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ISO/IEC 29341-4-13

Edition 2.0 2011-09

INTERNATIONAL STANDARD



**Information technology – UPnP device architecture –
Part 4-13: Audio Video Device Control Protocol – Level 2 – Rendering Control
Service**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE



ICS 35.200

ISBN 978-2-88912-682-8

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INFORMATION TECHNOLOGY – UPNP DEVICE ARCHITECTURE –

Part 4-13: Audio Video Device Control Protocol – Level 2 – Rendering Control Service

FOREWORD

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International Standard ISO/IEC 29341-4-13 was prepared by UPnP Forum Steering committee¹, was adopted, under the fast track procedure, by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

This International Standard replaces ISO/IEC 29341-4-13, first edition, published in 2008, and constitutes a technical revision.

The list of all currently available parts of the ISO/IEC 29341 series, under the general title *Information technology – UPnP device 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.

¹ UPnP Forum Steering committee, UPnP Forum, 3855 SW 153rd Drive, Beaverton, Oregon 97006 USA. See also "Introduction".

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1 Overview and Scope

This service template is compliant with the UPnP Device Architecture version 1.0. It defines a service type referred to herein as RenderingControl.

1.1 Introduction

Most rendering devices contain a number of dynamically configurable attributes that affect how the current content is rendered. For example, video rendering devices, such as TVs, allow user control of display characteristics such as brightness and contrast, whereas audio rendering devices allow control of audio characteristics such as volume, balance, equalizer settings, etc. The RenderingControl service is intended to provide control points with the ability to query and/or adjust any rendering attribute that the device supports.

The RenderingControl service enables a control point to:

- Discover the set of attributes supported by the device.
- Retrieve the current setting of any supported attribute
- Change the setting of (that is: control) any modifiable attribute
- Restore the settings defined by a named Preset

The RenderingControl service DOES NOT:

- Control the flow of the associated content (for example, Play, Stop, Pause, Seek, etc.).
- Provide a mechanism to enumerate locally stored content.
- Provide a mechanism to select the content that is to be rendered.
- Provide a mechanism to send content to another device (via the home network or direct connection).

1.2 Multi-input Devices

Some high-end AV device are capable of receiving multiple pieces of content at the same time and combining that content together so that it can be rendered together using a single set of output hardware. For example, while displaying a TV program, high-end TVs can also display additional content (for example, VCR content) in a PIP (Picture-In-Picture) window. Similarly, a Karaoke machine can mix together the background music with a singer's voice so that both sounds are played together on the same set of speakers.

As with all devices, the RenderingControl service allows a control point to adjust the output characteristics of the post-mixed content before it is actually rendered. However, in many cases, control points may need to control the output characteristics of the individual input content before it is mixed together with the other input content. In order to support this, the RenderingControl service includes an *InstanceID* argument with each action that allows the control point to identify on which content the action is to be applied (for example, the post-mixed content or one of the pre-mixed input content items).

By convention, an *InstanceID* of 0 indicates that the invoked action MUST be applied to the post-mixed content. Similarly, each pre-mixed input content is assigned a unique *InstanceID* whose value is a non-zero, positive integer. Refer to Clause 2.5, "Theory of Operation" for additional information.

1.7 References

This clause lists the normative references used in the UPnP AV specifications and includes the tag inside square brackets that is used for each such reference:

[AVARCH] – *AVArchitecture:1*, UPnP Forum, September 30, 2008. Available at: <http://www.upnp.org/specs/av/UPnP-av-AVArchitecture-v1-20080930.pdf>. Latest version available at: <http://www.upnp.org/specs/av/UPnP-av-AVArchitecture-v1.pdf>.

[AVDT] – *AV DataStructure Template:1*, UPnP Forum, September 30, 2008. Available at: <http://www.upnp.org/specs/av/UPnP-av-AVDataStructure-v1-20080930.pdf>. Latest version available at: <http://www.upnp.org/specs/av/UPnP-av-AVDataStructure-v1.pdf>.

[AVDT-XSD] – *XML Schema for UPnP AV Datastructure Template:1*, UPnP Forum, September 30, 2008. Available at: <http://www.upnp.org/schemas/av/avdt-v1-20080930.xsd>. Latest version available at: <http://www.upnp.org/schemas/av/avdt-v1.xsd>.

[AV-XSD] – *XML Schema for UPnP AV Common XML Data Types*, UPnP Forum, September 30, 2008. Available at: <http://www.upnp.org/schemas/av/av-v2-20080930.xsd>. Latest version available at: <http://www.upnp.org/schemas/av/av-v2.xsd>.

[AVS-XSD] – *XML Schema for UPnP AV Common XML Structures*, UPnP Forum, September 30, 2008. Available at: <http://www.upnp.org/schemas/av/avs-v2-20080930.xsd>. Latest version available at: <http://www.upnp.org/schemas/av/avs-v2.xsd>.

[AVT] – *AVTransport:2*, UPnP Forum, September 30, 2008. Available at: <http://www.upnp.org/specs/av/UPnP-av-AVTransport-v2-Service-20080930.pdf>. Latest version available at: <http://www.upnp.org/specs/av/UPnP-av-AVTransport-v2-Service.pdf>.

[AVT-EVENT-XSD] – *XML Schema for AVTransport:2 LastChange Eventing*, UPnP Forum, September 30, 2008. Available at: <http://www.upnp.org/schemas/av/avt-event-v2-20080930.xsd>. Latest version available at: <http://www.upnp.org/schemas/av/avt-event-v2.xsd>.

[CDS] – *ContentDirectory:3*, UPnP Forum, September 30, 2008. Available at: <http://www.upnp.org/specs/av/UPnP-av-ContentDirectory-v3-Service-20080930.pdf>. Latest version available at: <http://www.upnp.org/specs/av/UPnP-av-ContentDirectory-v3-Service.pdf>.

[CDS-EVENT-XSD] – *XML Schema for ContentDirectory:3 LastChange Eventing*, UPnP Forum, September 30, 2008. Available at: <http://www.upnp.org/schemas/av/cds-event-v1-20080930.xsd>. Latest version available at: <http://www.upnp.org/schemas/av/cds-event-v1.xsd>.

[CM] – *ConnectionManager:2*, UPnP Forum, September 30, 2008. Available at: <http://www.upnp.org/specs/av/UPnP-av-ConnectionManager-v2-Service-20080930.pdf>. Latest version available at: <http://www.upnp.org/specs/av/UPnP-av-ConnectionManager-v2-Service.pdf>.

[DC-XSD] – *XML Schema for UPnP AV Dublin Core*. Available at: <http://www.dublincore.org/schemas/xmls/simpledc20020312.xsd>.

[DC-TERMS] – *DCMI term declarations represented in XML schema language*. Available at: <http://www.dublincore.org/schemas/xmls>.

[DEVICE] – *UPnP Device Architecture, version 1.0*, UPnP Forum, July 20, 2006. Available at: <http://www.upnp.org/specs/architecture/UPnP-DeviceArchitecture-v1.0-20060720.htm>. Latest version available at: <http://www.upnp.org/specs/architecture/UPnP-DeviceArchitecture-v1.0.htm>.

[DIDL] – *ISO/IEC CD 21000-2:2001, Information Technology - Multimedia Framework - Part 2: Digital Item Declaration*, July 2001.

[DIDL-LITE-XSD] – *XML Schema for ContentDirectory:3 Structure and Metadata (DIDL-Lite)*, UPnP Forum, September 30, 2008. Available at: <http://www.upnp.org/schemas/av/didl-lite-v2-20080930.xsd>. Latest version available at: <http://www.upnp.org/schemas/av/didl-lite-v2.xsd>.

[EBNF] – *ISO/IEC 14977, Information technology - Syntactic metalanguage - Extended BNF*, December 1996.

[HTTP/1.1] – *HyperText Transport Protocol – HTTP/1.1*, R. Fielding, J. Gettys, J. Mogul, H. Frystyk, L. Masinter, P. Leach, T. Berners-Lee, June 1999. Available at: <http://www.ietf.org/rfc/rfc2616.txt>.

IEC 61883] – *IEC 61883 Consumer Audio/Video Equipment – Digital Interface - Part 1 to 5*. Available at: <http://www.iec.ch>.

[IEC-PAS 61883] – *IEC-PAS 61883 Consumer Audio/Video Equipment – Digital Interface - Part 6*. Available at: <http://www.iec.ch>.

[ISO 8601] – *Data elements and interchange formats – Information interchange -- Representation of dates and times*, International Standards Organization, December 21, 2000. Available at: [ISO 8601:2000](http://www.iso.org/iso/8601).

[MIME] – *IETF RFC 1341, MIME (Multipurpose Internet Mail Extensions)*, N. Borenstein, N. Freed, June 1992. Available at: <http://www.ietf.org/rfc/rfc1341.txt>.

[MR] – *MediaRenderer:2*, UPnP Forum, September 30, 2008. Available at: <http://www.upnp.org/specs/av/UPnP-av-MediaRenderer-v2-Device-20080930.pdf>. Latest version available at: <http://www.upnp.org/specs/av/UPnP-AV-MediaRenderer-v2-Device.pdf>.

- [MS] – *MediaServer:3*, UPnP Forum, September 30, 2008. Available at: <http://www.upnp.org/specs/av/UPnP-av-MediaServer-v3-Device-20080930.pdf>. Latest version available at: <http://www.upnp.org/specs/av/UPnP-AV-MediaServer-v3-Device.pdf>.
- [RCS] – *RenderingControl:2*, UPnP Forum, September 30, 2008. Available at: <http://www.upnp.org/specs/av/UPnP-av-RenderingControl-v2-Service-20080930.pdf>. Latest version available at: <http://www.upnp.org/specs/av/UPnP-av-RenderingControl-v2-Service.pdf>.
- [RCS-EVENT-XSD] – XML Schema for *RenderingControl:2* LastChange Eventing, UPnP Forum, September 30, 2008. Available at: <http://www.upnp.org/schemas/av/rcs-event-v1-20080930.xsd>. Latest version available at: <http://www.upnp.org/schemas/av/rcs-event-v1.xsd>.
- [RFC 1738] – *IETF RFC 1738, Uniform Resource Locators (URL)*, Tim Berners-Lee, et. Al., December 1994. Available at: <http://www.ietf.org/rfc/rfc1738.txt>.
- [RFC 2045] – IETF RFC 2045, Multipurpose Internet Mail Extensions (MIME) Part 1:Format of Internet Message Bodies, N. Freed, N. Borenstein, November 1996. Available at: <http://www.ietf.org/rfc/rfc2045.txt>.
- [RFC 2119] – IETF RFC 2119, Key words for use in RFCs to Indicate Requirement Levels, S. Bradner, 1997. Available at: <http://www.faqs.org/rfcs/rfc2119.html>.
- [RFC 2396] – IETF RFC 2396, Uniform Resource Identifiers (URI): Generic Syntax, Tim Berners-Lee, et al, 1998. Available at: <http://www.ietf.org/rfc/rfc2396.txt>.
- [RFC 3339] – *IETF RFC 3339, Date and Time on the Internet: Timestamps*, G. Klyne, Clearswift Corporation, C. Newman, Sun Microsystems, July 2002. Available at: <http://www.ietf.org/rfc/rfc3339.txt>.
- [RTP] – *IETF RFC 1889, Realtime Transport Protocol (RTP)*, H. Schulzrinne, S. Casner, R. Frederick, V. Jacobson, January 1996. Available at: <http://www.ietf.org/rfc/rfc1889.txt>.
- [RTSP] – *IETF RFC 2326, Real Time Streaming Protocol (RTSP)*, H. Schulzrinne, A. Rao, R. Lanphier, April 1998. Available at: <http://www.ietf.org/rfc/rfc2326.txt>.
- [SRS] – *ScheduledRecording:2*, UPnP Forum, September 30, 2008. Available at: <http://www.upnp.org/specs/av/UPnP-av-ScheduledRecording-v2-Service-20080930.pdf>. Latest version available at: <http://www.upnp.org/specs/av/UPnP-av-ScheduledRecording-v2-Service.pdf>.
- [SRS-XSD] – XML Schema for *ScheduledRecording:2* Metadata and Structure, UPnP Forum, September 30, 2008. Available at: <http://www.upnp.org/schemas/av/srs-v2-20080930.xsd>. Latest version available at: <http://www.upnp.org/schemas/av/srs-v2.xsd>.
- [SRS-EVENT-XSD] – XML Schema for *ScheduledRecording:2* LastChange Eventing, UPnP Forum, September 30, 2008. Available at: <http://www.upnp.org/schemas/av/srs-event-v1-20080930.xsd>. Latest version available at: <http://www.upnp.org/schemas/av/srs-event-v1.xsd>.
- [UAX 15] – Unicode Standard Annex #15, Unicode Normalization Forms, version 4.1.0, revision 25, M. Davis, M. Dürst, March 25, 2005. Available at: <http://www.unicode.org/reports/tr15/tr15-25.html>.
- [UNICODE COLLATION] – Unicode Technical Standard #10, Unicode Collation Algorithm version 4.1.0, M. Davis, K. Whistler, May 5, 2005. Available at: <http://www.unicode.org/reports/tr10/tr10-14.html>.
- [UPNP-XSD] – *XML Schema for ContentDirectory:3 Metadata*, UPnP Forum, September 30, 2008. Available at: <http://www.upnp.org/schemas/av/upnp-v3-20080930.xsd>. Latest version available at: <http://www.upnp.org/schemas/av/upnp-v3.xsd>.
- [UTS 10] – Unicode Technical Standard #10, Unicode Collation Algorithm, version 4.1.0, revision 14, M. Davis, K. Whistler, May 5, 2005. Available at: <http://www.unicode.org/reports/tr10/tr10-14.html>.

[UTS 35] – Unicode Technical Standard #35, Locale Data Markup Language, version 1.3R1, revision 5, M. Davis, June 2, 2005. Available at: <http://www.unicode.org/reports/tr35/tr35-5.html>.

[XML] – *Extensible Markup Language (XML) 1.0 (Third Edition)*, François Yergeau, Tim Bray, Jean Paoli, C. M. Sperberg-McQueen, Eve Maler, eds., W3C Recommendation, February 4, 2004. Available at: <http://www.w3.org/TR/2004/REC-xml-20040204>.

[XML-NS] – *The “xml:” Namespace*, November 3, 2004. Available at: <http://www.w3.org/XML/1998/namespace>.

[XML-XSD] – XML Schema for the “xml:” Namespace. Available at: <http://www.w3.org/2001/xml.xsd>.

[XML-NMSP] – *Namespaces in XML*, Tim Bray, Dave Hollander, Andrew Layman, eds., W3C Recommendation, January 14, 1999. Available at: <http://www.w3.org/TR/1999/REC-xml-names-19990114>.

[XML SCHEMA-1] – *XML Schema Part 1: Structures, Second Edition*, Henry S. Thompson, David Beech, Murray Maloney, Noah Mendelsohn, W3C Recommendation, 28 October 2004. Available at: <http://www.w3.org/TR/2004/REC-xmlschema-1-20041028>.

[XML SCHEMA-2] – *XML Schema Part 2: Data Types, Second Edition*, Paul V. Biron, Ashok Malhotra, W3C Recommendation, 28 October 2004. Available at: <http://www.w3.org/TR/2004/REC-xmlschema-2-20041028>.

[XMLSCHEMA-XSD] – XML Schema for XML Schema. Available at: <http://www.w3.org/2001/XMLSchema.xsd>.

[XPath20] – *XML Path Language (XPath) 2.0*. Anders Berglund, Scott Boag, Don Chamberlin, Mary F. Fernandez, Michael Kay, Jonathan Robie, Jerome Simeon. W3C Recommendation, 21 November 2006. Available at: <http://www.w3.org/TR/xpath20>.

[XQUERY10] – *XQuery 1.0 An XML Query Language*. W3C Recommendation, 23 January 2007. Available at: <http://www.w3.org/TR/2007/REC-xquery-20070123>.