ISO/IEC 14543-5-103

Edition 1.0 2023-10

INTERNATIONAL STANDARD

Information technology – Home electronic system (HES) architecture
Part 5-103: Intelligent grouping and resource sharing for HES Class 2 and Class 3 – Remote access smart audio interconnection profile

ISO/IEC 14543-5-103:2023-10(en)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ICS 35.240.67

ISBN 978-2-8322-7682-2

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FOREWORD

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ISO/IEC 14543-5-103 has been prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology. It is an International Standard.

The list of all currently available parts of the ISO/IEC 14543 series, under the general title *Information technology – Home Electronic System (HES) architecture*, can be found on the IEC website and ISO website.

The text of this International Standard is based on the following documents:

Draft	Report on voting
JTC1-SC25/3096/CDV	JTC1-SC25/3158/RVC

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1, available at www.iec.ch/members_experts/refdocs and www.iso.org/directives.

INTRODUCTION

ISO/IEC 14543-5 (all parts) specifies the services and protocol of the application layer for Intelligent Grouping and Resource Sharing (IGRS) devices and services in the Home Electronic System (HES). Some parts reference Classes 1, 2 and 3, which are HES designations specified in the HES architecture standard, ISO/IEC 14543-2-1.

ISO/IEC 14543-5 includes the following parts:

a) ISO/IEC 14543-5-1: Core protocol
   - Specifies the TCP/IP protocol stack as the basis and the HTTP protocol as the message-exchange framework among devices.
   - Specifies a series of device and service interaction/invocation standards, such as device and service discovery protocol, device and service description, service invocation and security mechanisms.
   - Specifies core protocols for a type of home network that supports streaming media and other high-speed data transports within a home.

b) ISO/IEC 14543-5-2#: Application profile
   - Based on the IGRS core protocol.
   - Specifies a device and service interaction mechanism, as well as application interfaces used in IGRS basic applications.
   - Multiple application profiles are specified, including:
     – ISO/IEC 14543-5-21: AV profile
     – ISO/IEC 14543-5-22: File profile

c) ISO/IEC 14543-5-3: Basic application
   - Includes an IGRS basic application list.
   - Specifies a basic application framework.
   - Specifies operation details (device grouping, service description template, etc.), function definitions and service invocation interfaces.

d) ISO/IEC 14543-5-4: Device validation
   - Specifies a standard method to validate an IGRS-compliant device.

e) ISO/IEC 14543-5-5: Device type
   - Specifies IGRS device types used in IGRS applications.

f) ISO/IEC 14543-5-6: Service type
   - Specifies basic service types used in IGRS applications.

g) ISO/IEC 14543-5-7: Remote access system architecture
   - Specifies the architecture and framework for remotely accessing IGRS devices and services in the Home Electronic System. The remote access communications protocol and application profiles are specified in the following parts of ISO/IEC 14543-5:
     – ISO/IEC 14543-5-8: Remote access core protocol
     – ISO/IEC 14543-5-9: Remote access service platform
     – ISO/IEC 14543-5-101: Remote media access profile
     – ISO/IEC 14543-5-102: Remote universal management profile
     – ISO/IEC 14543-5-103: RA Smart audio interconnection profile
     – ISO/IEC 14543-5-104: RA server-based smart lock application
     – ISO/IEC 14543-5-11: Remote user interface
     – ISO/IEC 14543-5-12: Remote access test and verification

Additional parts will be specified in the future, including:

  - ISO/IEC 14543-5-105: RA server-based smart lock application test and verification
  - ISO/IEC 14543-5-13: RA smart home device control using voice recognition
  - ISO/IEC 14543-5-141: Blockchain application protocols for HES based on IGRS RA specifications: core framework

- The relationships among these parts are specified in Part 5-7.

h) ISO/IEC 14543-5-8: Remote access core protocol

- Provides detailed system components, system function modules, basic concepts of IGRS remote access elements and their relationships, message exchange mechanisms and security related specifications.
- Specifies interfaces between IGRS remote access (RA) client and service platforms. Defines co-operative procedures among IGRS RA clients.

i) ISO/IEC 14543-5-9: Remote access service platform

- Specifies the IGRS RA service platform (IRSP) architectures and interfaces among servers in the service platforms.
- Based on ISO/IEC 14543-5-8: Remote access core protocol.

j) ISO/IEC 14543-5-10#: Remote access application profiles

- Specifies a device and service interaction mechanism for various applications.
- Based on ISO/IEC 14543-5-8: Remote access core protocol.
- Some of the profiles are specified, including:
  - ISO/IEC 14543-5-101: Remote media access profile. This part specifies the common requirements for IGRS RA media users and devices in IGRS networks.
  - ISO/IEC 14543-5-102: Remote universal management profile. This part specifies a mechanism for integrating devices with both relatively high and low processing capabilities into IGRS networks. It also specifies universal remote device discovery and a management framework.
  - ISO/IEC 14543-5-103: RA smart audio interconnection profile. This part specifies the interoperability requirements for smart audio devices (audio devices with built-in computing and communication capabilities) and creates various application functionalities to enhance these audio devices. It introduces some new device types and specifies the mandatory device/service discovery, device control, content delivery and audio transcoding methods and interfaces, etc. to enable smart audio device interactions and content services.
  - ISO/IEC 14543-5-104: RA server-based smart lock application. This part specifies a server-based smart lock application that utilizes the ISO/IEC 14543-5 series of standards for device interoperability. It specifies the required device interaction models, message formats and APIs and the authentication and security methods.
- Additional application profiles will be specified in the future, including:
  - ISO/IEC 14543-5-105: RA server-based smart lock application test and verification. This part will be the verification test specification for ISO/IEC 14543-5-104. It will describe all the required test cases and relevant pass/fail criteria to validate that a server-based smart lock device/application conforms to the ISO/IEC 14543-5 series of standard protocols (IGRS).

k) ISO/IEC 14543-5-11: Remote user interface

- Specifies adaptive user interface generation and remote device control mechanisms suitable for different remote access applications and devices.

l) ISO/IEC 14543-5-12: Remote access test and verification

- Specifies a standard method to test and verify IGRS-RA compliant device and service interfaces.

The following future parts are planned.

m) ISO/IEC 14543-5-13: RA smart home device control using voice recognition

- Will specify the requirements to allow remote access and control of various smart home devices that use the same IGRS RA device interoperability protocols with a variety of voice recognition platforms. This part will extend current IGRS RA device types to support the addition of voice recognition message format specifications. It will introduce an IGRS RA voice-enabled gateway profile in compliance with the HES gateway (ISO/IEC 15045 series and ISO/IEC 18012 series) and the IGRS RA platform. It will extend the HES environment to an external voice recognition service platform ("cross-platform" voice recognition interface platform) that includes specifications for universal voice recognition skill sets and translation interface service, platform security, IGRS RA (IGRS Remote Access Service Platform) message server API, and IGRS RA device control protocol parsing and status update service, etc.

n) ISO/IEC 14543-5-14#: Blockchain application protocols for HES based on IGRS RA specifications

- Will specify a blockchain application framework and profiles for various smart home HES applications.
- Based on the ISO/IEC 14543-5-8: Remote access core protocol.
- Some of the profiles are under development, including ISO/IEC 14543-5-141: Blockchain application protocols for HES based on the IGRS RA specifications: core framework. This will be the first in a series of standards that specifies a blockchain application framework to enhance the HES architecture using IGRS RA protocols. Blockchain technology provides additional data storage protection and a trusted authentication mechanism that includes a secure data exchange process. This part will specify the core framework requirements that establish a reference system architecture, interaction model, blockchain identity authentication, blockchain encryption-method requirements, generic data format template, RA server interface and configuration specification.

INFORMATION TECHNOLOGY – HOME ELECTRONIC SYSTEM (HES) ARCHITECTURE –

Part 5-103: Intelligent grouping and resource sharing for HES Class 2 and Class 3 – Remote access smart audio interconnection profile

1 Scope

This part of ISO/IEC 14543 specifies the application framework, device interaction process, request and response message formats and service description requirements to achieve intelligent grouping, resource sharing and service collaboration among various audio devices and controllers.

This document is applicable to many types of audio devices with network connection capability. Networked audio devices can include a multi-room home audio system, a high-fidelity audio system, a home theatre, a smart radio, background audio, mobile audio and public audio equipment. Services specified by this document enable smart audio interconnection applications to interoperate seamlessly among audio devices and resource servers at home, in an office or in other remote environments. These services can include multi-device synchronization, sound configuration, audio on-demand service and music streaming and rendering.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 14543-5-1, *Information technology – Home Electronic System (HES) architecture – Part 5-1: Intelligent grouping and resource sharing for HES Class 2 and Class 3 – Core protocol*

ISO/IEC 14543-5-8, *Information technology – Home Electronic System (HES) architecture – Part 5-8: Intelligent grouping and resource sharing for HES Class 2 and Class 3 – Remote access core protocol*

ISO/IEC 14543-5-21, *Information technology – Home Electronic System (HES) architecture – Part 5-21: Intelligent grouping and resource sharing for HES Class 2 and Class 3 – Application profile – AV profile*

ISO/IEC 14543-5-22, *Information technology – Home Electronic System (HES) architecture – Part 5-22: Intelligent grouping and resource sharing for HES Class 2 and Class 3 – File profile*

ISO/IEC 15045 (all parts), *Information technology – Home Electronic System (HES) gateway*

ISO/IEC 18012 (all parts), *Information technology – Home Electronic System (HES) – Guidelines for product interoperability*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 14543-5-1, ISO/IEC 14543-5-21, ISO/IEC 14543-5-22, ISO/IEC 14543-5-8 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1.1
IGRS RA agent service module
functional entity that provides the IGRS RA service to IGRS LAN devices

Note 1 to entry: The main functionalities of the IGRS RA agent service module are sending instructions to and receiving instructions from the IGRS RA service platform, and translating the instructions of local IGRS networks to and from those of the IGRS RA networks. The IGRS RA agent service module provides audio services compatibility between the local IGRS devices and the IGRS RA devices.

3.1.2
smart audio control point
network controller that discovers other IGRS audio devices on the network and invokes the services provided by these devices

3.1.3
smart audio gateway
IGRS network intermediary device that interconnects the local area network (LAN) audio devices with other RA audio devices or Internet audio content services via an IGRS RA service platform (IRSP)

3.1.4
smart audio renderer
IGRS audio device with network capability that supports audio playback function

3.1.5
smart audio server
IGRS audio device with network capability that provides audio content and supports audio transport service

3.2 Abbreviated terms

AG	smart audio gateway
API	application programming interface
AR	smart audio renderer
AS	smart audio server
AV	audio/video
BCM	back channel message
CIS	content index service
CMS	connection management service
CP	smart audio control point
DSIM	dynamic service invocation module
FAMS	file access management service
FCMS	file connection management service

FC	file client
FS	file server
GMS	group management service
HTTP	hypertext transfer protocol
ID	identification
IGRS	Intelligent Grouping and Resource Sharing
IP	Internet protocol
IRSP	IGRS RA service platform
LAN	local area network
MPTMS	media player transport management service
MSTMS	media server transport management service
NAS	network attached storage
RA	remote access
RMS	rendering management service
TCP	transmission control protocol
TMS	transport management service

4 Conformance

A system that conforms to this document shall be implemented in accordance with Clauses 5, 6, 7 and 8. The IGRS smart audio device models, system architecture and module interfaces shall conform to Clause 5, the device type definitions shall conform to Clause 6, the service type definitions shall conform to Clause 7, and the device interconnection process shall conform to Clause 8.

5 RA smart audio interconnection profile descriptions

5.1 Overview

The RA smart audio interconnection profile standard provides specific IGRS RA application scenarios based on the remote management of smart audio devices at home, in an office and at other remote locations. This document specifies the interaction model between an AR and an AS when implementing a smart audio application, the interconnection service invocation process and all of IGRS services for each logical device type.

The IGRS RA smart audio interconnection application enables audio devices to support various audio content formats. It is applicable to many types of audio devices with network connections and audio playback or transport capabilities, which include AR or AS devices such as mobile phones, TV, home audio systems, desktop or laptop PCs, tablets, MP3 players, game consoles, NAS, and Internet audio servers. The audio content supported by this document can use a variety of audio file formats such as ISO/IEC 11172-3 (MPEG Audio Layer 3, commonly called MP3), WMA (Windows Media Audio), RA (RealAudio®) and AAC (Advance Audio Coding), streaming audio, audio data stream in AV files and DSD (Direct Stream Digital) audio.[1]

[1] Windows Media Audio, RealAudio® and Direct Stream Digital are examples of a suitable products available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO or IEC of these products.

5.2 Basic functionalities

The IGRS smart audio interconnection profile shall support the following functions:

a) auto-discover all available AR and AS devices currently on the network;

b) discover and acquire content services or available audio files on the ASs currently available on the network;

c) manage, control and transport audio content;

d) control each audio device independently, in default groups or customized groups, if there are multiple devices present;

e) allow a CP to control audio rendering on multiple ARs in different groups, and also support simultaneous playback on all ARs within the same group;

f) device interconnection control management methods that support both local (LAN) and remote (Internet) operations.

5.3 Generic audio device categories

5.3.1 Overview

Generic audio devices are divided into three categories: home audio, public audio and mobile audio, according to the smart audio interconnection usage scenarios.

This document is applicable to these three categories of audio devices, which possess audio rendering functions and interconnection capabilities to other relevant audio devices.

5.3.2 Home audio

Home audio mainly focuses on devices that are capable of rendering home-theatre style sound quality. Typical home audio systems include various amplifiers, speakers and control units or configuration devices for karaoke, dance studio, home or movie theatre, etc.

Home audio interconnection applications are further divided into the following two categories: audio-to-audio device interconnection and audio-to-video device interconnection.

a) Audio-to-audio device interconnection refers to home audio devices with rendering capabilities that are interconnected through an existing home network. Typical application scenarios include multi-room audio and background music interconnections:
   - multi-room audio interconnection allows audio devices that are located in multiple rooms, such as the living room, bedroom, kitchen and bathroom, to render music simultaneously;
   - background music interconnection allows interconnected audio devices to render background music in every room through one or more audio sources.

b) Audio-to-video device interconnection refers to the networking of multimedia devices (including both audio and video) used in home-theatre applications. This document does not address this type of device interconnection.

5.3.3 Public audio

Public audio represents audio devices used in shopping malls, schools, public squares, hotels, theatres, gymnasiums, etc.

5.3.4 Mobile audio

Unlike the previous two categories, mobile audio contains portable, miniaturized and often embedded devices in other smart multimedia systems that support audio rendering in a mobile environment (e.g. various in-vehicle and ship-based audio systems).

5.4 Interaction model

The IGRS RA smart audio interconnection system architecture model is shown in Figure 1.

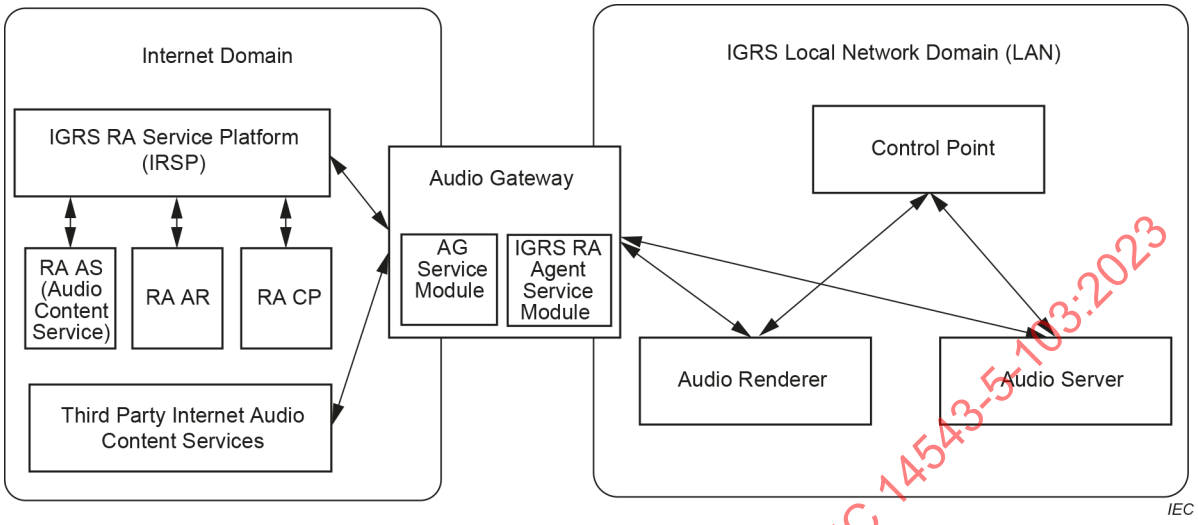

Figure 1 – RA smart audio interconnection system architecture

An IGRS RA smart audio interconnection system consists of one or more smart audio servers (AS), one or more smart audio renderers (AR) and a smart audio control point (CP). In this model, both a local AS and an RA AS are used to serve stored audio contents. An AR is a rendering device capable of processing the audio contents. The AS and an AR are connected through a CP for audio transport service invocation. The smart audio gateway (AG) enables interactions between IGRS remote audio devices and audio devices in the home. The AG is an implementation of the HES gateway (ISO/IEC 15045 series and ISO/IEC 18012 series) that includes a service module functioning as an IGRS RA agent, which is used for those IGRS LAN audio devices that cannot be discovered over the Internet as shown in Figure 1. All IGRS LAN audio devices and IGRS RA audio devices shall use published IGRS protocols (ISO/IEC 14543-5-1 and ISO/IEC 14543-5-8) to discover and interconnect with each other. The specific interaction models and flow methods shall comply with ISO/IEC 14543-5-21 and ISO/IEC 14543-5-22. Both push and pull models shall be supported..

5.5 Smart audio device types

5.5.1 Smart audio server (AS)

An AS is a logical device with networked computational audio storage capacity. Examples of typical physical AS devices are a desktop PC, mobile phone, NAS, CD or DVD player.

An AS shall be used as the source device that stores and manages audio content with a standard set of access interfaces for other IGRS smart audio devices. An AS may be located in the house connected to the home network or outside the house accessed remotely via the IGRS AG. A remote AS may be offered by the IGRS service provider or by a third-party provider.

5.5.2 Smart audio renderer (AR)

An AR is a logical device with networked audio decoding and rendering capabilities. Examples of typical physical AR devices are a desktop PC, TV, audio receiver, speaker or a handheld device.

An AR shall be used as the target device, which accesses and renders the audio contents delivered via network.

5.5.3 Smart audio control point (CP)

A CP is a logical device that is capable of discovering, coordinating and controlling an AR or AS. A CP can reside in an AR or AS device, and may also be a standalone device. Examples of typical physical CP devices are a desktop PC, TV, mobile phone, remote control or other relevant simple human-machine interface device with built-in IGRS RA smart audio services.

A CP shall be used to discover and invoke the audio management services provided by an AR or AS. However, a CP is not directly involved in the audio content transport between an AR and AS.

5.5.4 Smart audio gateway (AG)

An AG is a logical device that translates different protocols. An AG shall be used to interconnect local AR, AS and CP to RA audio devices and Internet audio content servers. An AG is an implementation of the HES gateway, specified in the ISO/IEC 15045 series and ISO/IEC 18012 series, and as shown in Figure 1. The AG shall include an AG service module as specified in the ISO/IEC 18012 series.

The AG shall meet the requirements as specified in ISO/IEC 15045-1 (gateway model). For HES simple gateway implementations, and for which no future expansion is planned, the AG shall meet the requirements as specified in ISO/IEC 15045-1. For all other implementations, the AG shall meet the requirements as specified in ISO/IEC 15045-2 (modularity and protocol) and in ISO/IEC 15045-1 that specify complex-integral, complex-modular and distributed classes.

The AG shall conform to the principles and requirements for privacy, security and safety as specified in the ISO/IEC 15045 series. In addition, the guidelines described are to be followed and vulnerabilities addressed.

The AG shall conform to privacy principles and recommendations, guidelines and requirements as specified in ISO/IEC 15045-1. The AG shall conform to security and safety considerations that are specified in ISO/IEC 15045-1.

The AG shall meet the requirements as specified in ISO/IEC 18012-1 (introduction to product interoperability) and ISO/IEC 18012-2 (taxonomy and application interoperability model).

5.5.5 IGRS RA service platform (IRSP)

The IRSP is the core service platform that enables interoperability among all IGRS remote access (RA) clients and service platforms. An AR, AS and CP shall use the IRSP to interact with any IGRS RA smart audio devices or gain access to Internet audio contents provided by third-party services.

5.5.6 Internet audio content server

Content that is not available from an AS in the home or on the IRSP may be offered by third-party providers. The Internet audio content server is located on a service platform that provides comprehensive capabilities for home, public and mobile users usually via the Internet. The platform integrates computing, storage and network capabilities to host a variety of Internet service applications including audio, with common access API services. This entity is developed by third parties and is out of scope for this document.

5.6 Interface specifications

5.6.1 Overview

IGRS RA smart audio interconnection service module interfaces are specified in 5.6 for AS, AR, CP and AG device types.

5.6.2 AS service module interface

An AS shall provide three service module interfaces: content index service, connection management service and transport management service.

a) Content index service (CIS): The CIS shall provide a set of service interfaces that allows a CP to discover the media content stored on an AS. One of the primary service interfaces, CIS::Browse(), enables the CP to acquire detailed attributes about the media content, such as name, author, transport protocols and data formats supported by that AS. The CP shall then use this information to determine whether the target AR can play that audio content. In addition, the CIS supports other service interfaces such as GetSearchCapabilityList(), GetSortCapabilityList() and GetContentUpdateId().

b) Connection management service: The CMS shall provide a set of service interfaces to manage the audio device connection. A CP shall invoke CMS::PrepareForConnection() to obtain an InstanceID from an AS for a CP to control the subsequent audio data transfer. This InstanceID shall be used to distinguish among instances of a CIS associated with different ARs. If PrepareForConnection() fails, the CP shall set the InstanceID to 0. The CP shall invoke ReleaseConnection() if it needs to terminate the connection. In addition, the CMS also defines other service interfaces such as GetActiveConnectionIdList(), Get GetCurrentConnectionInfo(), and GetProtocolInfo().

c) Transport management service: The TMS shall provide a set of service interfaces that allows a CP to control various audio rendering capabilities, such as stop, next, previous and seek. When an AS is transporting multiple audio content streams simultaneously, the CP shall distinguish and control each via InstanceIDs created by the CMS::PrepareForConnection() service. In addition, the TMS supports other service interfaces such as GetCurrentMediaInfo(), GetTransportInfo(), GetPlayURIList(), Next(), Pause(), Play(), Previous(), Seek(), SetTransportURIList(), SetPlayMode() and Stop().

5.6.3 AR service module interface

An AR shall provide three service module interfaces: rendering management service, connection management service and transport management service.

a) Rendering management service: The RMS shall provide a set of service interfaces that enables a CP to control the playback of audio content, such as rendering control preset and volume control. The RMS shall also support the rendering of multiple audio content streams via a list. The InstanceIDs of RMS shall be generated by CMS::PrepareForConnection(). In addition, RMS also defines other service interfaces such as GetMute(), SetMute(), GetVolume() and SetVolume().

b) Connection management service: The CMS shall provide a set of service interfaces to manage the audio device connection. CP shall invoke the CMS::GetProtocolInfo() to enumerate the transport protocols and data formats supported by an AR. Then the CP shall invoke the CMS::PrepareForConnection() to obtain an InstanceID from AS for CP to control the subsequent audio rendering. The CP shall invoke the ReleaseConnection() if it needs to terminate the connection. The CMS service interfaces provided by an AR shall be the same as an AS.

c) Transport management service: TMS service interfaces provided by an AR shall be the same as those for an AS.

5.6.4 CP module interface

A CP shall provide the following basic services or functionalities to enable the coordination of device interactions between an AS and AR.

a) Device discovery: The CP shall use the discovery mechanism specified in ISO/IEC 14543-5-1 and ISO/IEC 14543-5-8 to find other AS and AR devices on the network.

b) Audio content search: The CP shall invoke the CIS::Browse() or CIS::Search() service interfaces of the AS to acquire the audio content information and the transport protocols and data formats supported by AS.

c) AR transport protocol and data format capabilities search: The CP shall invoke the CMS::GetProtocolInfo() service interface of the AR to return the compatible transport protocols and data formats.

d) Transport protocol and data format match: The CP shall match the results from the CIS on the AS with CMS::GetProtocolInfo() on the AR in order to select a mutually supported transport protocol and data format for interoperability.

e) Audio content selection: The CP shall invoke the SetTransportURIList service interface to select the audio content for transport.

f) Start audio transport: This function shall invoke the transport control initiated by the user.

g) Rendering adjustment control: The CP shall use the RMS service interfaces to control audio playback adjustment.

h) Audio content control: The CP shall invoke the TMS service interfaces to control the actual audio content rendering, such as play, next, previous, pause and stop.

i) Service terminate: The CP shall invoke the ReleaseConnection() to disconnect from the AS and AR. All resources shall then be released.

5.6.5 Smart audio gateway module interface

A smart audio gateway (AG) shall be used to interconnect devices for audio rendering applications between LAN AR devices and IGRS RA AS and CP devices, as well as to access other popular Internet audio content services. It shall provide an IP port address for audio rendering and follow the APIs specified in ISO/IEC 14543-5-8 to establish a connection to the IRSP. However, third-party Internet audio content delivery services may require implementations of various audio service interface APIs from service providers, which are out of the scope for this document.

6 Smart audio device type descriptions

6.1 Smart audio renderer

6.1.1 Overview

An AR shall be used to manage audio content delivery playback. It shall provide CMS, MPTMS, RMS and GMS services. The CMS allows the IGRS DSIM to query an AR to obtain audio formats, transport protocols and transport control mechanisms supported by that AR. It also provides interfaces to the DSIM to discover active connection service instances and obtain attributes for each connection since, similar to an AS, the AR is capable of supporting multiple simultaneous connections. MPTMS and RMS enable a CP to adjust and control the transport and rendering of audio streams on an AR. The GMS makes it possible to synchronize playback control and volume adjustment, etc. within a group of devices.

6.1.2 Device type description

The device type of AR is defined as:

urn:IGRS:Device:DeviceType:AudioRenderer

6.1.3 AR service interfaces

AR service interfaces are shown in Table 1.

Table 1 – AR service interfaces

Service name	Required or optional	Service type	Description
CMS	Required	urn:IGRS:Service:ServiceType:ConnectionManagement:1	CMS is used to generate and manage the connection between AS and AR. AR is capable of supporting and managing multiple active connections simultaneously through CMS.
MPTMS	Required	urn:IGRS:Service:ServiceType:MediaPlayerTransportManagement:1	MPTMS enables IGRS DSIM to adjust and control the delivery of audio streams on AR, such as play, pause, stop, search.
RMS	Required	urn:IGRS:Service:ServiceType:RenderingManagement:1	RMS allows IGRS DSIM to adjust and control audio rendering settings, such as volume, mute.
GMS	Optional	urn:IGRS:Service:ServiceType:GroupManagement:1	GMS enables synchronization of playback controls, volume, time progression, change of device name, etc. within group devices.

6.1.4 Mandatory invocation interface descriptions

The mandatory invocation interfaces for AR are shown in Table 2.

Table 2 – Mandatory invocation interfaces for AR

Service name	Required interface	Description
MPTMS	SetTransportURIList	Set TransportURI variable. Specify the URI list of audio content object to be transported by MPTMS instance.
	GetTransportInfo	Get current transport state information of transport service instance.
	Play	Play audio object in media list in sequence with specified playing mode (optional) and playing speed. The starting point is determined by the Offset parameter, which is 0 for no offset or a positive number indicating where to start playing the audio object beyond the beginning. Playing is continued until the URI list on AS has been completely played or other interfaces have been invoked, such as stop.
	Next	Set the next audio object in the media list to be played. The selection mode is decided by the current audio-playing mode.
	Previous	Set the current audio object as the previous played audio object.
	Stop	Stop the current audio object played by MPTMS. The current position should be reset in some devices.
	Seek	Find the target position specified by input parameter in accordance with the input parameter Unit.
	GetPlayURIList	Get AS URI list transported by appointed transport service instance.
	GetAllMediaInfo	Get the detailed content information of media URI list transported by specified transport service instance.
	GetCurrentMediaInfo	Get audio information transported by specified transport service instance.
	GetCurrentPlayMode	Get the URI playing mode in the transport object list controlled by specified transport service instance.

Service name	Required interface	Description
RMS	ListPresets	Get current rendering control state variable list.
	SelectPresets	Recover rendering control state variable to preset value.
	GetMute	Get current mute state variable value.
	SetMute	Set mute state variable value.
	GetVolume	Get current volume state variable value.
	SetVolume	Set volume state variable value.
CMS	GetProtocolInfo	Get the transport protocol supported by current device, including transport control protocol name, network port, content format, other protocol information and available IP address list on AR.
	PrepareForConnection	Get the ConnectionId, which is used to prepare and instantiate audio data for sending and receiving, and TransportInstanceId, which is used for media transport.
	ReleaseConnection	Notify device to disconnect the connection corresponding to ConnectionId and release resource.
	GetActiveConnectionIdList	Get current active connection ID list on AS or AR.
GMS	GetGroupId	Get AR device grouping.
	SetGroupId	Set AR device grouping.
	SetName	Set AR device display name.
	GetName	Get AR device display name.
	SetLineinMode	Set AR device line input mode.
	GetLineinMode	Get AR device line input mode.
	RebootService	Restart GMS service.

6.2 Smart audio server

6.2.1 Overview

An AS shall be used to provide audio content. It shall contain CIS, CMS, BCM and MSTMS services. An AS enables the IGRS DSIM to browse and search the audio contents stored, including audio formats, supported transport protocols and transport control mechanisms. It also provides interfaces to establish connections between an AS and AR, execute media transport control (e.g. play and stop) and perform numerous media resource operations on the device. Relevant types of AS include the following.

a) Local audio server: devices that provide audio resources within the LAN.

b) An RA audio server: audio application servers or devices that provide audio contents through authenticated connections to the IRSP.

c) Third-party Internet audio server: servers that provide a variety of audio contents on the Internet that require non-standard API. These APIs are not a part of this document.

6.2.2 Device type description

The device type of an AS is defined as:

urn:IGRS:Device:DeviceType:AudioServer

6.2.3 AS service interfaces

AS service interfaces are shown in Table 3.

Table 3 – AS service interfaces

Service name	Required or optional	Service type	Description
CIS	Required	urn:IGRS:Service:ServiceType:ContentIndex:1	CIS allows IGRS DSIM to discover and enumerate audio content on AS so that CP can obtain the content information such as the name of audio, creation date, size, and format. With this information, DSIM is able to determine whether AR can render the content. The content directory structure supports nested sub-directories.
CMS	Required	urn:IGRS:Service:ServiceType:ConnectionManagement:1	CMS is used to generate and manage the connection between AS and AR. AS is capable of supporting and managing multiple active connections simultaneously through CMS.
MSTMS	Required	urn:IGRS:Service:ServiceType:MediaServerTransportManagement:1	MSTMS enables CP to adjust and control the delivery of audio content on AS, such as play, pause, stop, search.
BCM Service	Required		BCM service uses TCP to establish a pipe (Back-Channel) that connects between AS (BCM Server) and AR (BCM Client) for out-of-band transport control. BCM is specified in 6.2.3 of ISO/IEC 14543-5-21:2012.

6.2.4 Mandatory invocation interface description

The mandatory invocation interfaces for an AS are shown in Table 4.

Table 4 – Mandatory invocation interfaces for AS

Service	Required interface	Description
MSTMS	SetTransportURIList	Set TransportURI variable. Specify the URI list of audio content object to be transported by MSTMS instance.
	GetTransportInfo	Return the current transport state information of transport service instance.
	Next	Set the next audio object in the media list to be played. The selection mode is decided by the current audio-playing mode.
	Previous	Set the current audio object as the previous played audio object.
	Stop	Stop the current audio object played by MSTMS. The current position should be reset in some devices.
	Play	Play audio object in media list in sequence with specified playing mode (optional) and playing speed. The starting point is determined by the Offset parameter, which is 0 for no offset or a positive number indicating where to start playing the audio object beyond the beginning. Playing is continued until the URI list on AS has been completely played or other interfaces have been invoked, such as stop.
	Seek	Find the target position specified by input parameter in accordance with the input parameter Unit.
	GetPlayURIList	Get AS URI list transported by specified transport service instance.
	GetAllMediaInfo	Get the detailed content information of media URI list transported by specified transport service instance.
	GetCurrentMediaInfo	Get audio information transported by specified transport service instance.
	GetCurrentPlayMode	Get the URI playing mode in the transport object list controlled by specified transport service instance.

Service	Required interface	Description
CIS	GetSortCapabilityList	Retrieve the sorting list supported by CIS on AS.
	GetContentUpdateId	Retrieve the value of content update ID of CIS on AS.
	Browse	Return the browsed content directory object.
CMS	GetProtocolInfo	Get the transport protocol supported by current device, including transport control protocol name, network port, content format, other protocol information and available IP address list on AS.
	PrepareForConnection	Get the ConnectionId, which is used to prepare and instantiate audio data for sending and receiving, and TransportInstanceId, which is used for media transport.
	ReleaseConnection	Notify device to disconnect the connection corresponding to ConnectionId and release resource.
	GetActiveConnectionIdList	Get current active connection ID list on AS or AR.

6.3 Smart audio control point

6.3.1 Overview

The CP shall be used to provide audio control management and coordination of the AS and AR. It shall contain CIS, CMS, MSTMS, RMS, FAMS and GMS services. The CP shall use the IGRS DSIM to browse and search for audio content provided by the AS and invoke the relevant service interfaces to establish connections between the AS and AR, execute media transport control (e.g. play, stop) and perform numerous media resource operations on the device. Relevant types of CP include the following.

a) Local CP: an audio controller device that coordinates connections and resources between an AS and AR within LAN.

b) An RA CP: an audio controller device that coordinates RA connections to other smart audio devices and provides resource discovery and control management of remote audio application services through an authenticated connection to an IRSP.

6.3.2 Device type description

The device type of CP is defined as:

urn:IGRS:Device:DeviceType:ControlPoint

6.3.3 CP service interfaces

CP service interfaces are shown in Table 5.

Table 5 – CP service interfaces

Service name	Required or optional	Service type	Description
CIS	Required	urn:IGRS:Service:ServiceType:ContentIndex:1	CIS allows IGRS DSIM to discover and enumerate audio content on AS so that CP can obtain the content information such as the name of audio, creation date, size, and format. With this information, DSIM is able to determine whether AR can render the content. The content directory structure supports nested sub-directories.
CMS	Required	urn:IGRS:Service:ServiceType:ConnectionManagement:1	CMS is used to generate and manage the connection between AS and AR. Both AS and AR are capable of supporting and managing multiple active connections simultaneously through CMS.
MSTMS	Required	urn:IGRS:Service:ServiceType:MediaServerTransportManagement:1	MSTMS enables CP to adjust and control the delivery of audio content on AS, such as play, pause, stop, search.
RMS	Required	urn:IGRS:Service:ServiceType:RenderingManagement:1	RMS allows IGRS DSIM to adjust and control audio rendering settings, such as volume, mute.
FAMS	Required	urn:IGRS:Service:ServiceType:FileAccessManagement:1	Discoverable FAMS allows FC (file client) to invoke operations such as authenticate, browse, search, retrieve, upload and download all files and sub-directory information in any specified shared directory on FS (file server).
GMS	Optional	urn:IGRS:Service:ServiceType:GroupManagement:1	GMS enables synchronization of playback controls, volume, time progression, change of device name, etc. within group devices.

6.3.4 Mandatory invocation interface description

The mandatory invocation interfaces for a CP are shown in Table 6.

Table 6 – Mandatory invocation interfaces for CP

Service name	Required interface	Description
CIS	GetSortCapabilityList	Retrieve the sorting list supported by CIS on AS.
	GetContentUpdateId	Retrieve the value of content update ID of CIS on AS.
	Browse	Return the browsed content directory object.
CMS	GetProtocolInfo	Get the transport protocol supported by current device, including transport control protocol name, network port, content format, other protocol information and available IP address list on AS or AR.
	PrepareForConnection	Get the ConnectionId, which is used to prepare and instantiate audio data for sending and receiving, and TransportInstanceId, which is used for media transport.
	ReleaseConnection	Notify device to disconnect the connection corresponding to ConnectionId and release resource.
	GetActiveConnectionIdList	Get current active connection ID list on AS or AR.
RMS	ListPresets	Get current rendering control state variable list.
	SelectPresets	Recover rendering control state variable to preset value.
	GetMute	Get current mute state variable value.
	SetMute	Set mute state variable value.
	GetVolume	Get current volume state variable value.
	SetVolume	Set volume state variable value.

Service name	Required interface	Description
GMS	GetGroupId	Get AR device grouping.
	SetGroupId	Set AR device grouping.
	SetName	Set AR device display name.
	GetName	Get AR device display name.
	SetLineinMode	Set AR device line input mode.
	GetLineinMode	Get AR device line input mode.
	RebootService	Restart GMS service.
FAMS	Browse	Return to the lower level file or directory list of the specified directory on FS, and get back the basic attributes of each object.
MSTMS	SetTransportURIList	Set TransportURI variable. Specify the URI list of audio content object to be transported by MSTMS instance.
	GetTransportInfo	Return the current transport state information of transport service instance.
	Next	Set the next audio object in the media list to be played. The selection mode is decided by the current audio-playing mode.
	Previous	Set the current audio object as the previous played audio object.
	Stop	Stop the current audio object played by MSTMS. The current position should be reset in some devices.
	Play	Play audio object in media list in sequence with specified playing mode (optional) and playing speed. The starting point is determined by the Offset parameter, which is 0 for no offset or a positive number indicating where to start playing the audio object beyond the beginning. Playing is continued until the URI list on AS has been completely played or other interfaces have been invoked, such as stop.
	Seek	Find the target position specified by input parameter in accordance with the input parameter Unit.
	GetPlayURIList	Get AS URI list transported by specified transport service instance.
	GetAllMediaInfo	Get the detailed content information of media URI list transported by specified transport service instance.
	GetCurrentMediaInfo	Get audio information transported by specified transport service instance.
	GetCurrentPlayMode	Get the URI playing mode in the transport object list controlled by specified transport service instance.

6.4 Smart audio gateway

The AG shall be used to interconnect LAN audio devices and IGRS RA devices and to translate between networks with different protocols. It shall provide all required invocation interfaces defined in ISO/IEC 14543-5-8 to set up a connection to an IRSP so that RA audio devices or audio application services can discover and interact with AS, AR and CP in the home. Also through the AG, the CP in the home shall be able to browse Internet audio content sources (both RA AS and third-party AS) and coordinate audio services and data transport to AR devices. However, the invocation interfaces to third-party AS or Internet audio services are out of the scope and not defined in this document.

7 Smart audio service type descriptions

7.1 Reference BCM connection management and transport control process

The audio playback flow of the BCM-based connection management and transport control mechanism shall follow steps a) to d).

a) Connection setup: The BCM client sends a SETUP command to the BCM server to request setup of the BCM channel. The BCM server shall initialize a BCM channel, allocate a connection identifier and return the connection identifier to BCM client.

b) Select content: After connection setup, the BCM client sends a SELECT command to the BCM server on this connection with the URI of the content as the parameter in the multicast format. The BCM server shall check the AVMCastGroupName metadata of the content on the CIS to determine if there is any active multicast session for the content: If there is no multicast group setup for the content, the audio server shall set up a multicast group, initialize an out-of-band channel to transport the content and notify the media client about the multicast address of the content through the inner-group information exchange mechanism; if there is an active multicast session for the content, the media client shall join the group and obtain the multicast address of the content through the inner-group information exchange mechanism.

c) Transport control: The BCM client controls the transportation of the content selected in the last step, such as play (PLAY command), pause (PAUSE command), resume (RESUME command), stop (STOP command), record (RECORD command), pause record (PAUSE_RECORD command), resume record (RESUME_RECORD command), stop record (STOP_RECORD command), select subtitle (SUBTITLE command) and select audio track (AUDIO_TRACK command).

d) Connection release: The BCM client sends a RELEASE command to the BCM server to request to release the connection. If the transport is still active, the BCM server and BCM client shall first stop the content transport and then release the BCM channel.

7.2 Service types

The service types in IGRS RA smart audio interconnection application are shown in Table 7.

Table 7 – Service types in IGRS RA smart audio interconnection application

Name of service type	Service type identifier	Description
CIS	urn:IGRS:Service:ServiceType:ContentIndex:1	CIS allows IGRS DSIM to discover and enumerate audio content on AS so that CP can obtain the content information such as the name of audio, creation date, size, and format. With this information, DSIM is able to determine whether AR can render the content. The content directory structure supports nested sub-directories.
CMS	urn:IGRS:Service:ServiceType:ConnectionManagement:1	CMS is used to generate and manage the connection between AS and AR. Both AS and AR are capable of supporting and managing multiple active connections simultaneously through CMS.
MSTMS	urn:IGRS:Service:ServiceType:MediaServerTransportManagement:1	MSTMS enables IGRS DSIM to adjust and control the delivery of audio content on AS, such as play, pause, stop, search. AS shall support push mode with this service.
MPTMS	urn:IGRS:Service:ServiceType:MediaPlayerTransportManagement:1	MPTMS enables IGRS DSIM to adjust and control the delivery of audio streams on AR, such as play, pause, stop, search. AR shall support pull mode with this service.
RMS	urn:IGRS:Service:ServiceType:RenderingManagement:1	RMS allows IGRS DSIM to control and adjust media playback, such as volume, equalization, to support multiple dynamic instances at the same time, thus enabling simultaneous playback control of multiple audio objects, such as multi-room audio playback applications. RMS allows IGRS DSIM to adjust and control audio rendering settings, such as volume, mute.

Name of service type	Service type identifier	Description
MTS	urn:IGRS:Service:ServiceType:MediaTranscoding:1	MTS allows IGRS DSIM to control audio format transcoding, with support to multiple active transcoding control instances.
FAMS	urn:IGRS:Service:ServiceType:FileAccessManagement:1	FAMS provides the following functions to file client: a) provides authentication for FC and grants corresponding file access rights; b) allows FC to retrieve the sorting and searching capability supported by FS; c) allows FC to browse the content directory provided by FS in the network; d) allows FC to search for a specified file or directory; e) allows FC to retrieve and modify attributes of a file or directory; f) allows FC to retrieve and set a browsing filter; g) allows FC to subscribe to a file or directory object update event; h) allows FC to subscribe to a FAMS service update event; i) supports FC to upload and download the specified file or directory.
FCMS	urn:IGRS:Service:ServiceType:FileConnectionManagement:1	FCMS is used to create and manage the connection between FS and FC. FS is capable of supporting and managing multiple active connections simultaneously through FCMS.
GMS	urn:IGRS:Service:ServiceType:GroupManagement:1	GMS enables synchronization of playback controls, volume, time progression, change of device name, etc. within group devices.

7.3 Group management service

7.3.1 Overview

The GMS shall be used to create and manage groups of audio devices. It allows the synchronization of playback controls, volume, time progression, change of device name, etc. within these groups of devices.

7.3.2 Group management service type

The service type of GMS is defined as:

urn:IGRS:Service:ServiceType:GroupManagement:1

7.3.3 Group management service interface

7.3.3.1 GetGroupId

Function description: Get device grouping ID.

Input or output parameters are shown in Table 8.

Table 8 – Input or output parameters for GetGroupId

Parameter	Input or output	Data type	Field explanation
InstanceId	Input	UnsignedInt	Instance ID
CurrentGroupId	Output	UnsignedInt	Current device group ID. If there is no existing group, then return its device ID

Return Value: Success: 0, Failure: 1

7.3.3.2 SetGroupId

Function description: Set device grouping ID.

Input or output parameters are shown in Table 9.

Table 9 – Input or output parameters for SetGroupId

Parameter	Input or output	Data type	Field explanation
InstanceId	Input	UnsignedInt	Instance ID
CurrentGroupId	Input	UnsignedInt	Current device group ID
CurrentTimeStamp	Input	UnsignedInt	Current timestamp value
CurrentAction	Input	String	add: add device to current group remove: delete device from current group

Return Value: Success: 0, Failure: 1

7.3.3.3 GetName

Function description: Get device display name.

Input or output parameters are shown in Table 10.

Table 10 – Input or output parameters for GetName

Parameter	Input or output	Data type	Field explanation
InstanceId	Input	UnsignedInt	Instance ID
DeviceName	Output	String	Return current device name

Return Value: Success: 0, Failure: 1

7.3.3.4 SetName

Function description: Set device display name.

Input or output parameters are shown in Table 11.

Table 11 – Input or output parameters for SetName

Parameter	Input or output	Data type	Field explanation
InstanceId	Input	UnsignedInt	Instance ID
DesiredName	Input	String	Set desired device name

Return Value: Success: 0, Failure: 1