SMPTE ST 2071-2:2016
Revision of
SMPTE ST 2071-2:2014

SMPTE STANDARD

Media Device Control Protocol (MDCP)

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Foreword

SMPTE (the Society of Motion Picture and Television Engineers) is an internationally-recognized standards developing organization. Headquartered and incorporated in the United States of America, SMPTE has members in over 80 countries on six continents. SMPTE's Engineering Documents, including Standards, Recommended Practices, and Engineering Guidelines, are prepared by SMPTE's Technology Committees. Participation in these Committees is open to all with a bona fide interest in their work. SMPTE cooperates closely with other standards-developing organizations, including ISO, IEC and ITU.

SMPTE Engineering Documents are drafted in accordance with the rules given its Standards Operations Manual.

SMPTE ST 2071-2:2016 was prepared by Technology Committee 34CS.

Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to the implementation of this Engineering Document. However, attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. SMPTE shall not be held responsible for identifying any or all such patent rights.

1 Scope

The Media Device Control (MDC) specification defines a platform and protocol agnostic framework for the control of network-attached devices over Internet Protocol (IP) networks. The framework, known as the Media Device Control Framework (MDCF) defined by SMPTE ST 2071-1, can be implemented with nearly any Internet Protocol based transport protocol, but in order to support interoperability between implementations a single, minimal compliance, transport protocol must be defined. This single, minimal compliance protocol is referred to as the Media Device Control Protocol (MDCP). The Media Device Control Protocol (MDCP) is based on existing industry standards, simplifying the implementation and reducing the cost to implement, while supporting the implementation of vendor specific APIs, third party APIs, protocol extensions and the implementation of many existing standards relating to the control of media devices. Additional protocols may be implemented, but all implementations must implement the Media Device Control Protocol (MDCP) as it is defined within this document. These additional protocols should provide an additional means for controlling devices, but must not be required nor expose functionality that is not available via the Media Device Control Protocol (MDCP).

2 Conformance Notation

Normative text is text that describes elements of the design that are indispensable or contains the conformance language keywords: "shall", "should", or "may". Informative text is text that is potentially helpful to the user, but not indispensable, and can be removed, changed, or added editorially without affecting interoperability. Informative text does not contain any conformance keywords.

All text in this document is, by default, normative, except: the Introduction, any section explicitly labeled as "Informative" or individual paragraphs that start with "Note:"

The keywords "shall" and "shall not" indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

The keywords, "should" and "should not" indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

The keywords "may" and "need not" indicate courses of action permissible within the limits of the document.

The keyword “reserved” indicates a provision that is not defined at this time, shall not be used, and may be defined in the future. The keyword “forbidden” indicates “reserved” and in addition indicates that the provision will never be defined in the future.

A conformant implementation according to this document is one that includes all mandatory provisions ("shall") and, if implemented, all recommended provisions ("should") as described. A conformant implementation need not implement optional provisions ("may") and need not implement them as described.

Unless otherwise specified, the order of precedence of the types of normative information in this document shall be as follows: Normative prose shall be the authoritative definition; Tables shall be next; followed by formal languages; then figures; and then any other language forms.

3 Document Elements

The SMPTE 2071 suite is comprised of the following elements, which form an integral piece of this Standard. Additionally, the WSDL and schema files may be found at http://smpte-ra.org/schemas/2071/2015.

1.	Prose	ST2071-2.docx		[Normative]
2.	XML Schema	st2071-2a.xsd	http://www.smpte-ra.org/schemas/st2071/2015/types	[Normative]
3.	XML Schema	st2071-2b.xsd	http://www.smpte-ra.org/schemas/st2071/2015/identity	[Normative]
4.	XML Schema	st2071-2c.xsd	http://www.smpte-ra.org/schemas/st2071/2015/device	[Normative]
5.	XML Schema	st2071-2d.xsd	http://www.smpte-ra.org/schemas/st2071/2015/session	[Normative]
6.	XML Schema	st2071-2e.xsd	http://www.smpte-ra.org/schemas/st2071/2015/event	[Normative]
7.	XML Schema	st2071-2f.xsd	http://www.smpte-ra.org/schemas/st2071/2015/mode	[Normative]
8.	XML Schema	st2071-2g.xsd	http://www.smpte-ra.org/schemas/st2071/2015/media	[Normative]
9.	XML Schema	st2071-2h.xsd	http://www.smpte-ra.org/schemas/st2071/2015/query	[Normative]
10.	XML Schema	st2071-2i.xsd	http://www.smpte-ra.org/schemas/st2071/2015/security	[Normative]
11.	WSDL	st2071-2j.wsdl	http://www.smpte-ra.org/schemas/st2071/2015/device	[Normative]
12.	WSDL	st2071-2k.wsdl	http://www.smpte-ra.org/schemas/st2071/2015/session	[Normative]
13.	WSDL	st2071-2l.wsdl	http://www.smpte-ra.org/schemas/st2071/2015/event	[Normative]
14.	WSDL	st2071-2m.wsdl	http://www.smpte-ra.org/schemas/st2071/2015/mode	[Normative]
15.	WSDL	st2071-2n.wsdl	http://www.smpte-ra.org/schemas/st2071/2015/media	[Normative]
16.	WSDL	st2071-2o.wsdl	http://www.smpte-ra.org/schemas/st2071/2015/query	[Normative]
17.	WSDL	st2071-2p.wsdl	http://www.smpte-ra.org/schemas/st2071/2015/security	[Normative]
18.	XML Schema	st2071-2q.xsd	http://www.smpte-ra.org/schemas/st2071/2015/service	[Normative]
19.	WSDL	st2071-2r.wsdl	http://www.smpte-ra.org/schemas/st2071/2015/service	[Normative]

4 Normative References

The following standards contain provisions that, through reference in this text, constitute provisions of this recommended practice. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this recommended practice are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

SMPTE ST 2071-1:2016, Media Device Control Framework (MDCF)

IETF RFC 2474, Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers

IETF RFC 3168, The Addition of Explicit Congestion Notification (ECN) to IP

IETF RFC 3246, An Expedited Forwarding PHB

IETF RFC 4122, A Universally Unique Identifier (UUID) URN Namespace

OASIS WS-I BP 1.2, Organization for the Advancement of Structured Information Standards (OASIS) – Web Services Interoperability (WS-I) Basic Profile Version 1.2

5 Messaging Services

Messages are data packets exchanged between nodes for the purpose of executing operations, broadcasting notification events, and exchanging data. The Media Device Control specification defines this exchange of messages as the Media Device Control Protocol (MDCP). The Media Device Control Protocol (MDCP) shall be implemented in accordance to the OASIS Basic Profile 1.2 (OASIS WS-I BP 1.2) web services specification, using the SOAP 1.1 HTTP protocol binding. Service definitions shall be represented using Web Service Definition Language version 1.1 (WSDL 1.1) and may use WS-Addressing 1.0 for the addressing of request and/or response messages.

6 The MDCF Data and Operation Model

In compliance with the OASIS WS-I Basic Profile 1.2 the MDCF data and operation model shall be transposed to XML Schema 1.0 and WSDL 1.1. The WSDL and the corresponding SOAP envelopes shall conform to the requirements outlined in the OASIS WS-I Basic Profile 1.2 and the SOAP 1.1 in HTTP protocol binding.

6.1 Mapping the MDCF Data Model to WSDL

When transposing the MDCF data and operations model to XML 1.0 and WSDL 1.1 the following rules shall apply:

1. MDCF attributes shall be mapped to document-literal port type operations with an operation name equal to the word “get” prepended to the attribute name as it is defined in the MDCF data and operations model. For example, an attribute named “SomeAttribute” would transpose to a port type operation named “getSomeAttribute”. The resulting operation shall accept no input parts and shall specify one output part matching the data type of the attribute.

2. MDCF operations shall be mapped to document-literal port type operations with an operation name equal to the name as it is assigned to the operation in the MDCF data and operations model. For example, an operation named “SomeOperation” would transpose to a port type operation named “SomeOperation”. The resulting operation shall accept only one input part, containing an XML document representing the input parameters of the operation and one output part matching the return type of the operation.

3. Port type operations shall define faults representative of the error conditions that may arise. Errors conditions that invalidate the state of the operation shall terminate the operation and raise the appropriate fault.

4. Each port type operation shall specify a unique WS-Addressing 1.0 compliant *Action* attribute for both the input and output message parts.

6.2 Message Format and Structure

6.2.1 SOAP Envelope

The standard SOAP 1.1 envelope shall be used. The SOAP 1.1 Binding for MTOM 1.0 may be used to transport binary data or improve the performance of large result sets.

6.2.2 SOAP Headers

The web services endpoint may require the support of WS-Addressing 1.0.

6.2.2.1 *MessageID*

The *MessageID* header shall be specified if WS-Addressing 1.0 support is indicated. The *MessageID* shall be a UUID as defined by RFC 4122. For example:

urn:uuid:12345678-1234-1234-1234-123456789abc

6.2.2.2 *To*

The *To* header may be specified if WS-Addressing 1.0 support is indicated. The *To* header shall contain the endpoint address of the SOAP receiver.

6.2.2.3 *ReplyTo*

The *ReplyTo* header may be specified if WS-Addressing 1.0 support is indicated. The *ReplyTo* header shall contain the endpoint address of the SOAP sender.

6.2.2.4 *Action*

The *Action* header shall be specified if WS-Addressing 1.0 support is indicated. The *Action* header shall be derived from the *Action* attribute specified in the WSDL for the operation message part. If no *Action* attribute is specified for the operation message part, the value of the *Action* header shall be derived implicitly from the WSDL, refer to the WS-Addressing 1.0 documentation for specific details.

6.2.2.5 *RelatesTo*

The *RelatesTo* header may be specified if WS-Addressing 1.0 support is indicated. The *RelatesTo* header shall contain the *MessageID* of the corresponding request.

6.2.3 SOAP Body

The SOAP Body shall be specified in accordance to the OASIS WS-I Basic Profile 1.2, containing only one child XML element.

7 Device and Service Web Services

Devices and Services are aggregations of Capabilities, implementing more than one Capability Interface. In order to represent this relationship in WSDL, each Device or Service may be described as a WSDL service. If implemented, the WSDL service shall describe each exposed Capability Interface as a distinct web service endpoint and the URLs attribute of the Device or Service Capability shall contain one or more URLs that facilitate the connection to that interface.

7.1 Device and Service Endpoints

Each Capability Interface shall be exposed as a unique web service endpoint. Each web service endpoint shall be defined as a unique WSDL port type and there shall be a one to one relationship between the Capability Interfaces exposed by a Device or Service and the web service endpoints exposed by that Device or Service. The URLs attribute of the Capability data structure shall contain one or more URLs that facilitate the connection to the web service endpoint represented by that Capability data structure.

8 Map Data Type Representation

The Map data type defined within the MDCF requires a protocol specific binding for the conveyance of the data stored within the values of the Map entries. Therefore, MDCP implementations shall encode the Map entry values using the predefined XML base types. The values shall be stored within the Map entry XML elements encoded as prescribed within Table 1.

Table 1 – Map Entry Value Encoding

Name	Encoding
BOOLEAN	Shall be represented as an XML *string* type. TRUE = “TRUE”, FALSE = “FALSE”.
STRING	Shall be represented as an XML *string* type.
INTEGER	Shall be represented as an XML *string* type.
FLOAT	Shall be represented as an XML *string* type.
DATE_TIME	Shall be represented as an XML *dateTime* type.
URI	Shall be represented as an XML *anyURI* type.
MAP	Shall be represented as an XML *string* type, with escaping of reserved characters.
BLOB	Shall be represented as an XML *base64Binary* type.

9 Internet Protocol Considerations

9.1 The Differentiated Services Field (DS Field)

The Differentiated Services Field (DS Field) [RFC 2474] is an IP header field used to classify IP packets for Quality of Service (QoS) strategies. In order to specify that the MDCP IP packets require low delay, low jitter, and low loss, MDCP implementations should set the value of the DS Field within the IPv4 and IPv6 header to the binary value 101110*xx*, where *x* may be either 0 or 1 (hexadecimal values 0xB8, 0xB9, 0xBA, or 0xBB).

9.2 Explicit Congestion Notification (ECN)

RFC 3168, The Addition of Explicit Congestion Notification (ECN) to IP, defines a method by which bits 6 and 7 of the DS Field are used to indicate network congestion without the dropping of IP packets. MDCP implementations should implement ECN as defined by RFC 3168, but may also implement additional methods of Congestion Notification.

Annex A Network Considerations (Informative)

To facilitate the real-time control of devices and services within the network, Media Device Control Protocol (MDCP) Internet Protocol (IP) packets are expected to have a deterministic low latent period. Meaning that the packets are expected to traverse the network in a minimal amount of time, with little deviation in the inter-packet latencies. However, the same networks that are used for the MDCP are also used for the transmission of large media essence streams that pose a risk to the deterministic low latency requirement of the MDCP. To mitigate this risk, special considerations must be made to provide the network infrastructure with instructions on how to properly handle the MDCP IP packets.

A.1 The Differentiated Services Field (DS Field)

The Differentiated Services Field (DS Field) [RFC 2474] is a replacement header field for the IPv4 TOS octet [RFC 791] and the IPv6 Traffic Class octet [RFC 2460]. The low-order 6 bits (DS_0 – DS_5) of the DS Field are used for the Differentiated Services Codepoint (DSCP) and the 2 high-order bits (DS_6 & DS_7) for the Currently Unused (CU) field. The DSCP is used to specify the Per-Hop Behavior (PHB) that the marked packet will experience at each node within the network (also known as a “hop”) and is capable of representing 64 distinct codepoints, 32 of which are assigned through Standards Action and the remaining 32 are reserved for Local Use. Several standard PHBs have been defined to specify the standard set of routing and forwarding behaviors that can be applied to packets within a network.

A.1.1 RFC 3246 – An Expedited Forwarding PHB (EF PHB)

RFC 3246 – An Expedited Forwarding PHB (EF PHB) specifies the PHB for low delay, low jitter, and low loss network services. The EF PHB is the highest priority PHB that can be assigned to an application level protocol (protocols that are not used to facilitate networking and routing) and is designated with the 6 bit binary value 101110. The EF PHB is regularly used for the audio essence in Voice over IP (VoIP) applications. The MDCP specifies the use of the EF PHB to facilitate its deterministic low-latency requirement. Therefore, the DS Field of a MDCP IP packet header is expected to contain a hexadecimal value of 0xB8, 0xB9, 0xBA, or 0xBB (binary 101110*xx*, where *x* may be either 0 or 1).

A.2 Explicit Congestion Notification (ECN)

Explicit Congestion Notification (ECN) [RFC 3168] provides a mechanism by which network nodes can indicate persistent network congestion, without dropping packets. The ECN specification uses the CU field of the DS Field (the high-order 2 bits of the DS Field) to indicate whether a network node supports ECN and whether the network is experiencing persistent congestion. The following table indicates the meaning of each ECN bit pattern.

Table A.1 – ECN Bit Patterns

ECN Bits		Meaning
0	0	The network node does not support ECN.
0	1	ECN is Supported.
1	0	ECN is Supported.
1	1	ECN is Supported and congestion is present. A packet would have been dropped.

A.2.1 Network Zoning

In most practical applications, special purpose networks, such as device control networks, must coexist and integrate with other functional networks. Each of these functional networks can be viewed as a zone, with each zone having a distinct set of requirements and traffic patterns. When traffic from other network zones crosses the boundary into a device control network, the traffic demarcation indicating the Per-hop Behavior (PHB) of the packets must be altered to prevent the introduction of latency and jitter into the control network. For example, the specification of Voice over IP (VoIP) on general-purpose networks specifies the use of the EF PHB to guarantee that the voice essence is not unduly delayed by other traffic classifications. When such essence traffic crosses into a device control network, the traffic demarcation can be altered so that its PHB for the essence packets is consistent with the PHB demarcations of other essence packets within the network.

Annex B Bibliography (Informative)

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