ISO/IEC 29341-4-3

Edition 1.0 2008-11

INTERNATIONAL STANDARD

Information technology – UPnP Device Architecture – Part 4-3: Audio Video Device Control Protocol – Level 2 – Media Server Device



ISO/IEC 29341-4-3:2008(E)

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS

Not for Resale

THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2008 ISO/IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester.

If you have any questions about ISO/IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

- Catalogue of IEC publications: www.iec.ch/searchpub

The IEC on-line Catalogue enables you to search by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: www.iec.ch/online_news/justpub

Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.

- Electropedia: www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.

- Customer Service Centre: www.iec.ch/webstore/custserv

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:

Email: csc@iec.ch
Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

ISO/IEC 29341-4-3

Edition 1.0 2008-11

INTERNATIONAL STANDARD

Information technology – UPnP Device Architecture – Part 4-3: Audio Video Device Control Protocol – Level 2 – Media Server Device

INTERNATIONAL ELECTROTECHNICAL COMMISSION

PRICE CODE L

ICS 35.200

ISBN 2-8318-1006-3

--`,,```,,,,````-`-`,,`,,`,`,,`---

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS

Not for Resale

CONTENTS

FOREWORD 4
ORIGINAL UPNP DOCUMENTS (informative) 6
1 Overview and Scope 8
1.1 Introduction 8
1.2 Notation 9
1.2.1 Data Types 9
1.2.2 Strings Embedded in Other Strings 10
1.2.3 Extended Backus-Naur Form 10
1.3 Derived Data Types 11
1.3.1 Comma Separated Value (CSV) Lists 11
1.4 Management of XML Namespaces in Standardized DCPs 13
1.4.1 Namespace Prefix Requirements 16
1.4.2 Namespace Names, Namespace Versioning and Schema Versioning 17
1.4.3 Namespace Usage Examples 18
1.5 Vendor-defined Extensions 19
1.6 References 19
2 Device Definitions 23
2.1 Device Type 23
2.2 Device Model 23
2.2.1 Description of Device Requirements 24
2.2.2 Relationships between Services 24
2.3 Theory of Operation 24
2.3.1 Device Discovery 25
2.3.2 Locating Desired Content 25
2.3.3 Preparing to Transfer the Content 25
2.3.4 Controlling the Transfer of the Content 26
2.3.5 Recording Content 26
3 XML Device Description 27
4 Test 29

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS Not for Resale

LIST OF TABLES

Table 1-1: EBNF Operators....11
Table 1-2: CSV Examples....13
Table 1-3: Namespace Definitions....15
Table 1-4: Schema-related Information....16
Table 1-5: Default Namespaces for the AV Specifications....17
Table 2-6: Device Requirements....23

LIST OF FIGURES

Figure 1: MediaServer Functional Diagram....9

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

INFORMATION TECHNOLOGY – UPNP DEVICE ARCHITECTURE –

Part 4-3: Audio Video Device Control Protocol – Level 2 – Media Server Device

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.

IEC and ISO draw attention to the fact that it is claimed that compliance with this document may involve the use of patents as indicated below.

ISO and IEC take no position concerning the evidence, validity and scope of the putative patent rights. The holders of the putative patent rights have assured IEC and ISO that they are willing to negotiate free licences or licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statements of the holders of the putative patent rights are registered with IEC and ISO.

Intel Corporation has informed IEC and ISO that it has patent applications or granted patents.

Information may be obtained from:

Intel Corporation
Standards Licensing Department
5200 NE Elam Young Parkway
MS: JFS-98
USA – Hillsboro, Oregon 97124

Microsoft Corporation has informed IEC and ISO that it has patent applications or granted patents as listed below:

--`,,```,,,,````-`-,,,,,,`,,,`---

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS Not for Resale

6101499 / US; 6687755 / US; 6910068 / US; 7130895 / US; 6725281 / US; 7089307 / US; 7069312 / US; 10/783 524 /US

Information may be obtained from:

Microsoft Corporation
One Microsoft Way
USA – Redmond WA 98052

Philips International B.V. has informed IEC and ISO that it has patent applications or granted patents.

Information may be obtained from:

Philips International B.V. – IP&S
High Tech campus, building 44 3A21
NL – 5656 Eindhoven

NXP B.V. (NL) has informed IEC and ISO that it has patent applications or granted patents.

Information may be obtained from:

NXP B.V. (NL)
High Tech campus 60
NL – 5656 AG Eindhoven

Matsushita Electric Industrial Co. Ltd. has informed IEC and ISO that it has patent applications or granted patents.

Information may be obtained from:

Matsushita Electric Industrial Co. Ltd.
1-3-7 Shiromi, Chuoh-ku
JP – Osaka 540-6139

Hewlett Packard Company has informed IEC and ISO that it has patent applications or granted patents as listed below:

5 956 487 / US; 6 170 007 / US; 6 139 177 / US; 6 529 936 / US; 6 470 339 / US; 6 571 388 / US; 6 205 466 / US

Information may be obtained from:

Hewlett Packard Company
1501 Page Mill Road
USA – Palo Alto, CA 94304

Samsung Electronics Co. Ltd. has informed IEC and ISO that it has patent applications or granted patents.

Information may be obtained from:

Digital Media Business, Samsung Electronics Co. Ltd.
416 Maetan-3 Dong, Yeongtang-Gu,
KR – Suwon City 443-742

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights other than those identified above. IEC and ISO shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 29341-4-3 was prepared by UPnP Implementers Corporation and adopted, under the PAS procedure, by joint technical committee ISO/IEC JTC 1, *Information technology*, in parallel with its approval by national bodies of ISO and IEC.

The list of all currently available parts of the ISO/IEC 29341 series, under the general title *Universal plug and play (UPnP) 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.

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS Not for Resale

ORIGINAL UPNP DOCUMENTS
(informative)

Reference may be made in this document to original UPnP documents. These references are retained in order to maintain consistency between the specifications as published by ISO/IEC and by UPnP Implementers Corporation. The following table indicates the original UPnP document titles and the corresponding part of ISO/IEC 29341:

UPnP Document Title	**ISO/IEC 29341 Part**
UPnP Device Architecture 1.0	ISO/IEC 29341-1
UPnP Basic:1 Device	ISO/IEC 29341-2
UPnP AV Architecture:1	ISO/IEC 29341-3-1
UPnP MediaRenderer:1 Device	ISO/IEC 29341-3-2
UPnP MediaServer:1 Device	ISO/IEC 29341-3-3
UPnP AVTransport:1 Service	ISO/IEC 29341-3-10
UPnP ConnectionManager:1 Service	ISO/IEC 29341-3-11
UPnP ContentDirectory:1 Service	ISO/IEC 29341-3-12
UPnP RenderingControl:1 Service	ISO/IEC 29341-3-13
UPnP MediaRenderer:2 Device	ISO/IEC 29341-4-2
UPnP MediaServer:2 Device	ISO/IEC 29341-4-3
UPnP AV Datastructure Template:1	ISO/IEC 29341-4-4
UPnP AVTransport:2 Service	ISO/IEC 29341-4-10
UPnP ConnectionManager:2 Service	ISO/IEC 29341-4-11
UPnP ContentDirectory:2 Service	ISO/IEC 29341-4-12
UPnP RenderingControl:2 Service	ISO/IEC 29341-4-13
UPnP ScheduledRecording:1	ISO/IEC 29341-4-14
UPnP DigitalSecurityCamera:1 Device	ISO/IEC 29341-5-1
UPnP DigitalSecurityCameraMotionImage:1 Service	ISO/IEC 29341-5-10
UPnP DigitalSecurityCameraSettings:1 Service	ISO/IEC 29341-5-11
UPnP DigitalSecurityCameraStillImage:1 Service	ISO/IEC 29341-5-12
UPnP HVAC_System:1 Device	ISO/IEC 29341-6-1
UPnP HVAC_ZoneThermostat:1 Device	ISO/IEC 29341-6-2
UPnP ControlValve:1 Service	ISO/IEC 29341-6-10
UPnP HVAC_FanOperatingMode:1 Service	ISO/IEC 29341-6-11
UPnP FanSpeed:1 Service	ISO/IEC 29341-6-12
UPnP HouseStatus:1 Service	ISO/IEC 29341-6-13
UPnP HVAC_SetpointSchedule:1 Service	ISO/IEC 29341-6-14
UPnP TemperatureSensor:1 Service	ISO/IEC 29341-6-15
UPnP TemperatureSetpoint:1 Service	ISO/IEC 29341-6-16
UPnP HVAC_UserOperatingMode:1 Service	ISO/IEC 29341-6-17
UPnP BinaryLight:1 Device	ISO/IEC 29341-7-1
UPnP DimmableLight:1 Device	ISO/IEC 29341-7-2
UPnP Dimming:1 Service	ISO/IEC 29341-7-10
UPnP SwitchPower:1 Service	ISO/IEC 29341-7-11
UPnP InternetGatewayDevice:1 Device	ISO/IEC 29341-8-1
UPnP LANDevice:1 Device	ISO/IEC 29341-8-2
UPnP WANDevice:1 Device	ISO/IEC 29341-8-3
UPnP WANConnectionDevice:1 Device	ISO/IEC 29341-8-4
UPnP WLANAccessPointDevice:1 Device	ISO/IEC 29341-8-5
UPnP LANHostConfigManagement:1 Service	ISO/IEC 29341-8-10
UPnP Layer3Forwarding:1 Service	ISO/IEC 29341-8-11
UPnP LinkAuthentication:1 Service	ISO/IEC 29341-8-12
UPnP RadiusClient:1 Service	ISO/IEC 29341-8-13
UPnP WANCableLinkConfig:1 Service	ISO/IEC 29341-8-14
UPnP WANCommonInterfaceConfig:1 Service	ISO/IEC 29341-8-15
UPnP WANDSLLinkConfig:1 Service	ISO/IEC 29341-8-16
UPnP WANEthernetLinkConfig:1 Service	ISO/IEC 29341-8-17
UPnP WANIPConnection:1 Service	ISO/IEC 29341-8-18
UPnP WANPOTSLinkConfig:1 Service	ISO/IEC 29341-8-19
UPnP WANPPPConnection:1 Service	ISO/IEC 29341-8-20
UPnP WLANConfiguration:1 Service	ISO/IEC 29341-8-21
UPnP Printer:1 Device	ISO/IEC 29341-9-1
UPnP Scanner:1.0 Device	ISO/IEC 29341-9-2
UPnP ExternalActivity:1 Service	ISO/IEC 29341-9-10
UPnP Feeder:1.0 Service	ISO/IEC 29341-9-11
UPnP PrintBasic:1 Service	ISO/IEC 29341-9-12
UPnP Scan:1 Service	ISO/IEC 29341-9-13
UPnP QoS Architecture:1.0	ISO/IEC 29341-10-1
UPnP QosDevice:1 Service	ISO/IEC 29341-10-10
UPnP QosManager:1 Service	ISO/IEC 29341-10-11
UPnP QosPolicyHolder:1 Service	ISO/IEC 29341-10-12
UPnP QoS Architecture:2	ISO/IEC 29341-11-1
UPnP QOS v2 Schema Files	ISO/IEC 29341-11-2
UPnP QosDevice:2 Service	ISO/IEC 29341-11-10

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS Not for Resale

UPnP Document Title	ISO/IEC 29341 Part
UPnP QosManager:2 Service	ISO/IEC 29341-11-11
UPnP QosPolicyHolder:2 Service	ISO/IEC 29341-11-12
UPnP RemoteUIClientDevice:1 Device	ISO/IEC 29341-12-1
UPnP RemoteUIServerDevice:1 Device	ISO/IEC 29341-12-2
UPnP RemoteUIClient:1 Service	ISO/IEC 29341-12-10
UPnP RemoteUIServer:1 Service	ISO/IEC 29341-12-11
UPnP DeviceSecurity:1 Service	ISO/IEC 29341-13-10
UPnP SecurityConsole:1 Service	ISO/IEC 29341-13-11

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

1 Overview and Scope

1.1 Introduction

This device specification is compliant with the UPnP Device Architecture version 1.0. It defines a device type referred to herein as MediaServer.

The MediaServer specification defines a general-purpose device that can be used to instantiate any Consumer Electronics (CE) device that provides AV content (for example, media) to other UPnP devices on the home network. It is based on the UPnP AV Architecture Framework (described in another document). It exposes its content via the ContentDirectory service (refer to the ContentDirectory service specification for details). The MediaServer MAY also provide functionality to record content using the ScheduledRecording service (refer to the ScheduledRecording service specification). As such, the MediaServer can handle any specific type of media, any data format, and transfer protocol.

Example instances of a MediaServer include traditional devices such as VCRs, CD Players, DVD Players, audio-tape players, still-image cameras, camcorders, radios, TV Tuners, and set-top boxes. Additional examples of a MediaServer also include new digital devices such as MP3 servers, PVRs, and Home MediaServers such as the PC. Although these devices contain diverse (AV) content in one form or another, the MediaServer (via the ContentDirectory service) is able to expose this content to the home network in a uniform and consistent manner. This ability allows the MediaServer to instantiate traditional single-function devices as well as more recent multi-function devices such as VCR-DVD players and the general purpose Home MediaServer, which contains a wide variety of content such as MPEG2 video, CD audio, MP3 and/or WMA audio, JPEG images, etc.

The MediaServer specification is very lightweight and can easily be implemented on low-resource devices such as still-image cameras or MP3 players that want to expose their local content to the home network. The MediaServer can also be used for high-end Home MediaServers that contain dozens of Gigabytes of heterogeneous content. Refer to the Theory Of Operation section for some specific examples of the MediaServer.

A full-featured MediaServer device provides clients with the following capabilities:

- Enumerate and query any of the content that the MediaServer can provide to the home network.
- Negotiate a common transfer protocol and data format between the MediaServer and target device.
- Control the flow of the content (for example, FF, REW, etc).
- Copy (import) content to the MediaServer from another device.
- Record content using the ScheduledRecording service.

This device specification does not provide:

- The ability to render AV content.

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS Not for Resale

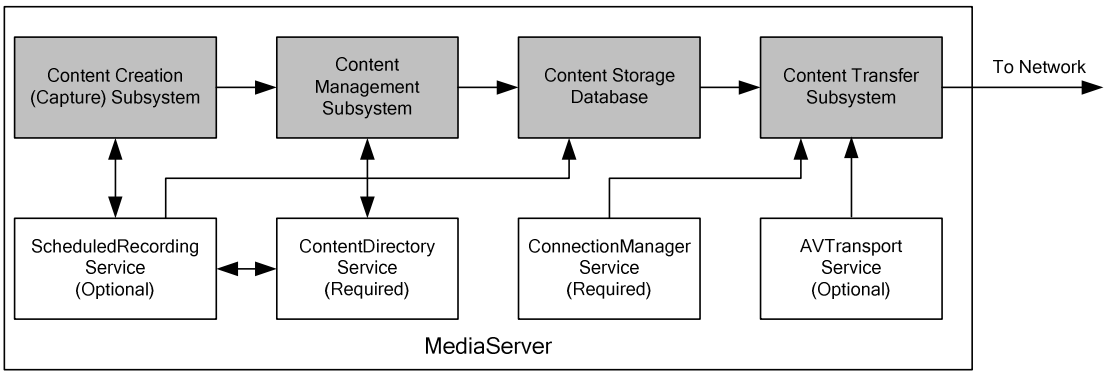

Figure 1: MediaServer Functional Diagram

The un-shaded blocks represent the UPnP services that are contained by a MediaServer device. The shaded blocks represent various device-specific modules that the UPnP services might interact with. However, the internal architecture of a MediaServer device is vendor specific.

1.2 Notation

- In this document, features are described as Required, Recommended, or Optional as follows:
  The key words “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 an absolute prohibition of 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 are printed using the **arch** character style.
- 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.

1.2.1 Data Types

This specification uses data type definitions from two different sources. The UPnP Device Architecture defined data types are used to define state variable and action argument data types [DEVICE]. The XML Schema namespace is used to define property data types [XML SCHEMA-2].

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

For UPnP Device Architecture defined Boolean data types, it is strongly RECOMMENDED to use the value "**0**" for false, and the value "**1**" for true. However, when used as input arguments, the values "**false**", "**no**", "**true**", "**yes**" may also be encountered and MUST be accepted. Nevertheless, it is strongly RECOMMENDED that all state variables and output arguments be represented as "**0**" and "**1**".
For XML Schema defined Boolean data types, it is strongly RECOMMENDED to use the value "*0*" for false, and the value "*1*" for true. However, when used as input properties, the values "*false*", "*true*" may also be encountered and MUST be accepted. Nevertheless, it is strongly RECOMMENDED that all properties be represented as "*0*" and "*1*".

1.2.2 Strings Embedded in Other Strings

Some string variables and arguments described in this document contain substrings that MUST be independently identifiable and extractable for other processing. This requires the definition of appropriate substring delimiters and an escaping mechanism so that these delimiters can also appear as ordinary characters in the string and/or its independent substrings. This document uses embedded strings in two contexts – Comma Separated Value (CSV) lists (see Section 1.3.1, "Comma Separated Value (CSV) Lists") and property values in search criteria strings. Escaping conventions use the backslash character, "\" (character code U+005C), as follows:

a. Backslash ("\") is represented as "\\" in both contexts.
b. Comma (",") is
    1. represented as "\," in individual substring entries in CSV lists
    2. not escaped in search strings
c. Double quote (""") is
    1. not escaped in CSV lists
    2. not escaped in search strings when it appears as the start or end delimiter of a property value
    3. represented as "\"" in search strings when it appears as a character that is part of the property value

1.2.3 Extended Backus-Naur Form

Extended Backus-Naur Form is used in this document for a formal syntax description of certain constructs. The usage here is according to the reference [EBNF].

1.2.3.1 Typographic conventions for EBNF

`Non-terminal` symbols are unquoted sequences of characters from the set of English upper and lower case letters, the digits "`0`" through "`9`", and the hyphen ("`-`"). Character sequences between `'single quotes'` are terminal strings and MUST appear literally in valid strings. Character sequences between `(*comment delimiters*)` are English language definitions or supplementary explanations of their associated symbols. White space in the EBNF is used to separate elements of the EBNF, not to represent white space in valid strings. White space usage in valid strings is described explicitly in the EBNF. Finally, the EBNF uses the following operators:

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS Not for Resale

Table 1-1: EBNF Operators

Operator	Semantics
::=	**definition** – the non-terminal symbol on the left is defined by one or more alternative sequences of terminals and/or non-terminals to its right.
|	**alternative separator** – separates sequences on the right that are independently allowed definitions for the non-terminal on the left.
*	**null repetition** – means the expression to its left MAY occur zero or more times.
+	**non-null repetition** – means the expression to its left MUST occur at least once and MAY occur more times.
[ ]	**optional –** the expression between the brackets is optional.
( )	**grouping –** groups the expressions between the parentheses.
-	**character range** – represents all characters between the left and right character operands inclusively.

1.3 Derived Data Types

This section defines a derived data type that is represented as a string data type with special syntax. This specification uses string data type definitions that originate from two different sources. The UPnP Device Architecture defined **string** data type is used to define state variable and action argument **string** data types. The XML Schema namespace is used to define property xsd:string data types. The following definition applies to both string data types.

1.3.1 Comma Separated Value (CSV) Lists

The UPnP AV services use state variables, action arguments and properties that represent lists – or one-dimensional arrays – of values. The UPnP Device Architecture, Version 1.0 [DEVICE], does not provide for either an array type or a list type, so a list type is defined here. Lists MAY either be homogeneous (all values are the same type) or heterogeneous (values of different types are allowed). Lists MAY also consist of repeated occurrences of homogeneous or heterogeneous subsequences, all of which have the same syntax and semantics (same number of values, same value types and in the same order). The data type of a homogeneous list is **string** or xsd:string and denoted by CSV (*x*), where *x* is the type of the individual values. The data type of a heterogeneous list is also **string** or xsd:string and denoted by CSV (*x, y, z*), where *x*, *y* and *z* are the types of the individual values. If the number of values in the heterogeneous list is too large to show each type individually, that variable type is represented as CSV (*heterogeneous*), and the variable description includes additional information as to the expected sequence of values appearing in the list and their corresponding types. The data type of a repeated subsequence list is **string** or xsd:string and denoted by CSV ({*x*, *y*, *z*}), where *x*, *y* and *z* are the types of the individual values in the subsequence and the subsequence MAY be repeated zero or more times.

- A list is represented as a **string** type (for state variables and action arguments) or xsd:string type (for properties).
- Commas separate values within a list.
- Integer values are represented in CSVs with the same syntax as the integer data type specified in [DEVICE] (that is: optional leading sign, optional leading zeroes, numeric ASCII)

--`,,```,,,,````-`-`,,`,,`,`,,`---

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS Not for Resale

- Boolean values are represented in state variable and action argument CSVs as either “**0**” for false or “**1**” for true. These values are a subset of the defined Boolean data type values specified in [DEVICE]: **0**, **false**, **no**, **1**, **true**, **yes**.
- Boolean values are represented in property CSVs as either “*0*” for false or “*1*” for true. These values are a subset of the defined Boolean data type values specified in [XML SCHEMA-2]: 0, false, 1, true.
- Escaping conventions for the comma and backslash characters are defined in Section 1.2.2, “Strings Embedded in Other Strings”.
- White space before, after, or interior to any numeric data type is not allowed.
- White space before, after, or interior to any other data type is part of the value.

--`,,```,,,,````-`-`,,`,,`,`,,`---
Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

Table 1-2: CSV Examples

Type refinement of string	Value	Comments
CSV (**string**) or CSV (xsd:string)	"+artist,-date"	List of 2 property sort criteria.
CSV (**int**) or CSV (xsd:integer)	"1,-5,006,0,+7"	List of 5 integers.
CSV (**boolean**) or CSV (xsd:Boolean)	"0,1,1,0"	List of 4 booleans
CSV (**string**) or CSV (xsd:string)	"Smith\, Fred,Jones\, Davey"	List of 2 names, "Smith, Fred" and "Jones, Davey"
CSV (**i4**,**string**,**ui2**) or CSV (xsd:int, xsd:string, xsd:unsignedShort)	"-29837, string with leading blanks,0"	Note that the second value is " string with leading blanks"
CSV (**i4**) or CSV (xsd:int)	"3, 4"	Illegal CSV. White space is not allowed as part of an integer value.
CSV (**string**) or CSV (xsd:string)	",,"	List of 3 empty string values
CSV (heterogeneous)	"Alice,Marketing,5,Sue,R&D,21,Dave,Finance,7"	List of unspecified number of people and associated attributes. Each person is described by 3 elements: a name **string**, a department **string** and years-of-service **ui2** or a name xsd:string, a department xsd:string and years-of-service xsd:unsignedShort.

1.4 Management of XML Namespaces in Standardized DCPs

UPnP specifications make extensive use of XML namespaces. This allows separate DCPs, and even separate components of an individual DCP, to be designed independently and still avoid name collisions when they share XML documents. Every name in an XML document belongs to exactly one namespace. In documents, XML names appear in one of two forms: qualified or unqualified. An unqualified name (or no-colon-name) contains no colon (":") characters. An unqualified name belongs to the document's default namespace. A qualified name is two no-colon-names separated by one colon character. The no-colon-name before the colon is the qualified name's namespace prefix, the no-colon-name after the colon is the qualified

--`,,```,,,,````-`-`,,`,,`,`,,`---

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS Not for Resale

name's "local" name (meaning local to the namespace identified by the namespace prefix). Similarly, the unqualified name is a local name in the default namespace.
The formal name of a namespace is a URI. The namespace prefix used in an XML document is *not* the name of the namespace. The namespace name is, or should be, globally unique. It has a single definition that is accessible to anyone who uses the namespace. It has the same meaning anywhere that it is used, both inside and outside XML documents. The namespace prefix, however, in formal XML usage, is defined only in an XML document. It must be locally unique to the document. Any valid XML no-colon-name may be used. And, in formal XML usage, no two XML documents are ever required to use the same namespace prefix to refer to the same namespace. The creation and use of the namespace prefix was standardized by the W3C XML Committee in [XML-NMSP] strictly as a convenient local shorthand replacement for the full URI name of a namespace in individual documents.
All AV object properties are represented in XML by element and attribute names, therefore, all property names belong to an XML namespace.
For the same reason that namespace prefixes are convenient in XML documents, it is convenient in specification text to refer to namespaces using a namespace prefix. Therefore, this specification declares a "standard" prefix for all XML namespaces used herein. In addition, this specification expands the scope where these prefixes have meaning, beyond a single XML document, to all of its text, XML examples, and certain string-valued properties. This expansion of scope *does not* supercede XML rules for usage in documents, it only augments and complements them in important contexts that are out-of-scope for the XML specifications.
All of the namespaces used in this specification are listed in the Tables "Namespace Definitions" and "Schema-related Information". For each such namespace, Table 1-3, "Namespace Definitions" gives a brief description of it, its name (a URI) and its defined "standard" prefix name. Some namespaces included in these tables are not directly used or referenced in this document. They are included for completeness to accommodate those situations where this specification is used in conjunction with other UPnP specifications to construct a complete system of devices and services. The individual specifications in such collections all use the same standard prefix. The standard prefixes are also used in Table 1-4, "Schema-related Information", to cross-reference additional namespace information. This second table includes each namespace's valid XML document root elements (if any), its schema file name, versioning information (to be discussed in more detail below), and links to the entries in the Reference section for its associated schema.
The normative definitions for these namespaces are the documents referenced in Table 1-3. The schemas are designed to support these definitions for both human understanding and as test tools. However, limitations of the XML Schema language itself make it difficult for the UPnP-defined schemas to accurately represent all details of the namespace definitions. As a result, the schemas will validate many XML documents that are not valid according to the specifications.
The Working Committee expects to continue refining these schemas after specification release to reduce the number of documents that are validated by the schemas while violating the specifications, but the schemas will still be informative, supporting documents. Some schemas might become normative in future versions of the specifications.

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS Not for Resale

Table 1-3: Namespace Definitions

Standard Name-space Prefix	Namespace Name	Namespace Description	Normative Definition Document Reference
AV Working Committee defined namespaces			
av:	urn:schemas-upnp-org:av:av	Common data types for use in AV schemas	[AV-XSD]
avs:	urn:schemas-upnp-org:av:avs	Common structures for use in AV schemas	[AVS-XSD]
avdt:	urn:schemas-upnp-org:av:avdt	Datastructure Template	[AVDT]
avt-event:	urn:schemas-upnp-org:metadata-1-0/AVT/	Evented *LastChange* state variable for AVTransport	[AVT]
didl-lite:	urn:schemas-upnp-org:metadata-1-0/DIDL-Lite/	Structure and metadata for ContentDirectory	[CDS]
rcs-event:	urn:schemas-upnp-org:metadata-1-0/RCS/	Evented *LastChange* state variable for RenderingControl	[RCS]
srs:	urn:schemas-upnp-org:av:srs	Metadata and structure for ScheduledRecording	[SRS]
srs-event:	urn:schemas-upnp-org:av:srs-event	Evented *LastChange* state variable for ScheduledRecording	[SRS]
upnp:	urn:schemas-upnp-org:metadata-1-0/upnp/	Metadata for ContentDirectory	[CDS]
Externally defined namespaces			
dc:	http://purl.org/dc/elements/1.1/	Dublin Core	[DC-TERMS]
xsd:	http://www.w3.org/2001/XMLSchema	XML Schema Language 1.0	[XML SCHEMA-1] [XML SCHEMA-2]
xsi:	http://www.w3.org/2001/XMLSchema-instance	XML Schema Instance Document schema	Sections 2.6 & 3.2.7 of [XML SCHEMA-1]
xml:	http://www.w3.org/XML/1998/namespace	The “xml:” Namespace	[XML-NS]

--`,,```,,,,````-`-`,,`,,`,`,,`---

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS Not for Resale

Table 1-4: Schema-related Information

Standard Name-space Prefix	Relative URI and File Name • Form 1 • Form 2	Valid Root Element(s)	Schema Reference
AV Working Committee Defined Namespaces			
av:	• av-v*n-yyyymmdd*.xsd • av-v*n*.xsd	*n/a*	[AV-XSD]
avs:	• avs-v*n-yyyymmdd*.xsd • avs-v*n*.xsd	`<Features>` `<stateVariableValuePairs>`	[AVS-XSD]
avdt:	• avdt-v*n-yyyymmdd*.xsd • avdt-v*n*.xsd	`<AVDT>`	[AVDT]
avt-event:	• avt-event-v*n-yyyymmdd*.xsd • avt-event-v*n*.xsd	`<Event>`	[AVT-EVENT-XSD]
didl-lite:	• didl-lite-v*n-yyyymmdd*.xsd • didl-lite-v*n*.xsd	`<DIDL-Lite>`	[DIDL-LITE-XSD]
rcs-event:	• rcs-event-v*n-yyyymmdd*.xsd • rcs-event-v*n*.xsd	`<Event>`	[RCS-EVENT-XSD]
srs:	• srs-v*n-yyyymmdd*.xsd • srs-v*n*.xsd	`<srs>`	[SRS-XSD]
srs-event:	• srs-event-v*n-yyyymmdd*.xsd • srs-event-v*n*.xsd	`<StateEvent>`	[SRS-EVENT-XSD]
upnp:	• upnp-v*n-yyyymmdd*.xsd • upnp-v*n*.xsd	*n/a*	[UPNP-XSD]
Externally Defined Namespaces			
dc:	*Absolute URL*: http://dublincore.org/schemas/xmls/simpledc20021212.xsd		[DC-XSD]
xsd:	*n/a*	`<schema>`	[XMLSCHEMA-XSD]
xsi:	*n/a*		*n/a*
xml:	*n/a*		[XML-XSD]

1.4.1 Namespace Prefix Requirements

There are many occurrences in this specification of string data types that contain XML names (property names). These XML names in strings will not be processed under namespace-aware conditions. Therefore, all occurrences in instance documents of XML names in strings MUST use the standard namespace prefixes as declared in Table 1-3. In order to properly process the XML documents described herein, control points and devices MUST use namespace-aware XML processors [XML-NMSP] for both reading and writing. As allowed by [XML-NMSP], the namespace prefixes used in an instance document are at the sole discretion of the document creator. Therefore, the declared prefix for a namespace in a document MAY be different from the standard prefix. All devices MUST be able to correctly process any valid XML instance document, even when it uses a non-standard prefix for ordinary XML names. It is strongly RECOMMENDED that all devices use these standard prefixes for all instance documents to avoid confusion on the part of both human and machine readers. These standard prefixes are used in all descriptive text and all XML examples in this and related UPnP specifications. Also, each individual specification may assume a default namespace for its descriptive text. In that case, names from that namespace may appear with no prefix.

--`,,```,,,,````-`-`,,`,,`,`,,`---

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS Not for Resale

The assumed default namespace, if any, for each UPnP AV specification is given in Table 1-5, “Default Namespaces for the AV Specifications”.
Note: all UPnP AV schemas declare attributes to be “unqualified”, so namespace prefixes are never used with AV Working Committee defined attribute names.

Table 1-5: Default Namespaces for the AV Specifications

AV Specification Name	Default Namespace Prefix
AVTransport:2	avt-event:
ConnectionManager:2	*n/a*
ContentDirectory:2	didl-lite:
MediaRenderer:2	*n/a*
MediaServer:2	*n/a*
RenderingControl:2	rcs-event:
ScheduledRecording:1	srs:

1.4.2 Namespace Names, Namespace Versioning and Schema Versioning

Each namespace that is defined by the AV Working Committee is named by a URN. In order to enable both forward and backward compatibility, the UPnP TC has established the general policy that namespace names will not change with new versions of specifications, even when the specification changes the definition of a namespace. But, namespaces still have version numbers that reflect definitional changes. Each time the definition of a namespace is changed, the namespace’s version number is incremented by one. Therefore, namespace version information must be provided with each XML instance document so that the document’s receiver can properly understand its meaning. This is achieved by the following rules:

- Every release of a schema is identified by a version number and date of the form “*n-yyyymmdd*”, where *n* corresponds to the namespace definition version number and *yyyymmdd* is the year, month and day in the Gregorian calendar that the schema is released.
  For example, the new version numbers of the pre-existing “DIDL-Lite” and “upnp” schemas are “2”. Versions for new schemas, such as “srs” are “1”.
  For each schema, the version-date will appear in two places:
  1. In the schema file name, according to the naming structure shown in Table 1-4, “Schema-related Information”.
  2. As the value of the `version` attribute of each schema’s `schema` root element.

Namespaces are referenced in both schema and XML instance documents by namespace name. The namespace name appears as the value of an `xmlns` attribute. The `xmlns` attribute also declares a namespace prefix that will be used to qualify names from each namespace. Schemas are referenced in both schema and XML instance documents by URI in the `schemaLocation` attribute. See section 1.4.3, “Namespace Usage Examples” . Two different forms of URI are available, each with a different meaning. All UPnP AV-defined schema URIs share a common base path of “http://www.upnp.org/schemas/av/”. Each schema URI has two unique relative forms (see Table 1-4, “Schema-related Information”), according to which version of a namespace and its representative schema is of interest. The allowed relative URI forms are:

1. *schema-root-name* “-v” *version-date*
   where *version-date* is a full version-date of the form *n-yyyymmdd*. This form references the schema whose “root” name (typically the standardized prefix

--`,,```,,,,````-`-`,,`,,`,`,,`---

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS Not for Resale

name used for the namespace that the schema represents) and version-date match *schema-root-name* and *version-date*, respectively.

2. *schema-root-name* "-v" *version*
   where *version* is an integer representing the namespace's version number. This form references the most recent version of the schema whose root name and namespace version number match *schema-root-name* and the *version*, respectively.

Usage rules for schema location URIs are as follows:

- All instance documents, whether generated by a service or a control point, MUST use Form 1.
- All UPnP AV published schemas that reference other UPnP AV schemas will also use Form 1.
- Validation of XML instance documents in UPnP AV systems potentially serves two purposes. The first is based on standard XML and XML Schema semantics: the document's creator asserts that the document is syntactically correct with respect to the referenced schema. The receiving processor can confirm this with a validating parser that uses the referenced schema(s). The second is based on UPnP AV namespace semantics. The receiving processor knows that the XML instance document is supposed to conform to one or more specific UPnP AV specifications. Since the second context is actually the more important context for instance document processing, the receiving processor MAY validate the instance document against any version of a schema that satisfies its needs in assessing the acceptability of the received instance document.

1.4.3 Namespace Usage Examples

The `schemaLocation` attribute for XML instance documents comes from the XML Schema instance namespace "http:://www.w3.org/2002/XMLSchema-instance". A single occurrence of the attribute can declare the location of one or more schemas. The `schemaLocation` attribute value consists of a whitespace separated list of values: namespace name followed by its schema location URL. This pair-sequence is repeated as necessary for the schemas that need to be located for this instance document.

Example 1:

Sample *DIDL-Lite XML Document*. This document assumes version-date 2-20060531 of the "didl-lite:" namespace/schema combination and (a possible later) version 2-20061231 of "upnp:". The lines with the gray background show how to express this versioning information in the instance document.

```
<?xml version="1.0" encoding="UTF-8"?>
<DIDL-Lite
 xmlns:dc="http://purl.org/dc/elements/1.1/"
 xmlns="urn:schemas-upnp-org:metadata-1-0/DIDL-Lite/"
 xmlns:upnp="urn:schemas-upnp-org:metadata-1-0/upnp/"
 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xsi:schemaLocation="
   urn:schemas-upnp-org:metadata-1-0/DIDL-Lite/
    http://www.upnp.org/schemas/av/didl-lite-v2-20060531.xsd
   urn:schemas-upnp-org:metadata-1-0/upnp/
    http://www.upnp.org/schemas/av/upnp-v2-20061231.xsd">
   <item id="18" parentID="13" restricted="0">
      ...
   </item>
</DIDL-Lite>
```

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS Not for Resale

Example 2:
Sample *srs XML Document*. This document assumes version 1-20060531 of the "srs:" namespace/schema combination. Again, the lines with the gray background show how to express this versioning information in the instance document.

```
<?xml version="1.0" encoding="UTF-8"?>
<srs
 xmlns="urn:schemas-upnp-org:av:srs"
 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xsi:schemaLocation="
   urn:schemas-upnp-org:av:srs
    http://www.upnp.org/schemas/av/srs-v1-20060531.xsd">
    ...
</srs>
```

1.5 Vendor-defined Extensions

Whenever vendors create additional vendor-defined state variables, actions or properties, their assigned names and XML representation MUST follow the naming conventions and XML rules as specified in [DEVICE], Section 2.5, "Description: Non-standard vendor extensions".

1.6 References

This section 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, June 25, 2002.
Available at: http://www.upnp.org/specs/av/UPnP-av-AVArchitecture-v1-20020625.pdf.

[AVDT] – *AV DataStructure Template:1*, UPnP Forum, May 31, 2006.
Available at: http://www.upnp.org/specs/av/UPnP-av-AVDataStructure-v1-20060531.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, May 31, 2006.
Available at: http://www.upnp.org/schemas/av/avdt-v1-20060531.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, May 31, 2006.
Available at: http://www.upnp.org/schemas/av/av-v1-20060531.xsd.
Latest version available at: http://www.upnp.org/schemas/av/av-v1.xsd.

[AVS-XSD] – *XML Schema for UPnP AV Common XML Structures*, UPnP Forum, May 31, 2006.
Available at: http://www.upnp.org/schemas/av/avs-v1-20060531.xsd.
Latest version available at: http://www.upnp.org/schemas/av/avs-v1.xsd.

[AVT] – *AVTransport:2*, UPnP Forum, May 31, 2006.
Available at: http://www.upnp.org/specs/av/UPnP-av-AVTransport-v2-Service-20060531.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, May 31, 2006.
Available at: http://www.upnp.org/schemas/av/avt-event-v2-20060531.xsd.
Latest version available at: http://www.upnp.org/schemas/av/avt-event-v2.xsd.

[CDS] – *ContentDirectory:2*, UPnP Forum, May 31, 2006.
Available at: http://www.upnp.org/specs/av/UPnP-av-ContentDirectory-v2-Service-20060531.pdf.

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

Latest version available at: http://www.upnp.org/specs/av/UPnP-av-ContentDirectory-v2-Service.pdf.
[CM] – *ConnectionManager:2*, UPnP Forum, May 31, 2006.
Available at: http://www.upnp.org/specs/av/UPnP-av-ConnectionManager-v2-Service-20060531.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, June 13, 2000.
Available at: http://www.upnp.org/specs/architecture/UPnP-DeviceArchitecture-v1.0-20000613.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:2 Structure and Metadata (DIDL-Lite)*, UPnP Forum, May 31, 2006.
Available at: http://www.upnp.org/schemas/av/didl-lite-v2-20060531.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.
[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, May 31, 2006.
Available at: http://www.upnp.org/specs/av/UPnP-av-MediaRenderer-v2-Device-20060531.pdf.
Latest version available at: http://www.upnp.org/specs/av/UPnP-AV-MediaRenderer-v2-Device.pdf.
[MS] – *MediaServer:2*, UPnP Forum, May 31, 2006.
Available at: http://www.upnp.org/specs/av/UPnP-av-MediaServer-v2-Device-20060531.pdf.
Latest version available at: http://www.upnp.org/specs/av/UPnP-AV-MediaServer-v2-Device.pdf.
[RCS] – *RenderingControl:2*, UPnP Forum, May 31, 2006.
Available at: http://www.upnp.org/specs/av/UPnP-av-RenderingControl-v2-Service-20060531.pdf.
Latest version available at: http://www.upnp.org/specs/av/UPnP-av-RenderingControl-v2-Service.pdf.

--`,,```,,,,````-`-`,,`,,`,`,,`---

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS Not for Resale

[RCS-EVENT-XSD] –*XML Schema for RenderingControl:2 LastChange Eventing*, UPnP Forum, May 31, 2006.
Available at: http://www.upnp.org/schemas/av/rcs-event-v1-20060531.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 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:1*, UPnP Forum, May 31, 2006.
Available at: http://www.upnp.org/specs/av/UPnP-av-ScheduledRecording-v1-Service-20060531.pdf.
Latest version available at: http://www.upnp.org/specs/av/UPnP-av-ScheduledRecording-v1-Service-20060531.pdf.
[SRS-XSD] – *XML Schema for ScheduledRecording:1 Metadata and Structure*, UPnP Forum, May 31, 2006.
Available at: http://www.upnp.org/schemas/av/srs-v1-20060531.xsd.
Latest version available at: http://www.upnp.org/schemas/av/srs-v1.xsd.
[SRS-EVENT-XSD] – *XML Schema for ScheduledRecording:1 LastChange Eventing*, UPnP Forum, May 31, 2006.
Available at: http://www.upnp.org/schemas/av/srs-event-v1-20060531.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:2 Metadata*, UPnP Forum, May 31, 2006.
Available at: http://www.upnp.org/schemas/av/upnp-v2-20060531.xsd.
Latest version available at: http://www.upnp.org/schemas/av/upnp-v2.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.

--`,,```,,,,````-`-`,,`,,`,`,,`---
Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

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.

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

2 Device Definitions

2.1 Device Type

The following device type identifies a device that is compliant with this specification:

urn:schemas-upnp-org:device:*MediaServer:2*

The shorthand MediaServer is used herein to refer to this device type.

2.2 Device Model

MediaServer products MUST implement minimum version numbers of all REQUIRED embedded devices and services specified in the table below. A MediaServer device can be either a *Root* device or can be *Embedded* in another UPnP device (MediaServer or other). A MediaServer device (*Root* or *Embedded*) can in turn contain other standard or non-standard *Embedded* UPnP devices.

Table 2-6: Device Requirements

DeviceType	Root	R/O[1]	ServiceType	R/O	Service ID[2]
MediaServer:2	*Root* or *Embedded*	*R*	*ContentDirectory:2*	*R*	*ContentDirectory*
			ConnectionManager:2	*R*	*ConnectionManager*
			AVTransport:2	*O*	*AVTransport*
			ScheduledRecording:1	*O*	*ScheduledRecording*
			Standard non-AV services defined by UPnP (QoS, Security, etc.) go here.	*X*	*TBD*
			Non-standard services embedded by a UPnP vendor go here.	*X*	*TBD*
Standard devices embedded by a UPnP vendor go here.	*Embedded*	*O*	*Services as defined by the corresponding standard UPnP Device Definition go here.*		
Non-standard devices embedded by a UPnP vendor go here.	*Embedded*	*X*	*TBD*	*TBD*	*TBD*

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

2.2.1 Description of Device Requirements

Any instance of a MediaServer MUST have a ContentDirectory service and a ConnectionManager service. For a given instance (MediaServer), there MUST only be one instance of these services. There MAY be one instance of a AVTransport service. There MAY also be one instance of a ScheduledRecording service. The semantics of additional standard AV services are not defined. Other standard services, such as UPnP QoS, MAY be added with semantics defined by the relevant specifications.

It should be noted that a MediaServer:2 implementation MUST respond to all SSDP queries that specify MediaServer:1 and MUST respond to all actions defined by the MediaServer:1

The ContentDirectory service allows control points to discover information about the AV content that is available from the device. The ConnectionManager is used to enumerate and select a particular transfer protocol and data format to be used for transferring the content. Additionally, the ConnectionManager also allows control points, such as a home network management application, to discover useful information about the content transfers that the device is actively participating in. Such information could be useful to a Quality of Service capability, which may be defined in the future.

The existence of the AVTransport service depends on the transfer protocols that are supported by the device. The ConnectionManager specification includes a table that identifies which transfer protocols REQUIRE an AVTransport service to be implemented on the MediaServer. If an implementation of the MediaServer supports any of these transfer protocols, then it MUST implement the AVTransport service.

2.2.2 Relationships between Services

The *ConnectionManager::PrepareForConnection()* action provides the trigger point for creating a new virtual instance of the AVTransport service (refer to the AVTransport service specification for a description of virtual instances of the AVTransport service). When a new connection is established (one that REQUIRES an AVTransport service on the MediaServer, which is determined by the selected transfer protocol), the *ConnectionManager::PrepareForConnection()* action returns the *InstanceID* of the virtual instance of the AVTransport service that is bound to that connection. This virtual instance is used by the control point to control the flow (for example, *AVTransport::Play()*, *AVTransport::Seek()*, etc.) of the content to the network. As described in the AVTransport service specification, each virtual instance of the AVTransport service operates independently.

The *ScheduledRecording::CreateRecordSchedule()* action may use objects (such as a User Channel item or an EPG item) exposed by the ContentDirectory service to specify what broadcast content will be recorded. The recorded content may then be exposed by the associated ContentDirectory service.

2.3 Theory of Operation

MediaServer devices are used in conjunction with one or more MediaRenderer devices to allow a control point to discover entertainment (AV) content (for example, video, music, images, etc) on the MediaServer and to render that content on any appropriate MediaRenderer within the home network. In general terms, the process begins with the control points discovering MediaServer and MediaRenderer devices within the home network. The control point interacts with a MediaServer(s) to locate a desired piece of content (for example, a movie, a song, a playlist, a photo album, etc). After the content has been identified, the control point needs to identify a common transfer protocol and data format that can be used to transfer the content from the MediaServer to the desired MediaRenderer. After these transfer parameters have been established, the control point controls the flow of the content (for example,

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS Not for Resale

AVTransport::Play(), *AVTransport::Pause()*, *AVTransport::Stop()*, *AVTransport::Seek()*, etc.) . (Depending on the selected transfer protocol, these flow control operations are sent either to the MediaServer or MediaRenderer, but not both). The actual transfer of the content is performed directly by the MediaServer and MediaRenderer. The content transfer happens independently from the control point and does not involve UPnP itself at all. The control point uses UPnP to setup the transfer of the content, but the transfer is performed using a transfer protocol other than UPnP. MediaServer devices also allow a control point to create a set of selection criteria to record content via the ScheduledRecording service. A control point can also discover recorded content on the MediaServer that was created by such a set of selection criteria.

2.3.1 Device Discovery

Control points can discover MediaServer devices using the standard UPnP SSDP-based device discovery mechanism to search for any device that is a member of the MediaServer device class including *Root* devices and/or *Embedded* devices.

2.3.2 Locating Desired Content

Control points use the MediaServer's ContentDirectory service to locate desired content. The ContentDirectory service exposes both a search capability and a browse capability. Searching is useful when the control point (via the end-user) knows something about the content it wants to find (for example, its name, artist, type, date created, etc). Browsing is useful for blindly discovering what content the device has to offer. Each content item that is referenced by the ContentDirectory service includes various information about that content including the transfer protocol(s) and file format(s) that the MediaServer can use to transfer the content to the MediaRenderer.

2.3.3 Preparing to Transfer the Content

After the desired content has been identified, the control point needs to determine which transfer protocol and data format should be used to transfer the content from the MediaServer to the MediaRenderer. (Transfer protocol examples include IEEE-1394, HTTP GET, RTSP/RTP, etc., and data format examples include MPEG2, MPEG4, MP3, WMA, JPEG, etc.) The control point makes this determination by comparing the content's protocol/format information (obtained via the MediaServer's ContentDirectory service) with the protocol/format information obtained via the MediaRenderer's *ConnectionManager::GetProtocolInfo()* action.

After the transfer protocol and data format have been identified, the control point uses the *ConnectionManager::PrepareForConnection()* action on each device to inform the device that the specified protocol/format are about to be used. Depending on which transfer protocol was selected, the *ConnectionManager::PrepareForConnection()* action on either the MediaServer or MediaRenderer will return an AVTransport *InstanceID* to the control point. This AVTransport *InstanceID* is used by the control point to control the transfer of the content (for example, *AVTransport::Play()*, *AVTransport::Pause()*, *AVTransport::Stop()*, *AVTransport::Seek()*, etc). Refer to the subsection below for more details.

Depending on which transfer protocols are supported by the device (for example, devices that only support HTTP GET), a MediaServer and/or MediaRenderer MAY choose to NOT implement the *ConnectionManager::PrepareForConnection()* action. In this case, the control point may not have been able to obtain an AVTransport *InstanceID* from either device. When this happens, the control point should use an AVTransport *InstanceID* of 0 (zero). If the MediaRenderer has implemented the AVTransport service, the control point should use it for all AVTransport actions.

--`,,```,,,,````-`-`,,`,,`,`,,`---
Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

Otherwise, AVTransport actions should be sent to the MediaServer device. Refer to the ConnectionManager service for more information.

2.3.4 Controlling the Transfer of the Content

In all cases, the control point uses the *InstanceID*, obtained as described above, to control the flow of the content. For example, to begin transferring the content, the control point invokes the *AVTransport::Play()* action. To skip to a specific location within the content, the control point invokes the *AVTransport::Seek()* action. In most cases, the choice of AVTransport actions that are actually invoked will likely be directed by the end-user while interacting with the control point's UI. Refer to the AVTransport service specification for additional details of these and other AVTransport actions.

2.3.5 Recording Content

A control point invokes the *ScheduledRecording::CreateRecordSchedule()* action on a MediaServer device with a set of selection criteria (called a *recordSchedule*) that the device will use to identify the content to record. These criteria are then used to create individual objects (called *recordTask* objects), each containing the information necessary to create a single recording. For example, a *recordSchedule* might hold criteria that select every occurrence of a broadcast series for recording. The ScheduledRecording service then creates a *recordTask* instance for every episode in the series.

After creating one or more *recordSchedule* instances, the control point can browse the list of *recordSchedule* instances and their associated *recordTask* instances using the *ScheduledRecording::BrowseRecordSchedules()* action.

--`,,```,,,,````-`-`,,`,,`,`,,`---

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS Not for Resale

3 XML Device Description

```
<?xml version="1.0"?>
<root xmlns="urn:schemas-upnp-org:device-1-0">
   <specVersion>
      <major>1</major>
      <minor>0</minor>
   </specVersion>
   <URLBase>base URL for all relative URLs</URLBase>
   <device>
      <deviceType>
         urn:schemas-upnp-org:device:MediaServer:2
      </deviceType>
      <friendlyName>short user-friendly title</friendlyName>
      <manufacturer>manufacturer name</manufacturer>
      <manufacturerURL>URL to manufacturer
site</manufacturerURL>
      <modelDescription>long user-friendly
title</modelDescription>
      <modelName>model name</modelName>
      <modelNumber>model number</modelNumber>
      <modelURL>URL to model site</modelURL>
      <serialNumber>manufacturer's serial number</serialNumber>
      <UDN>uuid:UUID</UDN>
      <UPC>Universal Product Code</UPC>
      <iconList>
         <icon>
            <mimetype>image/format</mimetype>
            <width>horizontal pixels</width>
            <height>vertical pixels</height>
            <depth>color depth</depth>
            <url>URL to icon</url>
         </icon>
         XML to declare other icons, if any, go here
      </iconList>
      <serviceList>
         <service>
            <serviceType>
               urn:schemas-upnp-org:service:ContentDirectory:2
            </serviceType>
            <serviceId>
               urn:upnp-org:serviceId:ContentDirectory
            </serviceId>
            <SCPDURL>URL to service description</SCPDURL>
            <controlURL>URL for control</controlURL>
            <eventSubURL>URL for eventing</eventSubURL>
         </service>
         <service>
            <serviceType>
               urn:schemas-upnp-org:service:ConnectionManager:2
            </serviceType>
            <serviceId>
               urn:upnp-org:serviceId:ConnectionManager
            </serviceId>
            <SCPDURL>URL to service description</SCPDURL>
            <controlURL>URL for control</controlURL>
```

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

```
            <eventSubURL>URL for eventing</eventSubURL>
         </service>
         <service>
            <serviceType>
               urn:schemas-upnp-org:service:AVTransport:2
            </serviceType>
            <serviceId>urn:upnp-
org:serviceId:AVTransport</serviceId>
            <SCPDURL>URL to service description</SCPDURL>
            <controlURL>URL for control</controlURL>
            <eventSubURL>URL for eventing</eventSubURL>
         </service>
         <service>
            <serviceType>
               urn:schemas-upnp-org:service:ScheduledRecording:1
            </serviceType>
            <serviceId>
               urn:upnp-org:serviceId:ScheduledRecording
            </serviceId>
            <SCPDURL>URL to service description</SCPDURL>
            <controlURL>URL for control</controlURL>
            <eventSubURL>URL for eventing</eventSubURL>
         </service>
         Declarations for standard non-AV services defined by
UPnP
         (if any) go here
         Declarations for other services added by UPnP vendor
         (if any) go here
      </serviceList>
      <deviceList>
      Description of embedded devices added by UPnP vendor
      (if any) go here
      </deviceList>
      <presentationURL>URL for presentation</presentationURL>
   </device>
</root>
```

--`,,```,,,,````-`-`,,`,,`,`,,`---
Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

4 Test

There are no semantic tests defined for this device.

[1] *R* = REQUIRED, *O* = OPTIONAL, *X* = Non-standard.
[2] Prefixed by urn:**upnp-org**:**serviceId**:

--`,,```,,,,````-`-`,,`,,`,`,,`---

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS

Not for Resale

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

--`,,```,,,,````-`-`,,`,,`,`,,`---

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS

Not for Resale

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

3, rue de Varembé
PO Box 131
CH-1211 Geneva 20
Switzerland

Tel: + 41 22 919 02 11
Fax: + 41 22 919 03 00
info@iec.ch
www.iec.ch

--`,,```,,,,````-`-`,,`,,`,`,,`---

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS

Not for Resale