (see Figure 7-1).

The SIP trunk configuration settings discussed in this section get applied through the Common Device Configuration profile that is created and assigned to the SIP trunk (**IP Addressing Mode** and **IP Addressing Mode Preference for Signaling**), and through the SIP Profile configuration assigned to the SIP trunk (**Enable ANAT**).

Figure 7-1 Trunk Configuration in Cisco Unified CM Administration



Common Device Configuration Settings for SIP Trunks

This section describes the configuration settings for SIP trunks.

SIP Trunk IP Addressing Mode

You can configure the IP Addressing Mode to one of the following settings (see Figure 7-2):

- IPv4 only

  In this mode, the SIP trunk uses the Unified CM IPv4 address for signaling and either an MTP or phone IPv4 address for media.

- IPv6 only

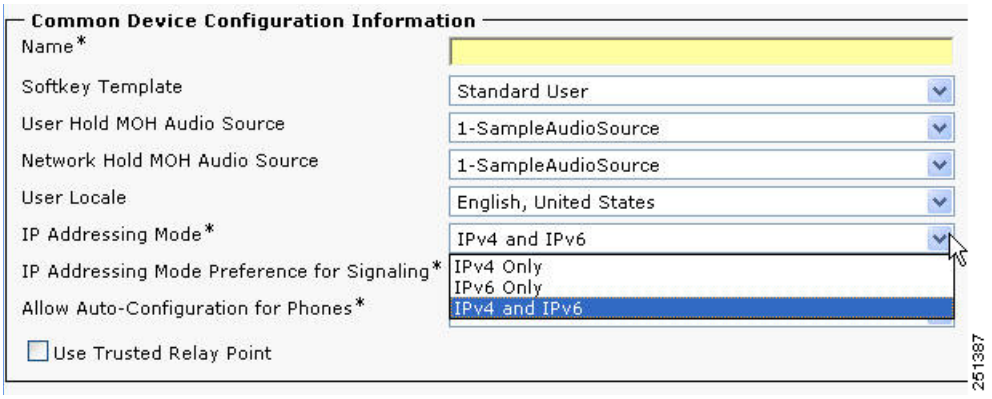
  In this mode, the SIP trunk uses the Unified CM IPv6 address for signaling and either an MTP or phone IPv6 address for media.

- IPv4 and IPv6

  In this mode, the SIP trunk uses either the Unified CM IPv4 address or the Unified CM IPv6 address for signaling, and either an MTP or phone IPv4 and/or IPv6 address for media.

For more information on these IP addressing modes, see SIP Trunks Using Delayed Offer, page 7-14.

Figure 7-2 Configuring the IP Addressing Mode



If IPv6 is enabled in the Unified CM cluster, the default SIP trunk setting for IP Addressing Mode is **IPv4 and IPv6**. All IPv4 trunks ignore this setting.

Cisco recommends **IPv4 and IPv6** as the setting for the IP Addressing Mode for IPv6 SIP trunks. **IPv6 Only** is not recommended for production environments.

SIP Trunk IP Addressing Mode Preference for Signaling

You can configure the IP Addressing Mode Preference for Signaling to one of the following settings (see Figure 7-3):

- IPv4

  In this mode, the SIP trunk uses the Unified CM IPv4 server address as its source address for SIP signaling.

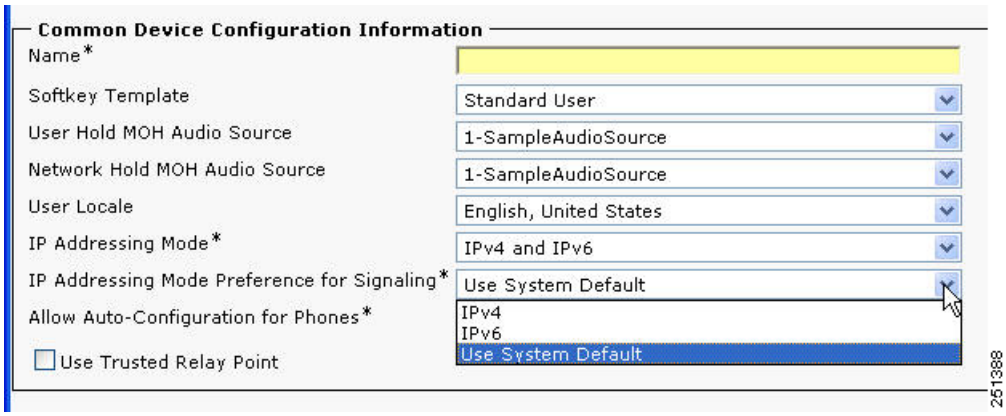
- IPv6

  In this mode, the SIP trunk uses the Unified CM IPv6 server address as its source address for SIP signaling.

- Use System Default

  In this mode, the SIP trunk uses the cluster-wide Enterprise Parameter configuration value for its IP addressing mode for signaling.

Figure 7-3 Configuring the IP Addressing Mode Preference for Signaling



If IPv6 is enabled in the Unified CM cluster, the default SIP trunk setting for the IP Addressing Mode for Signaling is **Use System Default**. With this setting, the SIP trunk will adopt the cluster-wide setting for its IP addressing mode for signaling, if the trunk is configured with a destination address of that type. All IPv4 trunks ignore this setting.

The SIP trunk's IP Addressing Mode Preference for Signaling is used only for outbound calls. Unified CM listens for incoming SIP signaling on both the IPv4 and IPv6 address.

Allow Auto-Configuration for Phones

The setting of Allow Auto-Configuration for Phones is not used by SIP trunks.

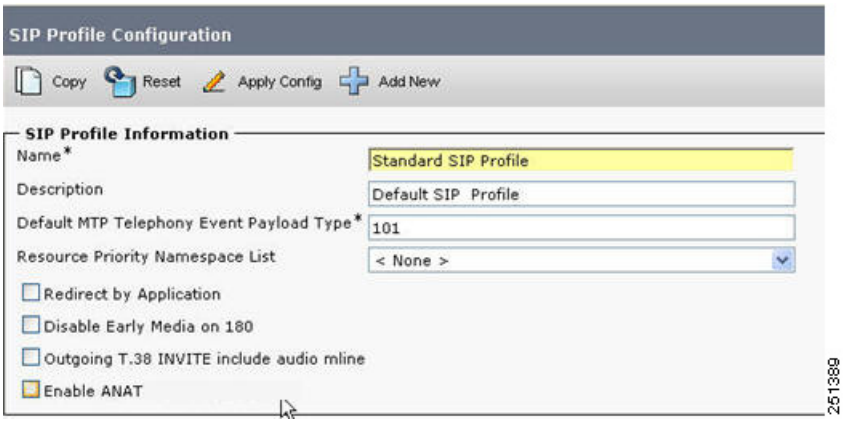
Alternative Network Address Types (ANAT)

ANAT is used in the SIP Offer and Answer exchange between dual-stack SIP trunks. ANAT allows SIP devices to send both IPv4 and IPv6 addresses in the Session Description Protocol (SDP) body of a SIP Offer, and to return in the SDP body of the SIP Answer a preferred IP address (IPv4 or IPv6) with which to establish a media connection.

Cisco supports ANAT over dual-stack (IPv4 and IPv4) SIP trunks. ANAT must be supported by both ends of the SIP trunk. To enable ANAT, check the **Enable ANAT** check box on the SIP Profile associated with the SIP trunk (see Figure 7-4). ANAT can be used with both Early Offer and Delayed Offer calls.

ANAT should be enabled only on SIP trunks with an IP Addressing Mode setting of **IPv4 and IPv6**.

Figure 7-4 Enabling ANAT in the SIP Trunk Profile



For more information on ANAT, see Alternative Network Address Types (ANAT), page 7-10.

Cluster-Wide Configuration Settings That Affect ANAT-Enabled SIP Trunk Calls

The cluster-wide setting **Addressing Mode Preference for Media** specifies which addressing version to use when a Unified CM SIP trunk with ANAT enabled receives an IPv6 and an IPv4 address in the SDP body of a SIP Offer. This cluster-wide setting also determines whether the phone's or trunk's MTP is selected when an MTP is dynamically inserted in a call through a SIP trunk. For more information, see Media Address Selection for Calls over Dual-Stack SIP Trunks, page 7-7.

Recommended IPv6 SIP Trunk Configurations and Associated Call Flows

How you configure your Unified CM IPv6 SIP trunk will, to some extent, depend upon the capabilities of the far-end SIP trunk device. In the majority of cases, this far-end SIP trunk device will be another Unified CM cluster, IPv6 SIP gateway, or third-party IPv6 SIP call agent.

For general guidance on IPv6 SIP trunk configuration, Cisco recommends the following:

- IPv6 SIP trunks should be configured with an IP addressing mode of **IPv4 and IPv6**.
- If ANAT is required, then the trunk's IP addressing mode must be set to **IPv4 and IPv6**.
- If ANAT is required, it must be supported by both trunk devices.

SIP Early Offer and SIP Delayed Offer are supported, both in symmetric and asymmetric configurations, as follows:

- Outbound and inbound SIP Early Offer
- Outbound and inbound SIP Delayed Offer
- Outbound SIP Early Offer and inbound SIP Delayed Offer
- Outbound SIP Delayed Offer and inbound SIP Early Offer

Early Offer and Delayed Offer calls are discussed briefly below and in greater detail later in this chapter.

Early Offer and SIP Trunk Calls

For all Unified CM SIP trunks, you must check the **MTP required** check box on the trunk configuration page to enable SIP Early Offer. When **MTP required** is checked, a media termination point (MTP) is used in the media path for all inbound and outbound calls. This statically assigned MTP affects all calls in the following ways:

- Because the MTP is placed in the media path for all calls, rather than having one call leg from the calling phone to the called phone, the insertion of the MTP creates two legs: one from the calling phone to the MTP, and the other from the MTP to the called phone. For signaling purposes, this can be considered to be two calls. The calling phone and MTP negotiate media capabilities (such as codec, IP addresses, and UDP port numbers to be used), as do the MTP and the called phone at the far end of the SIP trunk.
- The statically assigned MTP (**MTP required** checked) must be configured to use one codec type (G711 or G729). Assigning a single voice codec to this statically assigned MTP disables the use of the pass-through codec. This, in turn, prevents the negotiation of the pass-through codec that is required for video calls or encrypted calls. (T.38 fax calls are supported with statically assigned MTPs.) Therefore, if support for video or encryption is required over the SIP trunk, SIP Delayed Offer (no statically assigned MTP) must be used. (Note that the pass-through codec should be configured on all dynamically inserted MTPs. To enable the use of the pass-through codec, configure the MTP with both a standard codec and the pass-through codec.)

If SIP Early Offer is required for dual-stack SIP Unified CM trunks, then you must configure the Cisco IOS MTP to use both an IPv6 and IPv4 address. (For details, see the chapter on Media Resources and Music on Hold, page 8-1.)

Delayed Offer and SIP Trunks

Delayed Offer trunks do not have a statically assigned MTP and therefore MTP resources are not used for every call. For Delayed Offer calls, Unified CM attempts to set up the call using a single call leg between the calling and called device, and in doing so must consider the IP addressing mode configuration of both the Unified CM trunk and the IP phone registered with Unified CM. In certain calls where there are IP addressing mode mismatches between the Unified CM trunk and the registered phone, Unified CM will dynamically insert an MTP to resolve this mismatch. The pass-through codec is supported by this dynamically inserted MTP, and video calls and encrypted calls can be established with this MTP in the call path. (The pass-through codec should be configured on all dynamically inserted MTPs. To enable the use of the pass-through codec, configure the MTP with both a standard codec and the pass-through codec).

Unified CM SIP Trunk Signaling

The following factors affect which IP addressing version is used for signaling on Unified CM SIP trunks:

- Call direction
- IP addressing mode of the trunk
- Configured destination address(es) of the trunk
- Trunk's IP addressing mode preference for signaling
- Cluster-wide IP addressing mode preference for signaling

IP Addressing Version Used for SIP Signaling for Outbound Calls

The IP addressing version for signaling is determined the following factors, in the order listed here:

1. The IP Addressing Mode of the SIP trunk (IPv4 Only, IPv6 Only, or IPv4 and IPv6)
2. The configured destination address(es) of the SIP trunk (IPv4 Only, IPv6 Only, or IPv4 and IPv6)
   a. If only one destination address is configured (IPv4 or IPv6), the IP addressing version must match the IP Addressing Mode of the trunk. If these two values do not match, the SIP trunk connection is not established.
   b. If two trunk destination addresses are configured (IPv4 and IPv6), then the IP addressing version is determined by the SIP trunk's IP Addressing Mode Preference for Signaling (IPv4, IPv6, or Use System Default). If the **Use System Default** setting is used, then the IP addressing version is determine by the cluster-wide IP Addressing Mode Preference for Signaling (IPv4 or IPv6).

IP Addressing Version Used for SIP Signaling for Inbound Calls

For inbound calls, the IP addressing version used for signaling is based on the trunk destination address(es) and port number(s) configured in Unified CM. If the signaling source address and port number received from the calling device match a configured destination address and port number on the SIP trunk, then the signaling connection is established.

Unified CM provides the following configuration setting options for the SIP trunk destination address:

- One IPv4 address configured
- One IPv6 address configured
- One IPv4 and one IPv6 address configured

If IPv6 is enabled in the cluster, Unified CM servers will listen for incoming SIP trunk calls destined to their configured IPv4 and IPv6 addresses and source port number.

Media Address Selection for Calls over Dual-Stack SIP Trunks

Many configuration options are possible for SIP trunks. Trunks may be single or dual stack, have ANAT enabled or disabled, and use SIP Early Offer or SIP Delayed Offer. This chapter, while not exhaustive, discusses the significant configuration options and their outcomes in terms of the addresses that are exchanged and used for media. Early Offer call scenarios are considered first, followed by Delayed Offer call scenarios.

Depending on the call scenario, media address selection for calls over dual-stack SIP trunks can be based upon:

- Call direction
- Whether Delayed Offer or Early Offer is used
- The IP Addressing Mode of the trunk
- The cluster-wide IP Addressing Mode Preference for Media
- The IP Addressing Mode of the phone

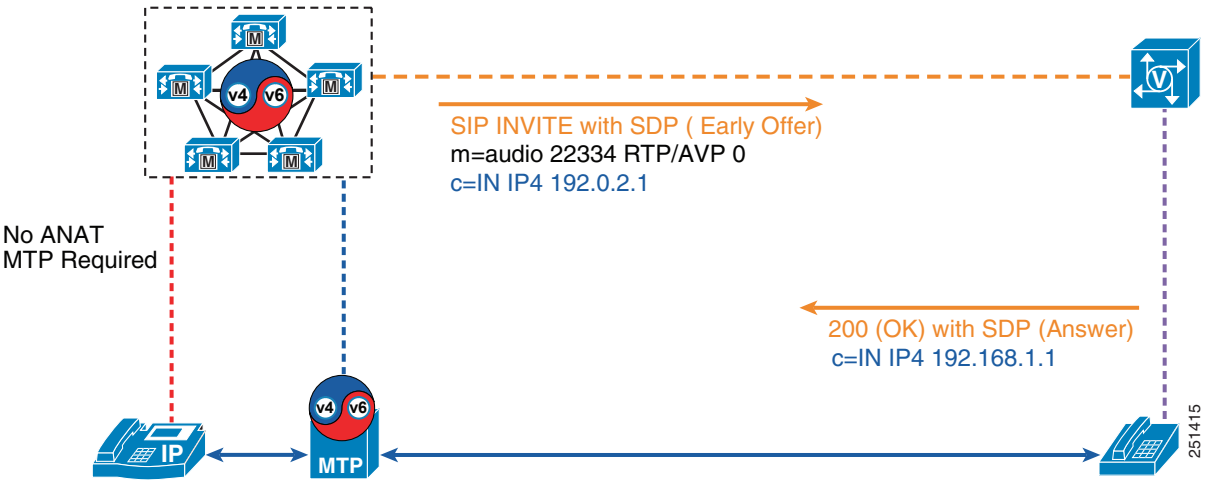
The remaining sections of this chapter review media selection for the following Unified CM call flows:

- SIP Early Offer calls
  - Outbound Early Offer calls without ANAT
  - Inbound Early Offer calls without ANAT
  - Outbound Early Offer calls with ANAT
  - Inbound Early Offer calls with ANAT
- SIP Delayed Offer calls
  - Outbound Delayed Offer calls without ANAT
  - Inbound Delayed Offer calls without ANAT
  - Outbound Delayed Offer calls with ANAT
  - Inbound Delayed Offer calls with ANAT

Media Selection for Outbound Early Offer Calls over Unified CM SIP Trunks without ANAT

As illustrated in Figure 7-5, SIP Early Offer calls involve two call legs: one from the phone to trunk MTP, and the other from the trunk MTP to the SIP voice gateway. The Cisco IOS MTP is configured to support both IPv4 and IPv6 addresses. ANAT has not been enabled on the SIP trunk in Figure 7-5, so as with a standard SIP trunk, only a single IP addressing version will be exchanged in the SIP Offer and Answer.

Figure 7-5 Media Selection on Unified CM SIP Trunks for Outbound Early Offer Calls without ANAT



Call Leg from Phone to Trunk MTP: Standard Unified CM In-Cluster Negotiation

The MTP is dual-stacked and can match the media addressing type of the phone if it is set to IPv4 only or IPv6 only. If the phone is also dual-stacked, the cluster-wide IP Addressing Mode Preference for Media (IPv4 or IPv6) determines which IP addressing version is used for media.

Call Leg from MTP Trunk to Voice Gateway: ANAT Not Enabled, and One Media Address is Sent in SDP (IPv4 or IPv6)

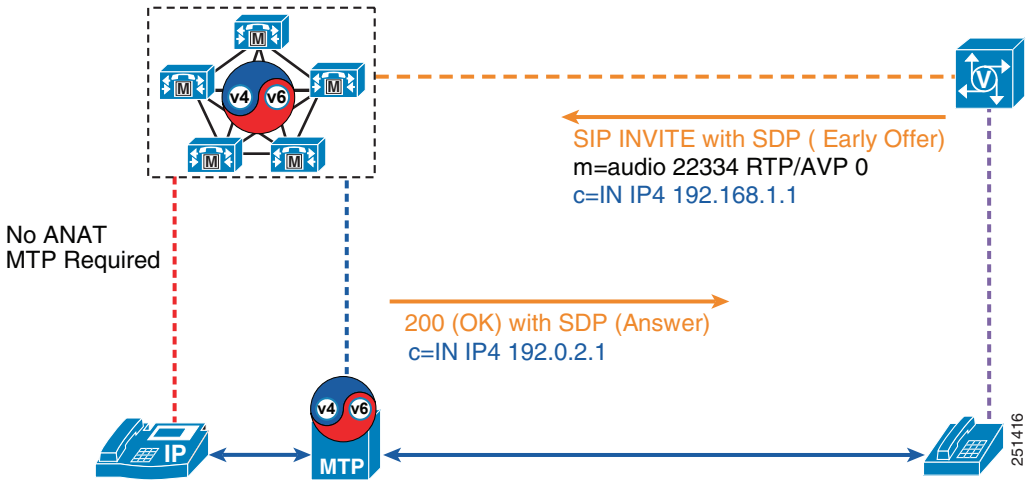
For outbound Early Offer calls where ANAT is not enabled, the IP Addressing Mode of the SIP trunk determines what is sent in the SDP body of the SIP Offer, as follows:

- IP Addressing Mode = IPv4 only — The IPv4 address of the MTP is sent in the SDP body.
- IP Addressing Mode = IPv6 only — The IPv6 address of the MTP is sent in the SDP body.
- IP Addressing Mode = IPv4 and IPv6 — The cluster-wide IP Addressing Mode Preference for Media (IPv4 or IPv6) is used to determine which MTP address is sent in the SDP body.

Media Selection for Inbound Early Offer Calls over Unified CM SIP Trunks without ANAT

As illustrated in Figure 7-6, SIP Early Offer calls involve two call legs: one from the phone to the trunk MTP, and the other from the trunk MTP to the SIP voice gateway. The Cisco IOS MTP is configured to support both IPv4 and IPv6 addresses. ANAT has not been enabled on the SIP trunk in Figure 7-6, so as with a standard SIP trunk, only a single IP addressing version is exchanged in the SIP Offer and Answer.

Figure 7-6 Media Selection on Unified CM SIP Trunks for Inbound Early Offer Calls without ANAT



Call Leg from Trunk MTP to Phone: Standard Unified CM In-Cluster Negotiation

The MTP is dual-stacked and can match the media addressing type of the phone if it is set to IPv4 only or IPv6 only. If the phone is also dual-stacked, the cluster-wide IP Addressing Mode Preference for Media (IPv4 or IPv6) determines which IP addressing version is used for media.

Call Leg from Voice Gateway to Trunk MTP: ANAT not enabled, and One Media Address is Received in SDP

For inbound Early Offer calls where ANAT is not enabled, the IP Addressing Mode of the SIP trunk determines whether the address received in the SDP body of the SIP Offer is accepted or rejected, As follows:

- IP Addressing Mode = IPv4 only:
  - If an IPv4 address is received in the SDP body, proceed with the call.
  - If an IPv6 address is received in the SDP body, reject the call.
- IP Addressing Mode = IPv6 only:
  - If an IPv6 address is received in the SDP body, proceed with the call.
  - If an IPv4 address is received in the SDP body, reject the call.

Note For these trunk calls, Unified CM does not insert an MTP to resolve a media addressing version mismatch between the two voice devices.

- IP Addressing Mode = IPv4 and IPv6:
  - If an IPv4 address is received in the SDP body, proceed with the call.
  - If an IPv6 address is received in the SDP body, proceed with the call.

SIP Early Offer Calls with ANAT

For the two call scenarios in this section, the SIP trunks use ANAT to exchange and negotiate IPv4 and IPv6 addresses for the media connection between the called and calling endpoints.

Alternative Network Address Types (ANAT)

ANAT is used in the SIP Offer and Answer exchange between dual-stack SIP trunks. ANAT allows devices to send both IPv4 and IPv6 addresses in the SDP body of the SIP Offer, and to return in the SDP body of the SIP Answer, a preferred IP address (IPv4 or IPv6) with which to establish a media connection.

The use of ANAT on a dual-stack SIP trunk is indicated in the header of the SIP Invite. The field **Require: sdp-anat** is used by Unified CM SIP trunks using Early Offer, and the field **Supported: sdp-anat** is used by Unified CM SIP trunks using Delayed Offer. The **Require: sdp-anat** value indicates to the far end of the SIP trunk connection that an ANAT response *must* be supported. The **Supported: sdp-anat** value indicates to the far end of the SIP trunk connection that an ANAT response *should* be supported.

Cisco supports ANAT on dual-stack SIP trunks only; that is, on SIP trunks configured with an addressing mode of **IPv4 and IPv6**.

The receipt of **Require: sdp-anat** or **Supported: sdp-anat** does not affect how Unified CM responds to inbound Invites on trunks configured for SIP Early Offer, but it does have an effect on how MTPs are assigned dynamically for inbound calls to Unified CM SIP trunks using Delayed Offer. (For details, see SIP Trunks Using Delayed Offer, page 7-14.)

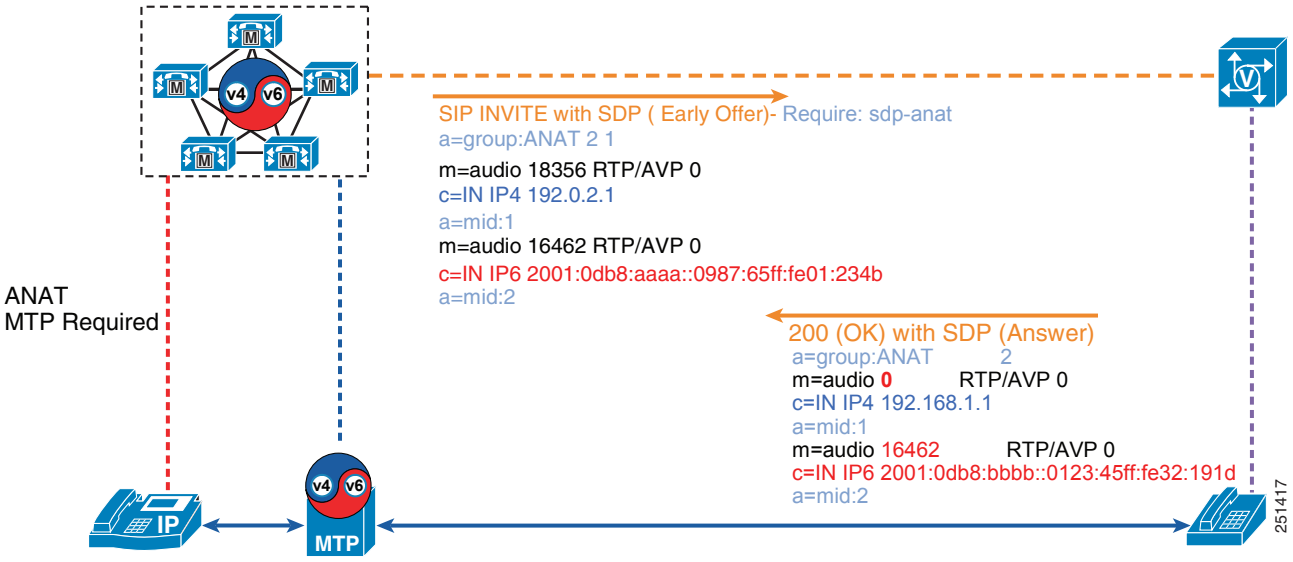
Unified CM supports ANAT over dual-stack (IPv4 and IPv6) SIP trunks. If ANAT is enabled, it should be configured on both ends of the SIP trunk. (If **Require: sdp-anat** is sent in the SIP Invite and the receiving SIP trunk does not support ANAT, all calls will be rejected.) To enable ANAT, check the **Enable ANAT** check box on the SIP Profile associated with the SIP trunk. ANAT can be used with both Early Offer and Delayed Offer calls.

ANAT should be enabled only on SIP trunks with an IP Addressing Mode setting of **IPv4 and IPv6**. Enabling ANAT on a single-stack SIP trunk (IPv4 only or IPv6 only) does not really make sense because only one IP address can be offered. Therefore, Cisco does not support ANAT on single-stack (IPv6 only or IPv4 only) SIP trunks.

Media Selection for Outbound Early Offer Calls over Unified CM SIP Trunks with ANAT Enabled

Figure 7-7 shows a simplified version the SIP Early Offer and SIP Answer using ANAT on dual-stack SIP trunks.

Figure 7-7 Media Selection on Unified CM SIP Trunks for Outbound Early Offer Calls with ANAT



As shown in Figure 7-7, SIP Early Offer calls involve two call legs: one from the phone to the trunk MTP, and the other from the trunk MTP to the SIP voice gateway. The Cisco IOS MTP is configured to support both IPv4 and IPv6 addresses. ANAT has been enabled on this SIP trunk, so both IPv4 and IPv6 addresses will be exchanged in the SIP Offer and Answer.

Call Leg from Phone to Trunk MTP: Standard Unified CM In-Cluster Negotiation

The MTP is dual-stacked and can match the media addressing type of the phone if it is set to IPv4 only or IPv6 only. If the phone is also dual-stacked, the cluster-wide IP Addressing Mode Preference for Media (IPv4 or IPv6) determines which IP addressing version is used for media.

Call Leg from MTP Trunk to Voice Gateway: ANAT Enabled, and Two Media Addresses Sent in SDP (IPv4 and IPv6)

Unified CM selects the media address preference indicated in the SDP body of the ANAT SIP Offer by using the cluster-wide setting for IP Addressing Mode Preference for Media. The IP Addressing Mode of the trunk must set to **IPv4 and IPv6**. The trunk's IP Addressing Mode could be set to IPv4 only or IPv6 only, but this would defeat the purpose of ANAT because only one address would be sent. (The trunk's IP Addressing Mode overrides the ANAT setting.)

The called device (voice gateway) selects which addressing version to use for the voice call. The caller's preference does not have to be honored. For the details of ANAT configuration on Cisco IOS gateways, see Configuring Cisco IOS Gateways, page D-1.

The Outbound SIP Early Offer

The SIP header of the Invite with the outbound SIP Early Offer contains the **Require: sdp-anat** field, indicating that ANAT must be supported by the far-end SIP device. For outbound SIP Offers on Unified CM SIP trunks configured for Early Offer, for all calls the SDP body of the SIP Offer includes the IPv4 address and UDP port number and the IPv6 address and UDP port number of the trunk's statically assigned MTP. The preferred addressing version for Unified CM is also indicated in the SDP body, and the field **a=group:ANAT 2 1** indicates that the second address (the IPv6 address) is preferred by Unified CM. For Early Offer calls, this preference is selected based on the cluster-wide IP Addressing Mode Preference for Media.

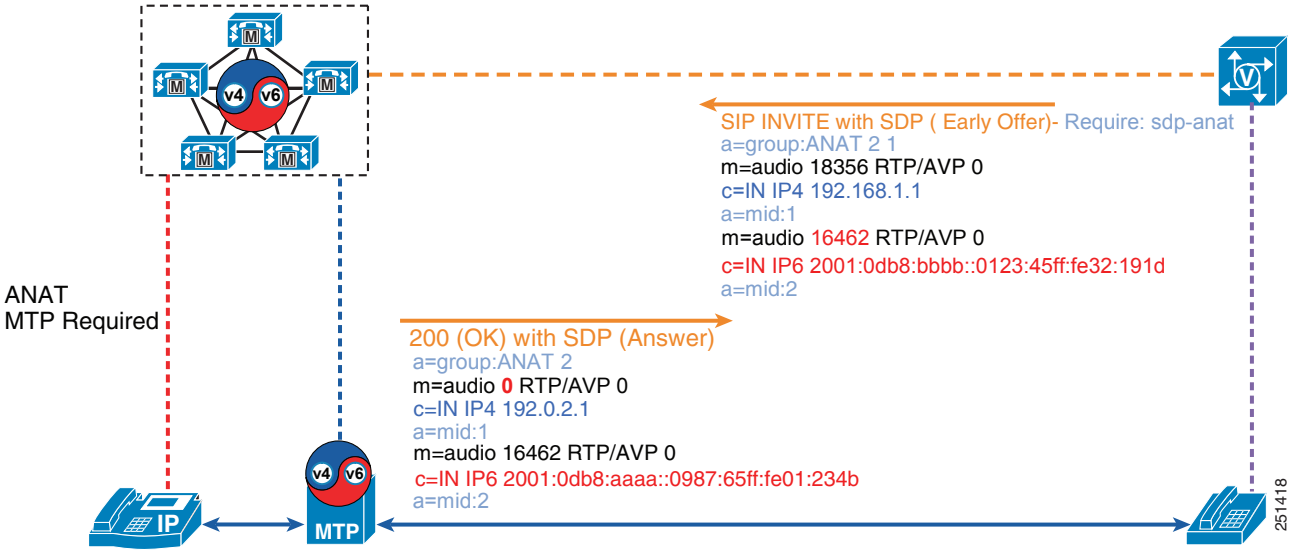
The Inbound SIP Answer

When the far-end SIP trunk receives an Invite with **Require: sdp-anat**, it must support ANAT and should return an ANAT-based response in its SIP Answer. If ANAT is not supported by the far-end SIP trunk, it should reject the call. In Figure 7-7, **a=group:ANAT 2** indicates the gateway's choice of its IPv6 address and port number for the voice call. Notice that the gateway's IPv6 address and IPv4 address are both included in the Answer; however, only the IPv6 UDP port number is returned, and the IPv4 UDP port number is set to zero.

Media Selection for Inbound Early Offer Calls over Unified CM SIP Trunks with ANAT Enabled

Figure 7-8 shows a simplified version the SIP Early Offer and SIP Answer using ANAT on dual-stack SIP trunks.

Figure 7-8 Media Selection on Unified CM SIP Trunks for Inbound Early Offer Calls with ANAT



As shown in Figure 7-8, SIP Early Offer calls involve two call legs: one from the phone to the trunk MTP, and the other from the trunk MTP to the SIP voice gateway. The Cisco IOS MTP is configured to support both IPv4 and IPv6 addresses. ANAT has been enabled on this SIP trunk, so both IPv4 and IPv6 addresses will be exchanged in the SIP Offer and Answer.

Call Leg from Trunk MTP to Phone: Standard Unified CM In-Cluster Negotiation

The MTP is dual-stacked and can match the media addressing version of the phone if it is set to IPv4 only or IPv6 only. If the phone is also dual stacked, the cluster-wide IP Addressing Mode Preference for Media (IPv4 or IPv6) is used to select which IP addressing version is used for media.

Call Leg from Voice Gateway to Trunk MTP: ANAT Enabled, and IPv4 and IPv6 Media Addresses Received in SDP

Unified CM does not honor the indicated address preference in the SDP body of the received SIP Offer. For dual-stack Unified CM SIP trunks (IP Addressing Mode = IPv4 and IPv6), Unified CM selects the addressing version for the voice call based on the setting of the cluster-wide IP Addressing Mode Preference for Media.

The Inbound SIP Early Offer

The SIP header of the Invite with the outbound SIP Early Offer contains the **Require: sdp-anat** field, indicating that ANAT must be supported by Unified CM. The SDP body of the SIP Offer includes the IPv4 address and UDP port number and the IPv6 address and UDP port number of the calling device. The preferred addressing version of the calling device is also indicated in the SDP body, and the field **a=group:ANAT 2 1** indicates that the second address (the IPv6 address) is preferred. For the details of ANAT configuration on Cisco IOS gateways, see Configuring Cisco IOS Gateways, page D-1.

The Outbound SIP Answer

When the Unified CM SIP Early Offer trunk receives an Invite with **Require: sdp-anat**, it must support ANAT and should return an ANAT-based response in its SIP Answer. If ANAT is not supported by the Unified CM SIP trunk, it will reject the call. For Unified CM trunks configured for Early Offer, Unified CM returns the IPv4 and IPv6 addresses of the trunk MTP in its SIP Answers. In Figure 7-8, **a=group:ANAT 2** indicates Unified CM's choice for the IPv6 address and port number of the MTP for the voice call. Notice that the MTP's IPv6 address and IPv4 address are both included in the Answer; however, only the IPv6 UDP port number is returned, and the IPv4 UDP port number is set to zero.

Note Unified CM selects the addressing version for the voice call based on the setting of the cluster-wide IP Addressing Mode Preference for Media. The incoming preference is not honored by Unified CM.

SIP Trunks Using Delayed Offer

With Delayed Offer, SIP trunks do not use a statically assigned MTP, and typically only one call leg is created between the calling phone and called phone or device. From the perspective of Unified CM, this makes the selection of which IP addressing version to use a little more involved because in this case both the trunk's settings and the phone's settings must be taken into account.

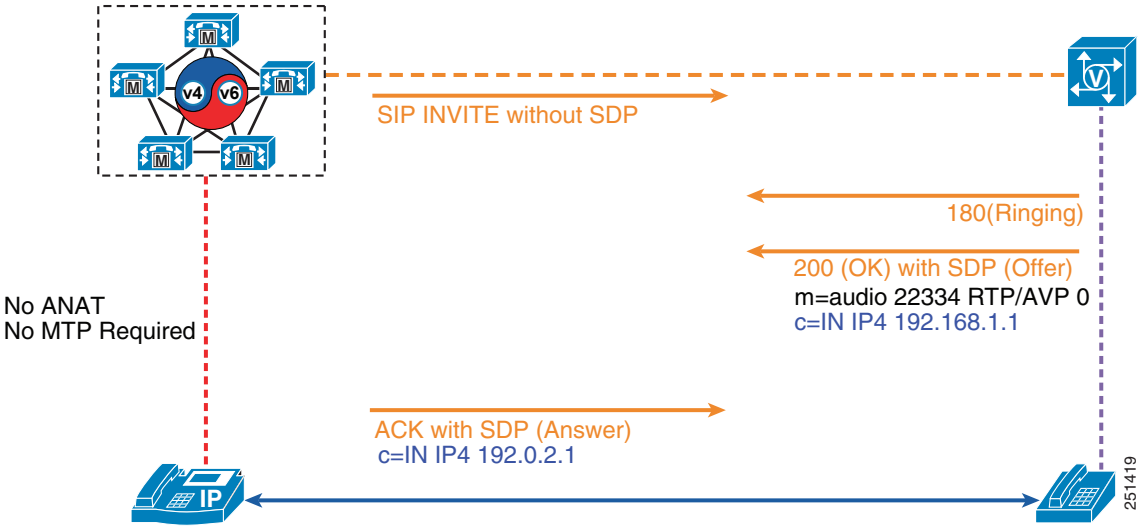
This section discusses the following call scenarios:

- Outbound Delayed Offer calls without ANAT
- Inbound Delayed Offer calls without ANAT
- Outbound Delayed Offer calls with ANAT
- Inbound Delayed Offer calls with ANAT and where **Supported: sdp-anat** is received
- Inbound Delayed Offer calls with ANAT and where **Require: sdp-anat** is received

Media Selection for Outbound Delayed Offer Calls over Unified CM SIP Trunks without ANAT

As shown in Figure 7-9, SIP Delayed Offer calls typically involve a single call leg from the phone to the SIP voice gateway. ANAT has not been enabled on this SIP trunk, so as with a standard SIP trunk, only a single IP addressing version is exchanged in the SIP Offer and Answer.

Figure 7-9 Media Selection on Unified CM SIP Trunks for Outbound Delayed Offer Calls without ANAT



For outbound Delayed Offer calls, the IP Addressing Mode settings of both the trunk and the phone influence the call setup in the following ways:

- The IP Addressing Mode setting of the trunk determines whether the received SIP Offer is accepted or rejected.
- The IP Addressing Mode setting of the phone determines which address (phone or MTP) is returned in the SIP Answer from Unified CM.

In this scenario, Unified CM can dynamically insert an MTP, if needed, into the call to convert the IP addressing version of the voice media stream between the calling and called devices. As mentioned previously, dynamically inserted MTPs support the pass-through codec, allowing video calls and encrypted calls to be established.

IP Addressing Mode of the Trunk

- IP Addressing Mode = IPv4 only:
  - If an IPv4 address is received in the SDP body, proceed with the call.
  - If an IPv6 address is received in the SDP body, reject the call.
- IP Addressing Mode = IPv6 only:
  - If an IPv6 address is received in the SDP body, proceed with the call.
  - If an IPv4 address is received in the SDP body, reject the call.

Note For trunk call signaling, Unified CM does not insert an MTP to resolve a media addressing version mismatch.

- IP Addressing Mode = IPv4 and IPv6 (Recommended configuration):
  - If an IPv4 address is received in the SDP body, proceed with the call.
  - If an IPv6 address is received in the SDP body, proceed with the call.

For SIP trunks using Delayed Offer and not using ANAT, the recommended trunk IP Addressing Mode setting is **IPv4 and IPv6** because both IPv6 calls and IPv4 calls will be accepted by the trunk.

IP Addressing Mode of the Phone

- IP Addressing Mode = IPv4 only:
  - If an IPv4 address is received in the SDP body, proceed with the call and return the IPv4 address of the phone in the SDP body of the SIP answer.
  - If an IPv6 address is received in the SDP body, dynamically insert an MTP into the media path to convert IP addressing versions, then proceed with the call. Return the IPv6 address of the MTP in the SDP body of the SIP answer.
- IP Addressing Mode = IPv6 only:
  - If an IPv6 address is received in the SDP body, proceed with the call and return the IPv6 address of the phone in the SDP body of the SIP answer.
  - If an IPv4 address is received in the SDP body, dynamically insert an MTP into the media path to convert IP addressing versions, then proceed with the call. Return the IPv4 address of the MTP in the SDP body of the SIP answer.
- IP Addressing Mode = IPv4 and IPv6:
  - If an IPv4 address is received in the SDP body, proceed with the call and return the IPv4 address of the phone in the SDP body of the SIP answer.
  - If an IPv6 address is received in the SDP body, proceed with the call and return the IPv6 address of the phone in the SDP body of the SIP answer.

When an MTP is Required, Will the MTP of the Phone or the Trunk Be Used?

The cluster-wide IP Addressing Mode Preference for Media determines whether the MTP of the phone or of the trunk is used to convert the voice media stream between IPv4 and IPv6. This preference is used to select an MTP so that the longest Real-Time Transport Protocol (RTP) call leg in the cluster matches the cluster-wide preference.

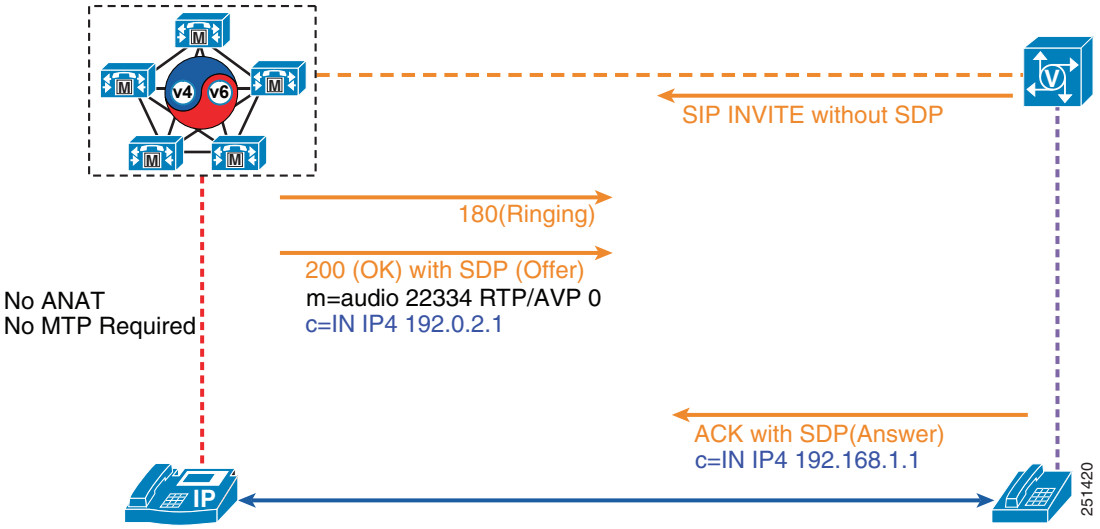
Deployment Considerations for Delayed Offer Calls over Trunks without ANAT

If a call from an IPv4-only phone receives a SIP Offer that contains an IPv6 address, or if a call from an IPv6-only phone receives a SIP Offer that contains an IPv4 address, Unified CM will dynamically insert an MTP to convert between IPv4 and IPv6. In deployments with large numbers of IPv4-only phones, any SIP trunk call to or from an IPv6-only device will require an MTP for conversion between IPv4 and IPv6. Therefore, Cisco recommends that you provide MTP resources for IPv4-only and IPv6-only devices in the Unified CM cluster.

Media Selection for Inbound Delayed Offer Calls over Unified CM SIP Trunks without ANAT

As shown in Figure 7-10, SIP Delayed Offer calls typically involve a single call leg from the phone to the SIP voice gateway. ANAT has not been enabled on this SIP trunk, so as with a standard SIP trunk, only a single IP addressing version is exchanged in the SIP Offer and Answer.

Figure 7-10 Media Selection on Unified CM SIP Trunks for Inbound Delayed Offer Calls without ANAT



For inbound Delayed Offer calls, the combined settings of the IP Addressing Mode of both the trunk and the phone determine which IP addressing version and which device's IP address is sent in the SDP body of the SIP Offer.

For inbound Delayed Offer calls, if a mismatch exists between the IP addressing modes of the phone and the trunk, Unified CM can dynamically insert an MTP into the call path to convert the IP addressing version of the voice media stream from the IP phone, so that it matches that configured on the trunk. In this case the address of the MTP is sent in the SDP body of Unified CM's SIP Offer.

For SIP trunks using Delayed Offer and not using ANAT, the recommended IP Addressing Mode setting for the trunk is **IPv4 and IPv6**. With this setting, Unified CM does not need to insert MTPs for inbound SIP Delayed Offer calls.

When an MTP is Required, Will the MTP of the Phone or the Trunk Be Used?

The cluster-wide IP Addressing Mode Preference for Media determines whether the MTP of the phone or of the trunk is used to convert the voice media stream between IPv4 and IPv6 (see Table 7-1). This preference is used to select an MTP so that the longest Real-Time Transport Protocol (RTP) call leg in the cluster matches the cluster-wide preference.

As mentioned previously, dynamically inserted MTPs do support the pass-through codec, allowing video calls and encrypted calls to be established.

Table 7-1 IP Addressing Mode Preference for Media

IP Addressing Mode of Phone	IP Addressing Mode of Trunk	Address Sent in SIP Offer by Unified CM
IPv4Only	IPv4Only	IPv4 address of phone
IPv4Only	IPv4 and IPv6	IPv4 address of phone
IPv6Only	IPv6Only	IPv6 address of phone
IPv6Only	IPv4 and IPv6	IPv6 address of phone
IPv4Only	IPv6Only	Insert an MTP and use its IPv6 address
IPv6Only	IPv4Only	Insert an MTP and use its IPv4 address
IPv4 and IPv6	IPv4Only	IPv4 address of phone
IPv4 and IPv6	IPv6Only	IPv6 address of phone
IPv4 and IPv6	IPv4 and IPv6	IPv4 or IPv6 address of phone[1]

1. The cluster-wide IP Addressing Mode Preference for Media determines which phone address (IPv4 or IPv6) Unified CM sends in the SDP body of the SIP Offer.

Media Selection for Delayed Offer Calls over Unified CM SIP Trunks with ANAT Enabled

In the following call scenarios, the SIP trunks use ANAT to exchange IPv4 and IPv6 addresses for the media connection between the called and calling endpoints:

- Outbound Delayed Offer calls with ANAT
- Inbound Delayed Offer calls with ANAT, where **Supported: sdp-anat** is received
- Inbound Delayed Offer calls with ANAT, where **Require: sdp-anat** is received

Alternative Network Address Types (ANAT)

ANAT is used in the SIP Offer and Answer exchange between dual-stack SIP trunks. ANAT allows SIP devices to send both IPv4 and IPv6 addresses in the SDP body of the SIP Offer, and to return in the SDP body of the SIP Answer, the preferred IP address (IPv4 or IPv6) with which to establish a media connection.

The use of ANAT on a SIP trunk is indicated in the header of the SIP Invite. The field **Require: sdp-anat** is used by Unified CM SIP trunks using Early Offer, and the field **Supported: sdp-anat** is used by Unified CM SIP trunks using Delayed Offer. The **Require: sdp-anat** value indicates to the far end of the SIP trunk connection that an ANAT response *must* be supported. The **Supported: sdp-anat** value indicates to the far end of the SIP trunk connection that an ANAT response *should* be supported.

For inbound calls to Unified CM SIP trunks using Delayed Offer, the receipt of these require or supported sdp-anat values by Unified CM has the following effects on how MTPs are assigned dynamically:

- If Unified CM receives an Invite with **Require: sdp-anat**, it returns two IP addressees in the SDP body of its ANAT SIP Offer (and therefore inserts an MTP for calls to IPv4-only and IPv6-only devices).
- If Unified CM receives an Invite with **Supported: sdp-anat**, it returns the IP address(es) supported by the called device in the SDP body of its SIP Offer. In the case of an IP addressing version mismatch between the calling and called device for calls between Unified CM clusters, the calling Unified CM cluster will insert an MTP for conversions between IPv4 and IPv6.

- MTPs are not needed for calls to ANAT-enabled dual-stack Unified CM SIP trunks where **Supported: sdp-anat** is received; whereas when **Require: sdp-anat** is received by Unified CM, MTPs are needed for single-stack (IPv4-only or IPv6-only) endpoints.

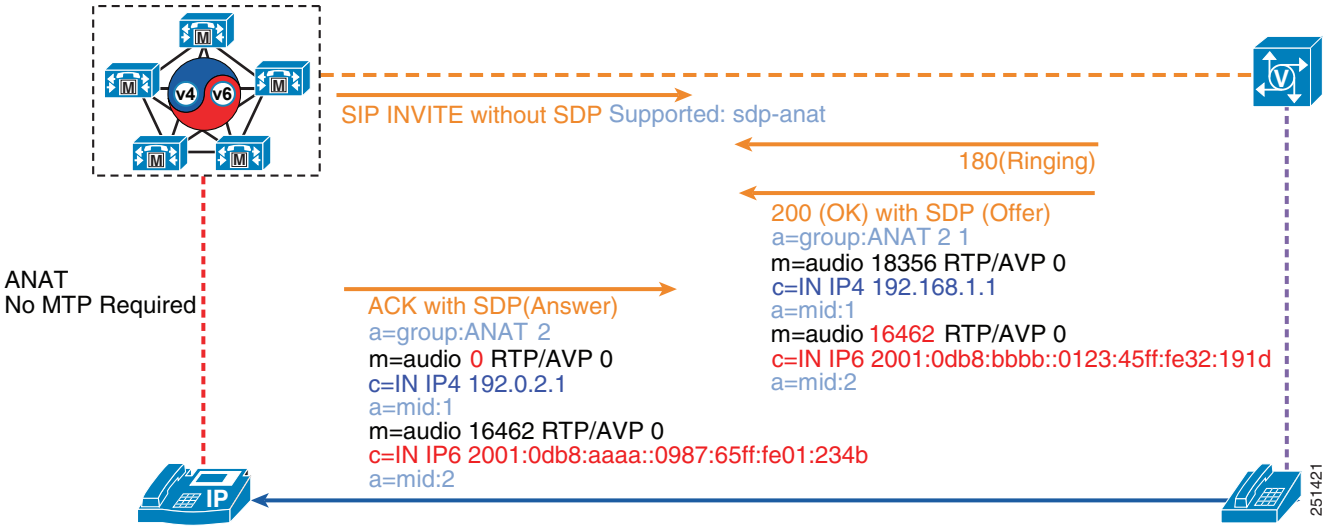
Unified CM supports ANAT over dual-stack (IPv4 and IPv6) SIP trunks. If ANAT is enabled, it should be configured on both ends of the SIP trunk. (If **Require: sdp-anat** is sent in the SIP Invite and the receiving SIP trunk does not support ANAT, all calls will be rejected.) To enable ANAT, check the **Enable ANAT** check box on the SIP Profile associated with the SIP trunk. ANAT can be used with both Early Offer and Delayed Offer calls.

ANAT should be enabled only on SIP trunks with an IP Addressing Mode setting of **IPv4 and IPv6**. Enabling ANAT on a single-stack SIP trunk (IPv4 only or IPv6 only) does not really make sense because only one IP address can be offered.

Media Selection for Outbound Delayed Offer Calls over Unified CM SIP Trunks with ANAT Enabled

Figure 7-11 shows a simplified version of the SIP Delayed Offer and SIP Answer using ANAT on dual-stack SIP trunks.

Figure 7-11 Media Selection on Unified CM SIP Trunks for Outbound Delayed Offer Calls with ANAT



SIP Delayed Offer calls typically involve a single call leg from the phone to SIP voice gateway. For outbound SIP Delayed Offer calls, Unified CM sends **Supported: sdp-anat** in its SIP Invite.

The Outbound SIP Invite

The SIP header of the outbound Delayed Offer SIP Invite contains **Supported: sdp-anat**, indicating to the far-end device that ANAT is supported by this Unified CM trunk and should be supported by the far-end trunk. If ANAT is not supported by the far-end trunk, the call can still proceed, and only a single IP address is returned in the (non-ANAT) SIP Offer. In this case, Unified CM selects a media address (and inserts MTPs if required), as described in the section on Media Selection for Outbound Delayed Offer Calls over Unified CM SIP Trunks without ANAT, page 7-15).

The Inbound SIP Delayed Offer

The SDP body of the inbound SIP Offer includes the IPv4 address and UDP port number as well as the IPv6 address and UDP port number of the voice gateway. The preferred addressing version of the gateway is also indicated in the SDP body, and **a=group:ANAT 2 1** indicates that the second address (the IPv6 address) is preferred by the gateway. For Cisco IOS gateways, the ANAT IP addressing version preference is configured at the **voice service voip** level using the **protocol mode dual-stack preference** CLI command

For the details of ANAT configuration on Cisco IOS gateways, see Configuring Cisco IOS Gateways, page D-1.

The Outbound SIP Answer

With ANAT supported but not required, the SIP Answer from Unified CM does not have to contain both an IPv4 and an IPv6 address. If the calling device supports IPv4 Only or IPv6 Only, then only a single IP address is sent in the SDP body of the outbound SIP Answer. For the call shown in Figure 7-11, both the calling phone and trunk support both IPv4 and IPv6, in which case both addresses of the phone are sent in the SIP Answer. The **a=group:ANAT 2** indicates Unified CM's choice of the phone's IPv6 address and port number for the voice call. In this example, the phone's IPv6 address and IPv4 address are both included in the SIP Answer; however, only the IPv6 UDP port number is returned, and the IPv4 UDP port number is set to zero.

Note Unified CM does not have to honor the IP addressing version preference received in the SIP Offer. The media addressing version preference sent by Unified CM in the SDP Answer is set by the cluster-wide IP Addressing Mode Preference for Media (see Table 7-2).

Table 7-2 Address(es) Sent in the SIP Answer from a Dual-Stack ANAT-Enabled Unified CM SIP Trunk

IP Addressing Mode of Phone	IP Addressing Mode of Trunk	Address Sent in SIP Answer by Unified CM
IPv4	IPv4 and IPv6	IPv4 address of the phone
IPv6	IPv4 and IPv6	IPv6 address of the phone
IPv4 and IPv6	IPv4 and IPv6	IPv4 and IPv6 addresses of phone[1]

1. The media addressing version preference sent in the SDP Answer is set by the cluster-wide IP Addressing Mode Preference for Media.

When only one valid IP address and UDP port number is available to be returned by Unified CM in the SIP Answer, a second invalid address (typically the IPv4 or IPv6 address received in the SIP Offer) is returned in the SIP Answer, with its UDP port number set to 0.

Inbound Delayed Offer Calls with ANAT

Based on the far-end trunk configuration, inbound SIP Invites to Unified CM from a trunk using Delayed Offer and ANAT could contain either **Require: sdp-anat** or **Supported: sdp-anat** in the SIP header. Dual-stack Unified CM SIP trunks respond as follows to inbound calls with each of these settings:

- With **Require: sdp-anat**, Unified CM always sends a valid IPv4 address and a valid IPv6 address in the SIP Offer.
- With **Supported: sdp-anat**, Unified CM sends the IP address(es) supported by the called device.

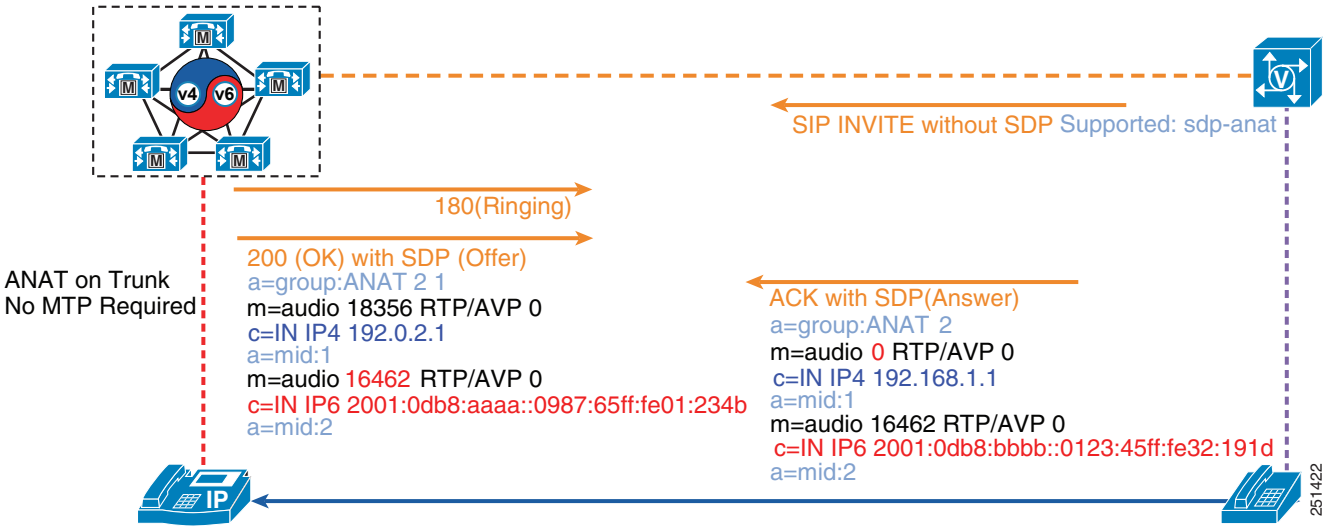
For inbound calls to ANAT-enabled dual-stack Unified CM SIP trunks where **Supported: sdp-anat** is received in the SIP Invite, Unified CM does not have to use MTPs; whereas when **Require: sdp-anat** is received by Unified CM, MTPs must be used for single-stack (IPv4-only or IPv6-only) endpoints. These two call types are discussed in detail below.

Note Unified CM trunks always send **Supported: sdp-anat** in Delayed Offer SIP Invites. The default setting for Cisco IOS gateways is to send **Require: sdp-anat** Early Offer calls.

Media Selection for Inbound Delayed Offer Calls over Unified CM SIP Trunks with ANAT Enabled and "Supported: sdp-anat" in the Inbound SIP Invite

Figure 7-12 shows a simplified version of the SIP Offer and SIP Answer using ANAT, where the calling trunk sends **Supported: sdp-anat** in its SIP Invite. As illustrated, SIP Delayed Offer calls typically involve a single call leg from the phone to the SIP voice gateway.

Figure 7-12 Media Selection on Unified CM SIP Trunks for Inbound Delayed Offer Calls with ANAT and Supported: sdp anat



The Inbound SIP Invite

The SIP header of the inbound Delayed Offer SIP Invite contains **sdp-anat** in the Supported field, indicating to Unified CM that an ANAT response *should* be supported by this trunk. For Cisco IOS gateways, you can configure the ANAT IP addressing version preference at the **voice service voip** level by using the **protocol mode dual-stack preference** CLI command.

For the details of ANAT configuration on Cisco IOS gateways, see Configuring Cisco IOS Gateways, page D-1.

The Outbound SIP Offer

With ANAT supported but not required, Unified CM's outbound SIP Offer does not have to contain both an IPv4 address and an IPv6 address. If the called device supports IPv4 Only or IPv6 Only, then only a single IP address is sent in the SDP body of the SIP Offer. For the call shown in Figure 7-12, both the

called phone and the trunk support both IPv4 and IPv6, in which case the SDP body of the SIP Delayed Offer includes the IPv4 address and UDP port number as well as the IPv6 address and UDP port number of the called IP phone. The preferred addressing version of Unified CM is also indicated in the SDP body, and **a=group:ANAT 2 1** indicates that the second address (the IPv6 address) is preferred by Unified CM. For outbound Delayed Offer calls, this preference is selected based on the cluster-wide IP Addressing Mode Preference for Media.

The Inbound SIP Answer

If Unified CM sends a single address in its SIP Offer, the calling trunk should respond as if it is a Delayed Offer call without ANAT enabled. For the call shown in Figure 7-12, both the called phone and the trunk support both IPv4 and IPv6. In the received SIP Answer, **a=group:ANAT 2** indicates the gateway's choice of its IPv6 address and port number for the voice call. Both the gateway's IPv6 address and its IPv4 address are included in the SIP Answer; however, only the IPv6 UDP port number is returned, and the IPv4 UDP port number is set to zero. (See Table 7-3.)

Note The called device does not have to honor the IP addressing version preference of the calling device.

Table 7-3 Address(es) Sent in the SIP Offer from a Dual-Stack ANAT-Enabled Unified CM SIP Trunk

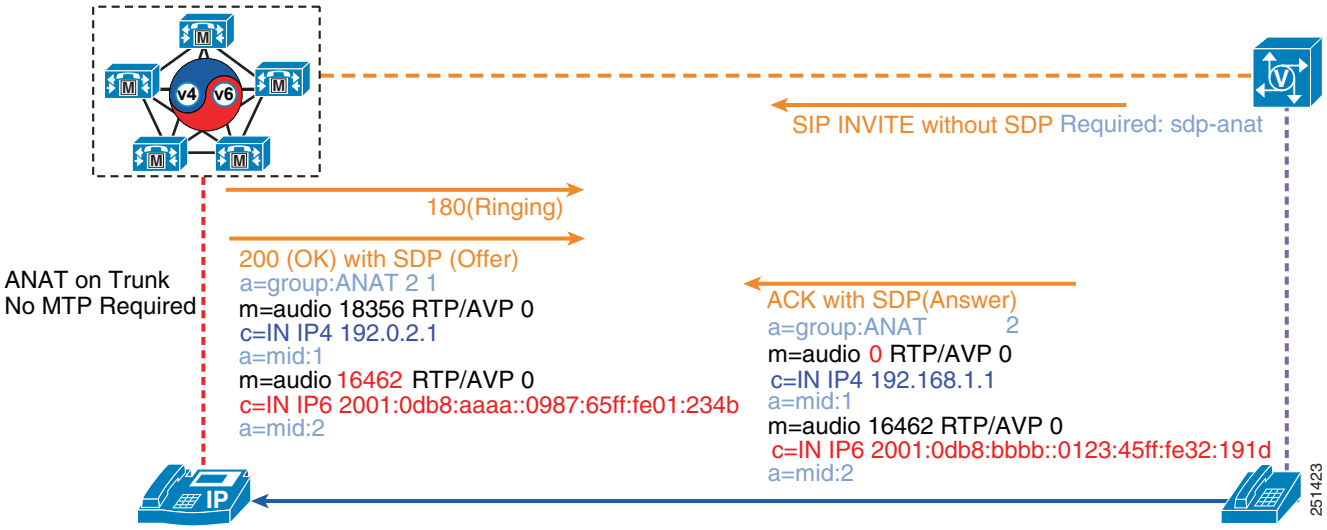
IP Addressing Mode of Phone	IP Addressing Mode of Trunk	Address Sent in SIP Offer from Unified CM
IPv4	IPv4 and IPv6	IPv4 address of phone
IPv6	IPv4 and IPv6	IPv6 address of phone
IPv4 and IPv6	IPv4 and IPv6	IPv4 and IPv6 addresses of phone

If only one IP address is available to be sent in the SIP Offer, then only this single IP address is sent, and accordingly only one address (of the same IP addressing version) is expected in the SIP Answer.

Media Selection for Inbound Delayed Offer Calls over Unified CM SIP Trunks with ANAT Enabled and "Require: sdp-anat" in the Inbound SIP Invite

Figure 7-13 shows a simplified version of the SIP Offer and SIP Answer using ANAT, where the calling device sends **Require: sdp-anat** in its SIP Invite. As illustrated, SIP Delayed Offer calls typically involve a single call leg from the phone to the SIP voice gateway.

Figure 7-13 Media Selection on Unified CM SIP Trunks for Inbound Delayed Offer Calls with ANAT and Require: sdp anat



The Inbound SIP Invite

The SIP header of the inbound Delayed Offer SIP Invite contains **sdp-anat** in the Require field, indicating that ANAT responses must be supported by this Unified CM trunk. For Cisco IOS gateways, you can configure the ANAT IP addressing version preference at the **voice service voip** level by using the **protocol mode dual-stack preference** CLI command.

For the details of ANAT configuration on Cisco IOS gateways, see Configuring Cisco IOS Gateways, page D-1.

The Outbound SIP Offer

With ANAT required, Unified CM's SIP Offer must contain both an IPv4 and an IPv6 address. If the called device supports an addressing mode of IPv4 Only or IPv6 Only, then Unified CM dynamically inserts an MTP and sends its IPv4 address as well as its IPv6 address in the SDP body of the SIP Offer. For the call shown in Figure 7-13, both the called phone and trunk support both IPv4 and IPv6, in which case the SDP body of the SIP Delayed Offer includes the IPv4 address and UDP port number as well as the IPv6 address and UDP port number of the called IP phone. Unified CM's preferred addressing version is also indicated in the SDP body, and **a=group:ANAT 2 1** indicates that the second address (the IPv6 address) is preferred by Unified CM. For Outbound Delayed Offer calls, the cluster-wide IP Addressing Mode Preference for Media determines this preference.

The Inbound SIP Answer

When ANAT is required by the calling trunk, it will send an ANAT-based response in its SIP answer. In the received SIP Answer, **a=group:ANAT 2** indicates the gateway's choice of its IPv6 address and port number for the voice call. Both the gateway's IPv6 address and its IPv4 address are included in the SIP Answer; however, only the IPv6 UDP port number is returned, and the IPv4 UDP port number is set to zero.

Note The called device does not have to honor the IP addressing version preference of the calling device.

For inbound Delayed Offer calls with **Require: sdp-anat** in the received Invite, the IP Addressing Mode of the trunk is set to **IPv4 and IPv6**. If a mismatch exists between the phone's and the trunk's IP Addressing Modes, Unified CM dynamically inserts an MTP into the call path and sends the MTP's IPv4 and IPv6 addresses in the SDP body of SIP Offer from Unified CM.

When an MTP is Required, Will the MTP of the Phone or the Trunk Be Used?

The cluster-wide IP Addressing Mode Preference for Media determines whether the MTP of the phone or of the trunk is used to convert the voice media stream between IPv4 and IPv6 (see Table 7-4). This preference is used to select an MTP so that the longest Real-Time Transport Protocol (RTP) call leg in the cluster matches the cluster-wide preference.

As mentioned previously, dynamically inserted MTPs do support the pass-through codec, allowing video calls and encrypted calls to be established.

Table 7-4 Address(es) Sent in the SIP Offer from a Dual-Stack ANAT-Enabled Unified CM SIP Trunk

IP Addressing Mode of Phone	IP Addressing Mode of Trunk	Address sent in SIP Offer from Unified CM
IPv4	IPv4 and IPv6	Insert MTP, and send IPv4 and IPv6 addresses of MTP
IPv6	IPv4 and IPv6	Insert MTP, and send IPv4 and IPv6 addresses of MTP
IPv4 and IPv6	IPv4 and IPv6	IPv4 and IPv6 addresses of phone