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Information technology – Home electronic system (HES) architecture – Part 5-3: Intelligent grouping and resource sharing for Class 2 and Class 3 – Basic application

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FOREWORD

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International Standard ISO/IEC 14543-5-3 was prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

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 web site.

This International Standard has been approved by vote of the member bodies, and the voting results may be obtained from the address given on the second title page.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

INTRODUCTION

ISO/IEC 14543-5, Information technology – Home electronic system (HES) architecture – Part 5: Intelligent grouping and resource sharing for HES (IGRS), consists of the following parts:

- **IGRS Part 5-1: Core protocol**
  - Specifies the TCP/IP protocol stack as the basis and the HTTP protocol as the message-exchanging framework among devices.
  - Specifies a series of device and service interaction/invocation standards, including device and service discovery protocol, device and service description, service invocation, security mechanisms, etc.
  - Specifies core protocols for a type of home network that supports streaming media and other high-speed data transport within a home.
- **IGRS Parts 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:
    - Part 5-21: AV profile
    - Part 5-22: File profile
  - Additional application profiles are planned (part numbers to be assigned)
    - Part 5-2w: DVD profile
    - Part 5-2x: QoS profile
    - Part 5-2y: DMCP profile
    - Part 5-2z: Universal control profile
- **IGRS Part 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.
- **IGRS Part 5-4: Device validation**
  - Specifies a standard method to validate an IGRS-compliant device.
- **IGRS Part 5-5: Device type**
  - Specifies IGRS Device types used in IGRS applications.
- **IGRS Part 5-6: Service type**
  - Specifies basic service types used in IGRS applications.

INFORMATION TECHNOLOGY – HOME ELECTRONIC SYSTEM (HES) ARCHITECTURE –

Part 5-3: Intelligent grouping and resource sharing for HES Class 2 and Class 3 – Basic application

1 Scope

This part of ISO/IEC 14543 defines design criteria and application requirements enabled by the relevant application profiles. It also defines required or optional interaction processes, interaction interfaces, software and hardware interfaces and the software framework that may or may not be specified by the existing application profiles related to the IGRS basic applications.

This part of the ISO/IEC 14543 is applicable to computers, household appliances and communication devices that implement media data streaming by wired or wireless means.

2 Normative references

The following referenced documents are indispensable for the application 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 8802-3:2000, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*

ISO/IEC 13818-11:2004, *Information technology – Generic coding of moving pictures and associated audio information – Part 11: IPMP on MPEG-2 systems*

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

ISO/IEC 14543-5-6, *Information technology – Home electronic system (HES) architecture – Part 5-6: Intelligent grouping and resource sharing for HES Class 2 and Class 3 – Service type*[1]

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 – Application profile – File profile*

ISO/IEC 15444-4:2004, *Information technology – JPEG 2000 image coding system: Conformance testing*

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ISO/IEC 23000-2:2008, *Information technology – Multimedia application format (MPEG-A) – Part 2: MPEG music player application format*

ISO/IEC 29341-3-1:2008, *Information technology – UPnP Device Architecture – Part 3-1: Audio Video Device Control Protocol – Audio Video Architecture*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document the following terms and definitions apply.

3.1.1
IGRS dynamic service invocation module
part of the AV application logic to orchestrate the interaction of application services with respect to the capability of the device or the device group involved and to coordinate the service invocation sequence between the media server and the media client

NOTE The IGRS dynamic service invocation module should be implemented on a media server, a media client or another separate device.

3.1.2
IGRS Service

shareable resource encapsulated in an IGRS device by implementing application interfaces and providing services for other IGRS devices

NOTE An IGRS service has an invocation interface that meets the requirements of the IGRS specification. These invocation interfaces are described and announced on the network through the IGRS Service Description Specification.

3.1.3
media client

audio/video device in an IGRS network that possesses multimedia decoding capability

NOTE Examples of media client devices include a TV, a set-top-box, etc. The media client may access content on the media server as the destination device in an audio/video application.

3.1.4
media server

audio/video device in an IGRS network that possesses storage and computing capabilities

NOTE Examples of a media server device include a PC, a network storage server, etc. The media server may provide a network interface to other audio/video devices to access content managed by the media server as the source device in an audio/video application.

3.2 Abbreviations

The following acronyms and abbreviations are used in this standard.

BCM	Back Channel Message
CIS	Content Index Service
CMS	Connection Management Service
IGRS	Intelligent Grouping and Resource Sharing
IGRSDSIM	IGRS Dynamic Service Invocation Module
MC	Media Client
MCTMS	Media Client Transport Management Service
MS	Media Server
MSTMS	Media Server Transport Management Service
RMS	Rendering Management Service

4 Conformance

This International Standard is intended to be used primarily as an implementation guideline for developers to ensure interoperability at the application level.

For conformance to this International Standard the following applies.

- The interaction model used in an IGRS media AV basic application shall meet the system design criteria specified in Clause 5.
- The specific interaction flow process used in an IGRS basic application for digital media forwarding, storage and playback system shall meet Clause 6.
- Media clients, media recorders and media servers shall be compliant with the relevant protocols, function descriptions, software profiles, software interfaces (including media format supported) and hardware interfaces (including physical and networking interfaces) that enable IGRS digital media forwarding, storage and playback system as specified in 6.3, 6.4, 6.5 and 6.6.

5 Overview

5.1 Summary

An IGRS application, based on the IGRS core protocol and IGRS application profiles, is classified in two types: IGRS basic application and IGRS extended application. As defined in ISO/IEC 14543-5-5, IGRS devices can be divided into many different device types according to usage scenarios. An IGRS basic application, which is directly related to a specific device type, is a standardized application defined by the IGRS specification that corresponds to a particular IGRS device function. It is expected that a specific device type on an IGRS device would result in a standardized IGRS basic application implementation. An IGRS extended application may be developed by a third party supplier based on the IGRS core protocol and IGRS application profile. An IGRS extended application conforms to the IGRS standard and is intended to diversify and to enhance the current IGRS device functionalities.

The IGRS basic application defines application requirements enabled by the relevant application profiles. It also defines the interaction process and interaction interfaces that may or may not be specified by the existing application profiles related to these basic applications. Application manufacturers are allowed to develop their own basic applications independently based on this standard guideline. However, interoperability shall be achieved among these various application implementations. Moreover, application manufacturers can also choose to develop their own extended applications independently, as necessary.

The guidelines of this standard include the following basic applications based on the IGRS core protocol and application profile:

- digital media forwarding,
- storage,
- a playback system.

This standard defines the application requirement, specific functional description, basic service description, basic device description, software profile, software interface and hardware interface for digital media forwarding, storage and a playback system.

5.2 Design criteria

5.2.1 Relationship between basic application and IGRS

The basic application includes two parts: one part specifies the application profile and the interaction process of the IGRS basic application; the other specifies the functional definition, interface invocation and service invocation message format of other software tools needed to ensure interoperability and ease of use. An IGRS application is triggered through the interactions between one or more IGRS services and one or more IGRS clients invoking IGRS services. The basic application shall guide users to design integrated applications based on IGRS protocols.

5.2.2 Relationship between basic application and transport protocol

The basic application does not rely on any specific transport protocols. Therefore, it shall support any transport protocols such as FTP, HTTP, etc.

5.2.3 Relationship between basic application and existing file sharing system

The basic application defines a set of standard interfaces used in an IGRS network. It does not pose any restriction on the back-end implementation method. Therefore, the file sharing system associated with the IGRS basic application cannot only support a proprietary system developed by users, but also any existing sharing system.

5.2.4 Relationship between basic application and file format

The basic application profile is independent of any specific file format, which means that it shall support interactions with files of any arbitrary format.

5.2.5 Basic application interaction model

An IGRS application is achieved through interactions between one or more IGRS services and one or more IGRS clients. Typically, the interaction of an IGRS application is as shown in Figure 1.

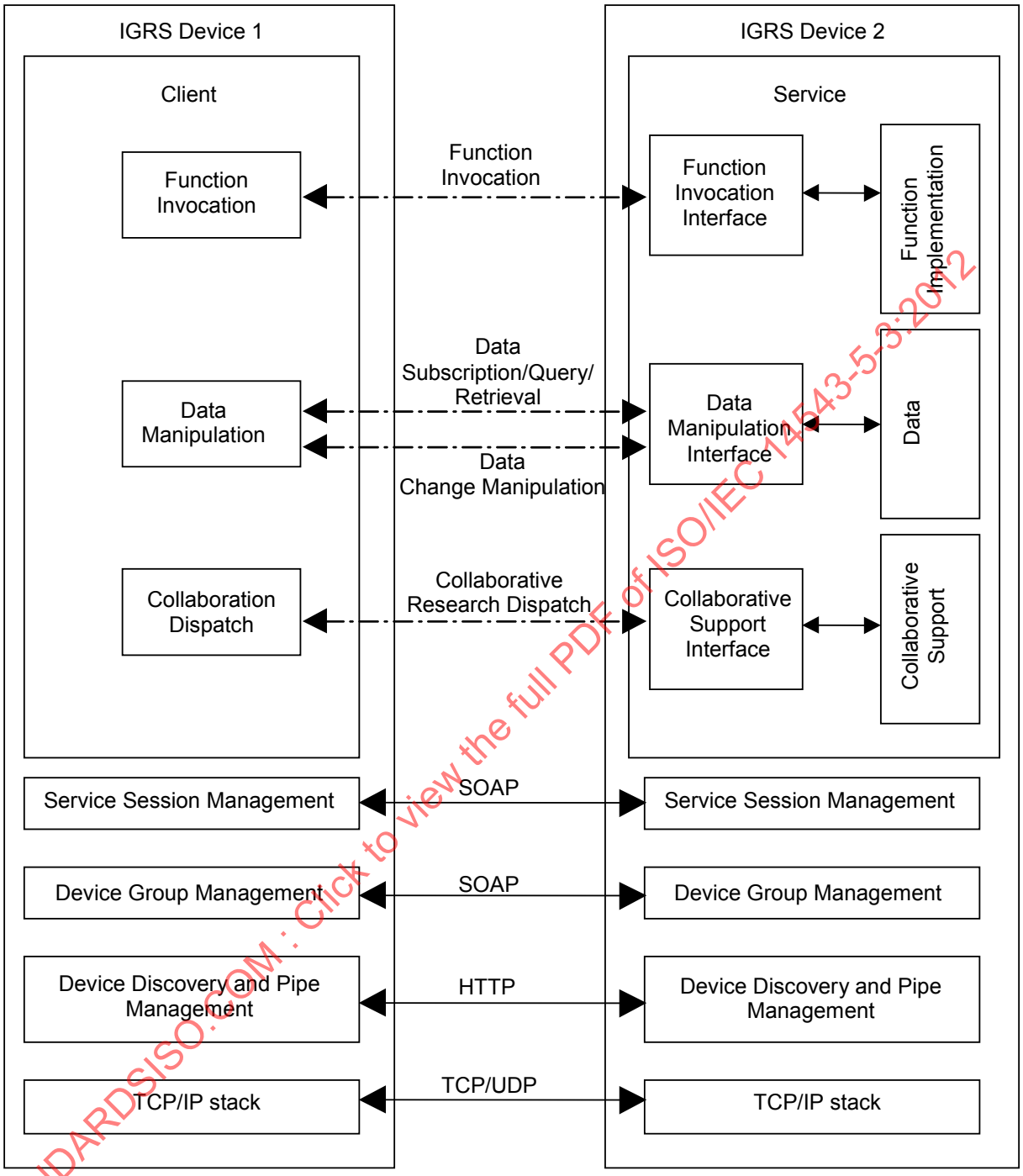

Figure 1 – IGRS application interaction model

5.2.6 Design principle

The following guidelines shall apply.

a) The application scenario shall be clearly described. Through a description of application scenarios, the users shall obtain valuable user experience information and learn about reusable operational procedures.

b) Description of specific functions shall be accurate. By describing specific functions, users shall know which IGRS device is used and what IGRS services and corresponding interfaces have been invoked.

c) Basic service and device descriptions shall conform to the IGRS standard.

d) Description of the software profile shall give the users a clear blueprint of the basic application design.

e) Description of the hardware interface shall be specific so that users shall achieve a preliminary understanding about the hardware interface design requirements.

5.3 Explanation remarks

This standard presents a guideline for designing basic applications based on the IGRS protocol. Other basic applications will be added in updated versions.

6 Digital media forwarding, storage and playback system

6.1 Overview

With recent advances in computer and networking technologies, massive amounts of digital multimedia sources are emerging, such as large volumes of music in MP3 format, Internet broadcasts and multimedia AV streams that are transmitted over a home network. The introduction of digital technologies has enabled the multimedia sources to surpass the capabilities of traditional multimedia technologies for content display, quality and upgrade speed. Present home theaters based on traditional technology may not include features that users expect as a result of developments in the Information Age, so new products are needed to close the gap. Alternatively, new functionalities may be integrated into existing products to provide additional features possibly at a lower cost.

Even the biggest PC screen cannot deliver the same visual effect as a TV. In addition, the operation of a PC is still too complicated to be used in the living room compared with other common electronic applicances such as the TV. Meanwhile, there is another problem: various existing video-on-demand services and set-top-boxes can only implement a limited set of functions. For example, existing boxes may not allow the TV to receive digital broadcasting programs nor allow the user to request video programs via the Internet or log onto the Internet via TV. Desired user features may be commercialized by working around various restrictions posed by broadband operators and content providers.

Based on the state of the industry as described above, and the present technologies, any single PC or CE (consumer electronics) device cannot provide a complete solution for enabling household multimedia in the Digital Age. The digital media forwarding, storage and playback system of this standard offers a specific solution to meet this demand by integrating digitization and networking technologies into relevant TV and PC devices. It specifies a multimedia system based on a digital home network concept that carries out a plethora of multimedia functions in a home network setting. The entire system architecture design is simple, easy to operate, convenient, individualized and easy to implement.

This application combines existing CE, PC, embedded systems, multimedia compression, transmission technologies, as well as emerging Internet networking technologies. A PC specializes in networking, storage, computing and personalised customization capabilities, while a traditional home theater multimedia system is characterized by ease of operation as well as a superior visual and audio experience for the home. By combining these two features, one can establish a multimedia system platform suitable for the home. Specifically, by adding a digital multimedia adaptor, this application closely ties the traditional PC and multimedia devices together while taking advantage of the dedicated functions provided by each device. This combination enables and extends the current digital multimedia experience in the home in a seamless way that is easy to operate.

A digital media forwarding, storage and playback system is mainly used in a home scenario (see Figure 2). Among the devices in this scenario, the computer serves as the media server; the set-top-box or TV with an embedded digital media-forwarding module serves as the media client. The contents include videos, music and photos. This application enables auto-

discovery and connection with the computer, requiring no manual configuration. First, the user installs a set-top-box called an “IGRS TV STB.” The IGRS TV set-top-box or an IGRS TV module embedded in an IGRS TV can be used as a digital media adaptor to connect the computer and IGRS TV through a wired or wireless network. This combination enables the user to watch movies, listen to music and and view photos on the TV seamlessly with only a few button clicks. The specific functions include media player and media recording, etc. After the IGRS TV set-top-box discovers an IGRS computer, they exchange service messages automatically in order to set up connections. The IGRS set-top-box or IGRS TV module embedded in an IGRS TV shall support format transcoding to enable interoperability. Meanwhile, this system can also compress TV programs captured by the modulator of a digital multimedia recorder device into media streams to be transmitted and stored in a digital multimedia server via a home network.

The consumer can easily use the TV to browse, select and play media contents stored in the computer via a TV remote control. The computer streams stored-media content through a set-top-box to play on an IGRS TV. The user can perform stop, pause, fast forward, rewind, volume operations, etc. while playing the contents. Moreover, the user can listen to music simultaneously while viewing pictures just downloaded. This basic application is supported by mature implementations of IGRS devices including HDTVs and wireless TVs.

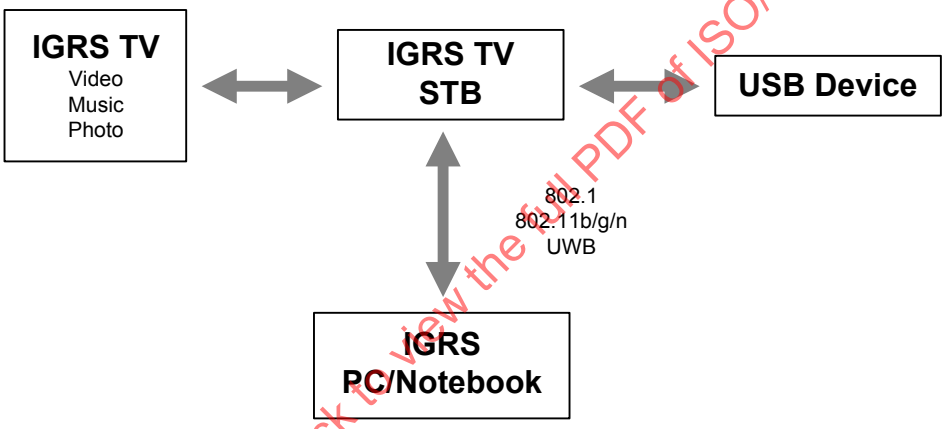

Figure 2 – IGRS TV application scenario

6.2 Media interaction flow selection

The devices in this basic application model are composed of an IGRS Dynamic Service Invocation Module (IGRSDSIM), Media Server and Media Client. When the IGRSDSIM discovers the media service in the MS and MC, it can control and coordinate the media transport and play by invoking the services in the MS and MC. The IGRSDSIM does not participate in the transport of the media stream directly. The MS provides the media content and implements the Content Index Service (CIS), Connection Management Service (CMS) (refer to ISO/IEC 29341-3-1:2008) and Media Server Transport Management Service (MSTMS) (refer to ISO/IEC 29341-3-1:2008). The MC is responsible for media play and implements the Connection Management Service, Rendering Management Service (RMS) and optional Media Client Transport Management Service (MCTMS). These services provide invocation interfaces to the IGRSDSIM so that it can control the MS and MC and thus complete the media transport and play between the MS and MC.

The interaction model of IGRS Basic profile is shown in Figure 3.

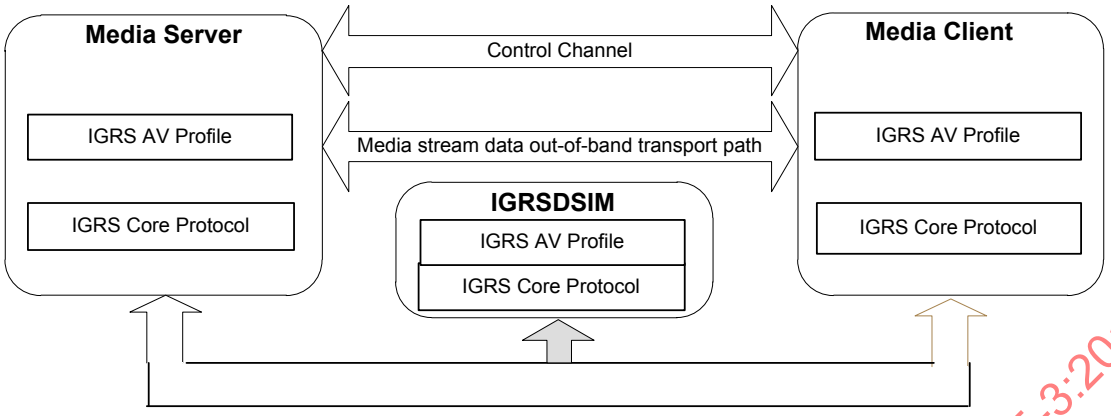

Figure 3 – Media interaction model

Media Interaction has two models, the independent device model specified in ISO/IEC 29341-3-1 and the two box model specified in this standard. In the independent device model, the MS, IGRSDSIM and MC are three independent devices. The transport mode includes a media-server initiated transport mode and a media-client initiated transport mode. In the media-client initiated transport mode, the media interaction and transport are initiated and managed by an MC. In the media-server initiated transport mode, the media interaction and transport is initiated and managed by an MS. In the two box model, the MS and MC are two independent devices with IGRSDSIM functionality residing in either device. It supports two transport methods: one is based on BCM and the other is based on SOAP. The two box model shall be implemented, while the independent device model is optional.

6.3 Specific description of digital media forwarding, storage and playback system

To realize an interactive application among multimedia clients and multimedia servers in a multimedia application system on an IGRS home network, the following required or optional protocols, functions and formats shall be implemented as follows.

a) Protocol conformance: determines the IGRS protocol conformance, see Table 1;

b) Function description: describes mandatory and optional functions and their service interface, see Table 2;

c) Media format supported: see Table 3.

Table 1 – Protocol conformance

Name	Mandatory or optional	Field explanation
Conformance to IGRS Core Protocol	Mandatory	The required clauses in ISO/IEC 14543-5-1 shall be fully supported.
Conformance to IGRS AV Profile	Mandatory	The required clauses in ISO/IEC 14543-5-21 shall be fully supported.
Conformance to IGRS File Profile	Mandatory	The required clauses in ISO/IEC 14543-5-22 shall be fully supported.

Table 2 – Function description

Name	Mandatory or optional	Device type	Field explanation
Network and connection	Mandatory	IGRSDSIM, MS, MC	– All required network interfaces as listed in 6.6.1 shall be met. – Support multiple network adaptors. When both wireless and wired network adaptors are available, it shall first determine which network is accessible. If both networks are accessible, it shall use wired network first. – Support multiple IP addresses.
Minimum set of service invocation interfaces that are supported by media server	Mandatory	IGRSDSIM, MS	Shall meet the set of mandatory interfaces defined in 8.3 of ISO/IEC 14543-5-6.
Minimum set of service invocation interfaces that are supported by media player	Mandatory	MC	Shall follow the set of mandatory interfaces defined in 8.4 of ISO/IEC 14543-5-6.
Service connection function	Mandatory	IGRSDSIM, MS, MC	Connection function shall be achieved through Connection Management Service defined in 8.2 of ISO/IEC 14543-5-6. Shall support auto-discovery, auto-connection with computer, requiring no manual configuration.
Directory management of audio, video and photo	Optional	IGRSDSIM, MS, MC	Directory management is performed through invoking content index service of media server defined in 8.1 of ISO/IEC 14543-5-6. The major management functions are: – Search; – Update directory content; – Retrieve relevant information.
Media transport	Optional	IGRSDSIM, MS, MC	– Support video transport from computer – Support photo transport from computer – Support music transport from computer – Support transmission and receiving of TS stream – Support media transport from USB disk and harddisk connected through USB interface – Support transport of media files in storage card.
Media play: audio play management	Optional	IGRSDSIM, MS, MC	The major management functions are the following. (1) play (2) stop (3) pause (4) fast forward (5) rewind (6) progress indicator, time, etc. (7) volume control

Name	Mandatory or optional	Device type	Field explanation
Media play: video play management	Optional	IGRSDSIM, MS, MC	– Support media play from USB disk and harddisk connected through USB interface – Support play of media files in the storage card – Support play of media files in the computer – Support play of photos and videos in the digital camera – The major management functions are the following. (1) play (2) stop (3) pause (4) fast forward (5) rewind (6) progress indicator, time, etc. (7) volume control (8) wide-screen display support
Media play: photo play management	Optional	IGRSDSIM, MS, MC	– Support media play from USB disk and harddisk connected through USB interface – Support play of media files in the storage card – Support play of media files in the computer – Support play of photos in the digital camera – The major management funcions are the following. (1) play (2) stop (3) pause (4) fast forward (5) rewind (6) progress indicator, time, etc. (7) volume control (8) enlarge and reduce photo size.
Media recording	Optional	IGRSDSIM, MS, MC	Support recording of TV programs
Media format support: media format transcoding	Optional		Digital CE devices support many types of media format with different data rate, resolution and frame rate. Therefore, the format transcoding problem shall be solved to enable other devices in the network to use the same content.

Table 3 – Media format supported

Mandatory Media format support	Video: MPEG1/2 (ISO/IEC 13818-11:2004) Audio: MP3 (ISO/IEC 23000-2:2008) Photo: JPEG (ISO/IEC 15444-4:2004)
Optional Media format support	Video: MPEG4 (ISO/IEC 14496-1:2004, ISO/IEC 14496-2:2004, ISO/IEC 14496-3:2009, ISO/IEC 14496-4:2004), H.264 (ITU H.264), VC-1(WMV), ASF, RM/RMVB, Divx/Xvid, VOB Audio: WMA, WAV, OGG, PCM, AC3, DTS, AAC (ISO/IEC 13818-7:2006) Photo: BMP, GIF, PNG (ISO/IEC 15948: 2003), TIF

6.4 Software profile of digital media forwarding, storage and playback system

The four general design goals of the software profile for digital media forwarding, storage and playback system are

- support a wide variety of content formats,
- support interoperability with other network equipment,
- support plug-and-play configuration,
- easy to use.

The objective is to achieve a balance among the four goals because the usage scenarios and configurations are much more complex if more functions and formats are to be supported.

As shown in Figure 4, the software profile of a digital media forwarding, storage and playback system includes a service side and client side. The basic application of a digital media forwarding, storage and playback system consists of a home media server, digital media adaptor and multiple home media client devices. Every home media client is connected to the home media server through the digital media adaptor. A centralized home media server registers and manages all instances of home media client connections as well as any multimedia signal transport. In this system, the home media server, the core of the entire multimedia system, can be a household PC or a specialized server with a specialized service management module. The digital media adaptor serves two roles in this system. On the one hand, the digital media adaptor extends the current functionalities of the existing home media client by receiving the digital media data stored in or forwarded by the PC and converting it to analog data to be rendered. On the other hand, the same digital media adaptor sends the remote control instructions of the user back to the PC to control the media play selection. In the digital forwarding, storage and playback system, the digital media adaptor can be built into the media server or may be a separate entity. As shown in Figure 4, both the digital media adaptor and media server belong to the server side.

The lower physical client can support IEEE 802.11a/b/g/n, IEEE 802.3, UWB, etc. The transport layer uses UDP or TCP/IP or other non-IP transport protocol, etc. The specific network interface requirements shall be found in 6.6.1.

Above the network layer, this application uses the IGRS core protocol (specified in ISO/IEC 14543-5-1) to enable intelligent discovery and resource sharing among IGRS devices. The core protocol defines a device discovery mechanism, device pipe setup mechanism, service discovery mechanism, device group management mechanism, session management and service access mechanisms. The device discovery mechanism defines the process by which an IGRS Device advertises itself and discovers other device information on the network. The Device Pipe setup mechanism defines the process by which two devices that have discovered each other establish a reliable connection pipe. The device group management mechanism defines the rules by which multiple devices form a specific device group on the basis of the connection pipe. The service discovery mechanism defines the process by which one device discovers the service information announced by other devices in the same device group. The session mechanism defines the process of session setup and management for supporting client and service access. The service access mechanism specified in ISO/IEC 14543-5-1 defines the rules and shall be followed in order to complete service invocation between the IGRS Clients and the IGRS Services.

Above the IGRS core protocol, there are various IGRS application profiles, such as AV profile (see ISO/IEC 14543-5-21), etc.

The IGRS AV profile defines an interaction model between IGRS AV devices and relevant applications. The IGRS AV profile allows the devices to support entertainment content using any transport protocols in any formats.

The IGRS AV profile is composed of an IGRSDSIM, MediaServer and MediaClient. When the IGRSDSIM discovers the media service in the MS and MC, it can control and coordinate the media transport and play by invoking the services in the MS and MC. The IGRSDSIM does not participate in the transport of media stream directly. The MS provides the media content and implements the Content Index Service, Connection Management Service and Media Server Transport Management Service. The MC is responsible for media play and implements the

Connection Management Service, Rendering Management Service and optional Media Client Transport Management Service. These services provide invocation interfaces to the IGRSDSIM so that the IGRSDSIM can control the MS and MC and complete the media transport and play between the MS and MC. This particular basic application relies on the AV profile requirements to set up corresponding AV devices such as IGRSDSIM, MS, MC as well as AV services.

By implementing a transcoding mechanism, the server side can support many kinds of media formats. The IGRSDSIM invokes the CIS:ConvertMediaFormat() of the CIS (refer to 3.2 for definitions) on the MS to ask if the media content format can be transcoded. The CIS on the MS determines whether it can transcode the media format returns the response to the IGRSDSIM.

Both the server and client side can ensure the quality of media service by applying a QoS (Quality of Service) control system. The server side can manage multimedia files through the file management system and the client side can request multimedia service by invoking service on the server side and playing content through an AV player. Both the server and client side shall provide the corresponding user interface for the user.

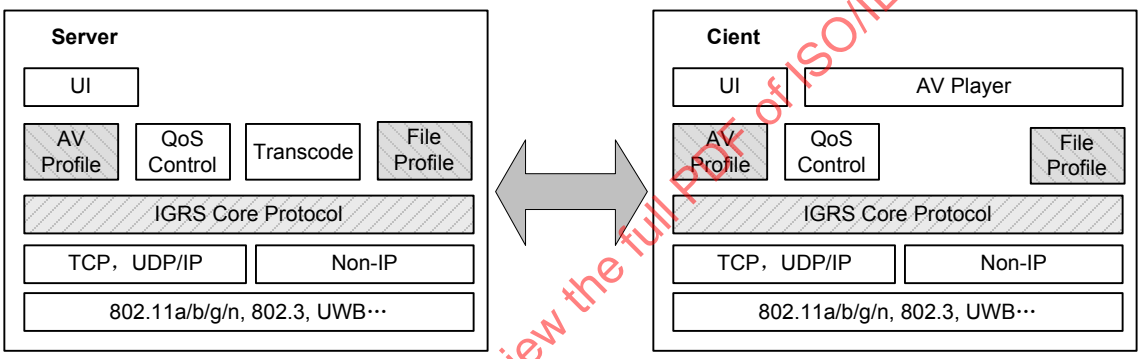

Figure 4 – Software profile of digital media forwarding, storage and playback system

6.5 Software interfaces

For future extensions and implementations of the application, it is recommended that all developers adopt a unified application program interface for the digital media forwarding, storage and playback system. This will ensure that applications developed by different manufacturers interoperate on a unified software platform and are independent of the hardware platform.

Meanwhile the software interface of media interaction services shall meet ISO/IEC 14543-5-6.

6.6 Hardware interfaces

6.6.1 Network interfaces

The physical client shall support the ininterfaces specified in Table 4.

Table 4 – Network interfaces

Name	Mandatory or optional	Field explanation
Ethernet interface	Mandatory	Digital media forwarding, storage and playback system shall provide one to four full duplex self-adapting Ethernet interfaces at 10/100 Mbit/s. Ethernet interfaces shall meet ISO/IEC 8802-3:2000-12 and support self-adapting network connection capability.
Wireless network interface	Optional	This interface can support the following: IEEE 802.11b/g (Wi-Fi) IEEE 802.11a (Wi-Fi in the 5-GHz band) IEEE 802.11n (WiFi with multiple-input and multiple-output antennas) IEEE 802.15.3 (Ultra wideband)
Other network connection	Optional	Other network connections can be extended through the following: PLC – Power Line Communication XDSL of ITU G serial IEEE 802.15.1/Bluetooth IEEE 802.16 (WiMAX)
USB	Optional	More network connections can be extended through the USB specification: (Universal Serial Bus Specification Revision 2.0)

6.6.2 Media Client interface

The media client shall support the interfaces listed in Table 5.

Table 5 – Media Client interfaces

Name	Mandatory or optional	Field explanation
CVBS	Mandatory	Composite video broadcast signal
Analog double-track audio	Mandatory	Stereo audio
S-Video	Optional	Separate video
YPbPr	Optional	Converted from the RGB video signal, which is split into three components, Y, PB and PR
VGA	Optional	Video graphics array
DVI	Optional	Digital video interface
HDMI	Optional	High definition media interface
Digital audio output interface	Optional	Optical fiber or coaxial cable