Research & Vehicle Technology
"Infotainment Systems Product Development"

Feature – Audio Management Variant 2

Subsystem Part Specific Specification (SPSS)

Version 1.2

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Revision History

Date	Version	Notes	
July 16, 2021	**1.0**	**Initial Release**	
August 18, 2021	**1.1**		
	MD-REQ-410347/B-AudioSource.St		rpaquet2 - Added description to the SDARS SAT and SDARS IP literals
	AUMGNT-SR-REQ-435597/A-PAC-AHU specific source change for PAC generated audio (Phoenix)		jmyslin2: new requirement
March 31, 2022	**1.2**		
	AUMGNTv2-FRD-REQ-410345/B-Audio Management - Variant 2		jmyslin2: added logical to physical CAN signal mapping table
	AUMGNT-SR-REQ-452678/A-Logical to Physical CAN signal mapping - Audio Management (Phoenix)+		jmyslin2: added logical to physical CAN signal mapping
	AUMGNT-SR-REQ-452678/B-Logical to Physical CAN signal mapping - Audio Management (Phoenix)		jmyslin2: table updated to identify MSS signals
	AUMGNT-SR-REQ-410391/B-Saveable source audio handling		jmyslin2: small clarification added
	AUMGNT-REQ-486877/A-Signals to use when Multi-Seat Zone audio is NOT supported		jmyslin2: new requirement when Zone mode is not enabled for a vehicle or supported by a module

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1 Overview

Audio sources are typically activated/deactivated due to an event which causes an audio source to be either requested for playback or released from playback. Since multiple clients may request access to the audio system for playback, mixing, etc. the Audio Resource Server must have a method in place to track the requests for sources and track the current sources.

The Audio Resource Server utilizes a tabular "stack" approach for tracking the states of all source requests and for currently active sources. Within the "stack" sources are logged with their current status and in order of their priority level. Highest priority sources/requests are placed higher in the stack. The active audio source is placed at the "top" of the "stack". Lower priority requests are placed at the bottom of the stack.

For every request/source that is in the "stack", the Audio Resource Server will, on a periodic basis, broadcast the status of all request/sources that are in the "stack".

Note: Audio Management variant 2 supports the Android audio management strategy and supports multi-zonal audio management.

2 Assumptions throughout this spec for multi-seat audio zone

1. Throughout this SPSS when signals/messages are the same name except an added zone number at the end of them (2 – 6) then when define the usage for one signal/message it applies for all 6. Audio Management for zone 1 – 6 follows the same rules as in Cabin mode. That is unless it is noted otherwise.

   Example:
   - in the SPSS when place requirements on the SourceType signal those same requirements apply to SourceType2, SourceType3, SourceType4… unless noted otherwise.
   - In the SPSS when place requirements on the message AudioSource.St those same requirements apply to AudioSourceZone2.St, AudioSourceZone3.St… unless noted otherwise.

2. The table below shall be used to define the individual audio zones. When individual audio zones are like below the vehicle is considered in zone mode.

   Left Hand Drive vehicle

Front of the Vehicle	
Zone 1 – Front Driver	Zone 2 – Front Passenger
Zone 3 – Middle Left Occupant	Zone 4 – Middle Right Occupant
Zone 5 – Rear Left Occupant	Zone 6 – Rear Right Occupant
Rear of the Vehicle	

   Right Hand Drive vehicle

Front of the Vehicle	
Zone 2 – Front Passenger	Zone 1 – Front Driver
Zone 4 – Middle Left Occupant	Zone 3 – Middle Right Occupant
Zone 6 – Rear Left Occupant	Zone 5 – Rear Right Occupant
Rear of the Vehicle	

3. Cabin mode is defined when there are no individual sound zones for the front passenger or rear occupants. Generally, audio is played throughout the entire vehicle in cabin mode.

4. For zone mode, details of the feature are in the applicable zone mode spec. Anything not in this spec would be defined in a zone mode feature spec. What is in this spec is how the audio manager software would respond for each zone.

3 Architectural Design

3.1 Deployment

The table below shows how the logical classes may be mapped to physical modules for the Audio Management feature. The table below covers the lead program.

At the time the specification was written the below table was the latest. If there are additional modules deployed to the class descriptions or the vehicle architecture changed since the spec was written and released, then the applicable implementation guide class description would cover those modules. If there is a conflict between the implementation guide and the table below the implementation guide takes precedent.

Logical Class	Physical Module (ECU)
Audio Resource Server	APIM Phoenix Domain Controller
Audio IO Controller	AHU/PAC, DSP AMP (see note)
Source Client	APIM Phoenix Domain Controller (internal sources), AHU/PAC (ex Radio Announcement audio request)
Zone Manager	APIM Phoenix Domain Controller

Note: when both the AHU/PAC and DSP AMP are on the vehicle, the physical connections determine what sources the AHU/PAC or DSP AMP are responsible for. The physical architecture with the connections are not within the scope of this spec.

3.2 AUMGNTv2-CLD-REQ-410571/A-Audio Resource Server

The Audio Resource Server object acts as the overall audio manager which is responsible for the interfaces between the requesters for the audio system (ie source clients/resource clients).

The Audio Resource Server is the audio prioritizer for audio requests.

The Audio Resource Server is responsible for providing the status of the audio sources to the source clients and status of the infotainment system.

The Audio Resource Server can stream audio to the Audio I/O controller for applicable sources

The Audio Resource Server mutes/unmutes it audio output signal as necessary for source changes.

3.3 AUMGNTv2-CLD-REQ-410572/A-Audio IO Controller

The Audio IO Controller is the object that controls the audio outputted to the vehicle speakers.

3.4 AUMGNTv2-CLD-REQ-410573/A-Source Client

The Source Client object is responsible for requesting audio sources and acting on the responses from the Audio Resource Server.

The Source Client object may or may not have an HMI output component

3.5 AUMGNT-CLD-REQ-411245/A-Zone Manager

The Zone Manager is responsible for interfacing with the Audio Resource Server for making any Zone mode transitions (ie Cabin to Zone, or Zone to Cabin).

3.6 Logical to Physical - CAN signal mapping

3.6.1 AUMGNT-SR-REQ-452678/B-Logical to Physical CAN signal mapping - Audio Management (Phoenix)

This CAN signal mapping table below maps the Audio Management logical signals to the physical CAN signals.

Note: This is for reference only. If there is a conflict between the name in the CAN signal name column and what is found in the actual CAN dB then the CAN dB takes precedent. Please bring to Ford's attention if there is a conflict.

If a module only supports Cabin mode (zone mode never supported) or is configured to only support Cabin mode for the vehicle then the zone mode signals labeled MSS won't apply. If a module is configured to be able to support zone mode (when VehicleAudioMode = Zone) then the signals labeled MSS apply.

Logical Message Name	Logical Signal Name	CAN signal name	Signals only supported for MSS	Comments
AudioSource.St	SourceType	SrcType_D_Stat		These signals have to be in the same CAN message grouped together
	SourceTypeStatus	SrcTypeActv_D_Stat		
	SourceTypeChannel	SrcTypeChnl_D_Stat	MSS only	
	MixableZonePrompts	MixblPrmptZone1_B_Stat	MSS only	
	MixableZonePromptsChannel	MixblChnlZone1_D_Stat	MSS only	
	MixableCabinPrompts	CabnMixblPrmpt_B_Stat		
	VehicleAudioMode	VehAudioMde_D_Stat	MSS only	
AudioSourceZone2.St	SourceType2	SrcTypeZone2_D_Stat	MSS only	These signals have to be in the same CAN message grouped together
	SourceTypeStatus2	SrcTypeActvZone2_D_St	MSS only	
	SourceTypeChannel2	SrcTypeChnlZone2_D_St	MSS only	
	MixableZonePrompts2	MixblPrmptZone2_B_Stat	MSS only	
	MixableZonePromptsChannel2	MixblChnlZone2_D_Stat	MSS only	
AudioSourceZone3.St	SourceType3	SrcTypeZone3_D_Stat	MSS only	These signals have to be in the same CAN message grouped together
	SourceTypeStatus3	SrcTypeActvZone3_D_St	MSS only	
	SourceTypeChannel3	SrcTypeChnlZone3_D_St	MSS only	
	MixableZonePrompts3	MixblPrmptZone3_B_Stat	MSS only	
	MixableZonePromptsChannel3	MixblChnlZone3_D_Stat	MSS only	
AudioSourceZone4.St	SourceType4	SrcTypeZone4_D_Stat	MSS only	These signals have to be in the same CAN message grouped together
	SourceTypeStatus4	SrcTypeActvZone4_D_St	MSS only	
	SourceTypeChannel4	SrcTypeChnlZone4_D_St	MSS only	
	MixableZonePrompts4	MixblPrmptZone4_B_Stat	MSS only	
	MixableZonePromptsChannel4	MixblChnlZone4_D_Stat	MSS only	
AudioSourceZone5.St	SourceType5	SrcTypeZone5_D_Stat	MSS only	These signals have to be in the same CAN message grouped together
	SourceTypeStatus5	SrcTypeActvZone5_D_St	MSS only	
	SourceTypeChannel5	SrcTypeChnlZone5_D_St	MSS only	
	MixableZonePrompts5	MixblPrmptZone5_B_Stat	MSS only	
	MixableZonePromptsChannel5	MixblChnlZone5_D_Stat	MSS only	
AudioSourceZone6.St	SourceType6	SrcTypeZone6_D_Stat	MSS only	These signals have to be in the same CAN message grouped together
	SourceTypeStatus6	SrcTypeActvZone6_D_St	MSS only	
	SourceTypeChannel6	SrcTypeChnlZone6_D_St	MSS only	
	MixableZonePrompts6	MixblPrmptZone6_B_Stat	MSS only	
	MixableZonePromptsChannel6	MixblChnlZone6_D_Stat	MSS only	
N/A	DSP_VehicleAudioMode_Rsp	VehAudioMdeCtl_D_Stat2	MSS only	
N/A	PAC_VehicleAudioMode_Rsp	VehAudioMdeCtl_D_Stat	MSS only	
N/A	InfoSysMasterPw_D_Stat	InfoSysMasterPw_D_Stat		
N/A	HMIAudioMode	HMI_HMIMode_St		

3.7 Interface Requirements

3.7.1 MD-REQ-410347/B-AudioSource.St

Message Type: Status

The AudioSource.St message defines the current active audio source(s) for the infotainment system in cabin mode or zone 1 in zone mode.

Logical Signal Name	Literals	Value	Description
SourceType	Inactive / Audio OFF	0x0	
	Aux_Media	0x1	
	AM	0x2	
	FM	0x3	
	SDARS SAT	0x4	Satellite broadcast audio routed from the embedded satellite radio module for SDARS.
	SDARS IP	0x5	IP streaming audio routed from TCU/modem for SDARS.
	DAB	0x6	
	Phone	0x7	
	Call Ring	0x8	
	Radio Announcement	0x9	Radio Announcement or RA applies for TA (traffic alert), News, Alarm, DAB announcements or other announcements from the radio.
	VR	0xA	
	Priority Assist	0xB	
	Reserved	0xC – 0x1F	
SourceTypeStatus	Inactive	0x0	
	Deallocated	0x1	
	Stacked	0x2	
	Granted	0x3	
SourceTypeChannel	Inactive	0x0	
	A2B_ID1	0x1	
	A2B_ID2	0x2	
	A2B_ID3	0x3	
	…	…	
	A2B_ID32	0x20	
	BT_Zone2	0x21	BT audio from phone paired to zone 2
	BT_Zone3	0x22	BT audio from phone paired to zone 3
	BT_Zone4	0x23	BT audio from phone paired to zone 4
	BT_Zone5	0x24	BT audio from phone paired to zone 5
	BT_Zone6	0x25	BT audio from phone paired to zone 6
	Reserved for future expansion	0x26 – 0xFF	

MixableZonePrompts	Inactive	0x0	
	Active	0x1	
MixableZonePromptsChannel	Inactive	0x0	
	A2B_ID1	0x1	
	A2B_ID2	0x2	
	A2B_ID3	0x3	
	…	…	
	A2B_ID32	0x20	
	Reserved for future expansion	0x21 – 0xFF	
MixableCabinPrompts	Inactive	0x0	
	Active	0x1	
VehicleAudioMode	Null	0x0	
	Cabin	0x1	
	Zone	0x2	

Note: For CAN all these signals need to be in the same message

3.7.2 MD-REQ-410348/A-AudioSourceZone2.St

Message Type: Status

The AudioSourceZone2.St message defines the current active audio source(s) for the infotainment system in zone 2

Logical Signal Name	Literals	Value	Description
SourceType2	Inactive / Audio OFF	0x0	
	Aux_Media	0x1	
	AM	0x2	
	FM	0x3	
	SDARS SAT	0x4	
	SDARS IP	0x5	
	DAB	0x6	
	Phone	0x7	
	Call Ring	0x8	
	Radio Announcement	0x9	Radio Announcement or RA applies for TA (traffic alert), News, Alarm, DAB announcements or other announcements from the radio.
	VR	0xA	

	Priority Assist	0xB	
	Reserved	0xC – 0x1F	
SourceTypeStatus2	Inactive	0x0	
	Deallocated	0x1	
	Stacked	0x2	
	Granted	0x3	
SourceTypeChannel2	Inactive	0x0	
	A2B_ID1	0x1	
	A2B_ID2	0x2	
	A2B_ID3	0x3	
	…	…	
	A2B_ID32	0x20	
	BT_Zone2	0x21	BT audio from phone paired to zone 2
	BT_Zone3	0x22	BT audio from phone paired to zone 3
	BT_Zone4	0x23	BT audio from phone paired to zone 4
	BT_Zone5	0x24	BT audio from phone paired to zone 5
	BT_Zone6	0x25	BT audio from phone paired to zone 6
	Reserved for future expansion	0x26 – 0xFF	
MixableZonePrompts2	Inactive	Inactive	
	Active	Active	
MixableZonePromptsChannel 2	Inactive	0x0	
	A2B_ID1	0x1	
	A2B_ID2	0x2	
	A2B_ID3	0x3	
	…	…	
	A2B_ID32	0x20	
	Reserved for future expansion	0x21 – 0xFF	

Note: For CAN all these signals need to be in the same message

3.7.3 MD-REQ-410387/A-AudioSourceZone3.St

Message Type: Status

The AudioSourceZone3.St message defines the current active audio source(s) for the infotainment system in zone 3

Logical Signal Name	Literals	Value	Description
SourceType3	Inactive / Audio OFF	0x0	
	Aux_Media	0x1	
	AM	0x2	
	FM	0x3	
	SDARS SAT	0x4	
	SDARS IP	0x5	
	DAB	0x6	
	Phone	0x7	
	Call Ring	0x8	
	Radio Announcement	0x9	Radio Announcement or RA applies for TA (traffic alert), News, Alarm, DAB announcements or other announcements from the radio.
	VR	0xA	
	Priority Assist	0xB	
	Reserved	0xC – 0x1F	
SourceTypeStatus3	Inactive	0x0	
	Deallocated	0x1	
	Stacked	0x2	
	Granted	0x3	
SourceTypeChannel3	Inactive	0x0	
	A2B_ID1	0x1	
	A2B_ID2	0x2	
	A2B_ID3	0x3	
	…	…	
	A2B_ID32	0x20	
	BT_Zone2	0X21	BT audio from phone paired to zone 2
	BT_Zone3	0x22	BT audio from phone paired to zone 3
	BT_Zone4	0x23	BT audio from phone paired to zone 4
	BT_Zone5	0x24	BT audio from phone paired to zone 5
	BT_Zone6	0x25	BT audio from phone paired to zone 6
	Reserved for future expansion	0x26 – 0xFF	
MixableZonePrompts3	Inactive	Inactive	
	Active	Active	

MixableZonePromptsChannel 3	Inactive	0x0	
	A2B_ID1	0x1	
	A2B_ID2	0x2	
	A2B_ID3	0x3	
	…	…	
	A2B_ID32	0x20	
	Reserved for future expansion	0x21 – 0xFF	

Note: For CAN all these signals need to be in the same message

3.7.4 MD-REQ-410388/A-AudioSourceZone4.St

Message Type: Status

The AudioSourceZone4.St message defines the current active audio source(s) for the infotainment system in zone 4

Logical Signal Name	Literals	Value	Description
SourceType4	Inactive / Audio OFF	0x0	
	Aux_Media	0x1	
	AM	0x2	
	FM	0x3	
	SDARS SAT	0x4	
	SDARS IP	0x5	
	DAB	0x6	
	Phone	0x7	
	Call Ring	0x8	
	Radio Announcement	0x9	Radio Announcement or RA applies for TA (traffic alert), News, Alarm, DAB announcements or other announcements from the radio.
	VR	0xA	
	Priority Assist	0xB	
	Reserved	0xC – 0x1F	
SourceTypeStatus4	Inactive	0x0	
	Deallocated	0x1	
	Stacked	0x2	
	Granted	0x3	
SourceTypeChannel4	Inactive	0x0	

	A2B_ID1	0x1	
	A2B_ID2	0x2	
	A2B_ID3	0x3	
	…	…	
	A2B_ID32	0x20	
	Bt_Zone2	0x21	BT audio from phone paired to zone 2
	BT_Zone3	0x22	BT audio from phone paired to zone 3
	BT_Zone4	0x23	BT audio from phone paired to zone 4
	BT_Zone5	0x24	BT audio from phone paired to zone 5
	BT_Zone6	0x25	BT audio from phone paired to zone 6
	Reserved for future expansion	0x26 – 0xFF	
MixableZonePrompts4	Inactive	Inactive	
	Active	Active	
MixableZonePromptsChannel 4	Inactive	0x0	
	A2B_ID1	0x1	
	A2B_ID2	0x2	
	A2B_ID3	0x3	
	…	…	
	A2B_ID32	0x20	
	Reserved for future expansion	0x21 – 0xFF	

Note: For CAN all these signals need to be in the same message

3.7.5 MD-REQ-410389/A-AudioSourceZone5.St

Message Type: Status

The AudioSourceZone5.St message defines the current active audio source(s) for the infotainment system in zone 5

Logical Signal Name	Literals	Value	Description
SourceType5	Inactive / Audio OFF	0x0	
	Aux_Media	0x1	
	AM	0x2	
	FM	0x3	
	SDARS SAT	0x4	
	SDARS IP	0x5	
	DAB	0x6	

	Phone	0x7	
	Call Ring	0x8	
	Radio Announcement	0x9	Radio Announcement or RA applies for TA (traffic alert), News, Alarm, DAB announcements or other announcements from the radio.
	VR	0xA	
	Priority Assist	0xB	
	Reserved	0xC – 0x1F	
SourceTypeStatus5	Inactive	0x0	
	Deallocated	0x1	
	Stacked	0x2	
	Granted	0x3	
SourceTypeChannel5	Inactive	0x0	
	A2B_ID1	0x1	
	A2B_ID2	0x2	
	A2B_ID3	0x3	
	…	…	
	A2B_ID32	0x20	
	BT_Zone2	0x21	BT audio from phone paired to zone 2
	BT_Zone3	0x22	BT audio from phone paired to zone 3
	BT_Zone4	0x23	BT audio from phone paired to zone 4
	BT_Zone5	0x24	BT audio from phone paired to zone 5
	BT_Zone6	0x25	BT audio from phone paired to zone 6
	Reserved for future expansion	0x26 – 0xFF	
MixableZonePrompts5	Inactive	Inactive	
	Active	Active	
MixableZonePromptsChannel 5	Inactive	0x0	
	A2B_ID1	0x1	
	A2B_ID2	0x2	
	A2B_ID3	0x3	
	…	…	
	A2B_ID32	0x20	
	Reserved for future expansion	0x21 – 0xFF	

Note: For CAN all these signals need to be in the same message

3.7.6 MD-REQ-410390/A-AudioSourceZone6.St

Message Type: Status

The AudioSourceZone6.St message defines the current active audio source(s) for the infotainment system in zone 6

Logical Signal Name	Literals	Value	Description
SourceType6	Inactive / Audio OFF	0x0	
	Aux_Media	0x1	
	AM	0x2	
	FM	0x3	
	SDARS SAT	0x4	
	SDARS IP	0x5	
	DAB	0x6	
	Phone	0x7	
	Call Ring	0x8	
	Radio Announcement	0x9	Radio Announcement or RA applies for TA (traffic alert), News, Alarm, DAB announcements or other announcements from the radio.
	VR	0xA	
	Priority Assist	0xB	
	Reserved	0xC – 0x1F	
SourceTypeStatus6	Inactive	0x0	
	Deallocated	0x1	
	Stacked	0x2	
	Granted	0x3	
SourceTypeChannel6	Inactive	0x0	
	A2B_ID1	0x1	
	A2B_ID2	0x2	
	A2B_ID3	0x3	
	…	…	
	A2B_ID32	0x20	
	BT_Zone2	0x21	BT audio from phone paired to zone 2
	BT_Zone3	0x22	BT audio from phone paired to zone 3
	BT_Zone4	0x23	BT audio from phone paired to zone 4
	BT_Zone5	0x24	BT audio from phone paired to zone 5
	BT_Zone6	0x25	BT audio from phone paired to zone 6
	Reserved for future expansion	0x26 – 0xFF	

MixableZonePrompts6	Inactive	Inactive	
	Active	Active	
MixableZonePromptsChannel 6	Inactive	0x0	
	A2B_ID1	0x1	
	A2B_ID2	0x2	
	A2B_ID3	0x3	
	…	…	
	A2B_ID32	0x20	
	Reserved for future expansion	0x21 – 0xFF	

Note: For CAN all these signals need to be in the same message

3.7.7 MD-REQ-421288/A-DSP_VehicleAudioMode_Rsp

Message Type: Status

Status signal indicating if the DSP AMP module is in Cabin or Zone mode.

The DSP AMP shall have either Zone or Cabin mode populated based on what audio mode it is in.

It is a response/status signal since this should be in response to the Audio Resource Server VehicleAudioMode signal but status since it is always broadcasting what state it is in periodically.

Logical Signal Name	Literals	Value	Description
DSP_VehicleAudioMode_Rsp	Null	0x0	
	Cabin	0x1	
	Zone	0x2	

3.7.8 MD-REQ-421286/A-PAC_VehicleAudioMode_Rsp

Message Type: Status

Status signal indicating if the PAC module is in Cabin or Zone mode.

The PAC shall have either Zone or Cabin mode populated based on what audio mode it is in.

It is a response/status signal since this should be in response to the Audio Resource Server VehicleAudioMode signal but status since it is always broadcasting what state it is in periodically.

Logical Signal Name	Literals	Value	Description
PAC_VehicleAudioMode_Rsp	Null	0x0	
	Cabin	0x1	
	Zone	0x2	

4 General Requirements

4.1 AUMGNT-SR-REQ-410349/A-Volume Source used for an Active Audio Source

The tables below list the volume source that shall be used for the audio management active audio source.

Active Source in Cabin mode	Volume Source	Comments
Audio_Off	N/A	
Aux_Media	Media	Applies when this SourceType is Granted.
AM	Media	
FM	Media	
SDARS SAT	Media	
SDARS IP	Media	
DAB	Media	
Phone	Phone	
Priority Assist Call	Phone	
Call Ring	Call Ring	
Radio Announcement	RA	
VR	Prompt	
Mixable Prompts	Prompt	Applies when MixablePrompts is set to active
Captains Announcement	N/A	Fixed volume so doesn't apply for volume source
In Car Communication	N/A	

If two volume sources are Granted at the same time with different volume sources, and the user tries to adjust the volume (ex volume knob, SWC volume etc) then the Volume Settings Server shall follow below:

- If it is specified a specific way for a particular use case which source has volume control, then follow that feature spec (ex if CarPlay had dedicated requirements), else
    - If one volume source is attenuated and one is not attenuated then any volume adjustments by the user would adjust the non-attenuated volume source
    - If neither Granted sources are attenuated then the following priorities shall be followed (1 being the highest priority and 10 being the lowest priority) and the highest priority volume shall be adjusted:
        1. Call Ring
        2. Phone Call
        3. Emergency
        4. Vehicle Status (Prompts)
        5. Alarm
        6. Safety Prompts (Prompts)
        7. Voice Recognition (Prompts)
        8. RA (Radio Announcements)
        9. Navigation (Prompts)
        10. Media (AM, FM, Aux_Media…)

Active Source in Zone mode	Volume Source	Comments
Audio_Off	N/A	
Aux_Media	Media	Applies when this SourceType is Granted.
AM	Media	
FM	Media	
SDARS SAT	Media	
SDARS IP	Media	
DAB	Media	
Phone	Temp Audio	
Priority Assist Call	Temp Audio	
Call Ring	Temp Audio	
Radio Announcement	Temp Audio	
VR	Prompt	
Mixable Prompts	Prompt	Applies when this MixablePrompts is set to active
Captains Announcement	N/A	Fixed volume so doesn't apply for volume source

In Car Communication	N/A	

Note: in zone mode, there are only three active volume sources, Media, Temp Audio and Prompts for each zone. There is also a volume offset signal in zone mode. See volume SPSS for details

4.2 AUMGNT-SR-REQ-410394/A-Saveable audio sources

The sources below list what sources are savable and what are not, such as between power mode changes. The Audio Resource Server is responsible for saving the source between power mode changes.

Active Source	Saveable Source	Comments
Audio_Off	Yes	Save as no audio source (ie empty audio stack)
Aux_Media	Yes	Applies when the SourceType is Granted
AM	Yes	
FM	Yes	
SDARS SAT	Yes	
SDARS IP	Yes	
DAB	Yes	
Phone	No	
Priority Assist Call	No	
Call Ring	No	
Radio Announcement	No	
VR	No	
Mixable Prompts	No	
Captains Announcement	N/A	Reference the Captains Announcement SPSS spec regarding if this is a saveable source or not and if saveable then for what module
In Car Communication	N/A	Reference the In Car Communication SPSS spec regarding if this is a saveable source or not and if savable then for what module

4.3 AUMGNT-SR-REQ-410391/B-Saveable source audio handling

TBD for this requirement

This requirement is for the Audio Resource Server

Powering On the infotainment system:
When the infotainment system is powered ON from an OFF state (ie HMIAudioMode = OFF → ON) then the infotainment system shall use the last saveable audio source. See requirement "AUMGNT-REQ-410394-Savable audio sources" for a list of saveable sources.

- Note regarding Android set-up:
  As far as audio management is concerned for Android that might mean an empty audio stack (ie audio focus released) with audio off but the last source has the Media focus at start-up (ie audio hold state). That could also mean for Android that the last saveable source as the Granted source with audio available (ie has Audio and Media focus). In general, the Audio Hold strategy would supported where the last source would be available at start-up whether it was producing audio or not. Android's Media Focus is outside the scope of Audio Management so won't be covered in this SPSS.

Power On/Off button:
If the last saveable source was Audio OFF (ie empty audio stack), and the power ON button is pressed to turn the infotainment system on, then the last available savable source (other than empty audio stack) would be Granted (or in an Audio Hold state).

Removeable sources:
If a saveable source was a removable source and was removed/disconnected (ex BT Phone, CarPlay phone…) and it is already defined in other specifications what to do (ex audio off, audio hold…), then follow those specifications.

USB only:
For USB audio device (unless specified otherwise), if it is removed, then the Audio Resource Server shall Grant the last active tuner source (AM/FM/SDARS/DAB).

At system start-up (ie HMIAudioMode OFF → ON) if USB was the last saveable source then the Audio Resource Server shall wait 30 seconds trying to detect if USB is present. After 30 second if USB is not present then the Audio Resource Server go to the last active tuner source (ie AM/FM/SDARS/DAB).

Source Release:
Unless noted or specified otherwise, if a saveable source releases itself (de-allocated) with the infotainment system ON (ie HMIAudioMode = ON) then the source would remain in an audio hold state.

- Example: For the particular App X the user presses the pause button and the Audio Resource Server releases the audio source (ie Android release audio focus but retains Media focus) so that there is an empty audio stack (ie audio Off). If the play button is pressed then the Audio Resource Server shall Grant the audio for App X (ie Android request audio focus and retains media focus).

If other specifications contradict this requirement then follow the other specification.

4.4 AUMGNT-REQ-486877/A-Signals to use when Multi-Seat Zone audio is NOT supported

When a module only supports Cabin mode (zone mode not supported) or is configured to only support Cabin mode then the following applies:

1. The VehicleAudioMode signal is not used and is considered not applicable. The default for all the audio and audio display components (ex AudioResourceServer, AudioIOController(s), Rear Audio Controller display etc) is Cabin mode.
2. The SourceTypeChannel signal is not used and considered not applicable. Refer to the A2B SPSS for details on what audio source uses what audio stream.
3. The following messages and signals are also not applicable:
    a. Messages AudioSourceZone2.St – AudioSourceZone6.St and all the signals contained in those messages are not applicable.
    b. PAC_VehicleAudioMode_Rsp is not appliable
    c. DSP_VehicleAudioMode_Rsp is not applicable
    d. MixableZonePrompts is not applicable
    e. MixableZonePromptsChannel is not applicable

This requirement is applicable for not just the Audio Management SPSS but all other specifications which may use these signals.

- Example: if feature spec X shows SourceTypeChannel in the sequence diagram but a module does not support zone mode (zone mode configured off or only supports cabin) then this requirement applies and the SourceTypeChannel signal shall be ignored in the sequence diagram.
- Example2: the Station Management SPSS showing using VehiceAudioMode but a module does not support zone mode (zone mode configured off or only supports cabin) then this requirement applies and the VehicleAudioMode signal shall be ignored and all modules shall consider the infotainment system in cabin mode.

AudioResourceServer only:
It is still required that the AudioResourceServer shall always set VehicleAudioMode = Cabin when zone mode is not supported (ex zone mode configured off or only supports cabin). While all modules should ignore the VehicleAudioMode signal if some more obscure module uses this and didn't see this requirement since the requirement is new since initial audio management SPSS release then the AudioResourceServer would still prevent issues from occurring.

- Note: other modules other than the AudioResourceServer shall not rely on this and shall treat VehicleAudioMode signal as not applicable and default to cabin mode as mentioned previously. Any failure resulting from using the VehicleAudioMode signal shall be considered the fault of the modules receiving this signal since they should be ignoring this signal when multi-zone audio is not supported.

5 Functional Definition

5.1 AUMGNT-FUN-REQ-410504/A-Performance Requirements

5.1.1 Requirements

5.1.1.1 AUMGNTv2-SR-REQ-410502/A-CarPlay - max time to change to CarPlay audio source

When an audio source changes from an audio source (ex FM) to CarPlay (ie a source in Aux_Media) then it shall happen within 100 msec of the beginning of the source change event. The 100 msec includes the total time for all the modules involved to make the source change.

- Reference CarPlay requirement "*CPY-FUR-REQ-089596-Audio Setup*" in the Apple CarPlay spec "*Apple Accessory Interface Specification in Features -> CarPlay -> General Requirements -> Audio*".
- Note: for non-CarPlay sources the 100 msec source change max time limit shall still be followed if possible

5.2 AUMGNT-FUN-REQ-410581/A-Audio Source Prioritization

5.2.1 Requirements

5.2.1.1 AUMGNT-SR-REQ-410582/A-Audio Source Prioritization

The Audio Resource Server shall follow these priority tables for audio management.

Pre-Condition: Media Priority Source Active

Post-Condition / Event	Active Source	Stackable (is pre-condition source stacked)	Comments
Priority Assist	Priority Assist	Yes*	*if feature spec contradicts stacking pre-condition follow the priority assist feature spec (ex if feature spec calls to go to audio off when Priority Assist ends)
Phone	Phone	Yes	
Call Ring	Call Ring	Yes	
Voice Recognition	VR	Yes	
Radio Announcement	RA	Yes	
Media (another media request)	New Media source active	No	
Mixable Prompts	Media & Mixable Prompts concurrent	No	Depending on the mixable prompt and what Android priority it is assigned, the mixable prompt could be mixed with Media. See mixable prompt spec(s) for details of what Android priority is used for a specific prompt
~~Captains Announcement~~	~~Captains Announcement~~	~~No~~	~~The Media source would be muted or paused during Captains announcement but remain the Granted source~~

Note: Media priority includes any volume media source in cabin mode (ex AM, FM, Aux_Media…) as called out in "AUMGNT-REQ-410349-Volume Source used for an Active Audio Source".

Pre-Condition: VR Priority Source Active

Post-Condition / Event	Active Source	Stackable (is pre-condition source stacked)	Comments
Priority Assist	Priority Assist	No	
Phone	Phone	No	
Call Ring	Call Ring	No	
Voice Recognition (new VR request)	VR and VR (new request) Concurrent	No	Note: This is to support Android Audio Management requirements where two VR priorities would be Granted concurrently. For CAN messaging though the Audio Resource Server would only show VR Granted with no indication of two Granted VR sources. See Ford VR spec for details if there any Ford specific requirements on the VR engine (such as

			if multiple Ford VR sources can be active concurrently or not).
Radio Announcement	VR	No	See tuner spec if RA can be requested when VR ends, if RA event still occurring
Media	VR and Media Concurrent	No	Note: This is to support Android Audio Management requirements where VR and Media priorities would be Granted concurrently if requested to audio manager.
Mixable Prompts	VR & Mixable Prompts concurrent, or VR only or mixable prompts only	No	Depending on the mixable prompt and what Android priority it is assigned, the mixable prompt could be mixed with Media, the mixable prompt could be exclusive or VR exclusive. See mixable prompt spec(s) for details of what Android priority is used for a specific prompt
~~Captains Announcement~~	~~Captain Announcement~~	~~No~~	~~VR would become deallocated when Captains Announcement is active~~

Pre-Condition: Phone Priority Source is active

Post-Condition / **Event**	**Active Source**	**Stackable (is pre-condition source stacked)**	**Comments**
Priority Assist	Priority Assist & Phone Concurrent	No	With Priority Assist being concurrent with Phone this rejects other requests that priority phone would not reject
Phone (new Phone request)	Phone and Phone (new request) Concurrent	No	This is to support Android Audio Management requirements where two Phone Concurrent priorities will be played concurrently if requested. For CAN messaging though the Audio Resource Server would only show Phone Granted with no indication of two Granted Phone sources. Ford phone software app can prevent two phone calls being active at the same time within that app, if it is specified that way. 3rd party apps could still place a phone priority request while a phone priority request is active and have two phone priorities concurrently granted. See phone spec for details.
Call Ring	Call Ring concurrent with phone call	No	This is to support Android Audio Management requirements where Phone and Call Ring Concurrent priorities will be played concurrently if requested (example one app requests Call Ring priority and another app requests Phone priority).
Voice Recognition	Phone	No	
Radio Announcement	Phone	No	See tuner spec if RA can be requested when phone call ends, if RA event still occurring
Media	Phone	No	

Mixable Prompts	Phone and Mixable prompts concurrent, or Phone only	No	Depending on the mixable prompt and what Android priority it is assigned, the mixable prompt could be mixed with Phone, or Phone could be exclusive. See mixable prompt spec(s) for details of what Android priority is used for a specific prompt
~~Captains Announcement~~	~~See Captains Announcement spec for details~~	~~No~~	

Pre-Condition: Call Ring Priority Source is active

Post-Condition / Event	Active Source	Stackable (is pre-condition source stacked)	Comments
Priority Assist	Priority Assist	No	
Phone	Phone concurrent with Call Ring	No	This is to support Android Audio Management requirements where Phone and Call Ring Concurrent priorities will be played concurrently if requested (example one app requests Call Ring priority and another app requests Phone priority). Note: Within one phone app (and one Android object), if there is an incoming call ring and then the phone call is picked up the phone app would follow the below audio management: 1. Call Ring is requested 2. Call Ring Granted and call ring audio is playing. 3. Phone priority requested when the phone call is answered 4. Call Ring Deallocated by Audio Resource Server 5. Phone Granted by Audio Resource Server
Call Ring (new call ring request)	Call Ring concurrent with Call Ring (new request)	No	This is to support Android Audio Management requirements where Call Ring and Call Ring (new request) Concurrent priorities will be played concurrently if requested. For CAN messaging though the Audio Resource Server would only show Call Ring Granted with no indication of two Granted Call Ring sources.
Voice Recognition	VR and Call Ring concurrent	No	
Radio Announcement	Call Ring	No	See tuner spec if RA can be requested when Call Ring call ends, if RA event still occurring
Media	Call Ring	No	
Mixable Prompts	Call Ring and Mixable prompts concurrent, Call Ring only	No	Depending on the mixable prompt and what Android priority it is assigned, the mixable prompt could be mixed with Call Ring, or Call Ring could be exclusive. See mixable prompt spec(s) for details of what Android priority is used for a specific prompt

~~Captains Announcement~~	~~Mix with Call Ring~~	~~No~~	

Pre-Condition: Radio Announcement Priority Source is active

Post-Condition / Event	Active Source	Stackable (is pre-condition source stacked)	Comments
Priority Assist	Priority Assist	No	
Phone	Phone	No	
Call Ring	Call Ring	No	
Voice Recognition	Voice Recognition	No	
Radio Announcement (new RA request)	RA (new request)	No	
Media	RA	No	
Mixable Prompts	RA & Mixable Prompts concurrent	No	Depending on the mixable prompt and what Android priority it is assigned, the mixable prompt could be mixed with RA. See mixable prompt spec(s) for details of what Android priority is used for a specific prompt
~~Captains Announcement~~	~~CA and RA concurrent~~	~~No~~	

Note: Radio Announcement includes items such as TA (Traffic Announcement), News and Alarm. See Tuner spec for details

Pre-Condition: "Priority Assist" Priority Source is active

Post-Condition / Event	Active Source	Stackable (is pre-condition source stacked)	Comments
Priority Assist (new priority assist request)	N/A	No	Ford app won't allow two priority assist priorities to be concurrent
Phone	Priority Assist is concurrent with Phone	No	Priority Assist is active and then outgoing phone call occurs so both Priority Assist and Phone concurrent are concurrent. With Priority Assist being concurrent this rejects other requests that priority phone would not reject
Call Ring	Priority Assist	No	
Voice Recognition	Priority Asisst	No	
Radio Announcement	Priority Assist	No	
Media	Priority Assist	No	
Mixable Prompts	Priority Assist, or Priority Assist mixed with mixable prompts	No	Depending on the mixable prompt and what Android priority it is assigned, the mixable prompt could be mixed with Priority Server, or Priority Service could be exclusive. See mixable prompt spec(s) for details of what Android priority is used for a specific prompt

~~Captains Announcement~~	~~Priority Assist~~	~~No~~	

Pre-Condition: Mixable Prompts Priority Source is active

Post-Condition / Event	Active Source	Stackable (is pre-condition source stacked)	Comments
Priority Assist	Mix if applicable	No	Reference prompts priority spec and Android priorities
Phone	Mix if applicable	No	
Call Ring	Mix if applicable	No	
Voice Recognition	Mix if applicable	No	
Radio Announcement	Mix if applicable	No	
Media	Mix if applicable	No	
Mixable Prompts (new mixable prompt request)	Mixable prompt concurrent with Mixable prompt new, or Mixable Prompt original only or Mixable Prompt new request only	No	Depending on the mixable prompt and what Android priority it is assigned, the mixable prompt could be mixed with another mixable prompt, or one mixable prompt might have higher priority and played exclusively. See mixable prompt spec(s) for details of what Android priority is used for a specific prompt. If Ford has any prompt arbitration requirements for multiple prompts at once then follow that spec which is outside the scope of this audio management SPSS.
~~Captains Announcement~~	~~Mix if applicable~~	~~No~~	

~~Pre-Condition: Captains Announcement Priority Source is active~~

~~Post-Condition / Event~~	~~Active Source~~	~~Stackable (is pre-condition source stacked)~~	~~Comments~~
~~Priority Assist~~	~~Priority Assist~~	~~No~~	
~~Phone~~	~~See Captains Announcement spec for details~~	~~No~~	
~~Call Ring~~	~~Call Ring concurrent with Captains Announcement~~	~~No~~	
~~Voice Recognition~~	~~Captains announcement~~	~~No~~	~~VR request would be rejected during a Captains Announcment~~
~~Radio Announcement~~	~~Mix~~	~~No~~	

~~Media~~	~~CA~~	~~No~~	~~The Media source would be muted or paused during Captains announcement but become the Granted source~~
~~Mixable Prompts~~	~~Mix~~	~~No~~	
~~Captains Announcement~~	~~N/A~~	~~N/A~~	

Note:

1. See In Car Communication spec for details on source priority. ICC is not handled by the AudioSource.St so not in this spec
2. See Captains Announcement spec for details on how captains announcement is used.

5.3 AUMGNT-FUN-REQ-410500/A-AudioSource.St - SourceType signals usage

5.3.1 Requirements

5.3.1.1 AUMGNTv2-SR-REQ-410539/A-AudioSource.St SourceType audio loop of Audio Stack

The entries in the audio stack consists of the Granted and Stacked sources in the AudioSource.St (SourceType, SourceTypeStatus) message. When no audio source is active (ie audio off) there will be an empty audio stack broadcast periodically.

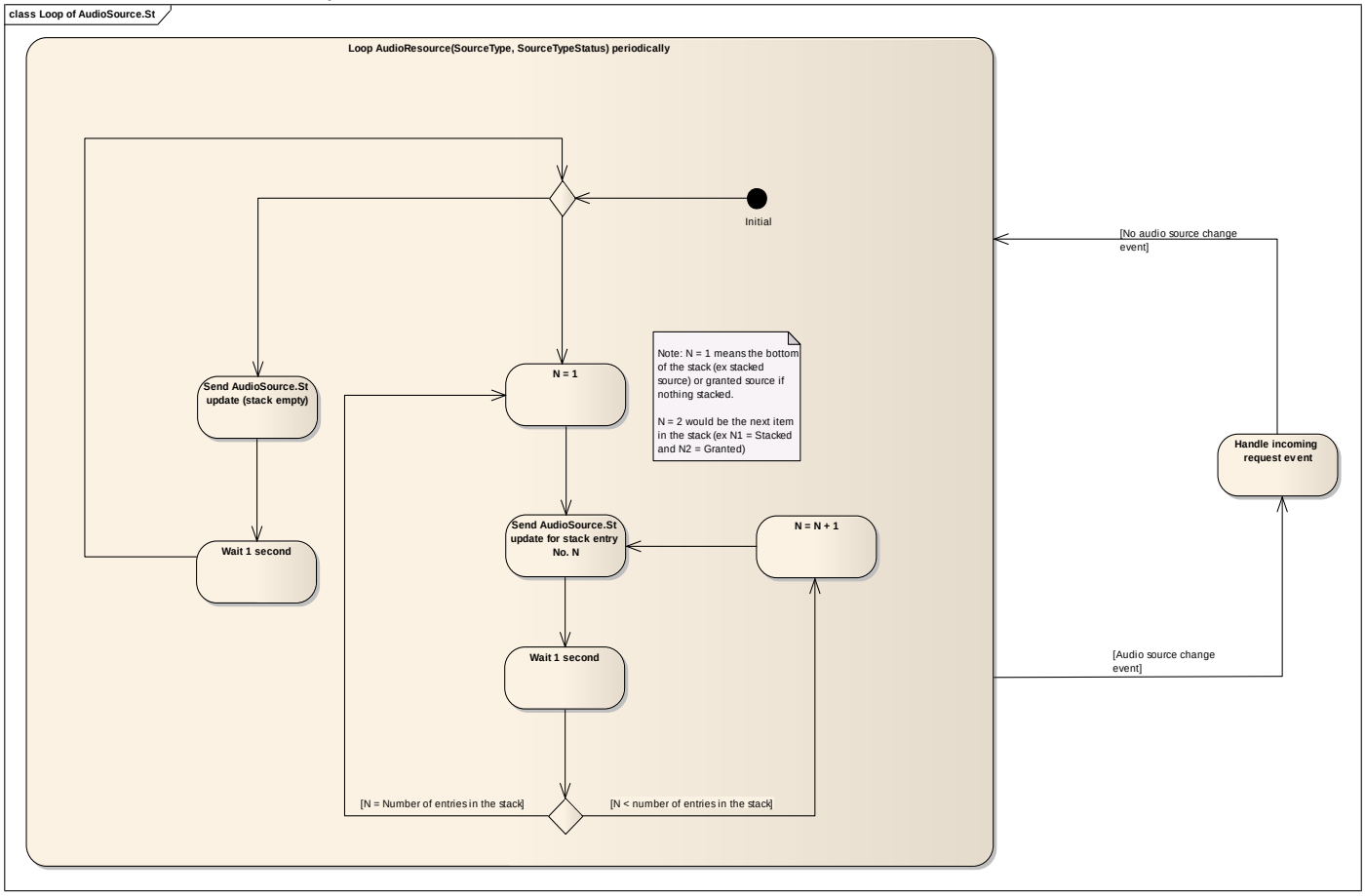
The Audio Stack shall be broadcast by the Audio Resource Server on a periodic basis going through every item in the stack starting with the bottom of the stack (ex stacked sources) and alternating to the top of the stack (ex granted sources).

The periodic audio stack can be interrupted at any time for an incoming audio event. The event shall be handled first (ex deallocating and granted new sources) and then return to the periodic broadcast audio stack after the audio event.

- An example could be:
  - Aux_Media is being broadcast out periodically as the granted source
  - A phone call request comes in
  - Aux_Media is stacked and then Phone is granted
  - Now the periodic broadcasting of the audio stack resumes alternating the status between the stacked audio source Aux_Media and then the granted audio source Phone and repeating in a loop.

Note: if AudioSource.St is in an event-periodic message you might see a value twice before you see the other item in the audio stack.

Below defines the details of the periodic audio stack:



5.3.1.2 AUMGNT-SR-REQ-410543/A-SourceType signal

The SourceType signal indicates the audio source being used with the SourceTypeStatus and SourceTypeChannel signals.

5.3.1.3 AUMGNT-SR-REQ-410501/A-Audio Off - SourceType signals

When no sources are active (ie Audio OFF/empty audio stack) in the SourceType signal then AudioSource.St shall be set as follows:

- SourceType = Inactive / Audio OFF
- SourceTypeStatus = Inactive
- SourceTypeChannel = Inactive

5.3.1.4 AUMGNT-SR-REQ-410540/A-SourceTypeStatus

Deallocated:

The source/request is no longer required and has been removed from the stack.

- The Audio Resource Server shall transmit the value “Deallocated” for a resource that has been released and is no longer in the audio stack.
- As a general rule when a source goes from Granted to Deallocated the HMI wouldn’t update until a new source is Granted or there is an empty audio stack

Stacked:

A source is stacked when a higher priority source/request pushes the current active source down in the stack. The stacked source will be Granted as soon as the audio system is available

- The Audio Resource Server shall transmit the value “Stacked” if the source is in the audio stack but not the Granted audio source.
- Stacked sources don’t have access to the audio system.
- If a source is in the stack it can be granted when the audio prioritizer permits. See priority table for details.
- Stacked sources can be paused for pauseable source. Example, if USB source was stacked it could pause the USB audio when it was stacked. See applicable feature specs for what is and what is not paused

Granted:

The source is granted access to the audio system. This is typically the request with the highest priority

- The Audio Resource Server shall transmit the value “Granted” for a resource that is the active audio source. The Granted source can produce audio using the vehicle audio system.
- Granted sources could be used by the module receiving the AudioSource.St to update their HMI for the respective source
    - Note: when media app pauses it is up to the media application if they release the Granted audio source or not. If specified, Ford could require that Ford apps to not release the audio source when paused but 3rd party apps do pause and release the Granted audio source.
- Control of the granted source is allowed by the requester (unless specified otherwise).
- There can be multiple sources Granted concurrently, both playing audio (one might be attenuated)

Example:

If the vehicle occupant was listing to FM then FM would be Granted. If a phone call comes in then the phone call would get Granted since it is a higher priority and FM would get Stacked.

5.3.1.5 AUMGNT-SR-REQ-410583/A-SourceTypeChannel

The SourceTypeChannel signal is used by the Audio Resource Server to tell the Audio IO Controller what audio source input to use for the SourceType and SourceTypeChannel signals.

If nothing defined for a particular audio source then SourceTypeChannel shall be set to 0x0 Inactive.

- Example: if the Audio IO Controller was internal to the same module as the Audio Resource Server then SourceTypeChannel would be set to 0x0 Inactive since nothing being sent to an external module.

For A2B_ID’s please reference the A2B SPSS for what ID is tied to what A2B audio stream

BT_Zone:

- BT_Zone3: Bluetooth audio from the phone paired to zone 3
- BT_Zone4: Bluetooth audio from the phone paired to zone 4
- BT_Zone5: Bluetooth audio from the phone paired to zone 5
- BT_Zone6: Bluetooth audio from the phone paired to zone 6

Note: see BT specifications for mapping the BT device address to the applicable BT zone

5.3.1.6 AUMGNT-SR-REQ-410815/A-Multiple Granted sources

Based on the priority table multiple source could be granted at the same time (ie concurrent audio sources).

When two sources are Granted, depending on the feature:

1. one source could be attenuated while the other is not,
2. both audio sources could be mixed with no attenuation,
3. If the two Granted audio sources have different volume sources (ex Media, Phone, RA, Call Ring, Prompts, VR) then one source might have volume control for the volume knob. See volume SPSS for further details.

Where applicable, see feature specs specifics on what happens for each concurrent Granted source.

Note: the audio management is based on Android audio management which allows multiple concurrent Granted audio sources

5.3.1.7 AUMGNT-SR-REQ-411343/A-Error Handling for modules receiving AudioSource.St without a deallocated/stacked for a previously Granted source

Error handling can be developed for a module receiving the AudioSource.St message if a deallocated/stacked was never received for a previously Granted audio source that is no longer Granted. Since multiple audio sources can be Granted concurrently it cannot be assumed that since a source is Granted another source is no longer Granted.

A module receiving the AudioSource.St may determine that error handling is needed if a source is never deallocated/stacked but is no longer in the audio stack. A module shall determine its own error handling and if it needs to have error handling to support what it needs.

For example, If a module receiving the AudioSource.St previously saw a source Granted in the audio stack, but the source is no longer in the Audio Stack after cycling through the stack (without seeing a deallocated/stacked) then after a number of cycles it could assume the source is deallocated.

Example:

Pre-condition:
Media Granted
VR is Granted

Event:
The audio stack cycles through
Media Granted → Media Granted → Media Granted → Media Granted
Error: Deallocated never received for VR

Post-Condition:
Module receiving AudioSource.St could assume VR is Deallocated after a set number of cycles through the audio stack.

Note: remember that on a CAN bus, if AudioSource.St is an event-periodic message then the AudioSource.St might send a status twice before going to the next item in the audio stack. That is because of the periodic nature of the signal.

5.3.1.8 AUMGNTv2-SR-REQ-412441/A-Media source Stacked under Phone/VR/Call Ring

When Phone, Call Ring or VR is Granted the AHU shall continue to update all status information on the network bus relative to the Media source stacked below Phone or VR.

- Ex. If AM/FM tuner is stacked below Phone, Call Ring or VR, and the current song changes, the AHU shall continue to update the radio text, PS Name, HD-Radio Text, etc. All information that normally is updated when listening to the stacked source continues to be updated while the source is stacked below Phone, Call Ring or VR.

5.4 AUMGNT-FUN-REQ-410541/A-Audio Source Change

5.4.1 Requirements

5.4.1.1 AUMGNTv2-SR-REQ-411531/A-Audio Requests

The Audio Resource Server supports Audio Request, Audio Release Requests from the source itself and Rejected responses from the Audio Resource Server. There is no request accepted response for an audio request from the Audio Resource Server. If a request is accepted the source will be Granted.

- Note: this supports the Android framework which has no requests accepted and just uses Granted as request accepted.

For an Audio Request for a SourceType source reference the Audio Source Prioritization table to determine if the new audio request will be Granted or Rejected and if the previous source would be stacked or not.

- Note: see requirement "AUMGNT-REQ-410482-Audio Source Prioritization" for the Audio Source Prioritization table

Audio requests for sources can be done internal to the module containing the Audio Resource Server or from an external module.

For external requester modules making requests over the vehicle network bus the Audio Request and Rejected response is not shown in audio management spec since the Rq and Rejected Rsp would be feature specific and defined in the feature spec.

When the infotainment system power mode signal HMIAudioMode is set to OFF any audio request shall be rejected by the Audio Resource Server.

5.4.1.2 AUMGNT-SR-REQ-412262/A-System start-up for Audio Resource Server module and when Audio Requests can be acted on

If the Audio Resource Server is in a module that takes a while to boot-up at start-up then the audio requests from external modules may be lost if sent while the Audio Resource Server module is booting up. The external module sending the audio requests might employ some error handling method (ex retry) if did not receive a response (ex Granted or Rejected) in a determined amount of time.

- Note: an example of a module who's Audio Resource Server could take a while to boot up is the APIM Phoenix Domain Controller.

APIM Phoenix Domain Controller specific boot-up signals:
The APIM Phoenix Domain Controller will start booting up when for infotainment mode when it sends HMIAudioMode = ON. It could be in the process of booting up while HMIAudioMode = ON though and might not be able to receive audio requests form an external module. When APIM Phoenix Domain Controller is booted up able to receive commands it will set signal InfoSysMasterPw_D_Stat = ON. An external module could look at "HMIAudioMode = ON AND InfoSystMasterPw_D_Stat = ON" to determine if the APIM Phoenix Domain Controller is ready to receive audio requests. Even with that combination the software apps (ex tuner app) might not be fully powered up on APIM Phoenix Domain Controller, so the external module that makes the audio request will have to determine if error handling is used (ex retry) for that audio request.

- See requirement "PWRMAN-REQ-295421-ISM usage of the InfoSysMaster_D_Stat signal" for details of the APIM Phoenix Domain Controller implementing this signal.

5.4.1.3 AUMGNT-SR-REQ-410880/A-Audio Source Change - Stackable from Audio Source Prioritization table

The "Stackable" attribute in the Audio Source Prioritization table determines if a source is Deallocated or Stacked when a higher priority source becomes Granted.

- Note: see requirement "AUMGNT-REQ-410482-Audio Source Prioritization" for the Audio Source Prioritization table

If the source was marked as "no" for stackable then the source shall be deallocated before the new source is Granted.

If the source was marked as "yes" for stackable then the source shall be Stacked before the new source is Granted.

5.4.1.4 AUMGNT-SR-REQ-410469/A-Radio Announcement source change event while FM or DAB is active

The audio shall not be muted when the current granted source is set to FM or DAB Radio with media volume active and there is a Radio Announcement (RA) event source change resulting in a RA volume setting source becoming active.

5.4.1.5 AUMGNT-SR-REQ-410505/A-Muting/Unmuting - Audio IO Controller

For audio sources changes that require muting and unmuting by the Audio IO Controller the Audio IO Controller shall mute, change audio parameters and start unmuting within 50 msec of receiving the Granted state from the Audio Resource Server. The Audio IO Controller shall not take more than 30 msec to mute a source before changing its audio parameters.

For audio sources the Audio IO Controller shall only mute/unmute a source change if it needs to make audio parameter change. If it does not make an audio parameter change (no changes to volume source signal, no EQ change etc) then the Audio IO controller shall remain unmuted between source changes.

- Note: see requirement "AUMGNT-REQ-410469-Radio Announcement source change event while FM or DAB is active"

Example:

Pre-condition:

All the media audio is sent over one audio stream.
The Media audio stream from the Audio Resource Server to the Audio IO Controller is unmuted.
AM is the active source with audio streaming over the media stream to the Audio IO Controller.

Event:

Media source changed to FM

Post-Condition:

If there are no audio parameter changes then the Audio IO Controller will never mute/unmute the media audio stream

5.4.1.6 AUMGNT-SR-REQ-410879/A-Muting/Unmuting - Audio Resource Server

For audio source changes that require muting and unmuting by the Audio Resource Server:

- When a source is deallocated, it shall be muted within 20 msec
- After Granted is put on the bus the new source audio shall not be unmuted before 30 msec has elapsed

5.4.1.7 AUMGNT-SR-REQ-416748/A-Changing Media sources in a Media zone made of multiple seat zones

This requirement only applies in zone mode if multiple seat zones are required to support a larger media zone.

When the vehicle is in zone mode, and multiple seat zones make up a larger Media zone (if applicable) and there is a Media source change (Media source X to Media source Y) then zones that make up a Media zone would have their AudioSource.St / AudioSourceZone(2-6).St messages sent out as a group for an event (ex Deallocated, Granted) as close together in time as possible.

Unless called out otherwise the AudioResourceServer shall use the same SourceTypeChannel source for everyone supporting a Media zone made up of multiple seats.

Example:

Pre-condition:

- In zone mode with Media source X active for the rear media zone made up of zones 3 – 6.

Event:

- User selects Media source Y for the rear media zone (ie zones 3 – 6)

Post-Condition:

1. The Audio Resource Server would send Deallocated for Media source X for all the applicable seat zone signals AudioSource.St and AudioSourceZone(2-6) as quickly as possible (separate messages so should be able to send out pretty close together timing wise – maybe less than 1 msec apart), then

2. Wait 20 msec +/- 10% from when each Deallocated message to be sent before sending Granted for that message (see "AUMGNT-REQ-410953-Request Audio Resource, At least one Entry in the Stack, Request Accepted"), then
3. The Audio Resource Server would send Granted for the new Media source Y for all the applicable seat zones signals AudioSource.St and AudioSourceZone(2-6) as quickly as possible (separate messages so should be able to send out pretty close together timing wise – maybe less than 1 msec apart)

- Note: this example is essentially all 4 rear seat zones (ie zones 3 -6) happening at the same time following "AUMGNT-REQ-410953-Request Audio Resource, At least one Entry in the Stack, Request Accepted". They key part is the Deallocated and Granted messages for each seat are all grouped together within a short period of time.

5.4.1.8 AUMGNT-SR-REQ-435597/A-PAC-AHU specific source change for PAC generated audio (Phoenix)

Tuner audio generated from the PAC module source change:
If the Tuner audio source goes from Granted to Stacked/Deallocated then the PAC module shall continue to send the Tuner audio stream to the PDC (ie Audio Resource Server) and shall not mute the Tuner audio. The PDC module shall handle all muting outputs for audio source changes.

When the infotainment system is powered ON (ie HMIAudioMode/HMI_HMIMode_St = ON) the Tuner audio is allowed to be continuously streamed to the PDC even if it is not the Granted source.

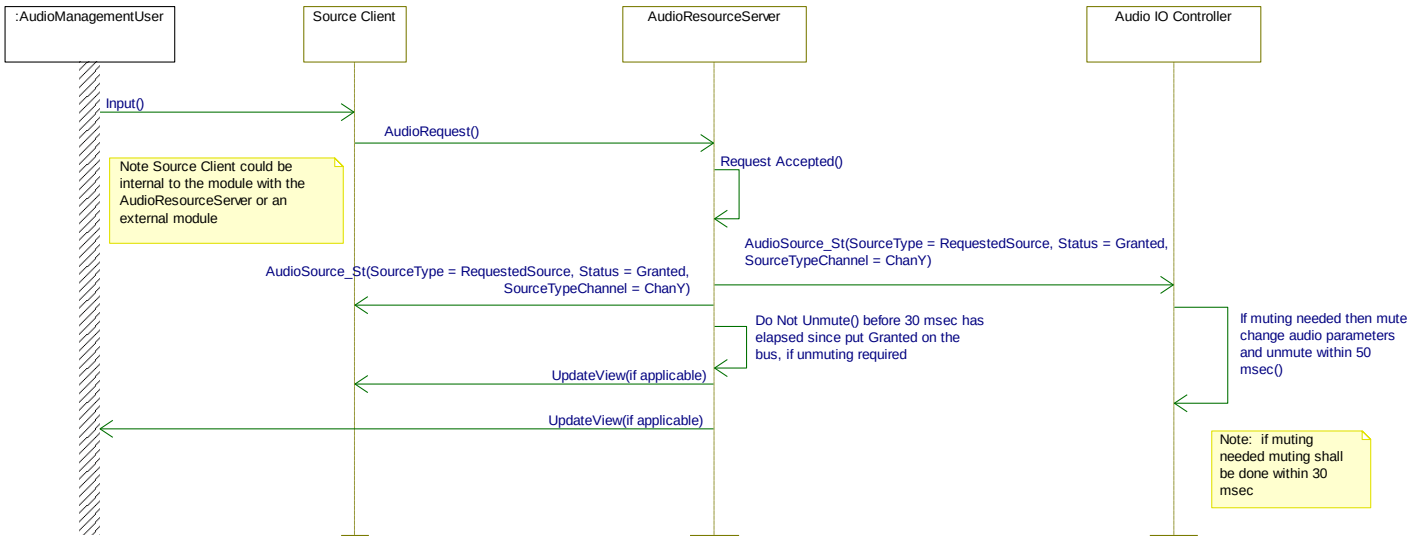
Audio from Bluetooth Phones paired to the PAC module (ex My Seat Space set-up):
When the PAC module is playing audio from a PAC paired Bluetooth Phone and the BT Phone goes from Granted to Stacked/Deallocated then the PAC module can mute to avoid any pops, cracks or audio distortions.

- Note: when Deallocated is sent to the PAC for audio not generated from the PAC, then audio is not muted on Deallocated but is muted/unmuted only if needed on Granted. See requirement "AUMGNT-REQ-410505-Muting/Unmuting – Audio IO Controller" and applicable sequence diagrams for more details.

5.4.2 Sequence Diagrams

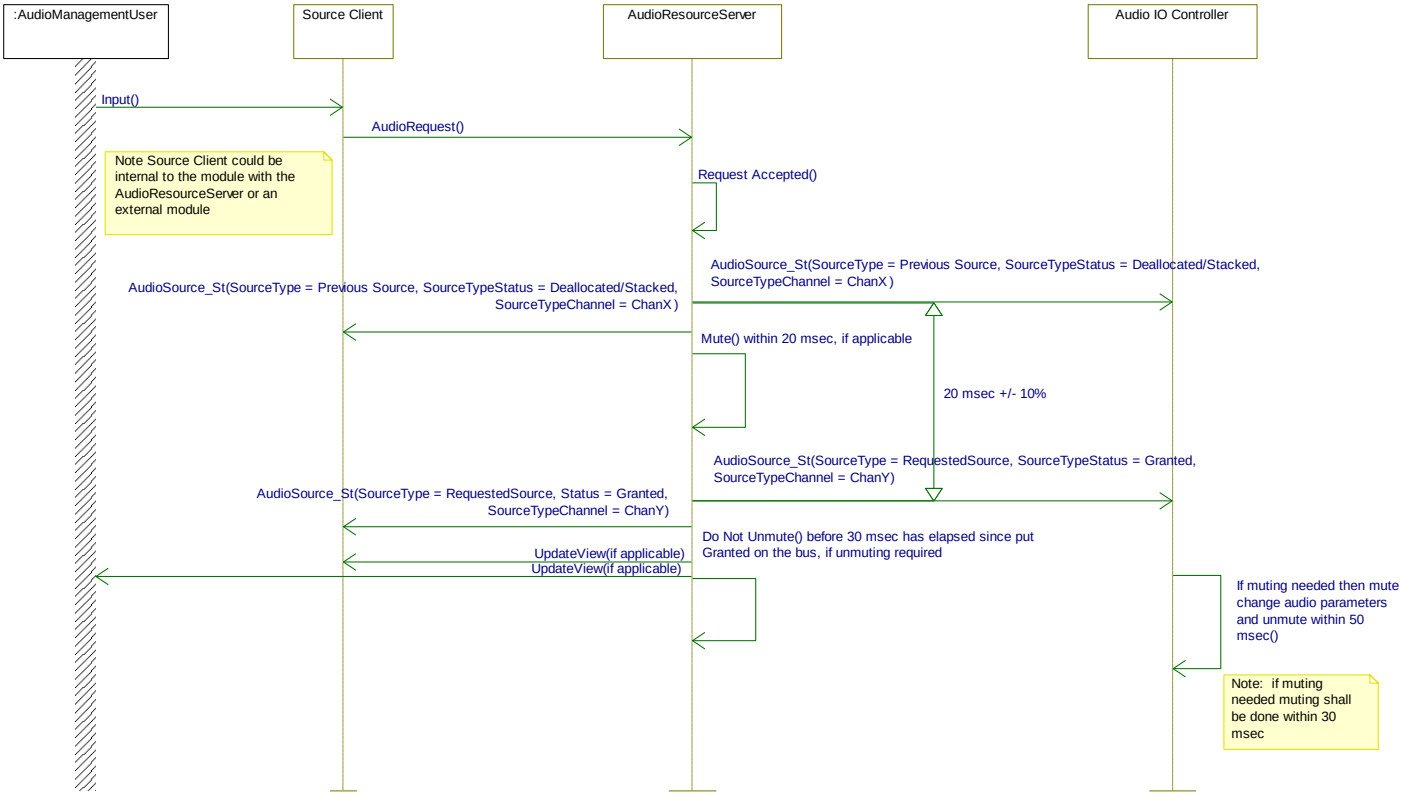
5.4.2.1 AUMGNTv2-SD-REQ-410882/A-Request Audio Resource, No Entry in Stack, Request Accepted

Pre-condition:
There are no audio sources in the audio stack (ie empty audio stack)

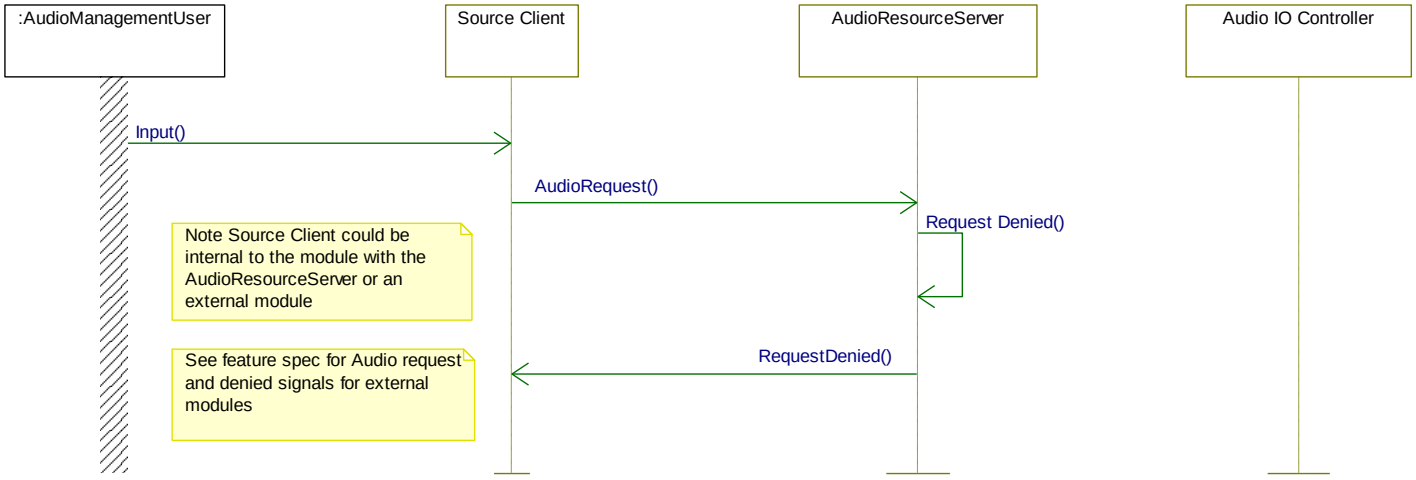


5.4.2.2 AUMGNTv2-SD-REQ-410953/A-Request Audio Resource, At least one Entry in the Stack, Request Accepted

Pre-condition:
The audio stack has at least one entry in the stack

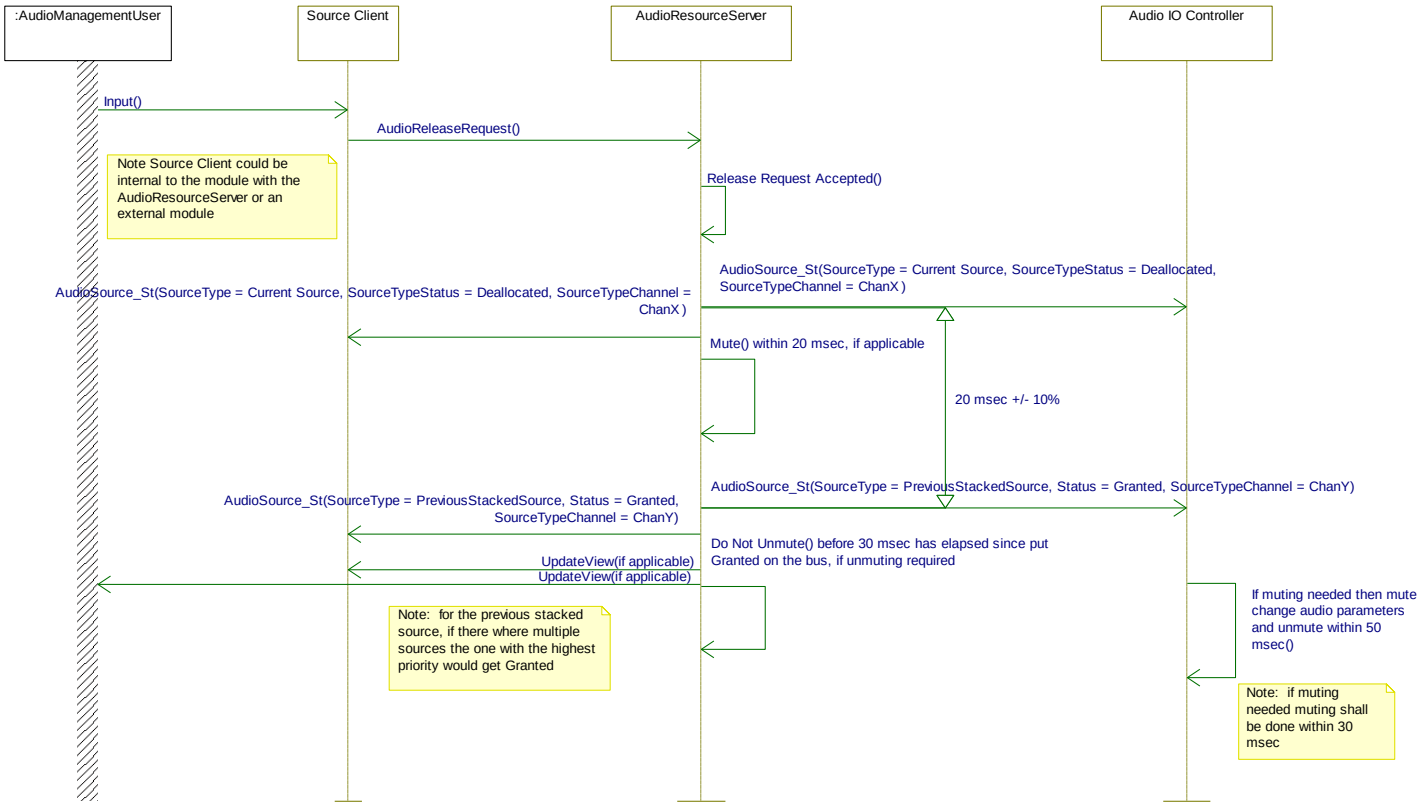


5.4.2.3 AUMGNTv2-SD-REQ-410883/A-Request Audio Resource, Request Denied



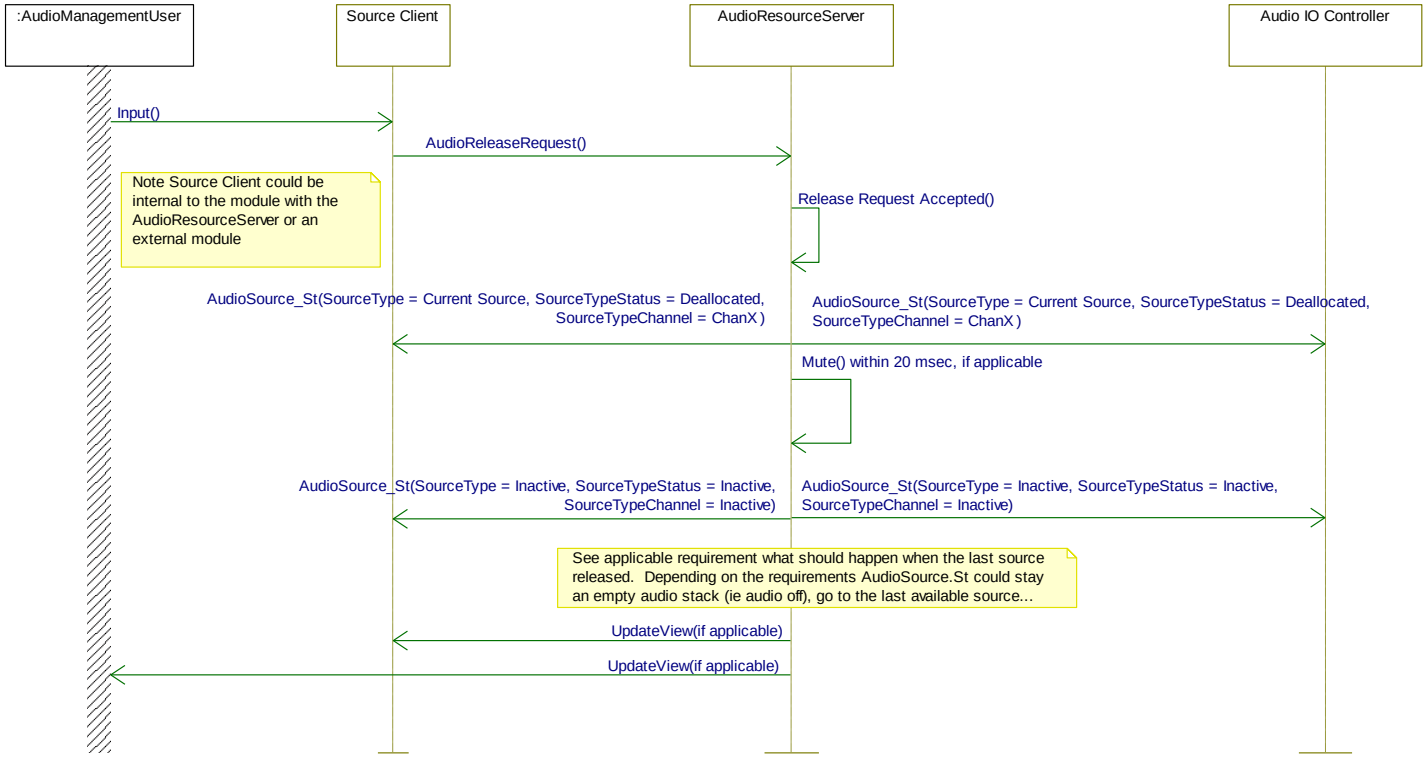
5.4.2.4 AUMGNTv2-SD-REQ-410954/A-Release Audio Resource, 2 or more entries in the Stack

Pre-condition:
2 or more entries in the audio stack



5.4.2.5 AUMGNTv2-SD-REQ-410955/A-Release Audio Resource, one Entry in the Stack

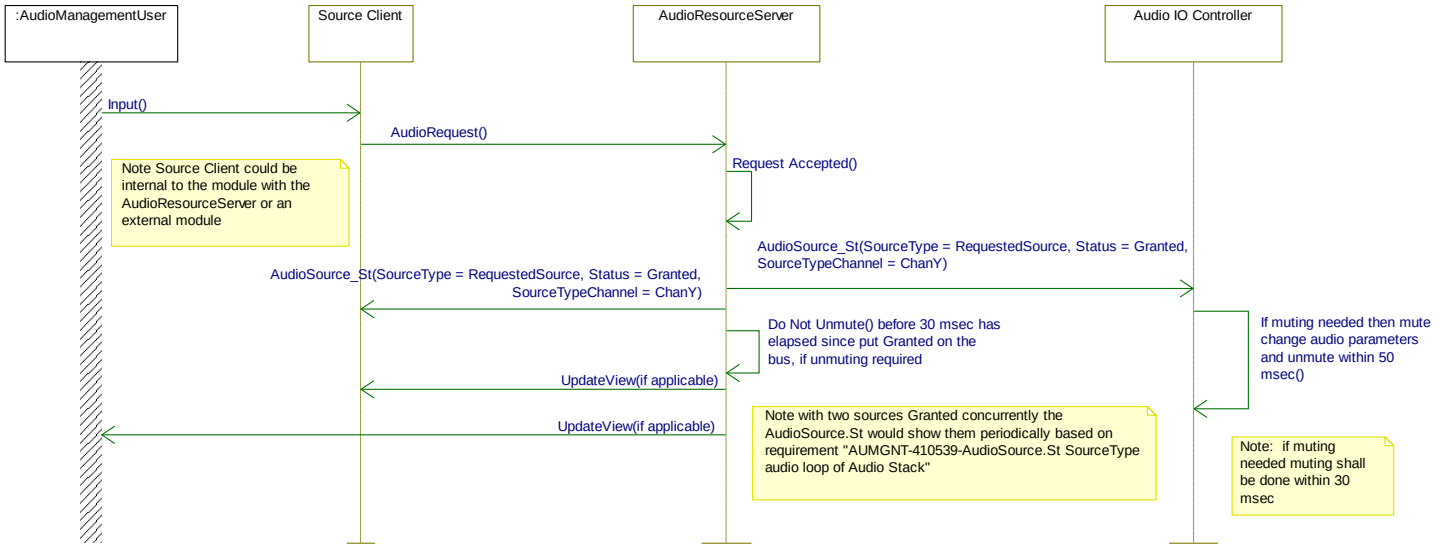
Pre-condition:
One entry in the audio stack



5.4.2.6 AUMGNTv2-SD-REQ-410956/A-Request Audio Resource, At least one Entry in the Stack, Request Accepted 2 Granted Sources

Pre-condition:
There is one source Granted in the audio stack

Post-condition:
Both sources are Granted concurrently based on requirement "AUMGNT-REQ-410582-Audio Source Prioritization".



5.5 AUMGNTv2-FUN-REQ-410881/A-Activation and Deactivation of the Savable Audio Source audio

5.5.1 Requirements

5.5.1.1 System Start-up and System Shutdown

See Station Management SPSS for system start-up and system shutdown (ie HMIAudioMode from OFF to ON and vice versa).

5.5.1.2 AUMGNTv2-SR-REQ-411658/A-Power Button Off - Deactivation of Saveable Audio Source

When there is a savable source Granted in the AudioSource.St and a power OFF button press event occurs then set AudioSource.St to an empty audio stack (ie audio off).

- Audio OFF (empty audio stack) is as follows: AudioSource.St(SourceType = Inactive, SourceTypeStatus = Inactive, SourceTypeChannel = Inactive)

Note: unless noted otherwise in the zone mode spec the power OFF button only impacts the AudioSource.St message for emptying the stack in zone mode and does not impact the AudioSourceZone(2 – 6).St messages. If there is a conflict between this spec and a zone mode spec for zone mode power OFF button press then the zone mode spec takes precedent.

5.5.1.3 AUMGNTv2-SR-REQ-411660/A-Power Button On - Activation of Saveable Audio Source

When there is an empty audio stack (ie audio off) in the AudioSource.St and a power ON button press event occurs then Grant the last available savable source in the AudioSource.St.

- In this case savable source does not include audio off state

5.6 AUMGNT-FUN-REQ-410538/A-Cabin and Zone mode transitions

5.6.1 Requirements

5.6.1.1 AUMGNT-SR-REQ-411231/A-Zone & Cabin mode transitions - Audio IO Controller

When VehicleAudioMode = Cabin the Audio IO Controller shall:

- Only play audio through the vehicle speakers based on AudioSource.St message. The AudioSourceZoneX.St messages shall not be used to play audio through the vehicle speakers in cabin mode
- Store AudioSourceZoneX.St last signal states for each zone so that if zone mode is entered the AudioIOController has the sources stored to be used for each zone.

When VehicleAudioMode = Zone the Audio IO Controller shall:

- Play audio through the vehicle speakers to specific audio zones. The AudioSourceZoneX.St messages shall be used to play audio through their specific zone
- When zone mode is first entered the Audio IO Controller shall use the last received AudioSourceZoneX.St messages for each zone.

When transition from Cabin to Zone (or vice versa) the Audio IO Controller shall mute and unmute only as needed to switch for the audio source(s). If no muting is required to transition between Cabin to Zone (or vice versa) then muting/unmuting should be avoided to support a seamless transition (ex Driver Cabin audio to Driver zone one).

Note: For AudioSourceZoneX.st the "X" represents the different zones that might be supported

5.6.1.2 AUMGNT-SR-REQ-411232/A-Zone & Cabin mode transitions - Audio Resource Server

The Audio Resource Server shall interface with the Zone Manager and support audio requests for each zone from the Zone Manager.

The Audio Resource Server shall accept requests from the Zone Manager regardless if in Cabin or Zone mode.

SourceTypeChannel change for driver when transition between Cabin and Zone mode:
If the driver SourceTypeChannel is changing when go to Cabin mode to zone mode (or vice versa) then the SourceTypeChannel signal change and VehicleAudioMode signal change shall occur in the same event in the AudioSource.St message.

- Example:
  Pre-condition:
  Driver is in a Phone call in Cabin mode using A2B_IDX and AudioSource.St is set as (SourceType = Phone, SourceTypeStatus = Granted. SourceTypeChannel = A2B_IDX, VehicleAudioMode = Cabin)

  Event:
  Vehicle is put in zone mode with the Phone A2B slot changing (see A2B spec if this is actually the case). To do this the AudioSource.St is set as (SourceType = Phone, SourceTypeStatus = Granted. SourceTypeChannel = A2B_IDY, VehicleAudioMode = Zone)

  Post-condition:
  Phone is active in Zone mode. There might have been muting/unmuting by the Audio IO Controller during this transition.

5.6.1.3 AUMGNT-SR-REQ-411233/A-Zone & Cabin mode transition - Zone Manager

The Zone Manager shall send VehicleAudioMode = Cabin when the vehicle is in cabin mode

The Zone Manager shall send VehicleAudioMode = Zone when the vehicle is in zone mode

Cabin to Zone mode transition:
The Zone Manager before setting VehicleAudioMode from Cabin to Zone shall:

- Determine if any of the AudioSourceZone.St messages need to be updated. If they do need to be updated then the Zone Manager will send the Audio Resource Server the audio request of source(s) to play in that zone.

After 50 msec has elapsed since the Audio Resource Server requested each of the audio sources for each zone based on the Zone Manager's audio requests, then the Zone Manager shall change VehicleAudioMode from Cabin to Zone in the AudioSource.St along with any audio source for zone 1.

Zone to Cabin mode transition:
The Zone Manager shall set VehicleAudioMode from Zone to Cabin to transition to Cabin mode.

After the Zone Manager has set VehicleAudioMode to Cabin then the Zone Manager shall deallocate any sources and then set all the non-driver audio zones to an empty audio stack (ie audio Off).

Cabin mode uses the same message as Zone 1 (ie AudioSource.St). If no source changes when going from Zone to Cabin mode then AudioSource.St shall not be changed for the source (exception might be SourceTypeChannel if that changed).

From zone mode, if the Driver source is changing when go to Cabin mode the Zone Manager could deallocate the existing source, send an empty audio stack for zone 1, then set VehicleAudioMode to Zone to Cabin and at the same time in the AudioSource.St set to the new audio source.

- Ex could be a shared source with the rear that is not available when go to cabin mode

Default at start-up:
The Zone manager shall be defaulted to Cabin mode every time the infotainment system is powered up (ie HMIAudioMode from OFF to ON). See Station Management SPSS for details

System Shutdown:
The Zone manager shall set each zone to an empty audio stack during infotainment shutdown (ie HMIAudioMdoe from ON to OFF). See Station Management SPSS for details

5.6.1.4 AUMGNT-SR-REQ-414539/A-High Priority events - transition to Cabin mode

For high priority events it shall be determined if zone mode should be exited to cabin mode or not.

For an emergency assist call event the vehicle shall transition to Cabin mode.

5.6.1.5 AUMGNT-SR-REQ-421289/A-Vehicle Audio Mode Error Handling (Cabin / Zone mode)

The DSP AMP module shall send out its Vehicle Audio Mode status as Zone or Cabin mode in the DSP_VehicleAudioMode_Rsp signal. This is event-periodic message and the status shall be broadcast periodically.

The PAC module shall send out its Vehicle Audio Mode status as Zone or Cabin mode in the PAC_VehicleAudioMode_Rsp signal. This is event-periodic message and the status shall be broadcast periodically

The Audio Resource Server shall receive the DSP_VehicleAudioMode_Rsp and PAC_VehicleAudioMode_Rsp signals and can perform error handling if those modules don't update as expected.

Example:

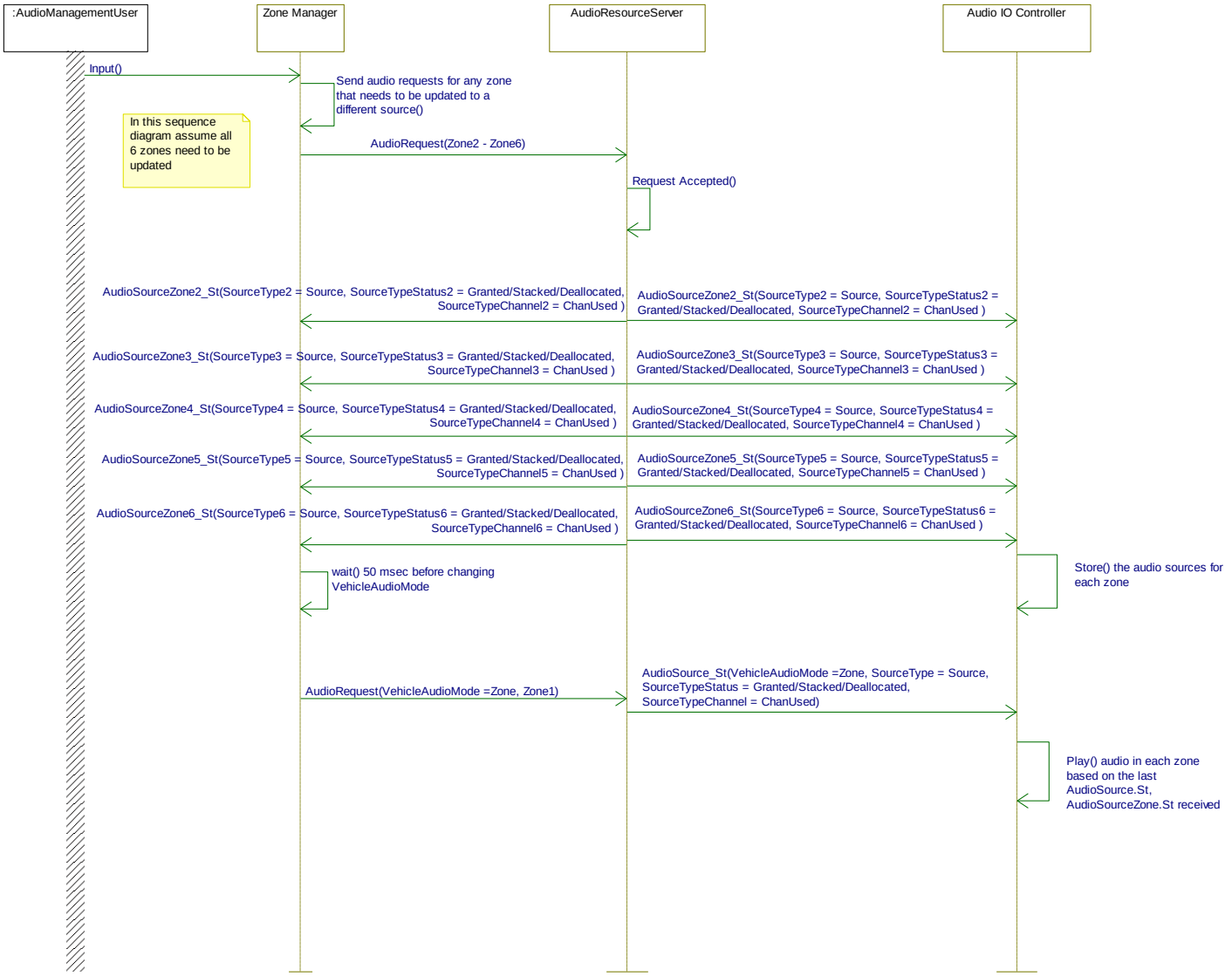
- The Audio Resource Server set VehicleAudioMode = Zone and if the DSP_VehicleAudioMode.St signal remains at Cabin then after 10 seconds the Audio Resource Server could set VehicleAudioMode back to Cabin if it so chose.

5.6.2 Sequence Diagrams

5.6.2.1 AUMGNTv2-SD-REQ-411239/A-Cabin to Zone mode transition

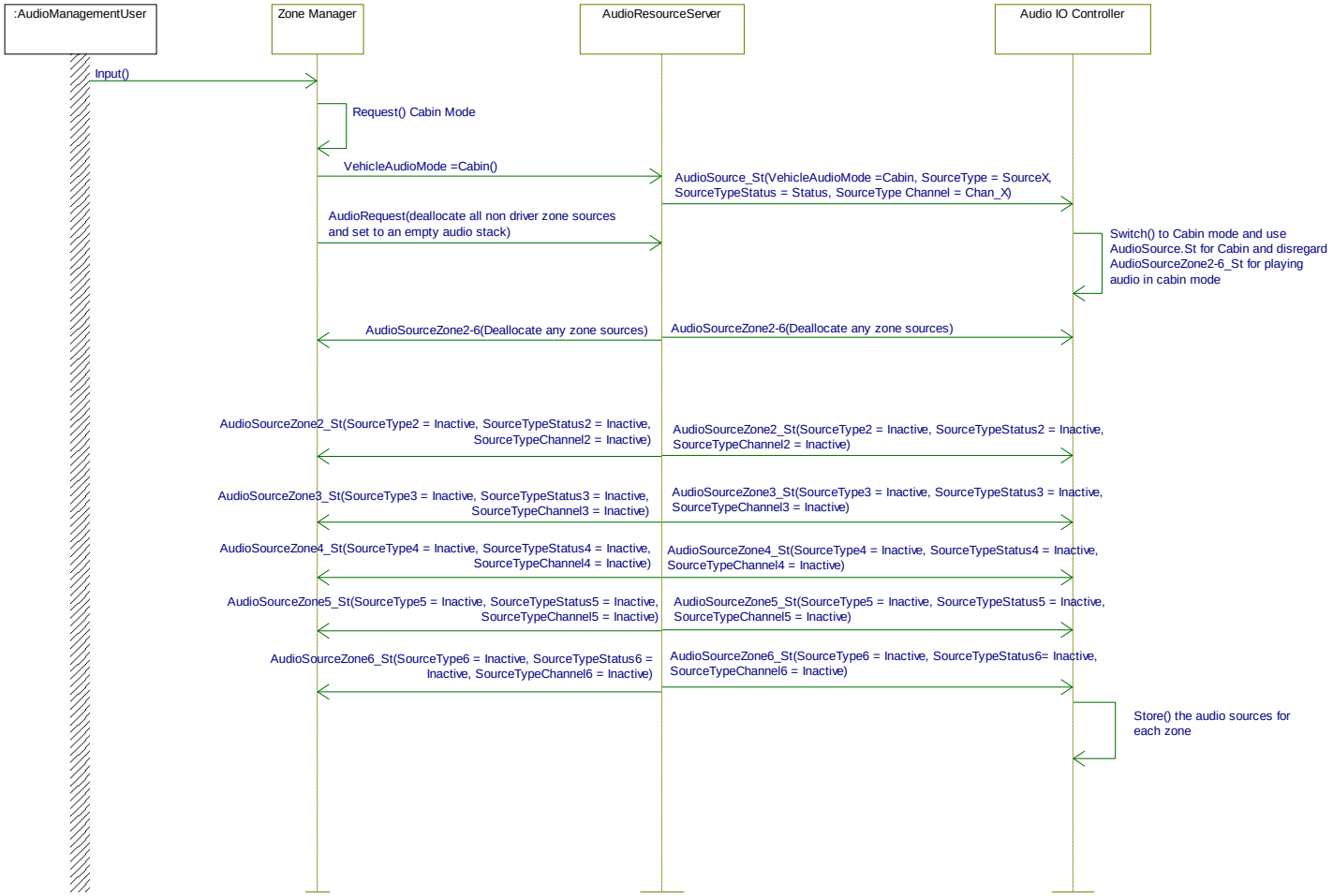
Pre-Condition:

Vehicle is in Cabin Mode



5.6.2.2 AUMGNTv2-SD-REQ-411240/A-Zone to Cabin mode transition

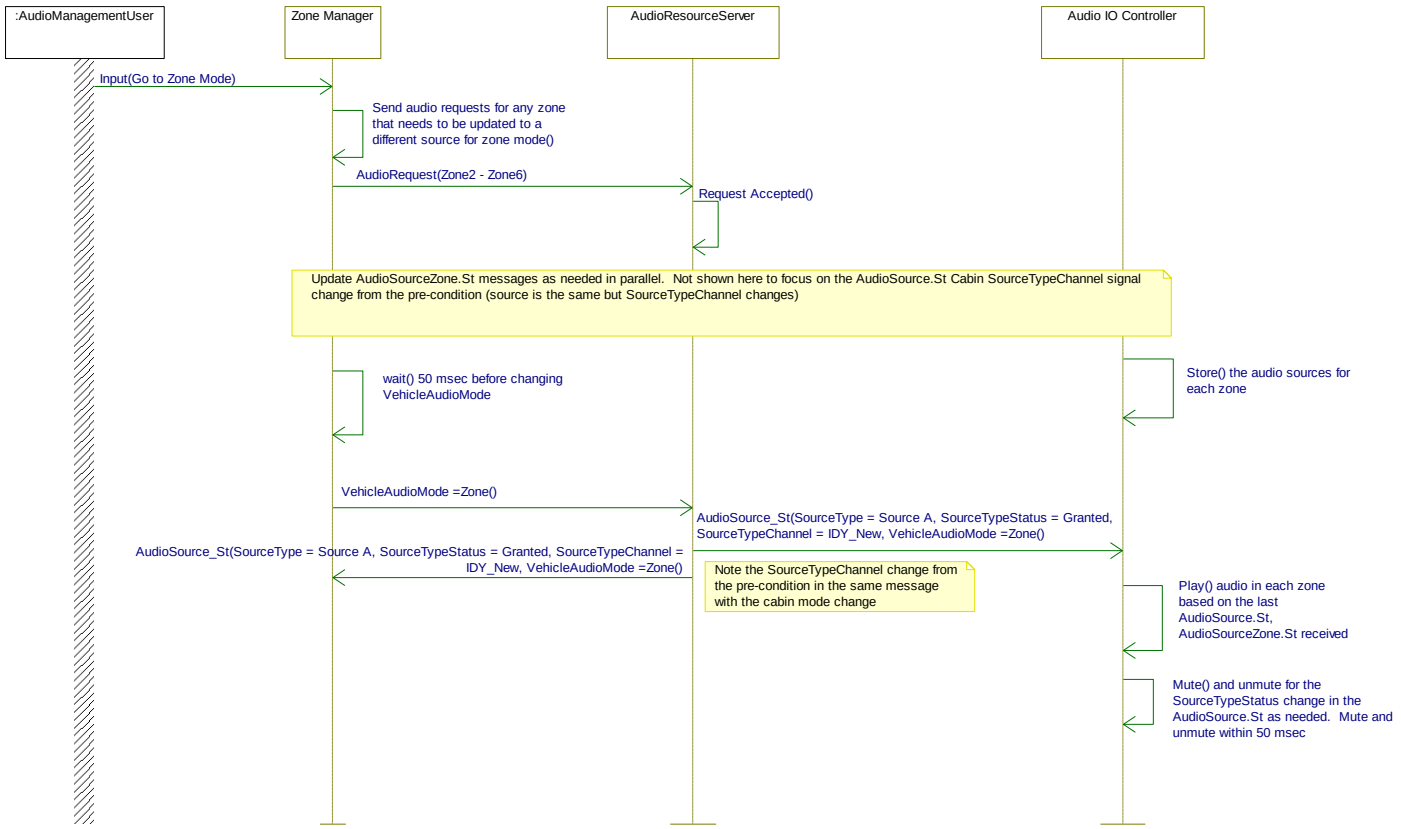
Pre-Condition:
Vehicle is in Zone Mode



5.6.2.3 AUMGNTv2-SD-REQ-411446/A-SourceTypeChannel change for driver when transition between Cabin and Zone mode

Pre-condition:

- Driver is listening to Source A
- Vehicle is in cabin mode (ie VehicleAudioMode = Cabin)
- AudioSource.St is set as follows (SourceType = SourceA, SourceTypeStatus = Granted, SourceTypeChannel = IDX, VehicleAudioMode = Cabin)


:AudioManagementUser
Zone Manager
AudioResourceServer
Audio IO Controller
Input(Go to Zone Mode)
Send audio requests for any zone that needs to be updated to a different source for zone mode()
AudioRequest(Zone2 - Zone6)
Request Accepted()
Update AudioSourceZone.St messages as needed in parallel. Not shown here to focus on the AudioSource.St Cabin SourceTypeChannel signal change from the pre-condition (source is the same but SourceTypeChannel changes)
Store() the audio sources for each zone
wait() 50 msec before changing VehicleAudioMode
VehicleAudioMode =Zone()
AudioSource_St(SourceType = Source A, SourceTypeStatus = Granted, SourceTypeChannel = IDY_New, VehicleAudioMode =Zone()
AudioSource_St(SourceType = Source A, SourceTypeStatus = Granted, SourceTypeChannel = IDY_New, VehicleAudioMode =Zone()
Note the SourceTypeChannel change from the pre-condition in the same message with the cabin mode change
Play() audio in each zone based on the last AudioSource.St, AudioSourceZone.St received
Mute() and unmute for the SourceTypeStatus change in the AudioSource.St as needed. Mute and unmute within 50 msec

5.7 AUMGNTv2-FUN-REQ-410867/A-Mixable Prompts

5.7.1 Requirements

5.7.1.1 AUMGNTv2-SR-REQ-411340/A-MixableCabinPrompts signal

MixableCabinPrompts uses the cabin speakers and is not limited to a particular audio zone. MixableCabinPrompts is still allowed to be used in zone mode but the prompt wouldn't be targeting a particular audio zone.

The MixableCabinPrompts signal is used for mixable audio sources that are not already defined in the SourceType signal that can be mixed in with existing audio Granted sources (ex mixed in with AM, FM, Aux_Media…).

When the AudioResourceServer sets MixableCabinPrompts = Active then the mixable cabin prompts are active.

When the AudioResourceServer sets MixableCabinPrompts = Inactive then there are no mixable cabin prompts active

The AudioResourceServer is responsible for generating the mixable cabin prompts and shall mute its mixable cabin prompts output when MixableCabinPrompts = Inactive.

The Audio IO Controller shall always have the MixableCabinPrompts alert channel unmuted when the infotainment system is powered on (ie HMIAudioMode = ON).

When MixableCabinPrompts = Active, if there is attenuation of the SourceType Granted source then this would be reflected in the volume signal sent to the volume server.

- Ex. MixableCabinPrompts = Active while an Aux_Media SourceType is Granted. The media volume signal to the volume server if it was at volume step 20 before prompts were activated might be at volume step 7 after mixable prompts was activated. See Volume SPSS for details.

Reference the Audio Source Priority table in requirement "AUMGNT-REQ-410582-Audio Source Prioritization" for what sources mixable prompts is supported for.

Note: mixable prompts in Android typically represents the Android mixable audio priorities not already called out in the SourceType sigal.

Many mixable prompts have audio attenuation of other audio while the mixable prompts are playing. For the Audio Resource Server supporting the audio attenuation reference:

- The Alert SPSS for details on the audio attenuation signals.
- In the Volume SPSS reference requirements:
  - "VOLv-REQ-412097-Volume Attenuation / Restoration – variant2"
  - "VOL-REQ-412869-Volume Audio Attenuation Event"
  - "VOLv2-REQ-412872-Audio Attenuation event ending"

5.7.1.2 AUMGNTv2-SR-REQ-411029/A-MixableZonePrompts signal

MixableZonePrompts are prompts that are dedicated only to a particular audio zone

The MixableZonePrompts signal is used for mixable audio sources that are not already defined in the SourceType signal that can be mixed in with existing audio Granted sources (ex mixed in with AM, FM, Aux_Media…).

When the AudioResourceServer sets MixableZonePrompts = Active then the mixable zone prompts are active.

When the AudioResourceServer sets MixableZonePrompts = Inactive then there are no mixable prompts active.

The AudioResourceServer is responsible for generating the mixable zone prompts and shall mute its mixable prompts output when MixableZonePrompts = Inactive.

When MixableZonePrompts = Active, if there is attenuation of the SourceType Granted source then this would be reflected in the volume signal sent to the volume server.

- Ex. MixableZonePrompts = Active while an Aux_Media SourceType is Granted. The media volume signal to the volume server if it was at volume step 20 before prompts were activated might be at volume step 7 after mixable prompts was activated. See Volume SPSS for details.

Reference the Audio Source Priority table in requirement "AUMGNT-REQ-410582-Audio Source Prioritization" for what sources mixable prompts is supported for.

Note: mixable prompts in Android typically represents the Android mixable audio priorities not already called out in the SourceType sigal.

Many mixable prompts have audio attenuation of other audio while the mixable prompts are playing. For the Audio Resource Server supporting the audio attenuation reference:

- The Alert SPSS for details on the audio attenuation signals.
- In the Volume SPSS reference requirements:
  - "VOLv-REQ-412097-Volume Attenuation / Restoration – variant2"
  - "VOL-REQ-412869-Volume Audio Attenuation Event"
  - "VOLv2-REQ-412872-Audio Attenuation event ending"

5.7.1.3 AUMGNTv2-SR-REQ-411030/A-MixableZonePromptsChannel signal

The MixableZonePromptsChannel signal is used by the Audio Resource Server to tell the Audio IO Controller what audio source input to use for mixable zone prompts.

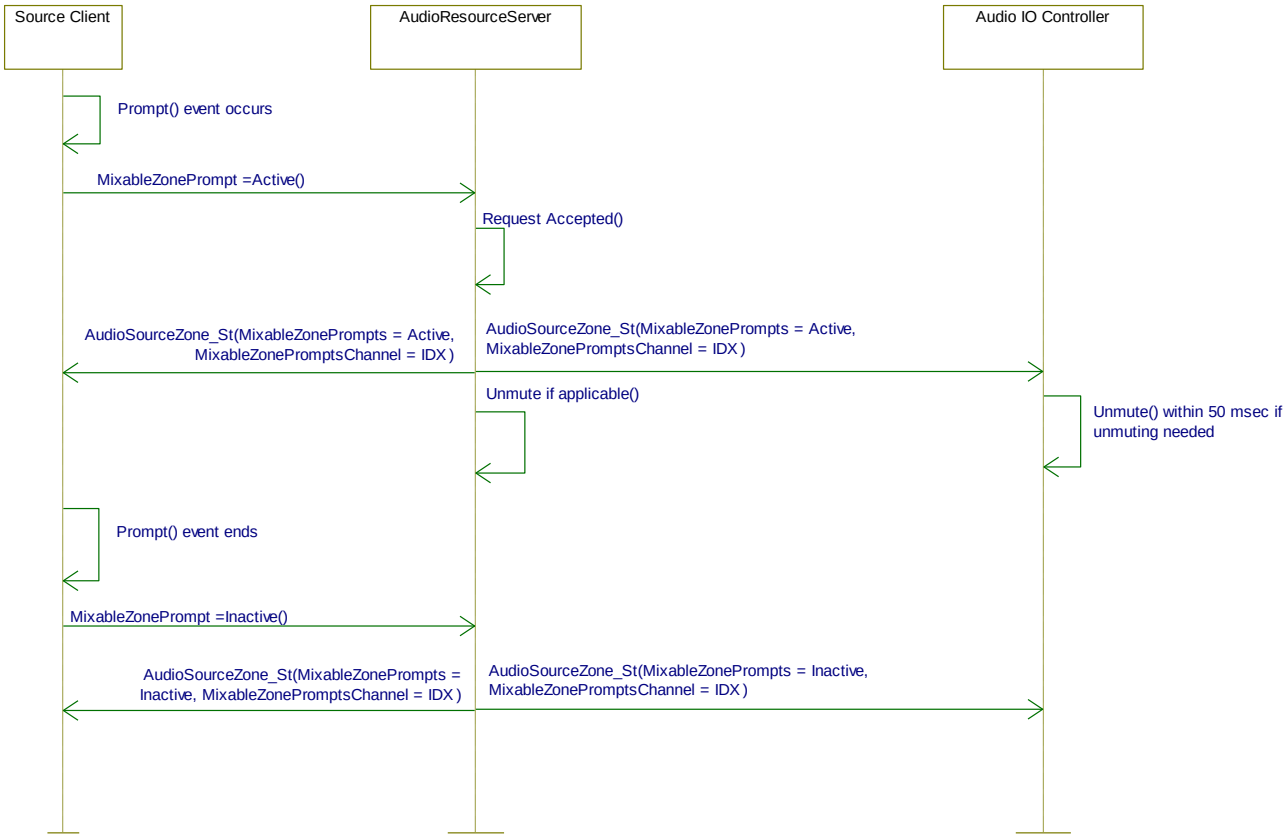
If nothing defined for a particular audio source then MixableZonePromptsChannel shall be set to 0x0 Inactive.

- Example: if the Audio IO Controller was internal to the same module as the Audio Resource Server then MixableZonePromptsChannel would be set to 0x0 Inactive since nothing being sent to an external module.

For A2B_ID's please reference the A2B SPSS for what ID is tied to what A2B audio stream

5.7.2 Sequence Diagram

5.7.2.1 AUMGNTv2-SD-REQ-411347/A-Mixable Zone Prompt event



5.8 AUMGNT-FUN-REQ-410868/A-Captains Announcement

5.8.1 Requirements

5.8.1.1 AUMGNTv2-SR-REQ-411662/A-Captains Announcement activation event

~~See the Audio Source Prioritization table in requirement "AUMGNT-REQ-410582-Audio Source Prioritization" for when Captains Announcement becomes active.~~

When Captains Announcement is Active the Media source remains Granted but can be muted or paused.

See the Captains Announcement SPSS for details on implementation of Captains Announcement.

6 Appendix: Reference Documents

Reference #	Document Title
1	AM/FM Tuner SPSS
2	SDARS Tuner SPSS
3	DAB Tuner SPSS
4	My Seat Space SPSS (ie audio zones)
5	Station Management SPSS
6	
7	
8	
9	
10	
11	
12	
13	
14	