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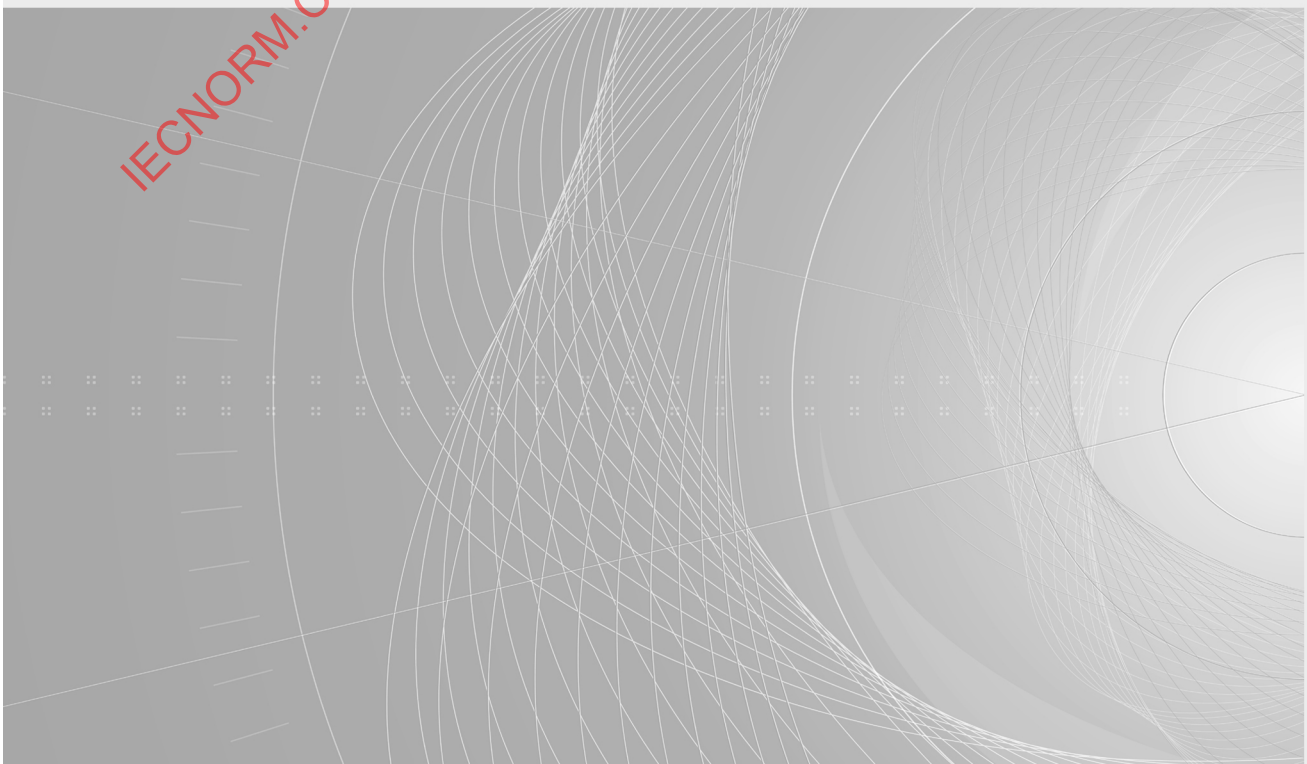
Edition 1.0 2015-04

INTERNATIONAL STANDARD

Information technology – Home electronic system (HES) architecture – Part 5-7: Intelligent grouping and resource sharing for HES Class 2 and Class 3 – Remote access system architecture



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CONTENTS

INFORMATION TECHNOLOGY – HOME ELECTRONIC SYSTEM (HES) ARCHITECTURE –

Part 5-7: Intelligent grouping and resource sharing for HES Class 2 and Class 3 – Remote access system architecture

FOREWORD

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International Standard ISO/IEC 14543-5-7 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 website and ISO website.

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

The ISO/IEC 14543-5 series of standards specifies the services and protocol of the application layer for Intelligent Grouping and Resource Sharing (IGRS) devices and services in the Home Electronic System.

The ISO/IEC 14543-5 series includes 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-exchange 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 transports within a home.
- **IGRS Parts 5-21 and 5-22: Application profiles**
  - Based on the IGRS core protocol.
  - Specify device and service interaction mechanisms, 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
- **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**
  - Defines 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.
- **IGRS Part 5-7: Remote access system architecture**
  - Specifies the architecture and framework for the remote access of IGRS devices and services in the Home Electronic System. The remote access communications protocol and application profiles are specified in following parts of this series:
    - ISO/IEC 14543-5-8: Remote access core protocol
    - ISO/IEC 14543-5-9: Remote access service platform
    - ISO/IEC 14543-5-101: Remote AV access profile
    - ISO/IEC 14543-5-102: Remote universal management profile

  - ISO/IEC 14543-5-11: Remote user interface
  - ISO/IEC 14543-5-12: Remote access test and verification
- The relationships between these parts are specified in this part.

➢ **IGRS Part 5-8: Remote access core protocol** (under consideration)

- Provides detailed system constructions, system function modules, basic conceptions 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.

➢ **IGRS Part 5-9: Remote access service platform** (under consideration)

- Specifies the IGRS RA service platform architectures and interfaces among servers in service platforms.
- Based on the IGRS Part 5-8: Remote access core protocol.

➢ **IGRS Part 5-101 and 5-102: Remote access application profiles** (under consideration)

- Define a device and service interaction mechanism for various applications
- Based on the IGRS Part 5-8: Remote access core protocol
- Two profiles are under development:
  - Part 5-101: Remote AV access profile. This part defines the common requirements for IGRS RA AV users/devices in IGRS networks.
  - Part 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 management frameworks.
- Additional application profiles will be specified in the future.

➢ **IGRS Part 5-11: Remote user interface** (under consideration)

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

➢ **IGRS Part 5-12: Remote access test and verification** (under consideration)

- Defines a standard method to test and verify IGRS-RA compliant devices and service interfaces.

INFORMATION TECHNOLOGY – HOME ELECTRONIC SYSTEM (HES) ARCHITECTURE –

Part 5-7: Intelligent grouping and resource sharing for HES Class 2 and Class 3 – Remote access system architecture

1 Scope

This part of ISO/IEC 14543 specifies the architecture and framework for the remote access of IGRS devices and services in the home electronic system. The remote access communications protocol and application profiles are specified in other parts of this series. The relationship among these parts are specified in this standard.

This standard is applicable to the remote access of an IGRS sub-network (called an IGRS subnet) for resource sharing and service collaboration among home and/or remote computers, consumer electronics and communication devices.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 18028-4, *Information technology – Security techniques – IT network security – Part 4: Securing remote access*

ISO/IEC 24767-1, *Information technology – Home network security – Part 1: Security requirements*

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 AS
basic service unit composed of one or multiple IGRS servers

Note 1 to entry: Each IGRS AS (Autonomous System) provides services for a dedicated user/device group and constructs an IGRS RA domain. Different IGRS ASs exchange messages with each other according to the IGRS service platform protocol.

3.1.2
IGRS LAN device
device that conforms to ISO/IEC 14543-5-1 through ISO/IEC 14543-5-6

Note 1 to entry: An IGRS LAN device can join an IGRS remote access (RA) network with the assistance of an IGRS RA agent.

3.1.3
IGRS RA user
user of the IGRS RA devices and application services

Note 1 to entry: Generally, an IGRS RA user is a human being. Each IGRS RA user has a unique user ID (identification). A bundle relationship can be established between one IGRS RA user and another. A binding relationship can be established between one IGRS RA user and one IGRS device.

3.1.4
IGRS RA device
device that is controlled by the IGRS RA user in the IGRS RA system

Note 1 to entry: Each IGRS RA device has a unique device ID (identification). A binding relationship can be established between an IGRS RA device and an IGRS RA user.

3.1.5
IGRS RA agent
functional entity that can provide an IGRS RA service to IGRS LAN devices

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

3.1.6
IGRS RA server
instantiation of a service provider that can be assembled into an IGRS RA AS

Note 1 to entry: An IGRS RA server is deployed on the Internet. It maintains relationships among the IGRS RA user and IGRS devices. It also provides retransmissions of collaborative messages. The IGRS RA user/device can start a data connection to the IGRS RA service platform and supports interconnection using the data connection and retransmission functions of the IGRS RA service platform. An IGRS RA AS consists of one or multiple IGRS RA servers.

3.1.7
IGRS RA service platform
collection of IGRS RA service providers that consist of one or multiple IGRS RA AS

Note 1 to entry: Each IGRS RA AS provides services in its own domain and exchanges information with other IGRS RA ASs to provide resource sharing and collaborative services between different domains.

3.1.8
IGRS RA universal management
mechanism for the universal management of all IGRS home appliances and devices

Note 1 to entry: An IGRS RA can manage not only smart devices that have relatively high computation capacities with IP addresses but also non-smart devices that have relatively low computation capacities without IP addresses.

3.2 Abbreviations

AS Autonomous System
AV Audio and Video
CPU Central Processing Unit
ID IDentification
IGRS Intelligent Grouping and Resource Sharing
IMT International Mobile Telecommunication
IP Internet Protocol
LAN Local Area Network
NAT Network Address Translation
PC Personal Computer
RA Remote Access

RUI	Remote User Interface
SMS	Short Message Service
TCP	Transmission Control Protocol
TV	Television
WAN	Wide Area Network

4 Conformance

An IGRS RA system conforming to this standard shall be designed according the architecture specified in Clause 5, the framework specified in Clause 6 and the security guideline specified in Clause 7.

5 IGRS remote access (RA) system architecture

5.1 IGRS RA functionality overview

The IGRS RA specifies a remote network environment that enables an IGRS user/device located outside of the home LAN coverage to connect to an IGRS RA service platform via the Internet or other IP network (such as cable, wireless or mobile network). All IGRS RA specifications are backward compatible with ISO/IEC 14543-5-1 through ISO/IEC 14543-5-6. The IGRS RA protocols extend the functionality of these parts.

According to IGRS RA standards, IGRS RA user/device and IGRS LAN devices can group intelligently, share resource with each other conveniently and interoperate with each other collaboratively.

The IGRS RA series specify:

a) the concepts of “IGRS RA user”, “IGRS RA device” and “IGRS RA service platform”;

b) descriptions of interconnectivity and interoperation relationships of “User-Device”, “Device-Device” and “User-User”;

c) interfaces between IGRS RA user/device and service platforms;

d) IGRS RA user/device online status query, description, control and notification mechanisms;

e) binding process between IGRS RA user and device in different subnets;

f) mechanisms for multiple message-exchange modes between IGRS RA clients, such as point-to-point, point-to-multiple point, instantaneous transmission, offline storage, etc. These messages may be transmitted through NAT (network address translation) devices so that IGRS RA clients can discover and share resources within the subnet of each device;

g) uniformed IGRS application layer primitives so that different applications of different providers may interconnect and interact with each other. Additionally, extended application message interfaces are offered to application providers to allow for self-defined interaction messages using an IGRS RA protocol stack.

In the IGRS RA system, TCP/IP persistent connections are established and maintained between the IGRS RA server and terminals. This enables the IGRS RA server to address and to push messages to an online IGRS RA terminal, even if the terminal is behind a NAT device.

NOTE Detailed differences between IGRS RA NAT traversal and other NAT traversal mechanisms, such as ISO/IEC 29341-8 (UPnP Internet gateway device control protocol) and IETF RFC 4918 (WebDAV) will be described in ISO/IEC 14543-5-8 (under consideration).

5.2 IGRS RA system structure

A system diagram of IGRS RA is shown in Figure 1.

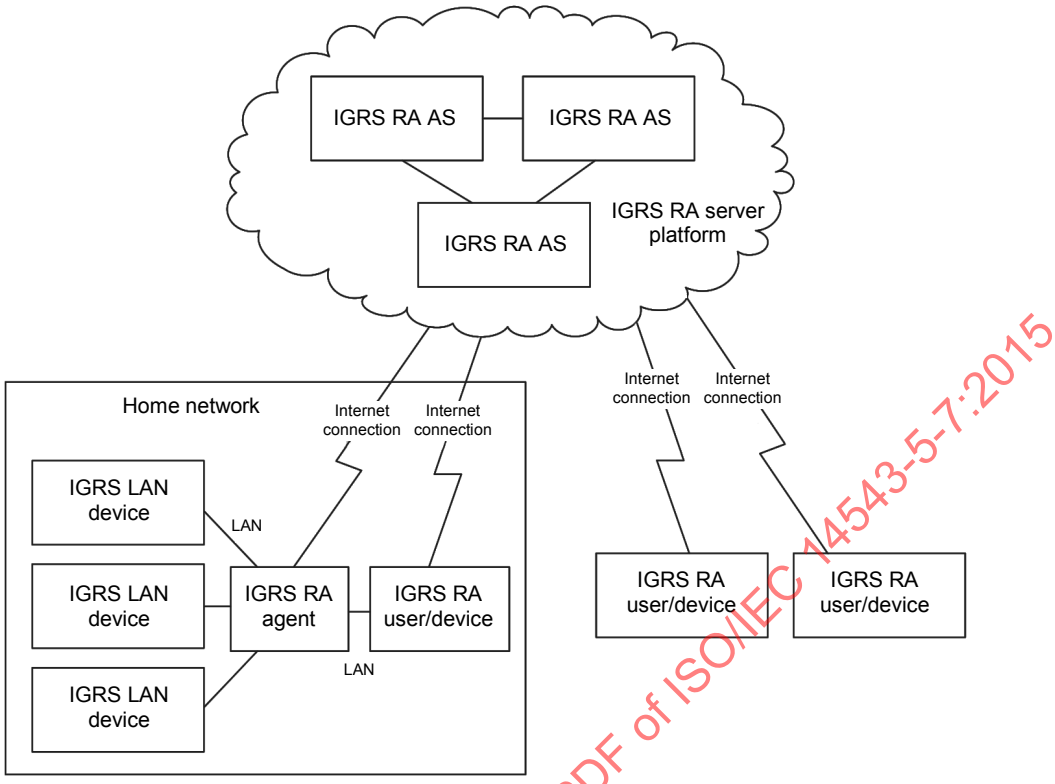

Figure 1 – IGRS RA system structure

In Figure 1, an IGRS RA system consists of an IGRS RA user/device, IGRS RA server platform, IGRS LAN device and IGRS RA agent (which is used for establishing a connection between IGRS RA user/device and IGRS LAN devices). All IGRS LAN devices and IGRS RA devices within a subnet shall use published IGRS protocols (such as ISO/IEC 14543-5-1, ISO/IEC 14543-5-21, ISO/IEC 14543-5-22, ISO/IEC 14543-5-3, ISO/IEC 14543-5-4, ISO/IEC 14543-5-5, and ISO/IEC 14543-5-6) to interconnect with each other and to establish a home IGRS subnet. That is, IGRS RA protocols are backward compatible to the published IGRS protocols.

When any IGRS RA device enters an IGRS home subnet, it operates as an IGRS LAN device. This IGRS RA device cannot only connect to other IGRS LAN devices by using the IGRS protocols, but can also access an IGRS RA service platform through a connection to an IGRS RA agent. In addition, if the IGRS RA user/device in the home LAN area can access the Internet directly, it may build a connection to the IGRS RA service platform and access the IGRS RA services without any intermediary agent.

An IGRS RA agent may be an independent device or an IGRS RA device embedded with an agent function. An IGRS RA agent shall maintain active Internet connections and can access an IGRS RA service platform by those Internet connections. Through the IGRS RA agent, IGRS LAN devices without IGRS RA functions can both access the IGRS RA service platform and be accessed by other IGRS RA users/devices.

The IGRS RA user/device can maintain a persistent connection to the IGRS RA service platform if it establishes an Internet access connection after leaving the home LAN environment.

An IGRS RA user/device shall register itself with a unique ID in the IGRS RA service platform. A “binding” relationship shall be maintained between the IGRS RA user and his/her devices.

By establishing this relationship, the user can be informed by the service platform as soon as a device executes a login/logout using the assigned ID.

Through the connection to the IGRS RA service platform, control messages can be sent from the user to the device. The user can operate his/her devices (such as playing a song) remotely by sending control messages. At the same time, the device can send event notifications to the user or other devices that subscribed to the event previously. The notification could be triggered either by an event (such as playing ended) or state changing (such as current play position).

An IGRS RA service platform is comprised of a number of autonomous systems. Each autonomous system is a collection of servers that contain independent IGRS RA services. After the IGRS RA clients log into an autonomous system, they shall announce their presence and information about other RA clients from this autonomous system. An IGRS user can also send/receive control and notification messages through the autonomous system. Furthermore, different autonomous systems may interoperate with each other to share user information and device configurations by exchanging messages.

6 IGRS RA specification framework

6.1 IGRS RA specification framework overview

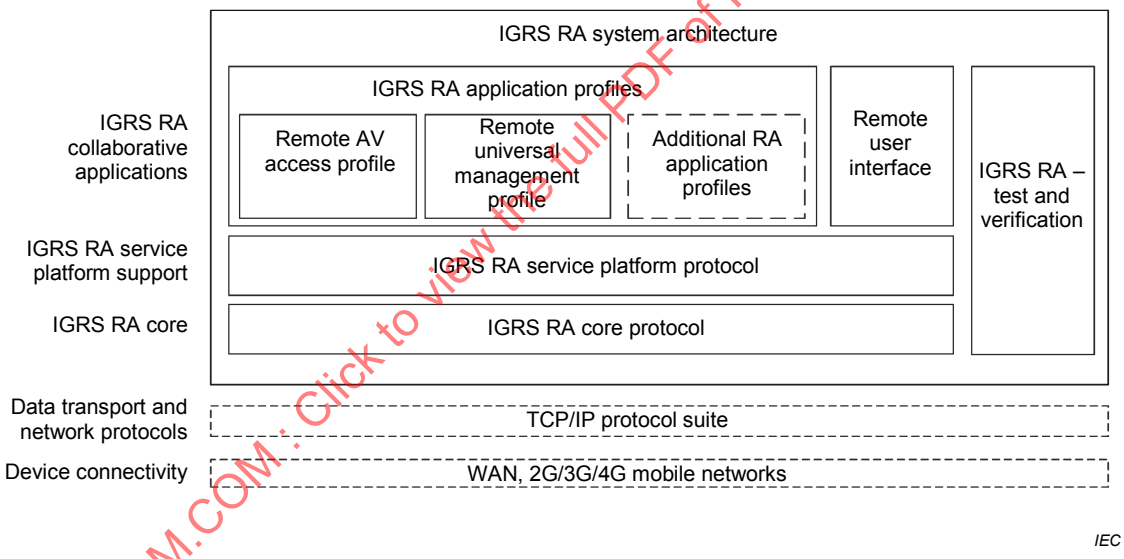

Figure 2 – IGRS RA specification architecture

The IGRS RA specification architecture is shown in Figure 2. Physical connections, network transport protocols and messaging mechanisms are out of scope of the IGRS RA protocol clusters. These parts are based on widely adopted, mature and open industry technologies. For physical network connections, ISO/IEC/IEEE 8802-3 (Ethernet), ISO/IEC/IEEE 8802-11 (Wi-Fi), and ITU-R M.1457 and ITU-R M.2012 (mobile networks) are supported. For a network transport protocol, the IGRS RA is based on IETF RFC 793 (the TCP/IP protocol suite).

Five parts are included in the IGRS RA specification architecture, consisting of the IGRS RA core protocol, IGRS RA service platform protocol, IGRS RA application profiles, IGRS remote user interface and IGRS RA test and verification.

6.2 IGRS RA core protocol

The IGRS RA core protocol is an extension of the IGRS core protocol (ISO 14543-5-1). In this protocol

a) IGRS user/device remote-access core mechanisms are specified,

b) a concept of “IGRS RA user” is defined, and

c) new descriptions and definitions of “user/device” are given as expansions to the original definition of the “IGRS device” in order to manage the IGRS LAN devices in the Internet domain.

The IGRS RA core protocol is based on an “IGRS RA user” and “IGRS device group,” user/device discovery and online status management mechanisms, user/device remote access message format and message exchange flow, and remote access data/service distribution and sharing mechanism. Additionally, detailed definition and management mechanisms for IGRS RA user/device relationships are specified to regulate multiple different affiliations between users and devices.

All of these mechanisms shall provide the basis of an IGRS RA system. The IGRS RA service platform and IGRS RA application profiles are established based on the IGRS RA core protocol.

6.3 IGRS RA service platform protocol

The IGRS RA service platform protocol specifies basic functionalities, module structures and interface specifications of the IGRS RA service platform. It specifies collaborative service flows and message formats in a homogeneous network environment and interoperation modes in a heterogeneous network environment.

The structure of a IGRS RA service platform is given in Figure 3.

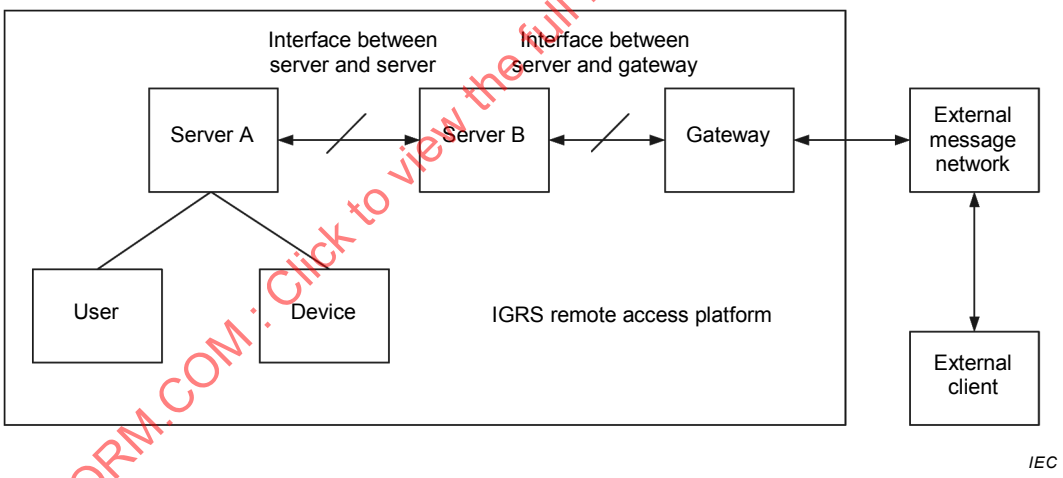

Figure 3 – Structure of IGRS RA service platform

Two collaborative services are supported by the IGRS RA service platform and interfaces:

- Collaborative service in homogeneous network environment

  Collaborative services provide load balancing among multiple servers of the same functionality or collaborative service among multiple servers of different functionalities, and facilitate different service providers to manage and control their services.

  All servers in the IGRS RA service platform should be interconnected. The IGRS RA service platform protocol provides application layer unified primitives and a series of message exchange flows between servers, including verification of authorisation messages, submission of control messages, relaying of status messages, etc. Additionally, message formats are also specified. Seamless service can be provided to the IGRS RA user/device by following the same message formats and message exchange flows as defined by the IGRS RA service platform.

- Interoperation collaborative service in heterogeneous network environment

  An IGRS RA application server may receive control commands from other network environments and return corresponding execution results. For example, a control command can be sent to IGRS devices by mobile SMS, or by voice mail. The IGRS RA service platform protocol specifies a series of translation services (incorporated into a gateway as specified in ISO/IEC 15045-1 and ISO/IEC 15045-2) that receive and parse these external commands. For example, when the gateway receives an SMS command, it translates the command into a message that can be recognised by the IGRS RA system and then transmits the translated command to the corresponding server. By the same principle, when the command is executed, the execution results are transmitted back to the external network via SMS after translation by the gateway.

6.4 IGRS RA application profiles

6.4.1 Overview

IGRS RA application profiles are a series of application interaction rules defined for the end applications based on the IGRS RA core protocol. IGRS RA application profiles are based on the IGRS RA core protocol and the IGRS RA service platform protocol. For example, the user can remotely push a video onto a home TV from his/her office. IGRS RA application profiles arrange the sequence of control messages between the user and the device. These profiles specify dedicated function modules, service modules and message exchange flows and interfaces between applications and core protocols. Different applications from different developers can interoperate with each other by unified operational primitives. Additionally, extension interfaces of applications are provided to realise self-defined application message exchanges.

IGRS RA application profiles include (but are not limited to) the following parts.

6.4.2 Remote AV access profile

The remote AV access profile defines the common interaction rules that the IGRS RA AV users/devices shall follow when used in IGRS networks. By following the remote AV access profile, the remote user/device can discover home devices, share resources and remote control AV playing. Possible application scenarios include:

a) users can use remote IGRS devices to discover other home IGRS devices (i.e. TV, media player, set-up-box, etc.) and the AV contents currently stored or played on these devices. Users can control the invocation of the AV contents (i.e. play/stop/pause/continue/replay, etc.) or manage the AV contents (i.e. delete/rename/copy/cut/move, etc.) remotely;

b) users can also use home IGRS devices to discover remote IGRS devices (i.e. mobile phone, tablet, remote TV, remote media player, remote set-up-box, etc.) and AV contents saved or played on these devices. Users can control the invocation of the AV contents (i.e. play/stop/pause/continue/replay, etc.) or manage the AV contents (i.e. delete/rename/copy/cut/move, etc.) remotely;

c) by using IGRS devices, users can explore AV contents through an IGRS RA service platform, and control the playing of the AV contents on IGRS LAN or RA devices (i.e. play/stop/pause/continue/replay, etc.) or manage the AV contents (i.e. delete/rename/copy/cut/move, etc.) remotely;

d) when the user plays AV contents in an IGRS network, he/she can pause the playing and save the current position of AV contents as a bookmark on the IGRS RA service platform, and then continue to play that previously viewed content on other IGRS devices in the network.

NOTE Content protection mechanism is an optional feature for the IGRS RA system architecture, and it is not specified here.

6.4.3 Remote universal management profile

The remote universal management profile regulates the remote management applications of all home appliances. This profile defines a mechanism for integrating and bridging both IP-

based home devices with relatively high processing capabilities (such as TV, PC, tablet, smart phone, set-top-box) and non-IP based home devices with relatively low processing capabilities into IGRS networks. A universal management gateway is proposed to manage the non-IP devices. A universal device description ID is assigned to each non-IP device. This profile further specifies the universal remote device discovery and management framework based on the universal management gateway and the universal device description ID. It defines device configuration interfaces, integrative management message formats and message exchange flows. It also defines connection methods and network structures of IGRS RA universal management applications.

Using this protocol, a non-IP device in the home can access an IGRS RA system as IP devices. By following the system structure, interfaces, message formats and message exchange flows of the IGRS RA universal management profile protocol, application layer solutions for integrated home device management can be developed.

6.4.4 Additional application profiles

Other IGRS remote access application profiles are being considered in this protocol. For example, a remote printing application profile specifies remote discovery of IGRS printer devices, remote printing work management (inserting/reordering/deletion/stopping printing work, etc.).

6.5 IGRS remote user interface (RUI) protocol

The IGRS RUI protocol specifies a set of adaptive user interface generation and display mechanisms to fit into different applications and devices. This subclause is optional.

In the case of remote access applications, IGRS devices and control points can remotely display user interface and control remote devices. However, device performances (screen size, display resolution, processor speed, memory size, mobility performance, etc.) may vary. If all devices do not share the similar user interface, the overall user experience may not be satisfactory. The IGRS RA RUI protocol specifies a standardised user interface description language and mechanism to generate and display a user interface adaptively according to various device settings. For example, when playing a video on a small screen device, the transcoding service will be executed to transcode the high-resolution video file to the low-resolution file. By changing to this method, network transmission bandwidth and device CPU processing power are conserved. Another example is adapting to different screen sizes and orientations (portrait and landscape) of a smart phone or a smart TV. The IGRS RA RUI protocol can generate and display different content layouts for a smart phone and a smart TV to optimise the user experience.

6.6 IGRS RA test and verification protocol

The IGRS RA test and verification protocol is an extension of the IGRS device verification (ISO/IEC 14543-5-4). In this standard, test and verification methods of the IGRS RA protocols, including IGRS RA core protocol, IGRS RA service platform protocol, IGRS RA application profiles and IGRS RUI protocol are provided (including the structure of a test and verification system, criteria for testing interfaces, message exchange contents and flows). Functional test, protocol conformance test and protocol interoperation test are also required.

7 Security

A security mechanism is important for remote access applications and the IGRS RA system. Existing mature security mechanisms shall be adopted in the IGRS RA system. The security mechanism of IGRS RA shall conform to ISO/IEC 18028-4. The IGRS RA shall satisfy the home network security requirements of ISO/IEC 24767-1.

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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 14543-5-3, *Information technology – Home electronic system (HES) architecture – Part 5-3: Intelligent grouping and resource sharing for HES Class 2 and Class 3 – Basic application*

ISO/IEC 14543-5-4, *Information technology – Home electronic system (HES) architecture – Part 5-4: Intelligent grouping and resource sharing for HES Class 2 and Class 3 – Device validation*

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

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*

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*[1]

ISO/IEC 14543-5-9, *Information technology – Home electronic system (HES) architecture – Intelligent grouping and resource sharing for HES Class 2 and Class 3 – Remote access service platform*[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 15045-1, *Information technology – Home electronic system (HES) gateway – Part 1: A residential gateway model for HES*

ISO/IEC 15045-2, *Information technology – Home electronic system (HES) gateway – Part 2: Modularity and protocol*

ISO/IEC 29341-8 (all parts), *Information technology – UPnP device architecture – Part 8: Internet gateway device control protocol*

ITU-R M.1457 (all parts), *Detailed specifications of the radio interfaces of International Mobile Telecommunications-2000 (IMT-2000)*

[1] Under consideration.