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A Mixer Control Package for the Media Control Channel Framework
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Abstract

This document defines a Media Control Channel Framework Package for managing mixers for media conferences and connections. The package defines request elements for managing conference mixers, managing mixers between conferences and/or connections, as well as associated responses and notifications. The package also defines elements for auditing package capabilities and mixers.

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Internet-Draft

Mixer Control Package

February 2010

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Internet-Draft

Mixer Control Package

February 2010

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[1.](#) Introduction

The Media Control Channel Framework [\[I-D.ietf-mediactrl-sip-control-framework\]](#) provides a generic approach for establishment and reporting capabilities of remotely initiated commands. The Framework utilizes many functions provided by the Session Initiation Protocol [\[RFC3261\]](#) (SIP) for the rendezvous and establishment of a reliable channel for control interactions. The Control Framework also introduces the concept of a Control Package. A Control Package is an explicit usage of the Control Framework for a particular interaction set. This specification defines a package for media conference mixers and media connection mixers.

This package defines mixer management elements for creating, modifying and deleting conference mixers, elements for joining, modifying and unjoining media streams between connections and conferences (including mixers between connections), as well as associated responses and notifications. The package also defines elements for auditing package capabilities and mixers.

This package has been designed to satisfy media mixing requirements

documented in the Media Server Control Protocol Requirements document ([[RFC5167](#)]); more specifically REQ-MCP-22, REQ-MCP-23, REQ-MCP-24, REQ-MCP-25, REQ-MCP-26 and REQ-MCP-27.

The package provides the major conferencing functionality of SIP Media Server languages such as MSCML ([[RFC5022](#)]) and MSML ([[RFC5707](#)]). A key differentiator is that this package provides such functionality using the Media Control Channel Framework.

Out of scope for this mixer package are more advanced functions including personalized video mixes for conference participants, support for floor control protocols, as well as support for video overlays and text insertion. Such functionality can be addressed by extensions to this package (through addition of foreign elements or attributes from another namespace) or use of other control packages which could build upon this package.

The functionality of this package is defined by messages, containing XML [[XML](#)] elements, transported using the Media Control Channel Framework. The XML elements can be divided into two types: mixer management elements; and elements for auditing package capabilities as well as mixers managed by the package.

The document is organized as follows. [Section 3](#) describes how this control package fulfills the requirements for a Media Control Channel Framework control package. [Section 4](#) describes the syntax and

semantics of defined elements, including mixer management ([Section 4.2](#)) and audit elements ([Section 4.3](#)). [Section 5](#) describes an XML schema for these elements and provides extensibility by allowing attributes and elements from other namespaces. [Section 6](#) provides examples of package usage. [Section 7](#) describes important security considerations for use of this control package. [Section 8](#) provides information on IANA registration of this control package, including its name, XML namespace and MIME media type.

2. Conventions and Terminology

In this document, [BCP 14](#)/RFC 2119 [[RFC2119](#)] defines the key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL". In addition, [BCP 15](#) indicates requirement levels for compliant implementations.

The following additional terms are defined for use in this document:

Application server: A SIP [[RFC3261](#)] application server (AS) is a control client that hosts and executes services such as interactive media and conferencing in an operator's network. An AS controls the media server (MS), influencing and impacting the SIP sessions terminating on a media server, which the AS can have established for example using SIP third party call control.

Media Server: A media server (MS) processes media streams on behalf of an AS by offering functionality such as interactive media, conferencing, and transcoding to the end user. Interactive media functionality is realized by way of dialogs, which are identified by a URI and initiated by the application server.

MS Conference: A MS Conference provides the media related mixing resources and services for conferences. In this document, A MS Conference is often referred to simply as a conference.

MS Connection: A Media Server connection represents the termination on a media server of one or more RTP [[RFC3550](#)] sessions that are associated to a single SIP dialog. A media server receives media from the output(s) of a connection and it transmits media on the input(s) of a connection.

Media Stream: A media stream on a media server represents a media flow between either a connection and a conference, between two connections, or between two conferences. Streams can be audio or video and can be bi-directional or uni-directional.

This section fulfills the mandatory requirement for information that MUST be specified during the definition of a Control Framework Package, as detailed in Section 8 of [\[I-D.ietf-mediactrl-sip-control-framework\]](#).

[3.1.](#) Control Package Name

The Control Framework requires a Control Package definition to specify and register a unique name. The name and version of this Control Package is "msc-mixer/1.0" (Media Server Control - Mixer - version 1.0). Its IANA registration is specified in [Section 8.1](#).

Since this is the initial ("1.0") version of the control package, there are no backwards compatibility issues to address.

[3.2.](#) Framework Message Usage

The Control Framework requires a Control Package to explicitly detail the control messages that can be used as well as provide an indication of directionality between entities. This will include which role type is allowed to initiate a request type.

This package specifies CONTROL and response messages in terms of XML elements defined in [Section 4](#), where the message bodies have the MIME media type defined in [Section 8.4](#). These elements describe requests, response and notifications and all are contained within a root <mscmixer> element ([Section 4.1](#)).

In this package, the MS operates as a Control Server in receiving requests from, and sending responses to, the AS (operating as Control Client). Mixer management requests and responses are defined in [Section 4.2](#). Audit requests and responses are defined in [Section 4.3](#). Mixer management and audit responses are carried in a framework 200 response or REPORT message bodies. This package's response codes are defined in [Section 4.5](#).

Note that package responses are different from framework response codes. Framework error response codes (see Section 8 of [\[I-D.ietf-mediactrl-sip-control-framework\]](#)) are used when the request or event notification is invalid; for example, a request is invalid XML (400), or not understood (500).

The MS also operates as a Control Client in sending event notification to the AS (Control Server). Event notifications ([Section 4.2.4](#)) are carried in CONTROL message bodies. The AS MUST respond with a Control Framework 200 response.

[3.3.](#) Common XML Support

The Control Framework requires a Control Package definition to specify if the attributes for media dialog or conference references are required.

This package requires that the XML Schema in Section 16.1 of [\[I-D.ietf-mediactrl-sip-control-framework\]](#) MUST be supported for media dialogs and conferences.

The package uses "connectionid" and "conferenceid" attributes for various element definitions ([Section 4](#)). The XML schema ([Section 5](#)) imports the definitions of these attributes from the framework schema.

[3.4.](#) CONTROL Message Body

The Control Framework requires a Control Package to define the control body that can be contained within a CONTROL command request and to indicate the location of detailed syntax definitions and semantics for the appropriate body types.

When operating as Control Server, the MS receives CONTROL messages with the MIME media type defined in [Section 8.4](#) and a body containing a <mscmixer> element ([Section 4.1](#)) with either a mixer management or audit request child element.

The following mixer management request elements are carried in CONTROL message bodies to MS: <createconference> ([Section 4.2.1.1](#)), <modifyconference> ([Section 4.2.1.2](#)), <destroyconference> ([Section 4.2.1.3](#)), <join> ([Section 4.2.2.2](#)), <modifyjoin> ([Section 4.2.2.3](#)) and <unjoin> ([Section 4.2.2.4](#)) elements.

The <audit> request element ([Section 4.3.1](#)) is also carried in CONTROL message bodies.

When operating as Control Client, the MS sends CONTROL messages with the MIME media type defined in [Section 8.4](#) and a body containing a <mscmixer> element ([Section 4.1](#)) with a notification <event> child element ([Section 4.2.4](#)).

[3.5.](#) REPORT Message Body

The Control Framework requires a control package definition to define the REPORT body that can be contained within a REPORT command request, or that no report package body is required. This section

indicates the location of detailed syntax definitions and semantics for the appropriate body types.

When operating as Control Server, the MS sends REPORT bodies with the MIME media type defined in [Section 8.4](#) and a <mscmixer> element with a response child element. The response element for mixer management requests is a <response> element ([Section 4.2.3](#)). The response element for an audit request is a <auditresponse> element ([Section 4.3.2](#)).

[3.6.](#) Audit

The Control Framework encourages Control Packages to specify whether auditing is available, how it is triggered as well as the query/response formats.

This Control Packages supports auditing of package capabilities and mixers on the MS. An audit request is carried in a CONTROL message and an audit response in a REPORT message (or a 200 response to the CONTROL if it can execute the audit in time).

The syntax and semantics of audit request and response elements is defined in [Section 4.3](#).

[3.7.](#) Examples

The Control Framework recommends Control Packages to provide a range of message flows that represent common flows using the package and this framework document.

This Control Package provides examples of such message flows in [Section 6](#).

[4.](#) Element Definitions

This section defines the XML elements for this package. The elements are defined in the XML namespace specified in [Section 8.2](#).

The root element is <mscmixer> ([Section 4.1](#)). All other XML elements (requests, responses and notification elements) are contained within it. Child elements describe mixer management ([Section 4.2](#)) and audit ([Section 4.3](#)) functionality. Response status codes are defined in [Section 4.5](#) and type definitions in [Section 4.6](#).

Implementation of this control package MUST address the Security Considerations described in [Section 7](#).

Implementation of this control package MUST adhere to the syntax and semantics of XML elements defined in this section and the schema ([Section 5](#)). The XML schema supports extensibility by allowing attributes and elements from other namespaces. Implementations MAY support attributes and elements from other (foreign) namespaces. If an MS implementation receives a <mscmixer> element containing attributes or elements from another namespace which it does not support, the MS sends a 428 response ([Section 4.5](#)).

Extensible attributes and elements are not described in this section. In all other cases where there is a difference in constraints between the XML schema and the textual description of elements in this section, the textual definition takes priority.

Usage examples are provided in [Section 6](#).

[4.1.](#) <mscmixer>

The <mscmixer> element has the following attributes (in addition to standard XML namespace attributes such as xmlns):

version: a string specifying the mscmixer package version. The value is fixed as '1.0' for this version of the package. The attribute is mandatory.

The <mscmixer> element has the following defined child elements, only one of which can occur:

1. mixer management elements defined in [Section 4.2](#):

<createconference> create and configure a new conference mixer.
See [Section 4.2.1.1](#)

<modifyconference> modify the configuration of an existing conference mixer. See [Section 4.2.1.2](#)

<destroyconference> destroy an existing conference mixer. See [Section 4.2.1.3](#)

<join> create and configure media streams between connections and/or conferences (for example, add a participant to a conference). See [Section 4.2.2.2](#)

<modifyjoin> modify the configuration of joined media streams. See [Section 4.2.2.3](#)

<unjoin> delete a media stream (for example, remove a participant from a conference). See [Section 4.2.2.4](#)

<response> response to a mixer request. See [Section 4.2.3](#)

<event> mixer or subscription notification. See [Section 4.2.4](#)

2. audit elements defined in [Section 4.3](#):

<audit> audit package capabilities and managed mixers. See [Section 4.3.1](#)

<auditresponse> response to an audit request. See [Section 4.3.2](#)

For example, a request to the MS to create a conference mixer:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">  
  <createconference/>  
</mscmixer>
```

and a response from the MS that the conference was successfully created:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">  
  <response status="200" conferenceid="conference1"/>  
</mscmixer>
```

[4.2.](#) Mixer Elements

This section defines the mixer management XML elements for this control package. These elements are divided into requests, responses and notifications.

Request elements are sent to the MS to request a specific mixer operation to be executed. The following request elements are

defined:

<createconference> create and configure a new a conference mixer.
See [Section 4.2.1.1](#)

<modifyconference> modify the configuration of an existing
conference mixer. See [Section 4.2.1.2](#)

<destroyconference> destroy an existing conference mixer. See
[Section 4.2.1.3](#)

<join> create and configure media streams between connections and/or
conferences (for example, add a participant to a conference). See
[Section 4.2.2.2](#)

<modifyjoin> modify the configuration of joined media streams. See
[Section 4.2.2.3](#)

<unjoin> delete a media stream (for example, remove a participant from a conference). See [Section 4.2.2.4](#)

Responses from the MS describe the status of the requested operation. Responses are specified in a <response> element ([Section 4.2.3](#)) which includes a mandatory attribute describing the status in terms of a numeric code. Response status codes are defined in [Section 4.5](#). The MS MUST respond to a request message with a response message. If the MS is not able to process the request and carry out the mixer operation (in whole or in part), then the request has failed: the MS MUST ensure that no part of the requested mixer operation is carried out, and the MS MUST indicate the class of failure using an appropriate 4xx response code. Unless an error response code is specified for a class of error within this section, implementations follow [Section 4.5](#) in determining the appropriate status code for the response.

Notifications are sent from the MS to provide updates on the status of a mixer operation or subscription. Notifications are specified in an <event> element ([Section 4.2.4](#)).

[4.2.1](#). Conference Elements

[4.2.1.1](#). <createconference>

The <createconference> element is sent to the MS to request creation of a new conference (multiparty) mixer.

The <createconference> element has the following attributes:

conferenceid: string indicating a unique name for the new conference. If this attribute is not specified, the MS MUST create a unique name for the conference. The value is used in subsequent references to the conference (e.g. as conferenceid in a <response>). The attribute is optional. There is no default value.

reserved-talkers: indicates the requested number of guaranteed speaker slots to be reserved for the conference. A valid value is a non-negative integer (see [Section 4.6.2](#)). The attribute is optional. The default value is 0.

reserved-listeners: indicates the requested number of guaranteed listener slots to be reserved for the conference. A valid value is a non-negative integer (see [Section 4.6.2](#)). The attribute is optional. The default value is 0.

The <createconference> element has the following sequence of child elements:

<codecs>: an element to configure the codecs supported by the conference (see [Section 4.4](#)). If codecs are specified, then they impose limitations in media capability when the MS attempts to join the conference to other entities (see [Section 4.2.2.2](#) and [Section 4.2.2.3](#)). The element is optional.

<audio-mixing>: an element to configure the audio mixing characteristics of a conference (see [Section 4.2.1.4.1](#)). The element is optional.

<video-layouts>: an element to configure the video layouts of a conference (see [Section 4.2.1.4.2](#)). The element is optional.

<video-switch>: an element to configure the video switch policy for the layout of a conference (see [Section 4.2.1.4.3](#)). The element is optional.

<subscribe>: an element to request subscription to conference events. (see [Section 4.2.1.4.4](#)). The element is optional.

If the conferenceid attribute specifies a value which is already used by an existing conference, the MS reports an error (405) and MUST NOT create a new conference and MUST NOT affect the existing conference.

If the MS is unable to configure the conference according to specified reserved-talkers or reserved-listeners attributes, the MS reports an error (420) and MUST NOT create the conference.

If the MS is unable to configure the conference according to a specified <audio-mixing> element, the MS reports an error (421) and MUST NOT create the conference.

If the MS is unable to configure the conference according to a specified <video-layouts> element, the MS reports an error (423) and MUST NOT create the conference.

If the MS is unable to configure the conference according to a specified <video-switch> element, the MS reports an error (424) and MUST NOT create the conference.

If the MS is unable to configure the conference according to a specified <codecs> element, the MS reports an error (425) and MUST NOT create the conference.

When a MS has finished processing a <createconference> request, it MUST reply with an appropriate <response> element ([Section 4.2.3](#)).

For example, a request to create an audio video conference mixer with specified codecs, video layout, video switch and subscription:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <createconference conferenceid="conference1"
    reserved-talkers="1" reserved-listeners="10">
    <codecs>
      <codec>
        <subtype>H264</subtype>
      </codec>
      <codec>
        <subtype>PCMA</subtype>
      </codec>
    </codecs>
    <audio-mixing type="nbest"/>
    <video-layouts>
      <video-layout min-participants="1">single-view</video-layout>
      <video-layout min-participants="2">dual-view</video-layout>
      <video-layout min-participants="3">quad-view</video-layout>
    </video-layouts>
    <video-switch type="vas" interval="5"/>
    <subscribe>
      <active-talkers-sub interval="4"/>
    </subscribe>
  </createconference>
</mscmixer>
```

and a response from the MS if the conference was successfully created:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">  
  <response status="200" conferenceid="conference1"/>  
</mscmixer>
```

alternatively, a response if MS could not create the conference due to a lack of support for the H264 codec:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">  
  <response status="425" conferenceid="conference1"  
    reason="H264 codec not supported"/>  
</mscmixer>
```

[4.2.1.2](#). <modifyconference>

The <modifyconference> element is sent to the MS to request modification of an existing conference.

The <modifyconference> element has the following attributes:

conferenceid: string indicating the name of the conference to modify. This attribute is mandatory.

The <modifyconference> element has the following sequence of child elements (1 or more):

<codecs>: an element to configure the codecs supported by the conference (see [Section 4.4](#)). If codecs are specified, then they impose limitations in media capability when the MS attempts to join the conference to other entities (see [Section 4.2.2.2](#) and [Section 4.2.2.3](#)). Existing conference participants are unaffected by any policy change. The element is optional.

<audio-mixing>: an element to configure the audio mixing characteristics of a conference (see [Section 4.2.1.4.1](#)). The element is optional.

<video-layouts>: an element to configure the video layouts of a conference (see [Section 4.2.1.4.2](#)). The element is optional.

<video-switch>: an element to configure the video switch policy for the layout of a conference (see [Section 4.2.1.4.3](#)). The element is optional.

<subscribe>: an element to request subscription to conference events. (see [Section 4.2.1.4.4](#)). The element is optional.

If the conferenceid attribute specifies the name of a conference

which does not exist, the MS reports an error (406).

If the MS is unable to configure the conference according to a specified `<audio-mixing>` element, the MS reports an error (421) and MUST NOT modify the conference in any way.

If the MS is unable to configure the conference according to a specified `<video-layouts>` element, the MS reports an error (423) and MUST NOT modify the conference in any way.

If the MS is unable to configure the conference according to a specified `<video-switch>` element, the MS reports an error (424) and MUST NOT modify the conference in any way.

If the MS is unable to configure the conference according to a specified `<codecs>` element, the MS reports an error (425) and MUST NOT modify the conference.

When a MS has finished processing a `<modifyconference>` request, it MUST reply with an appropriate `<response>` element ([Section 4.2.3](#)).

[4.2.1.3](#). `<destroyconference>`

The `<destroyconference>` element is sent to the MS to request destruction of an existing conference.

The `<destroyconference>` element has the following attributes:

`conferenceid`: string indicating the name of the conference to destroy. This attribute is mandatory.

The `<destroyconference>` element does not specify any child elements.

If the `conferenceid` attribute specifies the name of a conference which does not exist, the MS reports an error (406).

When a MS has finished processing a `<destroyconference>` request, it MUST reply with an appropriate `<response>` element ([Section 4.2.3](#)).

Successfully destroying the conference (status code 200) will result in all connection or conference participants being removed from the conference mixer, `<unjoin-notify>` notification events

([Section 4.2.4.2](#)) being sent for each conference participant and a <conferenceexit> notification event ([Section 4.2.4.3](#)) indicating that conference has exited. A <response> with any other status code indicates that the conference mixer still exists and participants are still joined to the mixer.

[4.2.1.4](#). Conference Configuration

The elements in this section are used to establish and modify the configuration of conferences.

[4.2.1.4.1](#). <audio-mixing>

The <audio-mixing> element defines the configuration of the conference audio mix.

The <audio-mixing> element has the following attributes:

- type: is a string indicating the audio stream mixing policy. Defined values are: "nbest" (where the N best (loudest) participant signals are mixed) and "controller" (where the contributing participant(s) is/are selected by the controlling AS via an external floor control protocol). The attribute is optional. The default value is "nbest".
- n: indicates the number of eligible participants included in the conference audio mix. An eligible participant is a participant who contributes audio to the conference. Inclusion is based on having the greatest audio energy. A valid value is a non-negative integer (see [Section 4.6.2](#)). A value of 0 indicates that all participants contributing audio to the conference are included in the audio mix. The default value is 0. The element is optional.

If the type attribute does not have the value "nbest", the MS ignores the "n" attribute.

The <audio-mixing> element has no child elements.

For example, a fragment where the audio mixing policy is set to

"nbest" with 3 participants to be included:

```
<audio-mixing type="nbest" n="3"/>
```

If the conference had 200 participants of whom 30 contributed audio, then there would be 30 eligible participants for the audio mix. Of these, the 3 loudest participants would have their audio included in the conference.

[4.2.1.4.2.](#) <video-layouts>

The <video-layouts> element describe the video presentation layout configuration for participants providing a video input stream to the conference. This element allows multiple video layouts to be specified so that the MS automatically changes layout depending on

the number of video-enabled participants.

The <video-layouts> element has no attributes.

The <video-layouts> element has the following sequence of child elements (1 or more):

<video-layout>: element describing a video layout
([Section 4.2.1.4.2.1](#)).

If the MS does not support video conferencing at all, or does not support multiple video layouts, or does not support a specific video layout, the MS reports an 423 error in the response to the request element containing the <video-layouts> element.

An MS MAY support more than one <video-layout> element, although only one layout can be active at a time. A <video-layout> is active if the number of participants in the conference is equal to or greater than the value of its "min-participants" attribute, but less than the value of the "min-participants" attribute for any other <video-layout> element. An MS reports an error (400) if more than one <video-layout> has the same value for the "min-participants" attribute. When the number of regions within the active layout is greater than the number of participants in the conference, the display of unassigned regions is implementation-specific.

The assignment of participant video streams to regions within the layout is according to the video switch policy specified by the `<video-switch>` element ([Section 4.2.1.4.3](#)).

For example, a fragment describing a single layout:

```
<video-layouts>
  <video-layout>single-view</video-layout>
</video-layouts>
```

And a fragment describing a sequence of layouts:

```
<video-layouts>
  <video-layout min-participants="1">single-view</video-layout>
  <video-layout min-participants="2">dual-view</video-layout>
  <video-layout min-participants="3">quad-view</video-layout>
  <video-layout min-participants="5">multiple-3x3</video-layout>
</video-layouts>
```

When the conference has one participant providing a video input stream to the conference, then the single-view format is used. When the conference has two such participants, the dual-view layout is

used. When the conference has three or four participants, the quad-view layout is used. When the conference has five or more participants, the multiple-3x3 layout is used.

[4.2.1.4.2.1](#). `<video-layout>`

The `<video-layout>` element describes a video layout containing one or more regions in which participant video input streams are displayed.

The `<video-layout>` element has the following attributes:

min-participants: the minimum number of conference participants needed to allow this layout to be active. A valid value is a positive integer (see [Section 4.6.3](#)). The attribute is optional. The default value is 1.

The `<video-layout>` element has a content model specifying the name of the video layout.

An MS MAY support the predefined video layouts defined in the XCON conference information data model ([[I-D.ietf-xcon-common-data-model](#)]). The MS MAY support other video layouts. Non-XCON layouts MUST be prefixed with a label; for example, <video-layout>mylayout:single-view<video-layout>.

Each video layout has associated with it one or more regions. The XCON layouts are associated with the following named regions:

single-view layout with one stream in a single region as shown in Figure 1.

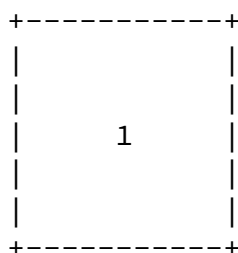


Figure 1: single-view video layout

dual-view layout presenting two streams side-by-side in two regions as shown in Figure 2. The MS MUST NOT alter the aspect ratio of each stream to fit the region and hence the MS might need to blank out part of each region.

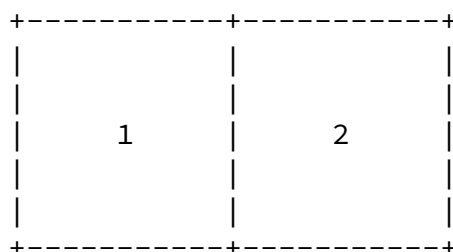


Figure 2: dual-view video layout

dual-view-crop layout presenting two streams side-by-side in two

regions as shown in Figure 3. The MS MUST alter the aspect ratio of each stream to fit its region so that no blanking is required.

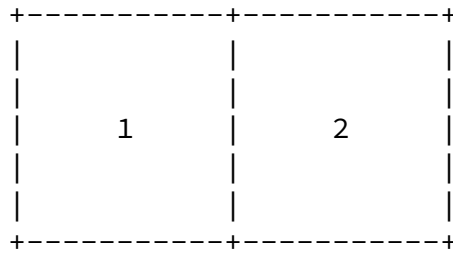


Figure 3: dual-view-crop video layout

dual-view-2x1 layout presenting two streams one above the other in two regions as shown in Figure 4. The MS MUST NOT alter the aspect ratio of each stream to fit its region and hence the MS might need to blank out part of each region.

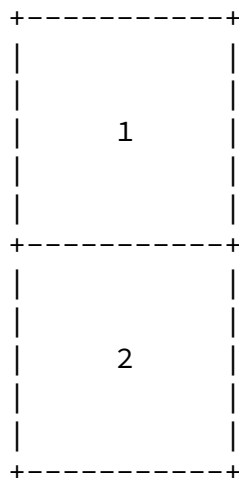


Figure 4: dual-view-2x1 video layout

dual-view-2x1-crop layout presenting two streams one above the other in two regions as shown in Figure 5. The MS MUST alter the aspect ratio of each stream to fit its region so that no blanking is

required.

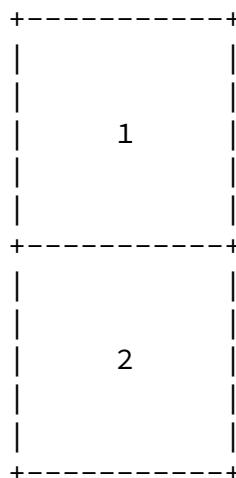


Figure 5: dual-view-2x1-crop video layout

quad-view layout presenting four equal-sized regions in a 2x2 layout as shown in Figure 6. Typically the aspect ratio of the streams is preserved, so blanking is required.

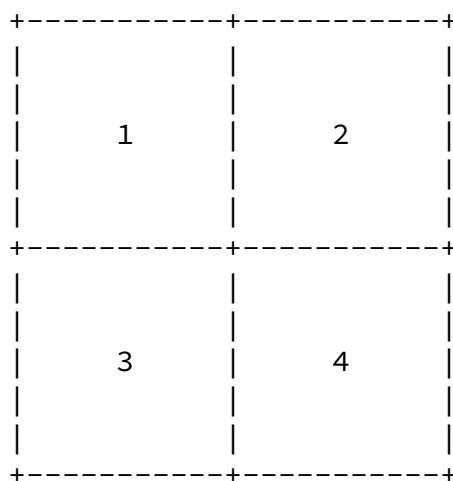


Figure 6: quad-view video layout

multiple-3x3 layout presenting nine equal-sized regions in a 3x3 layout as shown in Figure 7. Typically the aspect ratio of the streams is preserved, so blanking is required.

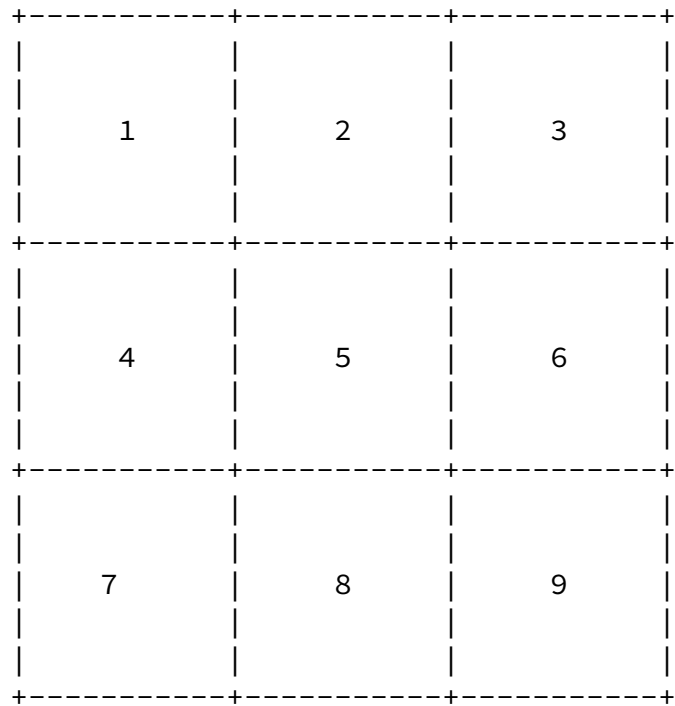


Figure 7: multiple-3x3 video layout

multiple-4x4 layout presenting sixteen equal-sized regions in a 4x4 layout as shown in Figure 8. Typically the aspect ratio of the streams is preserved, so blanking is required.

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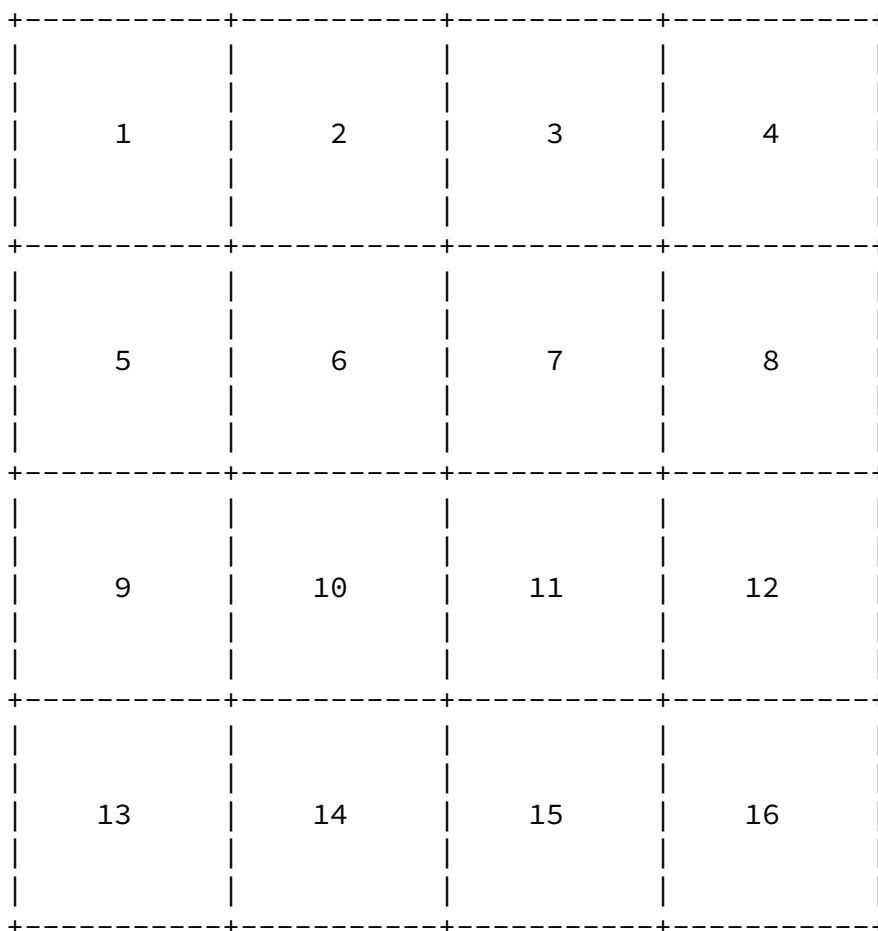


Figure 8: multiple-4x4 video layout

multiple-5x1 layout presents a 5x1 layout as shown in Figure 9 where one region will occupy 4/9 of the mixed video stream while the others will each occupy 1/9 of the stream. Typically the aspect ratio of the streams is preserved, so blanking is required.

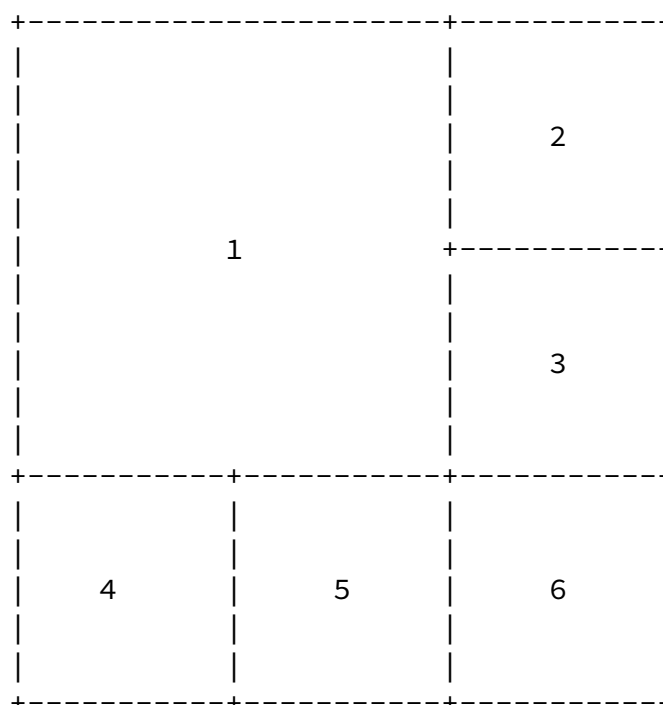


Figure 9: multiple-5x1 video layout

[4.2.1.4.3.](#) <video-switch>

The <video-switch> element describes the configuration of the conference policy for how participant's input video streams are assigned to regions within the active video layout.

The <video-switch> element has the following attributes:

type: a string indicating the video switching policy of the conference. Defined values are:

vas (Voice Activated Switching) enables automatic display of the

loudest speaker participant also providing a video input stream to the conference. Participants who do not provide an audio stream are not considered for automatic display. If a participant provides more than one audio stream, then the policy for inclusion of such a participant in the VAS is implementation-specific; an MS could select one stream, sum audio streams or ignore the participant for VAS consideration. If there is only one region in the layout, then the loudest speaker is displayed there. If more than one region is available, then the loudest speaker is displayed in the largest region, if any, and then in the first region from the top-left corner of the layout. The MS assigns the remaining regions based on the priority mechanism described in

[Section 4.2.1.4.3.1.](#)

controller enables manual control over video switching. The controller AS determines how the regions are assigned based on an external floor control policy. The MS receives <join>, <modifyjoin> and <join> commands with a <stream> element ([Section 4.2.2.5](#)) indicating the region where the stream is displayed. If no explicit region is specified, the MS assigns the region based on the priority mechanism described in [Section 4.2.1.4.3.1.](#)

An MS MAY support other video switching policies. Other policy names MUST be prefixed with a label; e.g. "mypolicies:policy1". The attribute is optional. The default value is 'vas'.

interval: specifies the period between video switches as a number of seconds. In the case of 'vas' policy, a speaker needs to be the loudest speaker for the interval before the switch takes place. A valid value is a non-negative integer (see [Section 4.6.2](#)). A value of 0 indicates that switching is applied immediately. The attribute is optional. The default value is 3 (seconds).

activespeakermix: indicates whether or not the active (loudest) speaker participant receives a video stream without themselves displayed in the case of the 'vas' switching policy. If enabled, the MS needs to generate two video streams for each conference mix: one for the active speaker participant without themselves displayed - details of this video layout are implementation-

specific; and one for other participants as described in the 'vas' switch policy above. A valid value is a boolean (see [Section 4.6.1](#)). A value of true indicates that a separate video mix is generated for the active speaker without themselves being displayed. A value of false indicates that all participants receive the same video mix. The attribute is optional. The default value is false. If the type attribute is not set to 'vas', the MS ignores this attribute.

If the MS does not support the specified video switching policy or other configuration parameters (including separate active speaker video mixes), then MS reports a 424 error ([Section 4.5](#)) in the response to the request element containing the <video-switch> element.

If the MS receives a <join> or <modifyjoin> request containing a <stream> element ([Section 4.2.2.5](#)) specifying a region and the conference video switching policy is set to 'vas', then the MS ignores the region (i.e. conference switching policy takes precedence).

If the MS receives a <join> or <modifyjoin> request containing a <stream> element ([Section 4.2.2.5](#)) specifying a region which is not defined for the currently active video layout, the MS MUST NOT report an error. Even though the participant is not currently visible, the MS displays the participant if the layout changes to one which defines the specified region.

The <video-switch> element has no child elements.

For example, a fragment specifying a 'vas' video switching policy with an interval of 2s

```
<video-switch type="vas" interval="2"/>
```

For example, a fragment specifying a 'controller' video switching policy where video switching takes place immediately:

```
<video-switch type="controller" interval="0"/>
```

[4.2.1.4.3.1](#). Priority assignment

In cases where the video switching policy does not explicitly determine the region to which a participant is assigned, the following priority assignment mechanism applies:

1. Each participant has an (positive integer) priority value: the lower the value, the higher the priority. The priority value is determined by the <priority> child element ([Section 4.2.2.5.4](#)) of <stream>. If not explicitly specified, the default priority value is 100.
2. The MS uses priority values to assign participants to regions in the video layout which remain unfilled after application of the video switching policy. The MS MUST dedicate larger and/or more prominent portions of the layout to participants with higher priority values first (e.g. first, all participants with priority 1, then those with 2, 3, etc).
3. The policy for displaying participants with the same priority is implementation-specific.

The MS applies this priority policy each time the video layout is changed or updated. It is RECOMMENDED that the MS does not move a participant from one region to another unless required by the video switching policy when an active video layout is updated.

This model allows the MS to apply default video layouts after applying the video switch policy. For example, region 2 is

statically assigned to Bob, so the priority mechanism only applies to regions 1, 3, 4, etc.

[4.2.1.4.4](#). <subscribe>

The <subscribe> element is a container for specifying conference notification events to which a controlling entity subscribes. Notifications of conference events are delivered using the <event> element (see [Section 4.2.4](#)).

The <subscribe> element has no attributes, but has the following child element:

<active-talkers-sub>: subscription to active talker events

([Section 4.2.1.4.4.1](#)). The element is optional.

The MS MUST support a <active-talkers-sub> subscription. It MAY support other event subscriptions (specified using attributes and child elements from a foreign namespace). If the MS does not support a subscription specified in a foreign namespace, it sends a <response> with a 428 status code (see [Section 4.5](#)).

[4.2.1.4.4.1](#). <active-talkers-sub>

The <active-talkers-sub> element has the following attributes:

interval: the minimum amount of time (in seconds) that elapses before further active talker events can be generated. A valid value is a non-negative integer (see [Section 4.6.2](#)). A value of 0 suppresses further notifications. The attribute is optional. The default value is 3 (seconds).

The <active-talker-sub> element has no child elements.

Active talker notifications are delivered in the <active-talker-notify> element ([Section 4.2.4.1](#)).

[4.2.2](#). Joining Elements

In this section, the joining model is defined ([Section 4.2.2.1](#)) as well as definitions of the <join> ([Section 4.2.2.2](#)), <modifyjoin> ([Section 4.2.2.3](#)), <unjoin> ([Section 4.2.2.4](#)) and <stream> ([Section 4.2.2.5](#)) elements.

[4.2.2.1](#). Joining Model

The <join> operation creates a media stream between a connection and a conference, between connections, or between conferences. This

section describes the model of conferences and connections and specifies the behavior for join requests to targets that already have an associated media stream.

Conferences support multiple inputs and have resources to mix them together. A media server conference in essence is a mixer that combines media streams. A simple audio mixer simply sums its input

audio signals to create a single common output. Conferences however use a more complex algorithm so that participants do not hear themselves as part of the mix. That algorithm, sometimes called an n-minus mix, subtracts each participants input signal from the summed input signals, creating a unique output for each contributing participant. Each <join> operation to a conference uses one of the conference's available inputs and/or outputs, to the maximum number of supported participants.

A connection is the termination of a RTP session(s) on a media server. It has a single input and output for each media session established by its SIP dialog. The output of a connection can feed several different inputs such as both a conference mixer and a recording of that participant's audio.

Joining two connections which are are not joined to anything else simply creates a media stream from the outputs(s) of one connection to the corresponding inputs(s) of the other connection. It is not necessary to combine media from multiple sources in this case. There are however several common scenarios where combining media from several sources to create a single input to a connection is needed.

In the first case, a connection can be receiving media from one source, for example a conference, and it is necessary to play an announcement to the connection so that both the conference audio and announcement can be heard by the conference participant. This is sometimes referred to as a whisper announcement. An alternative to a whisper announcement is to have the announcement pre-empt the conference media.

Another common case is the call center coaching scenario where a supervisor can listen to the conversation between an agent and a customer, and provide hints to the agent, which are not heard by the customer.

Both of these cases can be solved by having the controlling AS create one or more conferences for audio mixing, and then join and unjoin the media streams as required. A better solution is to have the media server automatically mix media streams that are requested to be joined to a common input when only the simple summing of audio signals as described above is required. This is the case for both

the use cases presented above.

Automatically mixing streams has several benefits. Conceptually, it is straight forward and simple, requiring no indirect requests on the part of the controlling AS. This increases transport efficiency and reduces the coordination complexity and the latency of the overall operation. Therefore, it is RECOMMENDED that a media server be able to automatically mix at least two audio streams where only the simple summing of signals is required.

When a media server receives a <join> request, it MUST automatically mix all of the media streams included in the request with any streams already joined to one of the entities identified in the request, or it MUST fail the request and MUST NOT join any of the streams (and MUST NOT change existing streams of the entities). A controlling AS uses the <createconference> request for generic conferences where the complex mixing algorithm is required.

Specifications which extend this package to handle additional media types such as text, MUST define the semantics of the join operation when multiple streams are requested to be joined to a single input, such as that for a connection with a single RTP session per media type.

4.2.2.2. <join>

The <join> element is sent to the MS to request creation of one or more media streams either between a connection and a conference, between connections, or between conferences. The two entities to join are specified by the attributes of <join>.

Streams can be of any media type, and can be bi-directional or uni-directional. A bi-directional stream is implicitly composed of two uni-directional streams that can be manipulated independently. The streams to be established are specified by child <stream> elements (see [Section 4.2.2.5](#)).

The <join> element has the following attributes:

- id1: an identifier for either a connection or a conference. The identifier MUST conform to the syntax defined in Section 16.1 of [\[I-D.ietf-mediactrl-sip-control-framework\]](#) The attribute is mandatory.
- id2: an identifier for either a connection or a conference. The identifier MUST conform to the syntax defined in Section 16.1 of [\[I-D.ietf-mediactrl-sip-control-framework\]](#) The attribute is mandatory.

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Note: Section 16.1 of [[I-D.ietf-mediactrl-sip-control-framework](#)] defines the semantics for a conference identifier but not its syntax. Media server implementations need to distinguish between conferences and connections based upon the values of the "id1" and "id2" attributes.

If id1 or id2 specify a conference identifier and the conference does not exist on the MS, the MS reports an error (406). If id1 or id2 specify a connection identifier and the connection does not exist on the MS, the MS reports an error (412).

The <join> element has the following child element (0 or more):

<stream>: an element that both identifies the media streams to join and defines the way that they are to be joined (see [Section 4.2.2.5](#)). The element is optional.

If no <stream> elements are specified, then the default is to join all streams between the entities according to the media configuration of the connection or conference.

One or more <stream> elements can be specified so that individual media streams can be controlled independently. For example, if a connection supports both audio and video streams, a <stream> element could be used to indicate that only the audio stream is used in receive mode. In cases where there are multiple media streams of the same type for a connection or conference, the configuration **MUST** be explicitly specified using <stream> elements.

Multiple <stream> elements can be specified for precise control over the media flow in different directions within the same media stream. One <stream> element can be specified for the receiving media flow and another element for the sending media flow, where each independently controls features such as volume (see child element of <stream> in [Section 4.2.2.5](#)). If there is only one <stream> element for a given media specifying a 'sendonly' or 'recvonly' direction, then the media flow in the opposite direction is inactive (established but no actual flow of media) unless this leads to a stream conflict.

If the MS is unable to execute the join as specified in <stream> because a <stream> element is in conflict with (a) another <stream> element, (b) with specified connection or conference media

capabilities (including supported or available codec information), or (c) with a SDP label value as part of the connection-id (see [Section 16.1](#) of [[I-D.ietf-mediactrl-sip-control-framework](#)]), then the MS reports an error (407) and MUST NOT join the entities and MUST NOT change existing streams of the entities.

If the MS is unable to execute the join as specified in <stream> elements because the MS does not support the media stream configuration, the MS reports an error (422) and MUST NOT join the entities and MUST NOT change existing streams of the entities.

If the MS is unable to join an entity to a conference because it is full, then the MS reports an error (410).

If the specified entities are already joined, then the MS reports an error (408).

If the MS does not support joining two specified connections together, the MS reports an error (426).

If the MS does not support joining two specified conferences together, the MS reports an error (427).

If the MS is unable to join the specified entities for any other reason, the MS reports an error (411).

When the MS has finished processing a <join> request, it MUST reply with an <response> element ([Section 4.2.3](#)).

For example, a request to join two connection together:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <join id1="1536067209:913cd14c" id2="1536067209:913cd14c"/>
</mscmixer>
```

and the response if the MS doesn't support joining media streams between connections:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <response status="426" reason="mixing connections not supported"/>
</mscmixer>
```

[4.2.2.3.](#) <modifyjoin>

The <modifyjoin> element is sent to the MS to request changes in the configuration of media stream(s) that were previously established between a connection and a conference, between two connections, or between two conferences.

The <modifyjoin> element has the following attributes:

id1: an identifier for either a connection or a conference. The identifier MUST conform to the syntax defined in Section 16.1 of [[I-D.ietf-mediactrl-sip-control-framework](#)] The attribute is mandatory.

id2: an identifier for either a connection or a conference. The identifier MUST conform to the syntax defined in Section 16.1 of [[I-D.ietf-mediactrl-sip-control-framework](#)] The attribute is mandatory.

The <modifyjoin> element has the following child elements (1 or more):

<stream>: an element that both identifies the media streams to modify and defines the way that each stream is now to be configured (see [Section 4.2.2.5](#)).

The MS MUST support <modifyjoin> for any stream that was established using <join>.

The MS MUST configure the streams that are included within <modifyjoin> to that stated by the child elements.

If the MS is unable to modify the join as specified in <stream> elements because a <stream> element is in conflict with (a) another <stream> element, (b) with specified connection or conference media capabilities (including supported or available codec information), or (c) with a SDP label value as part of the connection-id (see [Section 16.1](#) of [[I-D.ietf-mediactrl-sip-control-framework](#)]), then the MS

reports an error (407) and MUST NOT modify the join between the entities and MUST NOT change existing streams of the entities.

If the MS is unable to modify the join as specified in <stream> elements because the MS does not support the media stream configuration, the MS reports an error (422) and MUST NOT modify the join between the entities and MUST NOT change existing streams of the entities.

If the specified entities are not already joined, then the MS reports an error (409).

If the MS is unable to modify the join between the specified entities for any other reason, the MS reports an error (411).

When an MS has finished processing a <modifyjoin> request, it MUST reply with an appropriate <response> element ([Section 4.2.3](#)).

In cases where stream characteristics are controlled independently

for each direction, then a <modifyjoin> request needs to specify a child element for each direction in order to retain the original stream directionality. For the example, if a <join> request establishes independent control for each direction of an audio stream (see [Section 4.2.2.5](#)):

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <join id1="1536067209:913cd14c" id2="conference1">
    <stream media="audio" direction="sendonly">
      <volume controltype="setgain" value="-3"/>
    </stream>
    <stream media="audio" direction="recvonly">
      <volume controltype="setgain" value="+3"/>
    </stream>
  </join>
</mscmixer>
```

then the following <modifyjoin> request

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <modifyjoin id1="1536067209:913cd14c" id2="conference1">
    <stream media="audio" direction="sendonly">
```

```
    <volume controltype="setgain" value="0"/>
  </stream>
</modifyjoin>
</mscmixer>
```

would cause, in addition to the sendonly volume being modified, that the overall stream directionality changes from sendrecv to sendonly since there is no <stream> element in this <modifyjoin> request for the recvonly direction. The following would change the sendonly volume and retain the recvonly stream together with its original characteristics such as volume:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <modifyjoin id1="1536067209:913cd14c" id2="conference1">
    <stream media="audio" direction="sendonly">
      <volume controltype="setgain" value="0"/>
    </stream>
    <stream media="audio" direction="recvonly"/>
  </modifyjoin>
</mscmixer>
```

[4.2.2.4.](#) <unjoin>

The <unjoin> element is sent to the MS to request removal of previously established media stream(s) from between a connection and a conference, between two connections, or between two conferences.

The <unjoin> element has the following attributes:

id1: an identifier for either a connection or a conference. The identifier MUST conform to the syntax defined in Section 16.1 of [[I-D.ietf-mediactrl-sip-control-framework](#)] The attribute is mandatory.

id2: an identifier for either a connection or a conference. The identifier MUST conform to the syntax defined in Section 15.1 of [[I-D.ietf-mediactrl-sip-control-framework](#)] The attribute is mandatory.

The <unjoin> element has the following child element (0 or more occurrences):

<stream>: an element that identifies the media stream(s) to remove (see [Section 4.2.2.5](#)). The element is optional. When not present, all currently established streams between "id1" and "id2" are removed.

The MS MUST support <unjoin> for any stream that was established using <join> and has not already been removed by a previous <unjoin> on the same stream.

If the MS is unable to terminate the join as specified in <stream> elements because a <stream> element is in conflict with (a) another <stream> element, (b) with specified connection or conference media capabilities or (c) with a SDP label value as part of the connection-id (see Section 16.1 of [\[I-D.ietf-mediactrl-sip-control-framework\]](#)), then the MS reports an error (407) and MUST NOT terminate the join between the entities and MUST NOT change existing streams of the entities.

If the MS is unable to terminate the join as specified in <stream> elements because the MS does not support the media stream configuration, the MS reports an error (422) and MUST NOT terminate the join between the entities and MUST NOT change existing streams of the entities.

If the specified entities are not already joined, then the MS reports an error (409).

If the MS is unable to terminate the join between the specified entities for any other reason, the MS reports an error (411).

When an MS has successfully processed a <unjoin> request, it MUST reply with a successful <response> element ([Section 4.2.3](#)).

[4.2.2.5](#). <stream>

<join>, <modifyjoin> and <unjoin> require the identification and manipulations of media streams. Media streams represent the flow of media between a participant connection and a conference, between two connections, or between two conferences. The <stream> element is used (as a child to <join>, <modifyjoin> and <unjoin>) to identify the media stream(s) for the request and to specify the configuration of

the media stream.

The <stream> element has the following attributes:

media: a string indicating the type of media associated with the stream. The following values MUST be used for common types of media: "audio" for audio media, and "video" for video media. The attribute is mandatory.

label: a string indicating the SDP label associated with a media stream ([RFC4574](#)). The attribute is optional.

direction: a string indicating the allowed media flow of the stream relative to the value of the "id1" attribute of the parent element. Defined values are: "sendrecv" (media can be sent and received), "sendonly" (media can only be sent), "recvonly" (media can only be received) and "inactive" (stream established but no media flow). The default value is "sendrecv". The attribute is optional.

The <stream> element has the following sequence of child elements:

<volume>: an element ([Section 4.2.2.5.1](#)) to configure the volume or gain of the media stream. The element is optional.

<clamp>: an element ([Section 4.2.2.5.2](#)) to configure filtering and removal of tones from the media stream. The element is optional.

<region>: an element ([Section 4.2.2.5.3](#)) to configure a region within a video layout where the media stream is displayed. The element is optional.

<priority>: an element ([Section 4.2.2.5.4](#)) to configure priority associated with the stream in the media mix. The element is optional.

In each child element, the media stream affected is indicated by the value of the direction attribute of the parent element.

If the media attribute does not have the value of "audio", then the

If the media attribute does not have the value of "video", then the MS ignores a <region> element.

For example, a request to join a connection to conference in both directions with volume control:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <join id1="1536067209:913cd14c" id2="conference1">
    <stream media="audio" direction="sendrecv">
      <volume controltype="setgain" value="-3"/>
    </stream>
  </join>
</mscmixer>
```

where audio flow from the connection (id1) to the conference (id2) has the volume lowered by 3dB, and likewise the volume of the audio flow from the conference to the connection is lowered by 3 dB.

In this example, the volume is independently controlled for each direction.

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <join id1="1536067209:913cd14c" id2="conference1">
    <stream media="audio" direction="sendonly">
      <volume controltype="setgain" value="-3"/>
    </stream>
    <stream media="audio" direction="recvonly">
      <volume controltype="setgain" value="+3"/>
    </stream>
  </join>
</mscmixer>
```

where audio flow from the connection (id1) to the conference (id2) has the volume lowered by 3dB, but the volume of the audio flow from the conference to the connection is raised by 3 dB.

[4.2.2.5.1.](#) <volume>

The <volume> element is used to configure the volume of an audio media stream. It can be set to a specific gain amount, to automatically adjust the gain to a desired target level, or to mute the volume.

The <volume> element has no child elements but has the following attributes:

controltype: a string indicating the type of volume control to use for the stream. Defined values are: "automatic" (the volume will be adjusted automatically to the level specified by the "value" attribute), "setgain" (use the value of the "value" attribute as a specific gain measured in dB to apply), "setstate" (set the state of the stream to "mute" or "unmute" as specified by the value of the "value" attribute). The attribute is mandatory.

value: a string specifying the amount or state for the volume control defined by the value of the "controltype" attribute. The attribute is optional. There is no default value.

If the audio media stream is in a muted state, then the MS also changes automatically the state to unmuted with an "automatic" or "setgain" volume control. For the example, assume an audio stream has been muted with `<volume controltype="setstate" value="mute"/>`. If the gain on the same stream is changed with `<volume controltype="setgain" value="+3"/>`, then the volume is increased and stream state is also changed to unmuted.

[4.2.2.5.2.](#) `<clamp>`

The `<clamp>` element is used to configure whether tones are filtered and removed from a media stream.

The `<clamp>` element has no child elements but has the following attributes:

tones: A space-separated list of the tones to remove. The attribute is optional. The default value is "1 2 3 4 5 6 7 8 9 0 * # A B C D" (i.e. all DTMF tones removed).

[4.2.2.5.3.](#) `<region>`

The `<region>` element is used to explicitly specify the region within a video layout where the media stream is displayed.

The `<region>` element has no attributes and its content model specifies the name of the region layout.

[4.2.2.5.4.](#) `<priority>`

The `<priority>` element is used to explicitly specify the priority of a participant. The MS uses this priority to determine where the media stream is displayed within a video layout ([Section 4.2.1.4.3.1](#)).

The <priority> element has no attributes and its content model

specifies a positive integer (see [Section 4.6.3](#)). The lower the value, the higher the priority.

[4.2.3](#). <response>

Responses to requests are indicated by a <response> element.

The <response> element has following attributes:

status: numeric code indicating the response status. Valid values are defined in [Section 4.5](#). The attribute is mandatory.

reason: string specifying a reason for the response status. The attribute is optional.

conferenceid: string identifying the conference (see Section 16.1 of [[I-D.ietf-mediactrl-sip-control-framework](#)]). The attribute is optional.

connectionid: string identifying the SIP dialog connection (see Section 16.1 of [[I-D.ietf-mediactrl-sip-control-framework](#)]). The attribute is optional.

For example, a response when a conference was created successfully:

```
<response code="200">  
  <reason>Success</reason>  
</response>
```

The response if conference creation failed due to the requested conference id already existing:

```
<response code="403">  
  <reason>Conf already exists</reason>  
</response>
```

[4.2.4](#). <event>

When a mixer generates a notification event, the MS sends the event using an <event> element.

The <event> element has no attributes, but has the following sequence of child elements (0 or more instances of each child):

<active-talkers-notify> specifies an active talkers notification ([Section 4.2.4.1](#)).

<unjoin-notify> notifies that a connection or conference has been completely unjoined ([Section 4.2.4.2](#)).

<conferenceexit> notifies that a conference has exited ([Section 4.2.4.3](#)).

[4.2.4.1](#). <active-talkers-notify>

The <active-talkers-notify> element describes zero or more speakers that have been active in a conference during the specified interval (see [Section 4.2.1.4.4.1](#)).

The <active-talkers-notify> element has the following attributes:

conferenceid: string indicating the name of the conference from which the event originated. This attribute is mandatory.

The <active-talkers-notify> element has the following sequence of child elements (0 or more occurrences):

<active-talker> element describing an active talker ([Section 4.2.4.1.1](#)).

[4.2.4.1.1](#). <active-talker>

The <active-talker> element describes an active talker, associated with either a connection or conference participant in a conference.

The <active-talker> element has the following attributes:

connectionid: string indicating the connectionid of the active talker. This attribute is optional. There is no default value.

conferenceid: string indicating the conferenceid of the active talker. This attribute is optional. There is no default value.

Note that the element does not describe an active talker if both the connectionid and conferenceid attributes are specified, or if neither attribute is specified.

The <active-talker> element has no child elements.

[4.2.4.2](#). <unjoin-notify>

The <unjoin-notify> element describes a notification event where a connection and/or conference have been completely unjoined.

The <unjoin-notify> element has the following attributes:

status: a status code indicating why the unjoin occurred. A valid value is a non-negative integer (see [Section 4.6.2](#)). The MS MUST support the following values:

- 0 indicates the join has been terminated by a <unjoin> request.
- 1 indicates the join terminated due to an execution error.
- 2 indicates that the join terminated because a connection or conference has terminated.

All other valid but undefined values are reserved for future use, where a standards-track RFC is required to define new status codes. The AS MUST treat any status code it does not recognize as being equivalent to 1 (join execution error). The attribute is mandatory.

reason: a textual description providing a reason for the status

code; e.g. details about an error. A valid value is a string (see [Section 4.6.4](#)). The attribute is optional. There is no default value.

id1: an identifier for either a connection or a conference. The identifier MUST conform to the syntax defined in Section 16.1 of [[I-D.ietf-mediactrl-sip-control-framework](#)] The attribute is mandatory.

id2: an identifier for either a connection or a conference. The identifier MUST conform to the syntax defined in Section 16.1 of [[I-D.ietf-mediactrl-sip-control-framework](#)] The attribute is mandatory.

The <unjoin-notify> element has no child elements.

[4.2.4.3](#). <conferenceexit>

The <conferenceexit> element indicates that a conference has exited because it has been terminated or because a error occurred (for example, a hardware error in the conference mixing unit). This event MUST be sent by the MS whenever a successfully created conference exits.

The <conferenceexit> element has the following attributes:

conferenceid: string indicating the name of the conference. This attribute is mandatory.

status: a status code indicating why the conference exited. A valid value is a non-negative integer (see [Section 4.6.2](#)). The MS MUST support the following values:

- 0 indicates the conference has been terminated by a <destroyconference> request.
- 1 indicates the conference terminated due to an execution error.
- 2 indicates the conference terminated due to exceeding the maximum duration for a conference.

All other valid but undefined values are reserved for future use,

where a standards-track RFC is required to define new status codes. The AS MUST treat any status code it does not recognize as being equivalent to 1 (conference execution error). The attribute is mandatory.

reason: a textual description providing a reason for the status code; e.g. details about an error. A valid value is a string (see [Section 4.6.4](#)). The attribute is optional. There is no default value.

The <conferenceexit> element has no child elements.

When a MS sends a <conferenceexit> event, the identifier for the conference (conferenceid attribute) is no longer valid on the MS and can be reused for another conference.

For example, the following notification event would be sent from the MS when the conference with identifier "conference99" exits due to a successful <destroyconference/>:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <event>
    <conferenceexit conferenceid="conference99"
      status="0"/>
  </event>
</mscmixer>
```

[4.3.](#) Audit Elements

The audit elements defined in this section allow the MS to be audited for package capabilities as well as mixers managed by the package. Auditing is particularly important for two use cases. First, it enables discovery of package capabilities supported on an MS before an AS creates a conference mixer or joins connections and conferences. The AS can then use this information to create request elements using supported capabilities and, in the case of codecs, to negotiate an appropriate SDP for a user agent's connection. Second, auditing enables discovery of the existence and status of mixers

currently managed by the package on the MS. This could be used when one AS takes over management of mixers if the AS which created the mixers fails or is no longer available (see Security Considerations described in [Section 7](#)).

[4.3.1](#). <audit>

The <audit> request element is sent to the MS to request information about the capabilities of, and mixers currently managed with, this control package. Capabilities include supported conference codecs and video layouts. Mixer information includes the status of managed mixers as well as codecs.

The <audit> element has the following attributes:

capabilities: indicates whether package capabilities are to be audited. A valid value is a boolean (see [Section 4.6.1](#)). A value of true indicates that capability information is to be reported. A value of false indicates that capability information is not to be reported. The attribute is optional. The default value is true.

mixers: indicates whether mixers currently managed by the package are to be audited. A valid value is a boolean (see [Section 4.6.1](#)). A value of true indicates that mixer information is to be reported. A value of false indicates that mixer information is not to be reported. The attribute is optional. The default value is true.

conferenceid: string identifying a specific conference mixer to audit. It is an error (406) if the conferenceid attribute is specified and the conference identifier is not valid. The attribute is optional. There is no default value.

If the mixers attribute has the value true and conferenceid attribute is specified, then only audit information about the specified conference mixer is reported. If the mixers attribute has the value

false, then no mixer audit information is reported even if a conferenceid attribute is specified.

The <audit> element has no child elements.

When the MS receives an <audit> request, it MUST reply with a <auditresponse> element ([Section 4.3.2](#)) which includes a mandatory attribute describing the status in terms of a numeric code. Response status codes are defined in [Section 4.5](#). If the request is successful, the <auditresponse> contains (depending on attribute values) a <capabilities> element ([Section 4.3.2.1](#)) reporting package capabilities and a <mixers> element ([Section 4.3.2.2](#)) reporting managed mixer information. If the MS is not able to process the request and carry out the audit operation, the audit request has failed and the MS MUST indicate the class of failure using an appropriate 4xx response code. Unless an error response code is specified for a class of error within this section, implementations follow [Section 4.5](#) in determining the appropriate status code for the response.

For example, a request to audit capabilities and mixers managed by the package:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <audit/>
</mscmixer>
```

In this example, only capabilities are to be audited:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <audit mixers="false"/>
</mscmixer>
```

With this example, only a specific conference mixer is to be audited:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <audit capabilities="false" conferenceid="conf4"/>
</mscmixer>
```

[4.3.2](#). <auditresponse>

The <auditresponse> element describes a response to a <audit> request.

The <auditresponse> element has the following attributes:

status: numeric code indicating the audit response status. The attribute is mandatory. Valid values are defined in [Section 4.5](#).

reason: string specifying a reason for the status. The attribute is optional.

The <auditresponse> element has the following sequence of child elements:

<capabilities> element ([Section 4.3.2.1](#)) describing capabilities of the package. The element is optional.

<mixers> element ([Section 4.3.2.2](#)) describing information about managed mixers. The element is optional.

For example, a successful response to a <audit> request requesting capabilities and mixer information:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <auditresponse status="200">
    <capabilities>
      <codecs>
        <codec>
          <subtype>H263</subtype>
        </codec>
        <codec>
          <subtype>H264</subtype>
        </codec>
        <codec>
          <subtype>PCMU</subtype>
        </codec>
        <codec>
          <subtype>PCMA</subtype>
        </codec>
      </codecs>
    </capabilities>
    <mixers>
      <conferenceaudit conferenceid="conf1">
        <codecs>
          <codec>
            <subtype>PCMA</subtype>
          </codec>
        </codecs>
        <participants>
          <participant id="1536067209:913cd14c"/>
        </participants>
      </conferenceaudit>
      <joinaudit id1="1536067209:913cd14c" id2="conf1"/>
      <joinaudit id1="1636067209:113cd14c" id2="1836067209:313cd14c"/>
      <joinaudit id1="1736067209:213cd14c" id2="1936067209:413cd14c"/>
    </mixers>
  </auditresponse>
</mscmixer>
```

[4.3.2.1](#). <capabilities>

The <capabilities> element provides audit information about package capabilities.

The <capabilities> element has no attributes.

The <capabilities> element has the following sequence of child elements:

<codecs>: element ([Section 4.4](#)) describing codecs available to the package. The element is mandatory.

For example, a fragment describing capabilities:

```
<capabilities>
  <codecs>
    <codec>
      <subtype>H263</subtype>
    </codec>
    <codec>
      <subtype>H264</subtype>
    </codec>
    <codec>
      <subtype>PCMU</subtype>
    </codec>
    <codec>
      <subtype>PCMA</subtype>
    </codec>
  </codecs>
</capabilities>
```

[4.3.2.2](#). <mixers>

The <mixers> element provides audit information about mixers.

The <mixers> element has no attributes.

The <mixers> element has the following sequence of child elements (0 or more occurrences, any order):

<conferenceaudit>: audit information for a conference mixer ([Section 4.3.2.2.1](#)). The element is optional.

<joinaudit>: audit information for a join mixer ([Section 4.3.2.2.2](#)). The element is optional.

[4.3.2.2.1](#). <conferenceaudit>

The <conferenceaudit> element has the following attributes:

conferenceid: string identifying the conference (see Section 16.1 of [[I-D.ietf-mediactrl-sip-control-framework](#)]). The attribute is mandatory.

The <conferenceaudit> element has the following sequence of child elements:

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<codecs> element describing codecs used in the conference. See [Section 4.4](#). The element is optional.

<participants> element listing connections or conferences joined to the conference. See [Section 4.3.2.2.1.1](#). The element is optional.

<video-layout> element describing the active video layout for the conference. See [Section 4.2.1.4.2.1](#). The element is optional.

For example, a fragment describing a conference which has been created but has no participants:

```
<conferenceaudit conferenceid="conference1"/>
```

And a fragment when the same conference has three participants (two connections and another conference) joined to it:

```
<conferenceaudit conferenceid="conference1">
  <codecs>
    <codec>
      <subtype>PCMU</subtype>
    </codec>
  </codecs>
  <participants>
    <participant id="connection1"/>
```

```
<participant id="connection2"/>
<participant id="conference2"/>
</participants>
</conferenceaudit>
```

[4.3.2.2.1.1.](#) <participants>

The <participants> element is a container for <participant> elements ([Section 4.3.2.2.1.1.1](#)).

The <participants> element has no attributes, but the following child elements are defined (0 or more):

<participant>: specifies a participant ([Section 4.3.2.2.1.1.1](#)).

[4.3.2.2.1.1.1.](#) <participant>

The <participant> element describes a participant.

The <participant> element has the following attributes:

id: an identifier for either a connection or a conference. The identifier MUST conform to the syntax defined in Section 16.1 of [[I-D.ietf-mediactrl-sip-control-framework](#)]. The attribute is mandatory.

The <participant> element has no children.

[4.3.2.2.2.](#) <joinaudit>

The <joinaudit> element has the following attributes:

id1: an identifier for either a connection or a conference. The identifier MUST conform to the syntax defined in Section 16.1 of [[I-D.ietf-mediactrl-sip-control-framework](#)] The attribute is mandatory.

id2: an identifier for either a connection or a conference. The identifier MUST conform to the syntax defined in Section 16.1 of [[I-D.ietf-mediactrl-sip-control-framework](#)] The attribute is

mandatory.

The <joinaudit> element has no children.

For example, a fragment describing an audit of two join mixers, one between connections and the second between conferences:

```
<mixers>
  <joinaudit id1="1536067209:913cd14" id2="1636067209:413cd14"/>
  <joinaudit id1="conference1" id2="conference2"/>
</mixers>
```

[4.4.](#) <codecs>

The <codecs> element is a container for one or more codec definitions. Codec definitions are used by an AS to specify the codecs allowed for a conference (e.g. when used as a child of <createconference> or <modifyconference>). Codec definitions are used by an MS to provide audit information about the codecs supported by an MS and used in specific conferences.

The <codecs> element has no attributes.

The <codecs> element has the following sequence of child elements (0 or more occurrences):

<codec>: defines a codec and optionally its policy ([Section 4.4.1](#)). The element is optional.

For example, a fragment describing two codecs:

```
<codecs>
  <codec>
    <subtype>PCMA</subtype>
  </codec>
  <codec>
    <subtype>H263</subtype>
  </codec>
```


</codecs>

[4.4.1.](#) <codec>

The <codec> element describes a codec. The element is modeled on the <codec> element in the XCON conference information data model ([\[I-D.ietf-xcon-common-data-model\]](#)) and allows additional information (e.g. rate, speed, etc) to be specified.

The <codec> element has no attributes.

The <codec> element has the following sequence of child elements:

<subtype>: element ([Section 4.4.1.1](#)) describing the codec's name. The element is mandatory.

<params>: element ([Section 4.4.1.2](#)) describing additional information about the codec. This package is agnostic to the names and values of the codec parameters supported by an implementation. The element is optional.

For example, a fragment with a <codec> element describing the H263 codec:

```
<codec>
  <subtype>H263</subtype>
</codec>
```

And a fragment where the <codec> element describes the H264 codec with additional information about the profile level and packetization mode:

```
<codec>
  <subtype>H264</subtype>
  <params>
    <param name="profile-level-id">42A01E</param>
    <param name="packetization-mode">0</param>
```

</params>
</codec>

[4.4.1.1.](#) <subtype>

The <subtype> element specifies the name of a codec. The possible names are the values of the 'subtype' column of the RTP Payload Format media types per [\[RFC4855\]](#) defined in IANA ([\[IANA\]](#)).

The <subtype> element has no attributes and its content model is the codec name.

[4.4.1.2.](#) <params>

The <params> element is a container for <param> elements ([Section 4.4.1.2.1](#)).

The <params> element has no attributes, but the following child elements are defined (0 or more):

<param>: specifies a parameter name and value ([Section 4.4.1.2.1](#)).

[4.4.1.2.1.](#) <param>

The <param> element describes a parameter name and value.

The <param> element has the following attributes:

name: a string indicating the name of the parameter. The attribute is mandatory.

type: specifies a type indicating how the inline value of the parameter is to be interpreted. A valid value is a MIME media type (see [Section 4.6.6](#)). The attribute is optional. The default value is "text/plain".

The <param> element content model (text and/or XML) is the value of the parameter. Values in XML format MUST use a namespace other than the one used in this specification. Note that a text value which contains XML characters (e.g. "<") needs to be escaped following standard XML conventions.

[4.5.](#) Response Status Codes

This section describes the response codes in Table 1 for the status attribute of mixer management <response> ([Section 4.2.3](#)) and audit <auditresponse> ([Section 4.3.2](#)) responses. The MS MUST support the status response codes defined here. All other valid but undefined values are reserved for future use, where a standards-track RFC is required to define new status codes. The AS MUST treat any responses it does not recognize as being equivalent to the x00 response code for all classes. For example, if an AS receives an unrecognized response code of 499, it can safely assume that there was something wrong with its request and treat the response as if it had received a 400 (Syntax error) response code.

4xx responses are definite failure responses from a particular MS. The reason attribute in the response SHOULD identify the failure in more detail, for example, "Mandatory attribute missing: id2 join element" for a 400 (Syntax error) response code.

The AS SHOULD NOT retry the same request without modification (for example, correcting a syntax error or changing the conferenceid to use one available on the MS). However, the same request to a different MS might be successful; for example, if another MS supports a capability required in the request.

4xx failure responses can be grouped into three classes: failure due to a syntax error in the request (400); failure due to an error executing the request on the MS (405-419); and failure due to the request requiring a capability not supported by the MS (420-435).

In cases where more than one request code could be reported for a failure, the MS SHOULD use the most specific error code of the failure class for the detected error. For example, if the MS detects that the conference identifier in the request is invalid, then it uses a 406 status code. However, if the MS merely detects that an execution error occurred, then 419 is used.

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Code	Summary	Description	Informational: AS Possible Recovery Action
200	OK	request has succeeded	
400	Syntax error	request is syntactically invalid: it is not valid with respect to the XML schema specified in Section 5 or it violates a co-occurrence constraint for a request element defined in Section 4 .	Change the request so that it is syntactically valid.
405	Conference already exists	request uses an identifier to create a new conference (Section 4.2.1.1) which is already used by another conference on the MS.	Send an <audit> request (Section 4.3.1) requesting the list of conference mixer identifiers already used by the MS and then use a conference identifier which is not listed.
406	Conference does not exist	request uses an identifier for a conference which does not exist on the MS.	Send an <audit> request (Section 4.3.1) requesting the list of conference mixer identifiers used by the MS and then use a

			conference identifier which is listed.
--	--	--	--

407	Incompatible stream configuration	request specifies a media stream configuration which is in conflict with itself, or the connection or conference capabilities (see Section 4.2.2.2)	Change the media stream configuration to match the capabilities of the connection or conference
408	joining entities already joined	request attempts to create a join mixer (Section 4.2.2.2) where the entities are already joined	Send an <audit> request (Section 4.3.1) requesting the list of join mixers on the MS and then use entities which are not listed.
409	joining entities not joined	request attempts to manipulate a join mixer where entities which are not joined	Send an <audit> request (Section 4.3.1) requesting the list of join mixers on the MS and then use entities which are listed.
410	Unable to join - conference full	request attempts to join a participant to a conference (Section 4.2.2.2) but the conference	

		is already full	
411	Unable to perform join mixer operation	request attempts to create, modify or delete a join between entities but fails	
412	Connection does not exist	request uses an identifier for a connection which does not exist on the MS.	

419	Other execution error	requested operation cannot be executed by the MS.	
420	Conference reservation failed	request to create a new conference (Section 4.2.1.1) failed due to unsupported reservation of talkers or listeners.	
421	Unable to configure audio mix	request to create or modify a conference failed due to unsupported audio mix.	
422	Unsupported media stream configuration	request contains one or more <stream> elements (Section 4.2.2.5) whose configuration is not supported by the MS.	
423	Unable to	request to create or	

	configure video layouts	modify a conference failed due to unsupported video layout configuration.	
424	Unable to configure video switch	request to create or modify a conference failed due to unsupported video switch configuration.	
425	Unable to configure codecs	request to create or modify a conference failed due to unsupported codec.	

426	Unable to join - mixing connections not supported	request to join connection entities (Section 4.2.2.2) failed due lack of support for mixing connections.	
427	Unable to join - mixing conferences not supported	request to join conference entities (Section 4.2.2.2) failed due lack of support for mixing conferences.	
428	Unsupported foreign namespace attribute or element	the request contains attributes or elements from another namespace which the MS does not support	

435	Other	request requires	
	unsupported	another capability	
	capability	not supported by the	
		MS	
+-----+	+-----+	+-----+	+-----+

Table 1: status codes

4.6. Type Definitions

This section defines types referenced in attribute definitions.

4.6.1. Boolean

The value space of boolean is the set {true, false}.

4.6.2. Non-Negative Integer

The value space of non-negative integer is the infinite set {0,1,2,...}.

4.6.3. Positive Integer

The value space of positive integer is the infinite set {1,2,...}.

4.6.4. String

A string in the character encoding associated with the XML element.

4.6.5. Time Designation

A time designation consists of a non-negative real number followed by a time unit identifier.

The time unit identifiers are: "ms" (milliseconds) and "s" (seconds).

Examples include: "3s", "850ms", "0.7s", ".5s" and "+1.5s".

4.6.6. MIME Media Type

A string formatted as a IANA MIME media type ([\[MIME.mediatypes\]](#)).

[5.](#) Formal Syntax

This section defines the XML schema for the Mixer Control Package.

The schema defines datatypes, attributes, and mixer elements in the urn:ietf:params:xml:ns:msc-mixer namespace. In most elements the order of child elements is significant. The schema is extensible:

elements allow attributes and child elements from other namespaces. Elements from outside this package's namespace can occur after elements defined in this package.

The schema is dependent upon the schema (framework.xsd) defined in [Section 16.1](#) of the Control Framework [\[I-D.ietf-mediactrl-sip-control-framework\]](#).

```
<?xml version="1.0" encoding="UTF-8"?>
<xsd:schema targetNamespace="urn:ietf:params:xml:ns:msc-mixer"
  xmlns:fw="urn:ietf:params:xml:ns:control:framework-attributes"
  elementFormDefault="qualified"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns="urn:ietf:params:xml:ns:msc-mixer"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema">
```

```
<xsd:annotation>
  <xsd:documentation>
    IETF MediaCtrl Mixer 1.0 (20100225)
```

This is the schema of the Mixer control package. It defines request, response and notification elements for mixing.

The schema namespace is urn:ietf:params:xml:ns:msc-mixer

```
</xsd:documentation>
</xsd:annotation>
```

```
<!--
#####

SCHEMA IMPORTS

#####
-->
```

```
<xsd:import
  namespace="urn:ietf:params:xml:ns:control:framework-attributes"
```

```

schemaLocation="framework.xsd">
<xsd:annotation>
  <xsd:documentation>
    This import brings in the framework attributes for
    conferenceid and connectionid.
  </xsd:documentation>
</xsd:annotation>
</xsd:import>

<!--
#####

Extensible core type

#####
-->

<xsd:complexType name="Tcore">
  <xsd:annotation>
    <xsd:documentation>
      This type is extended by other (non-mixed) component types to
      allow attributes from other namespaces.
    </xsd:documentation>
  </xsd:annotation>
  <xsd:sequence/>
  <xsd:anyAttribute namespace="##other" processContents="lax" />
</xsd:complexType>

<!--
#####

TOP LEVEL ELEMENT: mscmixer

#####
-->

<xsd:complexType name="mscmixerType">
  <xsd:complexContent>
    <xsd:extension base="Tcore">
      <xsd:sequence>
        <xsd:choice>
          <xsd:element ref="createconference" />
          <xsd:element ref="modifyconference" />
          <xsd:element ref="destroyconference" />
          <xsd:element ref="join" />

```

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```
<xsd:element ref="unjoin" />
<xsd:element ref="modifyjoin" />
<xsd:element ref="response" />
<xsd:element ref="event" />
<xsd:element ref="audit" />
<xsd:element ref="auditresponse" />
<xsd:any namespace="##other" minOccurs="0"
  maxOccurs="unbounded" processContents="lax" />
</xsd:choice>
</xsd:sequence>
<xsd:attribute name="version" type="version.datatype"
  use="required" />
</xsd:extension>
</xsd:complexContent>
</xsd:complexType>

<xsd:element name="mscmixer" type="mscmixerType" />

<!--
#####

CONFERENCE MANAGEMENT TYPES

#####
-->

<!-- createconference -->

<xsd:complexType name="createconferenceType">
  <xsd:complexContent>
    <xsd:extension base="Tcore">
      <xsd:sequence>
        <xsd:element ref="codecs" minOccurs="0"
          maxOccurs="1" />
        <xsd:element ref="audio-mixing" minOccurs="0"
          maxOccurs="1" />
        <xsd:element ref="video-layouts" minOccurs="0"
          maxOccurs="1" />
        <xsd:element ref="video-switch" minOccurs="0"
          maxOccurs="1" />
        <xsd:element ref="subscribe" minOccurs="0"
          maxOccurs="1" />
      </xsd:sequence>
    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>
```

```

    <xsd:any namespace="##other"
      processContents="lax" minOccurs="0" maxOccurs="unbounded" />
  </xsd:sequence>
  <xsd:attribute name="conferenceid" type="xsd:string" />
  <xsd:attribute name="reserved-talkers"

```

```

    type="xsd:nonNegativeInteger" default="0" />
  <xsd:attribute name="reserved-listeners"
    type="xsd:nonNegativeInteger" default="0" />
</xsd:extension>
</xsd:complexContent>
</xsd:complexType>

<xsd:element name="createconference" type="createconferenceType" />

<!-- modifyconference -->

<xsd:complexType name="modifyconferenceType">
  <xsd:complexContent>
    <xsd:extension base="Tcore">
      <xsd:sequence>
        <xsd:element ref="codecs" minOccurs="0"
          maxOccurs="1" />
        <xsd:element ref="audio-mixing" minOccurs="0"
          maxOccurs="1" />
        <xsd:element ref="video-layouts" minOccurs="0"
          maxOccurs="1" />
        <xsd:element ref="video-switch" minOccurs="0"
          maxOccurs="1" />
        <xsd:element ref="subscribe" />
        <xsd:any namespace="##other"
          processContents="lax" minOccurs="0" maxOccurs="unbounded" />
      </xsd:sequence>
      <xsd:attribute name="conferenceid" type="xsd:string"
        use="required" />
    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>

<xsd:element name="modifyconference" type="modifyconferenceType" />

```

```

<!-- destroyconference -->

<xsd:complexType name="destroyconferenceType">
<xsd:complexContent>
  <xsd:extension base="Tcore">
    <xsd:sequence>
      <xsd:any namespace="##other" minOccurs="0"
        maxOccurs="unbounded" processContents="lax" />
    </xsd:sequence>
    <xsd:attribute name="conferenceid" type="xsd:string"
      use="required" />
  </xsd:extension>

```

```

</xsd:complexContent>
</xsd:complexType>

<xsd:element name="destroyconference"
  type="destroyconferenceType" />

```

```

<!--
#####

JOIN TYPES

#####
-->

```

```

<xsd:complexType name="joinType">
<xsd:complexContent>
  <xsd:extension base="Tcore">
    <xsd:sequence>
      <xsd:element ref="stream" minOccurs="0"
        maxOccurs="unbounded" />
      <xsd:any namespace="##other"
        processContents="lax" minOccurs="0" maxOccurs="unbounded" />
    </xsd:sequence>
    <xsd:attribute name="id1" type="xsd:string"
      use="required" />
    <xsd:attribute name="id2" type="xsd:string"

```

```

        use="required" />
    </xsd:extension>
</xsd:complexContent>
</xsd:complexType>

<xsd:element name="join" type="joinType" />

<xsd:complexType name="modifyjoinType">
    <xsd:complexContent>
        <xsd:extension base="Tcore">
            <xsd:sequence>
                <xsd:element ref="stream" minOccurs="0"
                    maxOccurs="unbounded" />
                <xsd:any namespace="##other"
                    processContents="lax" minOccurs="0" maxOccurs="unbounded" />
            </xsd:sequence>
            <xsd:attribute name="id1" type="xsd:string"
                use="required" />
            <xsd:attribute name="id2" type="xsd:string"

```

```

        use="required" />
    </xsd:extension>
</xsd:complexContent>
</xsd:complexType>

<xsd:element name="modifyjoin" type="modifyjoinType" />

<xsd:complexType name="unjoinType">
    <xsd:complexContent>
        <xsd:extension base="Tcore">
            <xsd:sequence>
                <xsd:element ref="stream" minOccurs="0"
                    maxOccurs="unbounded" />
                <xsd:any namespace="##other"
                    processContents="lax" minOccurs="0" maxOccurs="unbounded" />
            </xsd:sequence>
            <xsd:attribute name="id1" type="xsd:string"
                use="required" />
            <xsd:attribute name="id2" type="xsd:string"
                use="required" />
        </xsd:extension>

```

```

    </xsd:complexContent>
</xsd:complexType>

<xsd:element name="unjoin" type="unjoinType" />

<!--
#####

OTHER TYPES

#####
-->

<xsd:complexType name="eventType">
  <xsd:complexContent>
    <xsd:extension base="Tcore">
      <xsd:sequence>
        <xsd:choice>
          <xsd:element ref="active-talkers-notify"
            minOccurs="0" maxOccurs="1" />
          <xsd:element ref="unjoin-notify"
            minOccurs="0" maxOccurs="1" />
          <xsd:element ref="conferenceexit"
            minOccurs="0" maxOccurs="1" />
          <xsd:any namespace="##other" minOccurs="0"
            maxOccurs="unbounded" processContents="lax" />

```

```

    </xsd:choice>
  </xsd:sequence>
</xsd:extension>
</xsd:complexContent>
</xsd:complexType>

<xsd:element name="event" type="eventType" />

<xsd:complexType name="activetalkersnotifyType">
  <xsd:complexContent>
    <xsd:extension base="Tcore">
      <xsd:sequence>
        <xsd:element ref="active-talker" minOccurs="0"
          maxOccurs="unbounded" />
        <xsd:any namespace="##other" minOccurs="0"

```



```

        maxOccurs="unbounded" processContents="lax" />
    </xsd:sequence>
    <xsd:attribute name="conferenceid" type="xsd:string"
        use="required" />
</xsd:extension>
</xsd:complexContent>
</xsd:complexType>

<xsd:element name="active-talkers-notify"
    type="activetalkersnotifyType" />

<xsd:complexType name="activetalkerType">
    <xsd:complexContent>
        <xsd:extension base="Tcore">
            <xsd:sequence>
                <xsd:any namespace="##other" minOccurs="0"
                    maxOccurs="unbounded" processContents="lax" />
            </xsd:sequence>
            <xsd:attributeGroup ref="fw:framework-attributes" />
        </xsd:extension>
    </xsd:complexContent>
</xsd:complexType>

<xsd:element name="active-talker" type="activetalkerType" />

<xsd:complexType name="unjoinnotifyType">
    <xsd:complexContent>
        <xsd:extension base="Tcore">
            <xsd:sequence>
                <xsd:any namespace="##other" minOccurs="0"
                    maxOccurs="unbounded" processContents="lax" />
            </xsd:sequence>
        </xsd:extension>
    </xsd:complexContent>
</xsd:complexType>

```

```

</xsd:sequence>
<xsd:attribute name="status" type="xsd:nonNegativeInteger"
    use="required" />
<xsd:attribute name="reason" type="xsd:string" />
<xsd:attribute name="id1" type="xsd:string"
    use="required" />
<xsd:attribute name="id2" type="xsd:string"
    use="required" />

```

```

    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>

<xsd:element name="unjoin-notify" type="unjoinnotifyType" />

<!-- conferenceexit-->

<xsd:complexType name="conferenceexitType">
  <xsd:complexContent>
    <xsd:extension base="Tcore">
      <xsd:sequence>
        <xsd:any namespace="##other" minOccurs="0"
          maxOccurs="unbounded" processContents="lax" />
      </xsd:sequence>
      <xsd:attribute name="conferenceid" type="xsd:string"
        use="required" />
      <xsd:attribute name="status"
        type="xsd:nonNegativeInteger" use="required" />
      <xsd:attribute name="reason" type="xsd:string" />
    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>

<xsd:element name="conferenceexit" type="conferenceexitType" />

<xsd:complexType name="responseType">
  <xsd:complexContent>
    <xsd:extension base="Tcore">
      <xsd:sequence>
        <xsd:any namespace="##other" minOccurs="0"
          maxOccurs="unbounded" processContents="lax" />
      </xsd:sequence>
      <xsd:attribute name="status" type="status.datatype"
        use="required" />
      <xsd:attribute name="reason" type="xsd:string" />
    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>

```

```

<xsd:attributeGroup ref="fw:framework-attributes" />

```

```

    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>

<xsd:element name="response" type="responseType" />

<xsd:complexType name="subscribeType">
  <xsd:complexContent>
    <xsd:extension base="Tcore">
      <xsd:sequence>
        <xsd:element ref="active-talkers-sub"
          minOccurs="0" maxOccurs="1" />
        <xsd:any namespace="##other" minOccurs="0"
          maxOccurs="unbounded" processContents="lax" />
      </xsd:sequence>
    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>

<xsd:element name="subscribe" type="subscribeType" />

<xsd:complexType name="activetalkerssubType">
  <xsd:complexContent>
    <xsd:extension base="Tcore">
      <xsd:sequence>
        <xsd:any namespace="##other" minOccurs="0"
          maxOccurs="unbounded" processContents="lax" />
      </xsd:sequence>
      <xsd:attribute name="interval"
        type="xsd:nonNegativeInteger" default="3" />
    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>

<xsd:element name="active-talkers-sub"
  type="activetalkerssubType" />

<xsd:complexType name="streamType">
  <xsd:complexContent>
    <xsd:extension base="Tcore">
      <xsd:sequence>
        <xsd:element ref="volume" minOccurs="0"
          maxOccurs="1" />
        <xsd:element ref="clamp" minOccurs="0"

```

```
    maxOccurs="1" />
    <xsd:element ref="region" minOccurs="0"
      maxOccurs="1" />
    <xsd:element ref="priority" minOccurs="0"
      maxOccurs="1" />
    <xsd:any namespace="##other" minOccurs="0"
      maxOccurs="unbounded" processContents="lax" />
  </xsd:sequence>
  <xsd:attribute name="media" type="media.datatype"
    use="required" />
  <xsd:attribute name="label" type="label.datatype" />
  <xsd:attribute name="direction"
    type="direction.datatype" default="sendrecv" />
</xsd:extension>
</xsd:complexContent>
</xsd:complexType>

<xsd:element name="stream" type="streamType" />

<xsd:complexType name="volumeType">
  <xsd:complexContent>
    <xsd:extension base="Tcore">
      <xsd:sequence>
        <xsd:any namespace="##other" minOccurs="0"
          maxOccurs="unbounded" processContents="lax" />
      </xsd:sequence>
      <xsd:attribute name="controltype"
        type="volumecontroltype.datatype" use="required" />
      <xsd:attribute name="value" type="xsd:string" />
    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>

<xsd:element name="volume" type="volumeType" />

<xsd:complexType name="clampType">
  <xsd:complexContent>
    <xsd:extension base="Tcore">
      <xsd:sequence>
        <xsd:any namespace="##other" minOccurs="0"
          maxOccurs="unbounded" processContents="lax" />
      </xsd:sequence>
      <xsd:attribute name="tones" type="xsd:string"
        default="1 2 3 4 5 6 7 8 9 0 A B C D"/>
    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>
```

```
</xsd:extension>
</xsd:complexContent>
```

```
</xsd:complexType>

<xsd:element name="clamp" type="clampType" />

<!-- region -->
<xsd:simpleType name="regionType">
  <xsd:restriction base="xsd:NMTOKEN" />
</xsd:simpleType>

<xsd:element name="region" type="regionType" />

<!-- priority -->
<xsd:simpleType name="priorityType">
  <xsd:restriction base="xsd:positiveInteger" />
</xsd:simpleType>

<xsd:element name="priority" type="priorityType" />

<xsd:complexType name="audiomixingType">
  <xsd:complexContent>
    <xsd:extension base="Tcore">
      <xsd:sequence>
        <xsd:any namespace="##other" minOccurs="0"
          maxOccurs="unbounded" processContents="lax" />
      </xsd:sequence>
      <xsd:attribute name="type" type="audiomix.datatype"
        default="nbest" />
      <xsd:attribute name="n" type="xsd:nonNegativeInteger"
        default="0" />
    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>

<xsd:element name="audio-mixing" type="audiomixingType" />

<!-- video-switch -->
```

```

<xsd:complexType name="videoswitchType">
  <xsd:complexContent>
    <xsd:extension base="Tcore">
      <xsd:sequence>
        <xsd:any namespace="##other" minOccurs="0"
          maxOccurs="unbounded" processContents="lax" />
      </xsd:sequence>
      <xsd:attribute name="type"
        type="videoswitchtype.datatype" default="vas" />
    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>

```

```

      <xsd:attribute name="interval"
        type="xsd:nonNegativeInteger" default="3" />
      <xsd:attribute name="activespeakermix"
        type="boolean.datatype" default="false" />
    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>

<xsd:element name="video-switch" type="videoswitchType" />

<!-- video-layouts -->

<xsd:complexType name="videolayoutsType">
  <xsd:complexContent>
    <xsd:extension base="Tcore">
      <xsd:sequence>
        <xsd:element ref="video-layout" minOccurs="0"
          maxOccurs="unbounded" />
        <xsd:any namespace="##other" minOccurs="0"
          maxOccurs="unbounded" processContents="lax" />
      </xsd:sequence>
    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>

<xsd:element name="video-layouts" type="videolayoutsType" />

<!-- video-layout -->
<!-- doesn't extend tCore since its content model is mixed -->

<xsd:complexType name="videolayoutType" mixed="true">

```

```

<xsd:sequence>
  <xsd:any namespace="##other" minOccurs="0"
    maxOccurs="unbounded" processContents="lax" />
</xsd:sequence>
<xsd:attribute name="min-participants"
  type="xsd:positiveInteger" default="1" />
<xsd:anyAttribute namespace="##other" processContents="lax" />
</xsd:complexType>

<xsd:element name="video-layout" type="videolayoutType" />

<xsd:complexType name="auditType">
  <xsd:complexContent>
    <xsd:extension base="Tcore">
      <xsd:sequence>
        <xsd:any namespace="##other" minOccurs="0"

```

```

    maxOccurs="unbounded" processContents="lax" />
  </xsd:sequence>
  <xsd:attribute name="capabilities"
    type="boolean.datatype" default="true" />
  <xsd:attribute name="mixers" type="boolean.datatype"
    default="true" />
  <xsd:attribute name="conferenceid" type="xsd:string" />
</xsd:extension>
</xsd:complexContent>
</xsd:complexType>

<xsd:element name="audit" type="auditType" />

<xsd:complexType name="auditresponseType">
  <xsd:complexContent>
    <xsd:extension base="Tcore">
      <xsd:sequence>
        <xsd:element ref="capabilities" minOccurs="0"
          maxOccurs="1" />
        <xsd:element ref="mixers" minOccurs="0"
          maxOccurs="1" />
        <xsd:any namespace="##other" minOccurs="0"
          maxOccurs="unbounded" processContents="lax" />
      </xsd:sequence>

```

```

        <xsd:attribute name="status" type="status.datatype"
            use="required" />
        <xsd:attribute name="reason" type="xsd:string" />
    </xsd:extension>
</xsd:complexContent>
</xsd:complexType>

<xsd:element name="auditresponse" type="auditresponseType" />

<!-- mixers -->

<xsd:complexType name="mixersType">
    <xsd:complexContent>
        <xsd:extension base="Tcore">
            <xsd:sequence>
                <xsd:element ref="conferenceaudit" minOccurs="0"
                    maxOccurs="unbounded" />
                <xsd:element ref="joinaudit" minOccurs="0"
                    maxOccurs="unbounded" />
                <xsd:any namespace="##other" minOccurs="0"
                    maxOccurs="unbounded" processContents="lax" />
            </xsd:sequence>
        </xsd:extension>
    </xsd:complexContent>

```

```

    </xsd:complexContent>
</xsd:complexType>

<xsd:element name="mixers" type="mixersType" />

<!-- joinaudit -->

<xsd:complexType name="joinauditType">
    <xsd:complexContent>
        <xsd:extension base="Tcore">
            <xsd:sequence>
                <xsd:any namespace="##other"
                    processContents="lax" minOccurs="0" maxOccurs="unbounded" />
            </xsd:sequence>
            <xsd:attribute name="id1" type="xsd:string"
                use="required" />
            <xsd:attribute name="id2" type="xsd:string"
                use="required" />
        </xsd:extension>
    </xsd:complexContent>

```



```

    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>

<xsd:element name="joinaudit" type="joinauditType" />

<!-- conferenceaudit -->

<xsd:complexType name="conferenceauditType">
  <xsd:complexContent>
    <xsd:extension base="Tcore">
      <xsd:sequence>
        <xsd:element ref="codecs" minOccurs="0"
          maxOccurs="1" />
        <xsd:element ref="participants" minOccurs="0"
          maxOccurs="1" />
        <xsd:element ref="video-layout" minOccurs="0"
          maxOccurs="1" />
        <xsd:any namespace="##other" minOccurs="0"
          maxOccurs="unbounded" processContents="lax" />
      </xsd:sequence>
      <xsd:attribute name="conferenceid" type="xsd:string"
        use="required" />
    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>

<xsd:element name="conferenceaudit" type="conferenceauditType" />

```

```

<!-- participants -->

<xsd:complexType name="participantsType">
  <xsd:complexContent>
    <xsd:extension base="Tcore">
      <xsd:sequence>
        <xsd:element ref="participant" minOccurs="0"
          maxOccurs="unbounded" />
        <xsd:any namespace="##other" minOccurs="0"
          maxOccurs="unbounded" processContents="lax" />
      </xsd:sequence>
    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>

```

```

    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>

<xsd:element name="participants" type="participantsType" />

<!-- participant -->

<xsd:complexType name="participantType">
  <xsd:complexContent>
    <xsd:extension base="Tcore">
      <xsd:sequence>
        <xsd:any namespace="##other" minOccurs="0"
          maxOccurs="unbounded" processContents="lax" />
      </xsd:sequence>
      <xsd:attribute name="id" type="xsd:string"
        use="required" />
    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>

<xsd:element name="participant" type="participantType" />

<!-- capabilities -->

<xsd:complexType name="capabilitiesType">
  <xsd:complexContent>
    <xsd:extension base="Tcore">
      <xsd:sequence>
        <xsd:element ref="codecs" minOccurs="1"
          maxOccurs="1" />
        <xsd:any namespace="##other" minOccurs="0"
          maxOccurs="unbounded" processContents="lax" />
      </xsd:sequence>
    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>

```

```

<xsd:element name="capabilities" type="capabilitiesType" />

<!-- codecs -->

```

```

<xsd:complexType name="codecsType">
  <xsd:complexContent>
    <xsd:extension base="Tcore">
      <xsd:sequence>
        <xsd:element ref="codec" minOccurs="0"
          maxOccurs="unbounded" />
        <xsd:any namespace="##other" minOccurs="0"
          maxOccurs="unbounded" processContents="lax" />
      </xsd:sequence>
    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>

<xsd:element name="codecs" type="codecsType" />

<!-- codec -->

<xsd:complexType name="codecType">
  <xsd:complexContent>
    <xsd:extension base="Tcore">
      <xsd:sequence>
        <xsd:element ref="subtype" minOccurs="1"
          maxOccurs="1" />
        <xsd:element ref="params" minOccurs="0"
          maxOccurs="1" />
        <xsd:any namespace="##other" minOccurs="0"
          maxOccurs="unbounded" processContents="lax" />
      </xsd:sequence>
    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>

<xsd:element name="codec" type="codecType" />

<!-- subtype -->

<xsd:simpleType name="subtypeType">
  <xsd:restriction base="xsd:string" />
</xsd:simpleType>

<xsd:element name="subtype" type="subtypeType" />

```

```
<!-- params -->
<xsd:complexType name="paramsType">
  <xsd:complexContent>
    <xsd:extension base="Tcore">
      <xsd:sequence>
        <xsd:element ref="param" minOccurs="0"
          maxOccurs="unbounded" />
        <xsd:any namespace="##other" minOccurs="0"
          maxOccurs="unbounded" processContents="lax" />
      </xsd:sequence>
    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>

<xsd:element name="params" type="paramsType" />

<!-- param -->
<!-- doesn't extend tCore since its content model is mixed -->
<xsd:complexType name="paramType" mixed="true">
  <xsd:sequence>
    <xsd:any namespace="##other" minOccurs="0"
      maxOccurs="unbounded" processContents="lax" />
  </xsd:sequence>
  <xsd:attribute name="name" type="xsd:string" use="required" />
  <xsd:attribute name="type" type="mime.datatype"
    default="text/plain" />
  <xsd:anyAttribute namespace="##other" processContents="lax" />
</xsd:complexType>

<xsd:element name="param" type="paramType" />

<!--
#####

DATATYPES

#####
-->

<xsd:simpleType name="version.datatype">
  <xsd:restriction base="xsd:NMTOKEN">
    <xsd:enumeration value="1.0" />
  </xsd:restriction>
</xsd:simpleType>
```

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```
<xsd:simpleType name="eventname.datatype">
  <xsd:restriction base="xsd:NMTOKEN">
    <xsd:pattern value="[a-zA-Z0-9\.]+" />
  </xsd:restriction>
</xsd:simpleType>

<xsd:simpleType name="audiomix.datatype">
  <xsd:restriction base="xsd:NMTOKEN">
    <xsd:enumeration value="nbest" />
    <xsd:enumeration value="controller" />
  </xsd:restriction>
</xsd:simpleType>

<xsd:simpleType name="media.datatype">
  <xsd:restriction base="xsd:string" />
</xsd:simpleType>

<xsd:simpleType name="label.datatype">
  <xsd:restriction base="xsd:string" />
</xsd:simpleType>

<xsd:simpleType name="status.datatype">
  <xsd:restriction base="xsd:positiveInteger">
    <xsd:pattern value="[0-9][0-9][0-9]" />
  </xsd:restriction>
</xsd:simpleType>

<xsd:simpleType name="direction.datatype">
  <xsd:restriction base="xsd:NMTOKEN">
    <xsd:enumeration value="sendonly" />
    <xsd:enumeration value="recvonly" />
    <xsd:enumeration value="sendrecv" />
    <xsd:enumeration value="inactive" />
  </xsd:restriction>
</xsd:simpleType>

<xsd:simpleType name="boolean.datatype">
  <xsd:restriction base="xsd:NMTOKEN">
    <xsd:enumeration value="true" />
    <xsd:enumeration value="false" />
  </xsd:restriction>
</xsd:simpleType>
```

```

    </xsd:restriction>
</xsd:simpleType>

<xsd:simpleType name="mime.datatype">
  <xsd:restriction base="xsd:string" />
</xsd:simpleType>

```

```

<xsd:simpleType name="videoswitchtype.datatype">
  <xsd:restriction base="xsd:NMTOKEN">
    <xsd:enumeration value="vas" />
    <xsd:enumeration value="controller" />
  </xsd:restriction>
</xsd:simpleType>

<xsd:simpleType name="volumecontroltype.datatype">
  <xsd:restriction base="xsd:NMTOKEN">
    <xsd:enumeration value="automatic" />
    <xsd:enumeration value="setgain" />
    <xsd:enumeration value="setstate" />
  </xsd:restriction>
</xsd:simpleType>

</xsd:schema>

```

Figure 10: Mixer Package XML Schema

6. Examples

This section provides examples of the Mixer Control package.

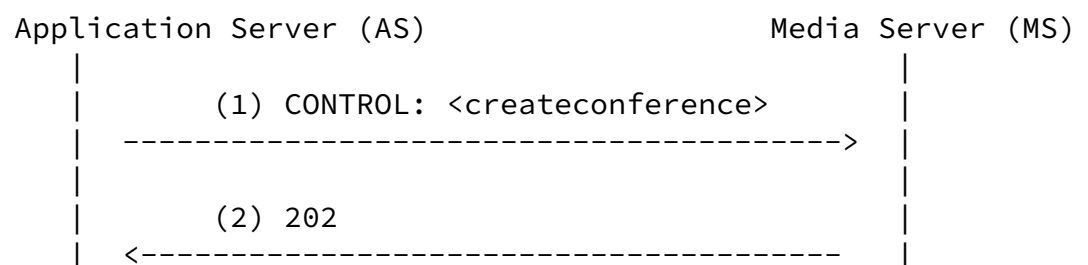
6.1. AS-MS Framework Interaction Examples

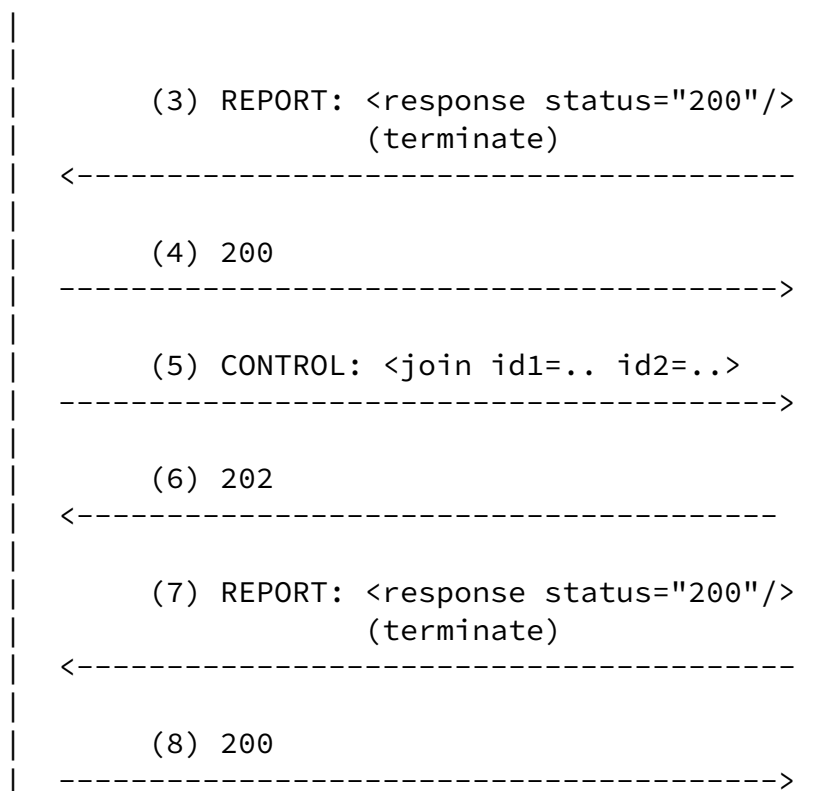
The following example assume a control channel has been established and synced as described in the Media Control Channel Framework ([[I-D.ietf-mediactrl-sip-control-framework](#)]).

The XML messages are in angled brackets (with the root <mscmixer> and other details omitted for clarity); the REPORT status is in round brackets. Other aspects of the protocol are omitted for readability.

6.1.1. Creating a conference mixer and joining a participant

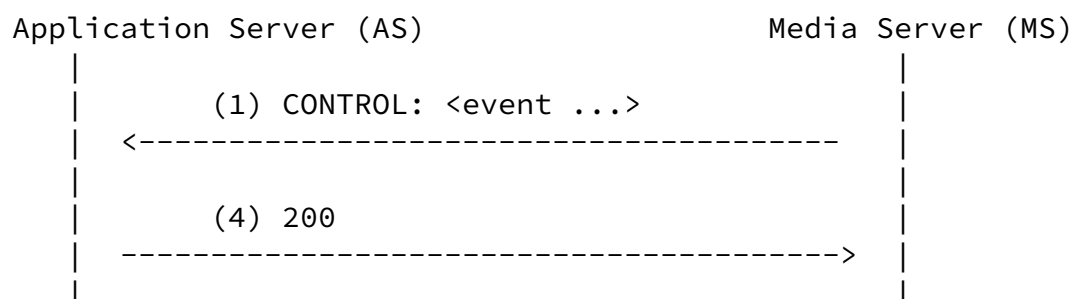
A conference mixer is created successfully and a participant is joined.





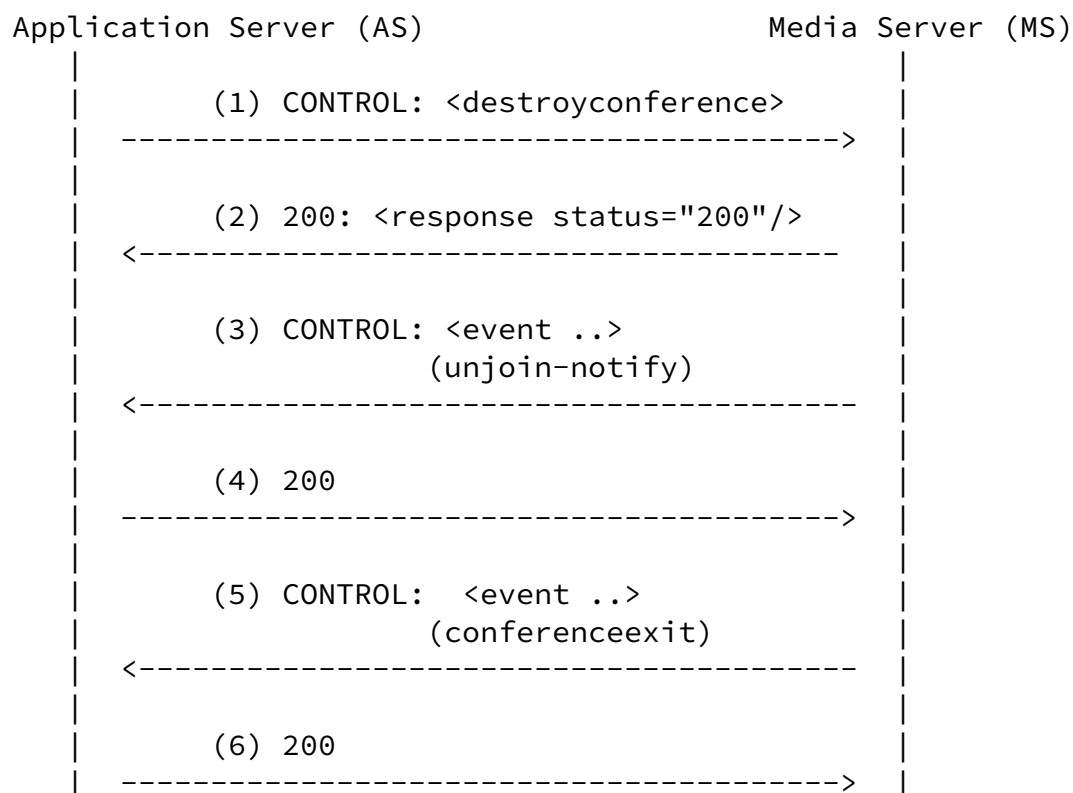
[6.1.2.](#) Receiving active talker notifications

An active talker notification event is sent by the MS.



[6.1.3.](#) Conference termination

The MS receives a request to terminate the conference, resulting in conferenceexit and participant unjoined notifications.



6.2. Mixing Examples

The following examples show how the mixing package can be used to create audio conferences, bridge connections and video conferences.

The examples do not specify all messages between the AS and MS.

6.2.1. Audio conferencing

The AS sends a request to create a conference mixer:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <createconference conferenceid="conf1"
    reserved-talkers="2" reserved-listeners="3">
    <audio-mixing type="nbest"/>
    <subscribe>
      <active-talkers-sub interval="5"/>
    </subscribe>
  </createconference>
```

</mscmixer>

The request specifies that the conference is assigned the conference id "conf1" and is configured with 2 reserved talkers, 3 reserved listener slots, audio mixing policy set to nbest and with active talkers notifications set to 5 seconds.

If the MS is able to create this conference mixer, it sends 200 response:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <response status="200" reason="conference created"
    conferenceid="conf1"/>
</mscmixer>
```

The AS is now able to join connections to the conference as participants. A participant able to contribute to the audio mix would be joined as follows:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <join id1="1536067209:913cd14c" id2="conf1">
    <stream media="audio" direction="sendrecv"/>
  </join>
</mscmixer>
```

If the MS can join the participant 1536067209:913cd14c to the conference conf1 with audio in both directions, then it sends a successful response:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <response status="200" reason="join successful"/>
</mscmixer>
```

The AS could also join listener-only participants to the conference by setting the stream direction to receive only:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <join id1="9936067209:914cd14c" id2="conf1">
    <stream media="audio" direction="recvonly"/>
  </join>
</mscmixer>
```

If the MS can join the participant 9936067209:914cd14c to the conference conf1 then it would send a successful response (not shown).

As the active talker changes, the MS sends an active talker notification to the AS:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <event>
    <active-talker-notify conferenceid="conf1">
      <active-talker connectionid="1536067209:913cd14c"/>
    </active-talker-notify>
  </event>
</mscmixer>
```

The AS could decide to change the status of a talker connection so that they can only listen:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <modifyjoin id1="1536067209:913cd14c" id2="conf1">
    <stream media="audio" direction="recvonly"/>
  </modifyjoin>
</mscmixer>
```

Where the participant 1536067209:913cd14c is no longer able to contribute to the audio mix on the conference. If the MS is able to execute this request, it would send a 200 response.

The AS could decide to remove this participant from the conference:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <unjoin id1="1536067209:913cd14c" id2="conf1"/>
</mscmixer>
```

Again, if the MS can execute this request, a 200 response would be sent.

Finally, the AS terminates the conference:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <destroyconference conferenceid="conf1"/>
</mscmixer>
```

If the MS is able to destroy the conference conf1, it sends a 200 response:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <response status="200" conferenceid="conf1"/>
</mscmixer>
```

For each participant attached to the conference when it is destroyed, the MS sends an unjoin notification event:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <event>
    <unjoin-notify status="2" id1="9936067209:914cd14c"
      id2="conf1"/>
  </event>
</mscmixer>
```

And the MS sends a conferenceexit notification event when the conference finally exits:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <event>
    <conferenceexit status="0" conferenceid="conf1"/>
  </event>
</mscmixer>
```

[6.2.2.](#) Bridging connections

The mixer package can be used to join connections to one another. In a call center scenario, for example, this package can be used to set up and modify connections between a caller, agent and supervisor.

A caller is joined to an agent with bi-directional audio:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <join id1="caller:001" id2="agent:002">
    <stream media="audio" direction="sendrecv"/>
  </join>
</mscmixer>
```

If the MS is able to establish this connection, then it would send a 200 response:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <response status="200"/>
</mscmixer>
```

Now assume that the AS wants a supervisor to listen into the agent

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conversation with the caller and provide whispered guidance to the agent. First the AS would send a request to join the supervisor and the caller connections:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <join id1="supervisor:003" id2="caller:001">
    <stream media="audio" direction="recvonly"/>
  </join>
</mscmixer>
```

If this request was successful, audio output from the caller connection would now be sent to both the agent and the supervisor.

Second, the AS would send a request to join the supervisor and the agent connections:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <join id1="supervisor:001" id2="agent:002">
    <stream media="audio" direction="sendrecv"/>
  </join>
</mscmixer>
```

If this request was successful, the audio mixing would occur on both the agent and supervisor connections: the agent would hear the caller and supervisor, and the supervisor would hear the agent and caller. The caller would only hear the agent. If the MS is unable to join and mix connections in this way, it would send a 426 response.

[6.2.3.](#) Video conferencing

In this example, an audio video-conference is created with the loudest participant has the most prominent region in the video layout.

The AS sends a request to create an audio-video conference:

```
<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <createconference conferenceid="conf2">
    <audio-mixing type="nbest"/>
    <video-switch type="vas"/>
    <video-layouts>
      <video-layout min-participants="1">single-view</video-layout>
    </video-layouts>
  </createconference>
</mscmixer>
```

```

    <video-layout min-participants="2">dual-view</video-layout>
    <video-layout min-participants="3">quad-view</video-layout>
    <video-layout min-participants="5">multiple-5x1</video-layout>
  </video-layouts>
</createconference>
</mscmixer>

```

In this configuration, the conference uses a nbest audio mixing policy and a vas video switch policy, so that the loudest speaker receives the most prominent region in the layout. Multiple video layouts are specified and active one depends on the number of participants.

Assume that 4 participants are already joined to the conference. In that case, the video layout will be quad-view (Figure 6) with the most active speaker displayed in region 1. When a fifth participant joins, the video layout automatically switches to a multiple-5x1 layout (Figure 9), again with the most active speaker in region 1.

The AS can manipulate which participants are displayed in the remaining regions. For example, it could force an existing conference participant to be displayed in region 2:

```

<mscmixer version="1.0" xmlns="urn:ietf:params:xml:ns:msc-mixer">
  <modifyjoin id1="1536067209:913cd14c" id2="conf2">
    <stream media="video">
      <region>2</region>
    </stream>
  </modifyjoin>
</mscmixer>

```

7. Security Considerations

As this control package processes XML markup, implementations MUST address the security considerations of [\[RFC3023\]](#).

As a Control Package of the Media Control Channel Framework, security, confidentiality and integrity of messages transported over the control channel MUST be addressed as described in [Section 12](#) of the Media Control channel Framework ([\[I-D.ietf-mediactrl-sip-control-framework\]](#)), including Transport Level Protection, Control Channel Policy Management and Session Establishment. In addition, implementations MUST address security, confidentiality and integrity of User Agent sessions with the MS, both in terms of SIP signaling and associated RTP media flow; see [\[I-D.ietf-mediactrl-sip-control-framework\]](#) for further details on this topic.

Adequate transport protection and authentication are critical, especially when the implementation is deployed in open networks. If the implementation fails to correctly address these issues, it risks exposure to malicious attacks, including (but not limited to):

Denial of Service: An attacker could insert a request message into the transport stream causing specific conferences or join mixers on the MS to be destroyed. For example, `<destroyconference conferenceid="XXXX">`, where the value of "XXXX" could be guessed or discovered by auditing active mixers on the MS using an `<audit>` request. Likewise, an attacker could impersonate the MS and

insert error responses into the transport stream so denying the AS access to package capabilities.

Resource Exhaustion: An attacker could insert into the control channel new request messages (or modify existing ones) with, for instance, <createconference> elements causing large numbers of conference mixer resources to be allocated. At some point this will exhaust the number of conference mixers that the MS is able to allocate.

The Media Control Channel Framework permits additional policy management, including resource access and control channel usage, to be specified at the control package level beyond that specified for the Media Control Channel Framework (see Section 12.3 of [[I-D.ietf-mediactrl-sip-control-framework](#)]).

Since creation of conference and join mixers is associated with media mixing resources on the MS, the security policy for this control package needs to address how such mixers are securely managed across more than one control channel. Such a security policy is only useful

for secure, confidential and integrity protected channels. The identity of control channels is determined by the channel identifier: i.e. the value of the cfw-id attribute in the SDP and Dialog-ID header in the channel protocol (see [[I-D.ietf-mediactrl-sip-control-framework](#)]). Channels are the same if they have the same identifier; otherwise, they are different. This control package imposes the following additional security policies:

Responses: The MS MUST only send a response to a mixer management or audit request using the same control channel as the one used to send the request.

Notifications: The MS MUST only send notification events for conference and join mixers using the same control channel as it received the request creating the mixer.

Auditing: The MS MUST only provide audit information about conference and join mixers which have been created on the same control channel as the one upon the <audit> request is sent. For example, if a join between two connections has been created on one

channel, then a request on another channel to audit all mixers - `<audit mixers="true"/>` - would not report on this join mixer.

Rejection: The MS SHOULD reject requests to audit or manipulate an existing conference or join mixer on the MS if the channel is not the same as the one used when the mixer was created. The MS rejects a request by sending a Control Framework 403 response (see [Section 7.4](#) and Section 12.3 of [\[I-D.ietf-mediactrl-sip-control-framework\]](#)). For example, if a channel with identifier 'cfw1234' has been used to send a request to create a particular conference and the MS receives on channel 'cfw98969' a request to audit or destroy this particular conference, then the MS sends a 403 framework response.

There can be valid reasons why an implementation does not reject an audit or mixer manipulation request on a different channel from the one which created the mixer. For example, a system administrator might require a separate channel to audit mixer resources created by system users and to terminate mixers consuming excessive system resources. Alternatively, a system monitor or resource broker might require a separate channel to audit mixers managed by this package on a MS. However, the full implications need to be understood by the implementation and carefully weighted before accepting these reasons as valid. If the reasons are not valid in their particular circumstances, the MS rejects such requests.

There can also be valid reasons for 'channel handover' including high

availability support or where one AS needs to take over management of mixers after the AS which created them has failed. This could be achieved by the control channels using the same channel identifier, one after another. For example, assume a channel is created with the identifier 'cfw1234' and the channel is used to create mixers on the MS. This channel (and associated SIP dialog) then terminates due to a failure on the AS. As permitted by the Control Framework, the channel identifier 'cfw1234' could then be reused so that another channel is created with the same identifier 'cfw1234', allowing it to 'take over' management of the mixers on the MS. Again, the implementation needs to understand the full implications and carefully weight them before accepting these reasons as valid. If the reasons are not valid for their particular circumstances, the MS uses the appropriate SIP mechanisms to prevent session establishment

when the same channel identifier is used in setting up another control channel (see Section 4 of [\[I-D.ietf-mediactrl-sip-control-framework\]](#)).

[8.](#) IANA Considerations

This specification instructs IANA to register a new Media Control Channel Framework Package, a new XML namespace, a new XML schema and a new MIME type.

[8.1.](#) Control Package Registration

This section registers a new Media Control Channel Framework package, per the instructions in Section 12.1 of [\[I-D.ietf-mediactrl-sip-control-framework\]](#).

To: ietf-sip-control@iana.org
Subject: Registration of new Channel Framework package
Package Name: msc-mixer/1.0
[NOTE TO IANA/RFC-EDITOR: Please replace XXXX with the RFC number for this specification.]
Published Specification(s): RFCXXXX
Person & email address to contact for further information:
IETF, MEDIACTRL working group, (mediactrl@ietf.org),
Scott McGlashan (smcg.stds01@mcglashan.org).

[8.2.](#) URN Sub-Namespace Registration

This section registers a new XML namespace, "urn:ietf:params:xml:ns:msc-mixer", per the guidelines in [RFC 3688](#) [[RFC3688](#)].

URI: urn:ietf:params:xml:ns:msc-mixer
 Registrant Contact: IETF, MEDIACTRL working group,
 (mediactrl@ietf.org), Scott McGlashan
 (smcg.stds01@mcglashan.org).
 XML:
 BEGIN
 <?xml version="1.0"?>
 <!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN"
 "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
 <html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en">
 <head>
 <title>Media Control Channel Framework Mixer
 Package attributes</title>
 </head>
 <body>
 <h1>Namespace for Media Control Channel
 Framework Mixer Package attributes</h1>
 <h2>urn:ietf:params:xml:ns:msc-mixer</h2>
 [NOTE TO IANA/RFC-EDITOR: Please replace XXXX
 with the RFC number for this specification.]
 <p>See RFCXXXX</p>
 </body>
 </html>
 END

[8.3.](#) XML Schema Registration

This section registers an XML schema as per the guidelines in [RFC 3688](#) [[RFC3688](#)].

URI: urn:ietf:params:xml:ns:msc-mixer
 Registrant Contact: IETF, MEDIACTRL working group,
 (mediactrl@ietf.org), Scott McGlashan
 (smcg.stds01@mcglashan.org).
 Schema: The XML for this schema can be found in
[Section 5](#) of this document.

[8.4.](#) MIME Media Type Registration for 'application/msc-mixer+xml'

This section registers the "application/msc-mixer+xml" MIME type.

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To: ietf-types@iana.org

Subject: Registration of MIME media type
application/msc-mixer+xml

MIME media type name: application

MIME subtype name: msc-mixer+xml

Required parameters: (none)

Optional parameters: charset

Indicates the character encoding of enclosed XML. Default is UTF-8.

Encoding considerations: Uses XML, which can employ 8-bit characters, depending on the character encoding used. See [RFC 3023 \[RFC3023\], section 3.2](#).

Security considerations: No known security considerations outside of those provided by the Media Control Channel Framework Mixer Package.

Interoperability considerations: This content type provides constructs for the Media Control Channel Framework Mixer package.

Published specification: RFC XXXX [NOTE TO IANA/RFC-EDITOR: Please replace XXXX with the RFC number for this specification.]

Applications which use this media type: Implementations of the Media Control Channel Framework Mixer package.

Additional Information: Magic Number(s): (none)

File extension(s): (none)

Macintosh File Type Code(s): (none)

Person & email address to contact for further information: Scott McGlashan <smcg.stds01@mcglashan.org>

Intended usage: LIMITED USE

Author/Change controller: The IETF

Other information: None.

[9.](#) Change Summary

Note to RFC Editor: Please remove this whole section.

The following are the changes between the -11 and -10 versions (addressing IETF Last Call comments):

- o 4.2.2.3: For <modifyjoin>, removed the statement "It MUST NOT change the configuration of any streams not included as child elements." since modifications in stream directionality can affect other streams of the same type.
- o 4.2.2.5.2: Changed definition of tones attribute of <clamp> element so that if the element is specified, then all DTMF tones are clamped by default. Updated XML schema.
- o 7: Corrected references from [Section 11](#) to [Section 12](#) in Control Framework.
- o Fixed various typos.

The following are the changes between the -10 and -09 versions:

- o References: Moved the XCON reference to the Normative References section.
- o 4.2: Mixer Elements: clarified that when a requested mixer operation (partially) fails, the MS carries out no part of the operation and sends an error response.

The following are the changes between the -09 and -08 versions following shepherd writeup:

- o 4.2.4.1.1: <active-talker>: Removed the statement that it is an error if an <active-talker> element has both connectionid and conferenceid attributes specified because the AS always sends a

framework 200 in response to notification events, including active talker events. Instead, clarified that no active talker is described if both attributes are specified or if neither attribute is specified.

- o Various spelling and grammatical errors fixed.

The following are the changes between the -08 and -07 versions.

- o 8.4: Changed file extension from '.xml' to (none)

- o Changed "~" to a ":" for connectionid
- o 4.2.6.1: Clarified that <param> can contain an XML value.
- o 4.2.4.2: Changed <unjoin-notify> status codes so that only 0-2 defined and all others are reserved for future use requiring a standard-track RFC.
- o 4.2.4.3: Changed <conferenceexit> status codes so that only 0-2 defined and all others are reserved for future use requiring a standard-track RFC.
- o 4.5: Changed status code for <response> and <auditresponse> so that certain codes are defined and all others are reserved for future use requiring a standard-track RFC.

The following are the changes between the -07 and -06 versions.

- o Generally corrected references from [Section 17.1](#) to [Section 16.1](#) of Control Channel Framework.
- o 4.2.2.2: removed "is" in "unless this is leads to a stream conflict"
- o 4.2.2.3: corrected error code from 408 to 409 for "If the specified entities are not already joined, then the MS reports an error (408)."
- o 4.2.1.4.3: corrected error code from 409 to 424 for "If the MS

does not support the specified video switching policy or ..., then MS reports a 409 error".

- o 4.2.1.4.2: corrected error code from 408 to 423 for "If the MS does not support video conferencing at all, or, the MS reports an 408 error ..."
- o 4.2.1.1, 4.2.1.2, 4.2.2.2, 4.2.2.3: Clarified that <codecs> specified in <createconference> or <modifyconference> impose a limitation in the media capability of a conference and this limitation affects whether the conference can be <join> or <modifyjoin>ed to another entity.

The following are the changes between the -06 and -05 versions.

- o 4.4.1: <codec>: corrected typos, added an example of <params> usage, added a <subtype> section and moved the <params> section inside this section.

- o 8: IANA Considerations: Updated IANA registration information and added registration for the XML Schema

The following are the changes between the -05 and -04 versions.

- o Schema: Fixed problem with non-deterministic content models.
- o 7. Security Considerations: Added requirement that implementations need to secure SIP and RTP sessions with User Agents.

The following are the changes between the -04 and -03 versions.

- o 4.2.1.4.3: corrected typo
- o 4.2.2.3: Clarified the behavior of <modifyjoin> for cases where each direction of a stream is independently controlled.
- o 4.2.2.5: Corrected syntax error in examples.
- o 4.2.2.5.1: Clarified that when an audio stream is in the muted state, then a <volume> automatic or setgain control causes the

state to change automatically to unmuted.

- o 7 Security: Clarified that both conference and join mixers are covered by the package security policies.
- o 7 Security: Added a denial of service example where the attacker impersonates the MS.
- o 7 Security: Clarified that the package security policy for multiple channels is only useful if the channels themselves are secured.
- o Updated acknowledgements.

The following are the major changes between the -03 and -02 versions.

- o Corrected various typos and nits.
- o Conformance language: Removed unnecessary MUSTs, especially for error codes. Changed most RECOMMENDEDs to MUST or MAY. Removed lowercase 'should', 'must' and 'may'.
- o Tidied up Abstract
- o Removed old Introduction section (it just duplicated the abstract). Replaced it with the old Overview Section. Section

numbering changed!

- o Introduction: Clarified which MediaCtrl Requirements are satisfied by this package.
- o 4.2.1.1: <createconference>: Clarified that an attempt to create a conference with an identifier already used by an existing conference does not affect the existing conference (405 error response).
- o 4.2.1.4.1: <audio-mixing>: Added a 'n' attribute for the number of participants to be included in nbest audio mixing.
- o 4.2.1.4.3: <video-switch>: Clarified that the active speaker in video switching is the loudest speaker.

- o 4.2.1.4.4: <subscribe>: Clarified that if a subscription specified in a foreign namespace element or attribute is not supported by the MS, then the MS generates a 428 error response. Changed conformance support for <active-talkers-sub> from SHOULD to MUST. Removed 422 error response.
- o 4.2.2: Joining Elements: Added text to the empty section.
- o 4.2.2.2, 4.2.2.3, 4.2.2.4: <join>, <modifyjoin> and <unjoin>: Clarified that join operation failures do not affect existing stream properties of the entities (407 and new 422 error response). Clarified stream failure errors in <modifyjoin> and <unjoin>.
- o 4.2.2.2: <join>. Clarified that <stream> elements can be used to independently control properties of the media flow in different directions. Added a response code (422) for when the MS does not support a media stream configuration.
- o 4.2.2.2: <join>. Clarified that error responses are generated if id1 or id2 reference a conference or connection which does not exist. Added an error status code (412) for non-existent connections.
- o 4.2.2.5: <stream>: Changed the definition so that in each child element, the media stream affected is indicated by the value of the direction attribute of the parent element. Added examples of controlling the media flow properties.
- o 4.2.4.2: <unjoin-notify>. Added reserved range of status codes. Changed code from 1 to 0 for the unjoin case. Changed code from 3 to 1 for execution error.

- o 4.2.4.3: <conferenceexit>. Added reserved range of status codes. Changed code from 1 to 0 for the destroyconference case (align with IVR). Added a code for conference exiting due to exceeding its maximum duration.
- o Schema: Adding missing version attribute on <mscmixer>.
- o Security Considerations: Major update. Added examples showing

malicious attacks when channel security is not correctly addressed. Added more details on multiple channel cases including administrator and monitor channels as well as channel handover.

- o Removed affiliations in Contributors section.

The following are the major changes between the -02 and -01 versions.

- o [Section 4](#): Aligned Control Package definitions with requirements in [Section 8](#) of the Control Framework.
- o Following October Interim meeting discussion on response codes, generally clarified usage of error status codes, modified some codes and re-organized the response codes section ([Section 4.5](#)) with more guidance and details.
- o MIXER-006. No action required following October 2008 interim discussion.
- o MIXER-008. No action required following October 2008 interim discussion.
- o MIXER-009. No action required for control package - addressed in -05 framework draft following interim October 2008 discussion.
- o MIXER-010/5.2.2.5: Clarified that in the <stream> element, an "inactive" direction value indicates the stream is established but there is no media flow. Such a stream can be manipulated by <modifyjoin> and <unjoin>.
- o 5.2.2.5: <stream>: Clarified that the media stream specified in child elements <volume>, <clamp>, <region> and <priority> is the stream originating from the entity identified as id1.
- o 5.2.1.4.3: <video-switch>: Clarified that it is not an error if a <stream> specifies a region which is not defined for the currently active video layout.
- o 5.2.1.4.2.1: <video-layout>: Added descriptions and ASCII art for layout and regions of XCON video layouts.

- o Added examples of audio conferencing, connection bridging and

video conferencing.

The following are the major changes between the -01 and -00 versions.

- o [MIXER-001]/5.2.4.3: Added <conferenceexit> notification event.
- o [MIXER-003]/5.2.1.4.2.1: Added ASCII diagrams for video layouts.
- o [MIXER-004]/5.3.2.2.1: Added active <video-layout> information to <conferenceaudit>.
- o [MIXER-007]/5.4.1: Added <params> inside <codec> so additional codec information can be specified.
- o 5.2.1.1: Fixed <createconference> example with missing min-participants attributes.
- o 5: Changed handling of unsupported foreign namespace elements and attributes. The MS send a 427 error response if it encounters foreign elements and attributes it does not support.
- o 5.2.1.4.3: <video-switch>. Clarified that the VAS policy is implementation-specific if a participant provides more than one audio stream.
- o 5.2.2.2/5.2.2.3/5.2.2.4: Clarified that joining behavior so that streams which have previously been <modifiedjoin>ed or <unjoin>ed are not affected by a general <unjoin>.
- o 5.2.1.4.3: <video-switch>: Added support for whether active speaker is displayed on their video layout ('activespeakermix' attribute) and clarified that personal video mixes are out of scope for this package.
- o 5.2.1.4.3/5.2.2.5.4: <video-switch>: Added support for a priority mechanism in video switching policy and a <priority child element on <stream>.
- o 8:Updated security section
- o 13:Updated references
- o 5.2.1.4.4.1: Added default of 3 seconds for <active-talkers-sub> interval.
- o 5.2.2.5.1: <volume> controltype attribute set to mandatory.

- o Updated schema

The following are the major changes between the -00 of this work group item draft and the individual submission -04 version.

- o Control package name is now 'msc-mixer/1.0'. Namespace is now 'urn:ietf:params:xml:ns:msc-mixer'. Mime type is now 'application/msc-mixer+xml'.
- o Added XML root element <mscmixer>.
- o Editorial tidy up of sections.
- o Added audit request/response elements.
- o Added video layout and switching conference configuration.
- o <audio-mixing>: changed 'mix-type' attribute to 'type' (consistency with video-switch)
- o Added "inactive" as value of <stream>'s direction attribute.
- o Added <region> child to <stream> element.
- o <createconference>: <audio-mixing> element is no longer mandatory; added <video-layouts> and <video-switch> child elements. reserved-talkers and reserved-listeners as attributes.
- o replaced conf-id attribute with conferenceid attribute.
- o Removed <data> element. Active talkers subscription and notifications used dedicated elements now.
- o Added <unjoin-notify> notification event to indicate when (un)expected joins occur. Use case: connection or conference joined to a conference and conference exits (either by request or runtime error).

The following are the major changes between the -04 of the draft and the -03 version.

- o Updated reference for Media Control Channel Framework

The following are the major changes between the -03 of the draft and the -02 version.

- o None

The following are the major changes between the -02 of the draft and the -01 version.

- o clarified the model for join operations and introduced several new package error codes
- o added definition for MS connection

The following are the major changes between the -01 of the draft and the -00 version.

- o restructured into single request response model for non-trivial operations
- o aligned with XML structure of other control framework packages

[10](#). Contributors

Asher Shiratzky provided valuable support and contributions to early versions of this document.

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[11.](#) Acknowledgments

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