



ISO/IEC 29341-4-11

Edition 2.0 2011-09

INTERNATIONAL STANDARD



Information technology – UPnP device architecture
Part 4-11: Audio Video Device Control Protocol – Level 2 – Connection Manager
Service

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE

S

ICS 35.200

ISBN 978-2-88912-681-1

CONTENTS

1	Overview and Scope.....	3
1.1	Introduction	3
1.2	Notation	3
1.2.1	Data Types	4
1.2.2	Strings Embedded in Other Strings	4
1.2.3	Extended Backus-Naur Form	4
1.3	Derived Data Types.....	5
1.3.1	Comma Separated Value (CSV) Lists.....	5
1.4	Management of XML Namespaces in Standardized DCPs	6
1.4.1	Namespace Prefix Requirements	9
1.4.2	Namespace Names, Namespace Versioning and Schema Versioning	10
1.4.3	Namespace Usage Examples.....	12
1.5	Vendor-defined Extensions	13
1.5.1	Vendor-defined Action Names.....	13
1.5.2	Vendor-defined State Variable Names.....	13
1.5.3	Vendor-defined XML Elements and attributes	13
1.5.4	Vendor-defined Property Names	13
1.6	References.....	13
2	Service Modeling Definitions.....	17
2.1	ServiceType	17
2.2	State Variables.....	17
2.2.1	<u>SourceProtocolInfo</u>	18
2.2.2	<u>SinkProtocolInfo</u>	18
2.2.3	<u>CurrentConnectionIDs</u>	18
2.2.4	<u>A_ARG_TYPE_ConnectionStatus</u>	19
2.2.5	<u>A_ARG_TYPE_ConnectionManager</u>	19
2.2.6	<u>A_ARG_TYPE_Direction</u>	19
2.2.7	<u>A_ARG_TYPE_ProtocolInfo</u>	19
2.2.8	<u>A_ARG_TYPE_ConnectionID</u>	19
2.2.9	<u>A_ARG_TYPE_AVTransportID</u>	19
2.2.10	<u>A_ARG_TYPE_RcsID</u>	19
2.3	Eventing and Moderation	20
2.4	Actions.....	20
2.4.1	<u>GetProtocolInfo()</u>	20
2.4.2	<u>PrepareForConnection()</u>	21
2.4.3	<u>ConnectionComplete()</u>	23
2.4.4	<u>GetCurrentConnectionIDs()</u>	24
2.4.5	<u>GetCurrentConnectionInfo()</u>	25
2.4.6	Common Error Codes	26
2.5	Theory of Operation.....	27
2.5.1	Purpose.....	27
2.5.2	<u>ProtocolInfo</u> Concept	27
2.5.3	Typical Control Point Operations	32
2.5.4	Relation to Devices without ConnectionManagers.....	33
2.5.5	<u>PrepareForConnection()</u> and <u>ConnectionComplete()</u>	33

3	XML Service Description	36
4	Test	39
	Annex A (normative) Protocol Specifics.....	40
	A.1 Application to HTTP Streaming	40
	A.1.1 ProtocolInfo Definition.....	40
	A.1.2 Implementation of PrepareForConnection()	40
	A.1.3 Implementation of ConnectionComplete()	40
	A.1.4 Automatic Connection Cleanup	40
	A.2 Application to RTSP/RTP/UDP Streaming	41
	A.2.1 ProtocolInfo Definition.....	41
	A.2.2 Implementation of PrepareForConnection()	41
	A.2.3 Implementation of ConnectionComplete()	41
	A.2.4 Automatic Connection Cleanup	41
	A.3 Application to Device-Internal Streaming.....	42
	A.4 Application to IEC61883 Streaming.....	42
	A.4.1 ProtocolInfo Definition.....	42
	A.4.2 Implementation of PrepareForConnection()	43
	A.4.3 Implementation of ConnectionComplete()	44
	A.4.4 Automatic Connection Cleanup	44
	A.5 Application to Vendor-specific Streaming	45
	Table 1-1 — EBNF Operators	5
	Table 1-2 — CSV Examples.....	6
	Table 1-3 — Namespace Definitions	8
	Table 1-4 — Schema-related Information	9
	Table 1-5 — Default Namespaces for the AV Specifications	10
	Table 2-6 — State Variables	17
	Table 2-7 — Event Moderation.....	20
	Table 2-8 — Actions	20
	Table 2-9 — Arguments for GetProtocolInfo()	20
	Table 2-10 — Arguments for PrepareForConnection()	22
	Table 2-11 — Error Codes for PrepareForConnection()	23
	Table 2-12 — Arguments for ConnectionComplete()	24
	Table 2-13 — Error Codes for ConnectionComplete()	24
	Table 2-14 — Arguments for GetCurrentConnectionIDs()	24
	Table 2-15 — Error Codes for GetCurrentConnectionIDs()	25
	Table 2-16 — Arguments for GetCurrentConnectionInfo()	25
	Table 2-17 — Error Codes for GetCurrentConnectionInfo()	26
	Table 2-18 — Common Error Codes	26
	Table 2-19 — Defined Protocols and their associated ProtocolInfo Values.....	28
	Table A.1 — <contentFormat> for Protocol IEC61883	43

INFORMATION TECHNOLOGY – UPNP DEVICE ARCHITECTURE –

Part 4-11: Audio Video Device Control Protocol – Level 2 – Connection Manager Service

FOREWORD

- 1) ISO (International Organization for Standardization) and IEC (International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards. Their preparation is entrusted to technical committees; any ISO and IEC member body interested in the subject dealt with may participate in this preparatory work. International governmental and non-governmental organizations liaising with ISO and IEC also participate in this preparation.
- 2) In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.
- 3) The formal decisions or agreements of IEC and ISO on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC and ISO member bodies.
- 4) IEC, ISO and ISO/IEC publications have the form of recommendations for international use and are accepted by IEC and ISO member bodies in that sense. While all reasonable efforts are made to ensure that the technical content of IEC, ISO and ISO/IEC publications is accurate, IEC or ISO cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 5) In order to promote international uniformity, IEC and ISO member bodies undertake to apply IEC, ISO and ISO/IEC publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any ISO/IEC publication and the corresponding national or regional publication should be clearly indicated in the latter.
- 6) ISO and IEC provide no marking procedure to indicate their approval and cannot be rendered responsible for any equipment declared to be in conformity with an ISO/IEC publication.
- 7) All users should ensure that they have the latest edition of this publication.
- 8) No liability shall attach to IEC or ISO or its directors, employees, servants or agents including individual experts and members of their technical committees and IEC or ISO member bodies for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication of, use of, or reliance upon, this ISO/IEC publication or any other IEC, ISO or ISO/IEC publications.
- 9) Attention is drawn to the normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 10) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

International Standard ISO/IEC 29341-4-11 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 29341-4-11, 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".

IMPORTANT – The “colour inside” logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this publication using a colour printer.

1 Overview and Scope

1.1 Introduction

This service definition is compliant with the UPnP Device Architecture version 1.0.

This service-type enables modeling of streaming capabilities of A/V devices, and binding of those capabilities between devices. Each device that is able to send or receive a stream according to the UPnP AV Architecture will have 1 instance of the ConnectionManager service. This service provides a mechanism for control points to:

- a) Perform capability matching between source/server devices and sink/renderer devices,
- b) Find information about currently ongoing transfers in the network,
- c) Setup and teardown connections between devices (when required by the streaming protocol).

The ConnectionManager service is generic enough to properly abstract different kinds of streaming mechanisms, such as HTTP-based streaming, RTSP/RTP-based and 1394-based streaming.

The ConnectionManager enables control points to abstract from physical media interconnect technology when making connections. The term 'stream' used in this service template refers to both analog and digital data transfer.

1.2 Notation

- In this document, features are described as Required, Recommended, or Optional as follows:

The keywords "MUST," "MUST NOT," "REQUIRED," "SHALL," "SHALL NOT," "SHOULD," "SHOULD NOT," "RECOMMENDED," "MAY," and "OPTIONAL" in this specification are to be interpreted as described in [RFC 2119].

In addition, the following keywords are used in this specification:

PROHIBITED – The definition or behavior is prohibited by this specification. Opposite of **REQUIRED**.

CONDITIONALLY REQUIRED – The definition or behavior depends on a condition. If the specified condition is met, then the definition or behavior is **REQUIRED**, otherwise it is **PROHIBITED**.

CONDITIONALLY OPTIONAL – The definition or behavior depends on a condition. If the specified condition is met, then the definition or behavior is **OPTIONAL**, otherwise it is **PROHIBITED**.

These keywords are thus capitalized when used to unambiguously specify requirements over protocol and application features and behavior that affect the interoperability and security of implementations. When these words are not capitalized, they are meant in their natural-language sense.

- Strings that are to be taken literally are enclosed in "double quotes".
- Words that are emphasized are printed in *italic*.
- Keywords that are defined by the UPnP AV Working Committee are printed using the *forum* character style.
- Keywords that are defined by the UPnP Device Architecture specification are printed using the *arch* character style [DEVICE].
- A double colon delimiter, "::", signifies a hierarchical parent-child (parent::child) relationship between the two objects separated by the double colon. This delimiter is used in multiple contexts, for example: Service::Action(), Action()::Argument, parentProperty::childProperty.

1.6 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>.