
**Information technology — Media
context and control —**

**Part 5:
Data formats for interaction devices**

*Technologies de l'information — Contrôle et contexte de supports —
Partie 5: Formats des données pour dispositifs d'interaction*





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Foreword

ISO (the International Organization for Standardization) and IEC (the 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 through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see: www.iso.org/iso/foreword.html.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

This fourth edition cancels and replaces the third edition (ISO/IEC 23005-5:2016), which has been technically revised.

The main changes compared to the previous edition are as follows:

- added new device command type of ThreeDPrinterType;
- added new device command type of SoundDisplaySettingType;
- added new device command type of ThreeDPrintingColorReproductionType;
- added new device command type of ArrayLightType;
- added new sensed information type of RADARSensorType;
- added new sensed information type of RADARSensorType;
- added new sensed information type of ArrayCameraType;
- added new sensed information type of MicrophoneSensorType;

— added new sensed information type of E-NoseSensorType.

A list of all parts in the ISO 23005 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The ISO/IEC 23005 series provides an architecture and specifies information representation of data flowing in and out of the real world and virtual worlds.

The data for the real world are communicated through sensors and actuators. The data for virtual worlds consist of properties of virtual objects and multi-sensorial data embedded in audio-visual content. The ISO/IEC 23005 series specifies data formats for sensors, actuators, virtual objects, and audio-visual content.

Data captured from the real world may need to be adapted for use in a virtual world and data from virtual worlds may also need to be adapted for use in the real world. The standard does not specify how the adaptation is carried out but only specifies the interfaces.

Data for sensors are sensor capabilities, sensed data, and sensor adaptation preferences.

Data for actuators are sensory device capabilities, sensory device commands, and sensory effect preferences.

Data for virtual objects are characteristics of avatars and virtual world objects.

Data for audio-visual content are sensory effects.

This document contains the tools for exchanging information for interaction devices. To be specific, it specifies normative command formats for controlling actuators (e.g., actuator commands for sensory devices) and data formats for receiving information from sensors (e.g., sensed information from sensors) as illustrated as the yellow boxes in Figure 1. It also specifies some non-normative examples. The adaptation engine is not within the scope.

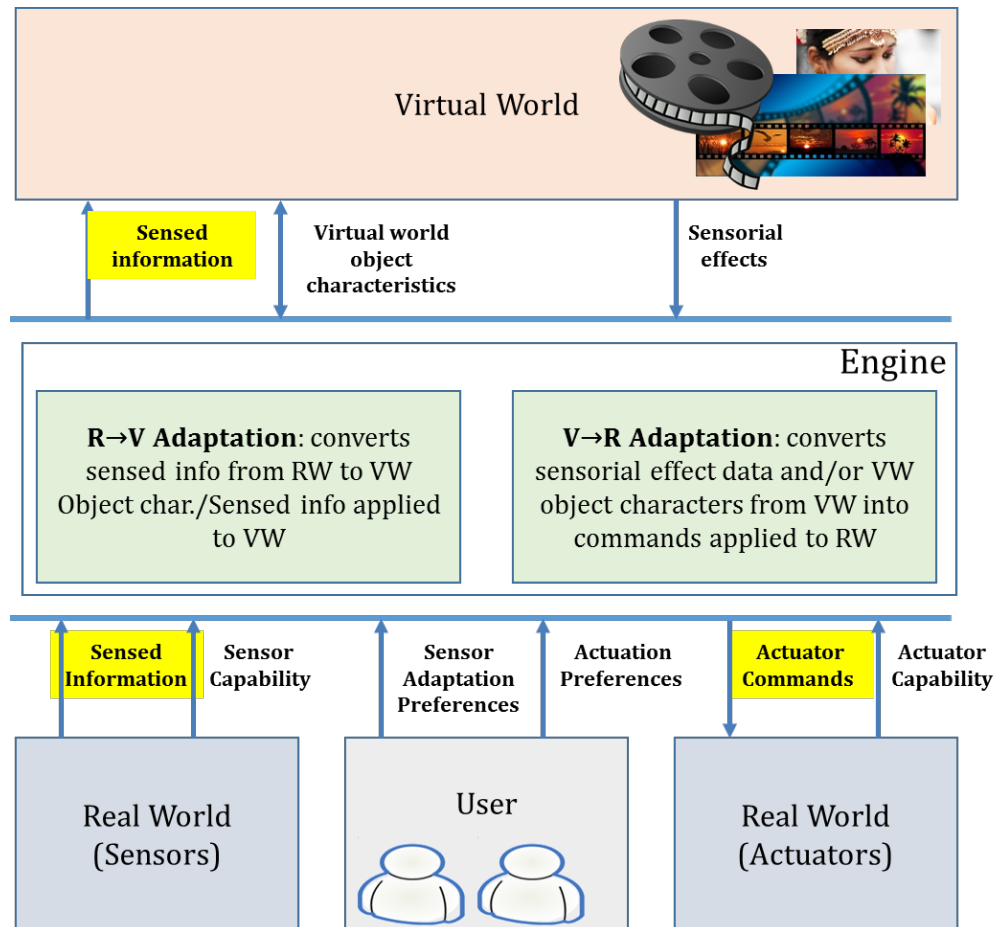


Figure 1 — Scope of the data formats for interaction devices

When this document is used, the adaptation engine (RV or VR engine), which is not within the scope of standardization, performs bi-directional communications using data formats specified in this document. The adaptation engine can also utilize other tools defined in ISO/IEC 23005-2, which are user's sensory preferences (USP), sensory device capabilities (SDC), sensor capabilities (SC), and sensor adaptation preferences (SAP) for fine controlling devices in both real and virtual worlds.

The International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) draw attention to the fact that it is claimed that compliance with this document may involve the use of patents.

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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 below. ISO and the IEC shall not be held responsible for identifying any or all such patent rights.

ISO (www.iso.org/patents) and IEC (<http://patents.iec.ch>) maintain online databases of patents relevant to their standards. Users are encouraged to consult the databases for the most up to date information concerning patents.

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Gwangju Institute of Science and Technology	261 Cheomdan - gwagiro (Oryong-dong), Buk-gu, Gwangju 500-712, Korea
Electronics and Telecommunications Research Institute (ETRI)	218 Gajeongno, Yuseong-gu, Daejeon, 305-700, Korea
Konkuk University	1 Hwayang-dong, Gwangjin-gu, Seoul, 143-701, Korea

Information technology — Media context and control —

Part 5: Data formats for interaction devices

1 Scope

This document specifies syntax and semantics of the data formats for interaction devices by providing a standardized format for interfacing actuators and sensors by defining XML schema-based language named Interaction Information Description Language (IIDL). IIDL provides a basic structure with common information for communication with various actuators and sensors in consistency. Device Command Vocabulary (DCV) is defined to provide a standardized format for commanding individual actuator, and Sensed Information Vocabulary (SIV) is defined to provide a standardized format for holding information from individual sensors either to get environmental information from real world or to influence virtual world objects using the acquired information on the basis of IIDL.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 15938-5:2003, *Information technology — Multimedia content description interface — Part 5: Multimedia description schemes*

ISO/IEC FDIS 23005-6:—¹, *Information technology — Media context and control — Part 6: Common types and tools*

ISO/IEC 10646, *Information technology — Universal Coded Character Set (UCS)*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 23005-6 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.2 Abbreviated terms

CS classification scheme (see ISO/IEC 15938-5)

DAC digital-to-analog conversion

¹ Fourth Edition under preparation. Stage at time of publication: ISO/IEC FDIS 23005-6:2018.

RV	real to virtual
URI	Uniform Resource Identifier (see RFC 2396)
VR	virtual to real
XML	Extensible Markup Language (W3C, http://www.w3.org/XML/)
RW	real world
VW	virtual world

4 Interaction information description language

4.1 General

This Clause describes basic structure of the tools in this document in the form of interaction information description language including the schema wrapper conventions, basic data types, root element, and top-level elements.

4.2 Schema wrapper conventions

The syntax defined in this Clause assumes the following schema wrapper to form a valid XML schema document.

```
<schema xmlns="http://www.w3.org/2001/XMLSchema"
xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004" xmlns:iidl="urn:mpeg:mpeg-v:2018:01-
IIDL-NS" xmlns:mpegvct="urn:mpeg:mpeg-v:2018:01-CT-NS" xmlns:dcv="urn:mpeg:mpeg-
v:2018:01-DCV-NS" xmlns:siv="urn:mpeg:mpeg-v:2018:01-SIV-NS"
targetNamespace="urn:mpeg:mpeg-v:2018:01-IIDL-NS" elementFormDefault="qualified"
attributeFormDefault="unqualified" version="ISO/IEC 23005-5" id="MPEG-V-
IIDL.xsd">
  <import namespace="urn:mpeg:mpeg7:schema:2004"
schemaLocation="http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-
7_schema_files/mpeg7-v2.xsd"/>
  <import namespace="urn:mpeg:mpeg-v:2018:01-CT-NS" schemaLocation="
http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-
V_schema_files/MPEG-V-CT.xsd"/>
  <import namespace="urn:mpeg:mpeg-v:2018:01-DCV-NS"
schemaLocation="http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-
V_schema_files/MPEG-V-DCV.xsd"/>
  <import namespace="urn:mpeg:mpeg-v:2018:01-SIV-NS"
schemaLocation="http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-
V_schema_files/MPEG-V-SIV.xsd"/>
```

Additionally, the following line should be appended to the resulting schema document in order to obtain a well-formed XML document.

```
</schema>
```

For clarity, throughout this document, consistent namespace prefixes are used.

"xsi:" prefix is not normative. It is a naming convention in this document to refer to an element of the <http://www.w3.org/2001/XMLSchema-instance> namespace.

"xml:" and "xmlns:" are normative prefixes defined in Reference [10]. The prefix "xml:" is by definition bound to "http://www.w3.org/XML/1998/namespace". The prefix "xmlns:" is used only for namespace bindings and is not itself bound to any namespace name.

All other prefixes used in either the text or examples of this specification are not normative, e.g., "sedl:", "sev:", "dia:", "si:", "mpeg7:".

In particular, most of the informative examples in this specification are provided as XML fragments without the normally required XML document declaration and, thus, miss a correct namespace binding context declaration. In these descriptions fragments the different prefixes are bound to the namespaces as given in Table 1.

The XML schema defined in this standard is available through appendix 1.

Table 1 — Mapping of prefixes to namespaces in examples and text

Prefix	Corresponding namespace
mpegvct	urn:mpeg:mpeg-v:2018:01-CT-NS
iidl	urn:mpeg:mpeg-v:2018:01-IIDL-NS
dcv	urn:mpeg:mpeg-v:2018:01-DCV-NS
sedl	urn:mpeg:mpeg-v:2018:01-SEDL-NS
sev	urn:mpeg:mpeg-v:2018:01-SEV-NS
dia	urn:mpeg:mpeg21:2003:01-DIA-NS
Si	urn:mpeg:mpeg21:2003:01-DIA-XSI-NS
mpeg7	urn:mpeg:mpeg7:schema:2004
xsi	http://www.w3.org/2001/XMLSchema-instance
xsd	http://www.w3.org/2001/XMLSchema

4.3 Root element and top-level tools

4.3.1 General

This subclause specifies the root elements and the top-level tools which can follow a root element in interactive information. The root elements are the only elements, one of which can appear as the topmost element when the interactive information specified in this document is instantiated. The top-level tools are defined as the elements which are allowed to appear as the topmost element within the root element.

4.3.2 Syntax

```
<!-- ##### -->
<!-- Root and Top-Level Elements -->
<!-- ##### -->
<element name="InteractionInfo" type="iidl:InteractionInfoType"/>
<element name="DeviceCommand" type="iidl:DeviceCommandBaseType"/>
<element name="SensedInfo" type="iidl:SensedInfoBaseType"/>

<complexType name="InteractionInfoType">
  <choice>
    <element name="DeviceCommandList" type="iidl:DeviceCmdListType"/>
    <element name="SensedInfoList" type="iidl:SensedInfoListType"/>
  </choice>
</complexType>

<complexType name="DeviceCmdListType">
  <sequence>
    <element ref="iidl:DeviceCommand" maxOccurs="unbounded"/>
  </sequence>
```

```

</complexType>

<complexType name="SensedInfoListType">
  <sequence>
    <element ref="iidl:SensedInfo" maxOccurs="unbounded"/>
  </sequence>
</complexType>

```

4.3.3 Binary representation syntax

InteractionInfo {	Number of bits	Mnemonic
InteractionType	1	bslbf
If (InteractionType){		
DeviceCommandList		DeviceCmdListType
}else{		
SensedInfoList		SensedInfoListType
}		
}		
SensedInfoListType{		
NumOfSensedInfo	32	uimsbf
for(i=1;i<NumOfSensedInfo;i++){		
IndividualSensedInfoType	8	bslbf
SensedInfo		SensedInfoType specified by IndividualSensedInfoType
}		
}		
}		
DeviceCmdListType{		
NumOfDeviceCmd	32	uimsbf
for(i=1;i<NumOfDeviceCmd;i++){		
IndividualDeviceCmdType	8	bslbf
DeviceCmd		DeviceCmdType specified by

		IndividualDeviceCmdType
}		
}		

4.3.4 Semantics

Semantics of the InteractionInfo type:

<i>Name</i>	<i>Definition</i>
InteractionInfo	One of the root elements that serve as the topmost element in the interaction information description. This element may have DeviceCommandList and SensedInfoList as its subelements.
DeviceCommand	One of the root elements that serve as the topmost element in the interaction information description. It specifies a single command for a certain device. This element can be instantiated as a root element or subelements of DeviceCommandList.
SensedInfo	One of the root elements that serve as the topmost element in the interaction information description. It specifies a single description of information acquired through a sensor. This element can be instantiated as a root element or subelements of SensedInfoList.
InteractionInfoType	The root type provides basic structure that the interaction information description should follow through the root element.
DeviceCommandList	Optional wrapper element that serves as the placeholder for the sequence of device commands.
SensedInfoList	Optional wrapper element that serves as the placeholder for the list of information acquired through sensors (SensedInfo).
DeviceCommandBaseType	DeviceCommandBaseType is an abstract type providing a base for individual command (DeviceCommand).
SensedInfoBaseType	SensedInfoBaseType is an abstract type providing a base for description of individual type of sensor.
InteractionType	This field, which is only present in the binary representation, indicates the type of the InteractionInfo element. If it is "1" then the DeviceCommandList element is present, otherwise the SensedInfoList element is present.
SensedInfoListType	A type that serves as the placeholder for the list of information acquired through sensors.
NumOfSensedInfo	This field, which is only present in the binary representation, specifies the number of SensedInfo instances accommodated in the SensedInfoList.

Name	Definition
IndividualSensedInfoType	This field, which is only present in the binary representation, describes which SenseInfo type shall be used.

In the binary description, the following mapping table is used,

Terms of sensor	Binary representation for sensor type (8 bits)
Light sensor	00000000
Ambient noise sensor	00000001
Temperature sensor	00000010
Humidity sensor	00000011
Distance sensor	00000100
Atmospheric pressure sensor	00000101
Position sensor	00000110
Velocity sensor	00000111
Acceleration sensor	00001000
Orientation sensor	00001001
Angular velocity sensor	00001010
Angular acceleration sensor	00001011
Force sensor	00001100
Torque sensor	00001101
Pressure sensor	00001110
Motion sensor	00001111
Intelligent camera sensor	00010000
MultiInteraction point sensor	00010001
Gaze tacking sensor	00010010
Wind sensor	00010011
Global position sensor	00010100
Altitude sensor	00010101
Bend sensor	00010110
Gas sensor	00010111
Dust sensor	00011000
Body height sensor	00011001

Name	Definition
	Body weight sensor 00011010
	Body temperature sensor 00011011
	Body fat sensor 00011100
	Blood type sensor 00011101
	Blood pressure sensor 00011110
	Blood sugar sensor 00011111
	Blood oxygen sensor 00100000
	Heart rate sensor 00100001
	Electrograph sensor 00100010
	EEG sensor 00100011
	ECG sensor 00100100
	EMG sensor 00100101
	EOG sensor 00100110
	GSR sensor 00100111
	Bio sensor 00101000
	Weather sensor 00101001
	Facial expression sensor 00101010
	Facial morphology sensor 00101011
	Facial expression characteristics sensor 00101100
	Geomagnetic sensor 00101101
	Proximity sensor 00101110
	Switch sensor 00101111
	Camera sensor 00110001
	Spectrum camera sensor 00110010
	Color camera sensor 00110011
	Depth camera sensor 00110100
	Stereo camera sensor 00110101
	Thermographic camera sensor 00110111
	Engine oil temperature sensor 00111000

Name	Definition																																
	<table> <tr> <td>Intake air temperature sensor</td><td>00111001</td></tr> <tr> <td>Tire pressure monitor system sensor</td><td>00111010</td></tr> <tr> <td>Distance traveled sensor</td><td>00111011</td></tr> <tr> <td>Speed sensor</td><td>00111100</td></tr> <tr> <td>Vehicle speed sensor</td><td>00111101</td></tr> <tr> <td>Mass air flow sensor</td><td>00111110</td></tr> <tr> <td>Percentage sensor</td><td>00111111</td></tr> <tr> <td>Fuel level sensor</td><td>01000000</td></tr> <tr> <td>Manifold absolute pressure sensor</td><td>01000001</td></tr> <tr> <td>Engine RPM sensor</td><td>01000010</td></tr> <tr> <td>CoM sensor</td><td>01000011</td></tr> <tr> <td>Radar sensor</td><td>01000100</td></tr> <tr> <td>Array camera sensor</td><td>01000101</td></tr> <tr> <td>Microphone sensor</td><td>01000110</td></tr> <tr> <td>E-nose sensor</td><td>01000111</td></tr> <tr> <td>Reserved</td><td>01001000-11111111</td></tr> </table>	Intake air temperature sensor	00111001	Tire pressure monitor system sensor	00111010	Distance traveled sensor	00111011	Speed sensor	00111100	Vehicle speed sensor	00111101	Mass air flow sensor	00111110	Percentage sensor	00111111	Fuel level sensor	01000000	Manifold absolute pressure sensor	01000001	Engine RPM sensor	01000010	CoM sensor	01000011	Radar sensor	01000100	Array camera sensor	01000101	Microphone sensor	01000110	E-nose sensor	01000111	Reserved	01001000-11111111
Intake air temperature sensor	00111001																																
Tire pressure monitor system sensor	00111010																																
Distance traveled sensor	00111011																																
Speed sensor	00111100																																
Vehicle speed sensor	00111101																																
Mass air flow sensor	00111110																																
Percentage sensor	00111111																																
Fuel level sensor	01000000																																
Manifold absolute pressure sensor	01000001																																
Engine RPM sensor	01000010																																
CoM sensor	01000011																																
Radar sensor	01000100																																
Array camera sensor	01000101																																
Microphone sensor	01000110																																
E-nose sensor	01000111																																
Reserved	01001000-11111111																																
DeviceCommandListType	A type that serves as the placeholder for the sequence of device commands.																																
NumOfDeviceCmd	This field, which is only present in the binary representation, specifies the number of DeviceCmd instances accommodated in the DeviceCommandList.																																
IndividualDeviceCmdType	This field, which is only present in the binary representation, describes which DeviceCmd type shall be used. In the binary description, the following mapping table is used, <table> <tr> <th>Terms of device</th><th>Binary representation for device type (8bits)</th></tr> <tr> <td>Light device</td><td>00000000</td></tr> <tr> <td>Flash device</td><td>00000001</td></tr> <tr> <td>Heating device</td><td>00000010</td></tr> <tr> <td>Cooling device</td><td>00000011</td></tr> <tr> <td>Wind device</td><td>00000100</td></tr> </table>	Terms of device	Binary representation for device type (8bits)	Light device	00000000	Flash device	00000001	Heating device	00000010	Cooling device	00000011	Wind device	00000100																				
Terms of device	Binary representation for device type (8bits)																																
Light device	00000000																																
Flash device	00000001																																
Heating device	00000010																																
Cooling device	00000011																																
Wind device	00000100																																

Name	Definition
Vibration device	00000101
Sprayer device	00000110
Scent device	00000111
Fog device	00001000
Color correction device	00001001
Initialize color correction parameter device	00001010
Rigid body motion device	00001011
Tactile device	00001100
Kinesthetic device	00001101
Global position command device	00001110
Bubble device	00001111
3D printer device	00010000
Sound display setting device	00010001
3D printing color reproduction device	00010010
Array light device	00010011
Reserved	00010100-11111111

4.3.5 Examples

The following shows two use cases of InteractionInfo element, which are for listing device commands and for listing sensed informations.

The first example shows the case when the InteractionInfo is used for DeviceCommandList.

```
<iidl:InteractionInfo xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004" xmlns:mpegvct="urn:mpeg:mpeg-v:2017:01-
CT-NS" xmlns:iidl="urn:mpeg:mpeg-v:2018:01-IIDL-NS" xmlns:dcv="urn:mpeg:mpeg-
v:2018:01-DCV-NS" xsi:schemaLocation="urn:mpeg:mpeg-v:2018:01-DCV-NS
http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-
V_schema_files/MPEG-V-DCV.xsd">
  <iidl:DeviceCommandList>
    <iidl:DeviceCommand xsi:type="dcv:FogType" activate="true"
deviceIdRef="fdc1" id="command1" intensity="20"/>
    ...
    <iidl:DeviceCommand xsi:type="dcv:..." .../>
    ...
  </iidl:DeviceCommandList>
</iidl:InteractionInfo>
```

The second example shows the case when the InteractionInfo is used for SensedInfoList.

```
<iidl:InteractionInfo xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004" xmlns:mpegvct="urn:mpeg:mpeg-v:2018:01-
CT-NS" xmlns:iidl="urn:mpeg:mpeg-v:2018:01-IIDL-NS" xmlns:siv="urn:mpeg:mpeg-
v:2018:01-SIV-NS" xsi:schemaLocation="urn:mpeg:mpeg-v:2018:01-SIV-NS
http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-
V_schema_files/MPEG-V-SIV.xsd">
  <iidl:SensedInfoList>
    <iidl:SensedInfo xsi:type="a_type_derived_from_SensedInfoBaseType" .../>
    ...
    <iidl:SensedInfo xsi:type="siv:AccelerationSensorType" .../>
    ...
  </iidl:SensedInfoList>
</iidl:InteractionInfo>
```

The third example shows the case when the DeviceCommand is used directly as the root element.

```
<iidl:DeviceCommand xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004" xmlns:mpegvct="urn:mpeg:mpeg-v:2018:01-
CT-NS" xmlns:dcv="urn:mpeg:mpeg-v:2018:01-DCV-NS" xmlns:iidl="urn:mpeg:mpeg-
v:2018:01-IIDL-NS" xsi:schemaLocation="urn:mpeg:mpeg-v:2018:01-DCV-NS
http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-
V_schema_files/MPEG-V-DCV.xsd" xsi:type="dcv:LightType" id="light1"
color="urn:mpeg:mpeg-v:01-SI-ColorCS-NS:red" intensity="5">
  <iidl:TimeStamp xsi:type="mpegvct:AbsoluteTimeType" absTime="1:30:23"/>
</iidl:DeviceCommand>
```

The fourth example shows the case when the SensedInfo is used directly as the root element.

```
<iidl:SensedInfo xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004" xmlns:mpegvct="urn:mpeg:mpeg-v:2018:01-
CT-NS" xmlns:iidl="urn:mpeg:mpeg-v:2018:01-IIDL-NS" xmlns:siv="urn:mpeg:mpeg-
v:2018:01-SIV-NS" xsi:schemaLocation="urn:mpeg:mpeg-v:2018:01-SIV-NS
http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-
V_schema_files/MPEG-V-SIV.xsd" xsi:type="siv:LightSensorType" id="LS001"
sensorIdRef="LSID001" activate="true" value="200" color="#FF0000">
  <iidl:TimeStamp xsi:type="mpegvct:ClockTickTimeType" timeScale="1000"
pts="6000000"/>
</iidl:SensedInfo>
```

Note that these examples are only showing a part of the complete XML description to show the use of the root element, InteractionInfo, with the choice of DeviceCommandList or SensedInfoList.

4.4 Device commands

4.4.1 General

This subclause specifies tools for describing actions that each individual device (actuators) is supposed to take. Instances of following device commands defined in this Clause may be generated as an output of the VR engine and used to drive actuators. In 4.4.3, an abstract complex type of DeviceCommandBaseType is defined, which the device command types of individual device should inherit.

4.4.2 Reference coordinate system

The origin of the reference coordinate for actuators is located at the position of the user as depicted in Figure 2. Each axis is defined as follows. X-axis is in the direction of the left-hand side of the user facing the screen. Y-axis is in the reverse direction of gravity. Z-axis is in the direction of the user's facing the screen. Rotating clockwise along the X-axis is defined as pitch, rotating clockwise along the Y-axis is defined as yaw, and rotating clockwise along the Z-axis is defined as roll.

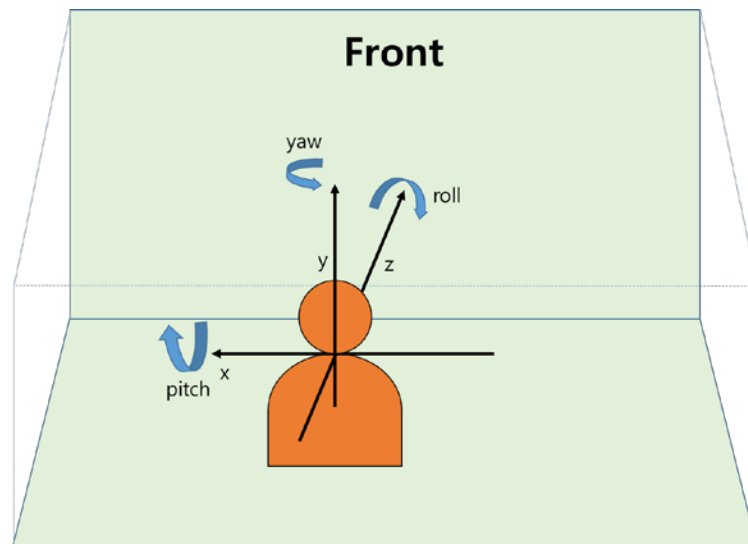


Figure 2 — Reference coordinate system for actuators

4.4.3 Device command base type

4.4.3.1 Syntax

```
<!-- ##### -->
<!-- Device command base type -->
<!-- ##### -->
<complexType name="DeviceCommandBaseType" abstract="true">
  <sequence>
    <element name="TimeStamp" type="mpegvct:TimeStampType"/>
  </sequence>
  <attributeGroup ref="iidl:DeviceCmdBaseAttributes"/>
</complexType>
```

4.4.3.2 Binary representation syntax

DeviceCommandBaseType{	Number of bits	Mnemonic
TimeStamp		TimeStampType
DeviceCmdBaseAttributes		DeviceCmdBaseAttributesType
}		

4.4.3.3 Semantics

Semantics of the DeviceCommandBaseType:

Name	Definition										
DeviceCommandBaseType	Provides the topmost type of the base type hierarchy which each individual device command can inherit.										
TimeStamp	Provides the timing information for the device command to be executed. As defined in ISO/IEC 23005-6:—, 4.7 ² , there is a choice of selection among three timing schemes, which are absolute time, clocktick time, and delta of clock tick time.										
DeviceCmdBaseAttributes	Describes a group of attributes for the commands.										
TimeStampType	This field, which is only present in the binary representation, describes which time stamp scheme shall be used. "1" means that the absolute time stamp type shall be used, "2" means that the clock tick time stamp type shall be used, and "3" means that the clock tick time delta stamp type shall be used. "0" is reserved. <table> <tr> <th>TimeStampSelect</th><th>Type Stamp Type</th></tr> <tr> <td>00</td><td>Reserved</td></tr> <tr> <td>01</td><td>AbsoluteTimeType</td></tr> <tr> <td>10</td><td>ClockTickTimeType</td></tr> <tr> <td>11</td><td>ClockTickTimeDeltaType</td></tr> </table>	TimeStampSelect	Type Stamp Type	00	Reserved	01	AbsoluteTimeType	10	ClockTickTimeType	11	ClockTickTimeDeltaType
TimeStampSelect	Type Stamp Type										
00	Reserved										
01	AbsoluteTimeType										
10	ClockTickTimeType										
11	ClockTickTimeDeltaType										
AbsoluteTimeType	The absolute time stamp is defined in ISO/IEC 23005-6:—, 4.7.										
ClockTickTimeType	The clock tick time stamp is defined in ISO/IEC 23005-6:—, 4.7.										
ClockTickTimeDeltaType	The clock tick time delta stamp, which value is the time delta between the present and the past time, is defined in ISO/IEC 23005-6:—, 4.7.										

4.4.3.4 Examples

For the examples of the DeviceCommandBaseType, please see the examples of individual types of device commands.

4.4.4 Device command base attributes

4.4.4.1 Syntax

```

<!-- ##### -->
<!-- Definition of Device Command Base Attributes -->
<!-- ##### -->
<attributeGroup name="DeviceCmdBaseAttributes">
  <attribute name="id" type="ID" use="optional"/>
  <attribute name="deviceIdRef" type="anyURI" use="optional"/>
  <attribute name="activate" type="boolean" use="optional" default="true"/>
</attributeGroup>

```

² Fourth Edition under preparation. Stage at time of publication: ISO/IEC FDIS 23005-6:2018.

4.4.4.2 Binary representation syntax

DeviceCmdBaseAttributesType{	Number of bits	Mnemonic
idFlag	1	Bslbf
deviceIdRefFlag	1	Bslbf
activateFlag	1	Bslbf
if(idFlag) {		
id	See ISO/IEC 10646	UTF-8
}		
if(deviceIdRefFlag) {		
deviceIdRef	See ISO/IEC 10646	UTF-8
}		
if(activateFlag) {		
activate	1	bslbf
}		
}		

4.4.4.3 Semantics

Semantics of the DeviceCmdBaseAttributes:

Name	Definition
DeviceCmdBaseAttributes	Specifies the common attributes for any type inherits from the DeviceCommandBaseType.
id	To be used to identify each individual device command.
deviceIdRef	To specify an individual device to which the command is associated.
activate	Describes whether the effect shall be activated. A value of true means the device shall be activated (switch on) and false means the device shall be deactivated (switch off).
DeviceCmdBaseAttributesType	Provides the topmost type of the base type hierarchy which the attributes of each individual device command can inherit.
idFlag	This field, which is only present in the binary representation, signals the presence of the id attribute. A value of "1" means the attribute shall be used and "0" means the attribute shall not be used.

Name	Definition
deviceIdRefFlag	This field, which is only present in the binary representation, signals the presence of the sensor ID reference attribute. A value of "1" means the attribute shall be used and "0" means the attribute shall not be used.
activateFlag	This field, which is only present in the binary representation, signals the presence of the activation attribute. A value of "1" means the attribute shall be used and "0" means the attribute shall not be used.

4.4.4.4 Examples

The following is a snippet of an XML document showing the use of the DeviceCmdBaseAttributes. It shows a device command specified by the identifier of command1 to activate a device type *any_specific_device_command_type* with device identifier fdc1.

```
<iidl:InteractionInfo>
  <iidl:DeviceCommandList>
    <iidl:DeviceCommand xsi:type="dcv:any_specific_device_command_type"
activate="true" deviceIdRef="fdc1" id="command1"/>
    ...
  </iidl:DeviceCommandList>
</iidl:InteractionInfo>
```

4.5 Sensed information description tools

4.5.1 General

This subclause specifies tools for describing information acquired through each individual sensor. Instances of following sensed information defined in this Clause may be generated as an output of the sensors. The following subclause defines an abstract complex type of *SensedInfoBaseType*, which the sensed information types for each individual sensor should inherit.

4.5.2 Global coordinate for sensors

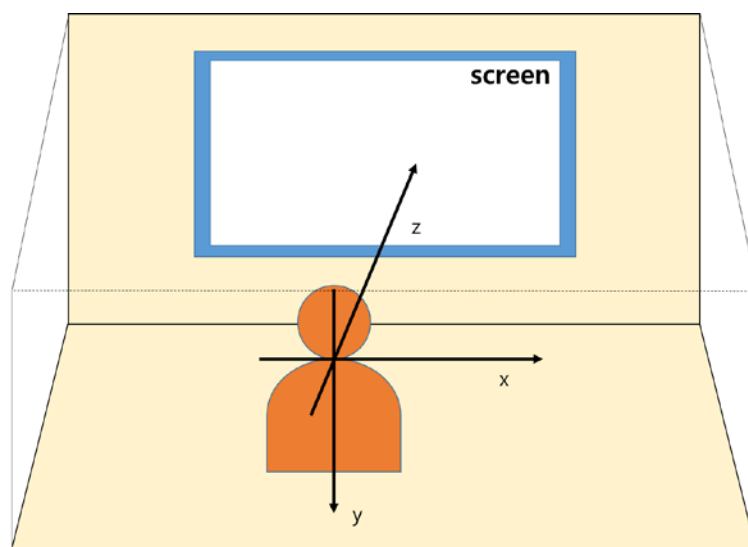


Figure 3 — Reference coordinate for sensors

The reference coordinate for sensors is defined adapting the right-handed coordinate system. Each axis is defined as follows: Y-axis is in the direction of gravity; Z-axis is in the direction of user's front (in common sense) which is orthogonal to the y-axis; X-axis is in the direction of user's right side which is also orthogonal to both y-axis and z-axis. The x-, y-, and z-axis are depicted in Figure 3. The default origin of the reference coordinate for sensors is the position of the user. The origin of the coordinate system differs depending on the type of the sensor.

4.5.3 Sensed information base type

4.5.3.1 Syntax

```
<!-- ##### -->
<!-- Sensed information base type -->
<!-- ##### -->
<complexType name="SensedInfoBaseType" abstract="true">
  <sequence>
    <element name="TimeStamp" type="mpegvct:TimeStampType" minOccurs="0"/>
  </sequence>
  <attributeGroup ref="iidl:sensedInfoBaseAttributes"/>
</complexType>
```

4.5.3.2 Binary representation syntax

SensedInfoBaseTypeType{	<i>Number of bits</i>	<i>Mnemonic</i>
TimeStampFlag	1	bslbf
SensedInfoBaseAttributes		SensedInfoBaseAttributesType
If(TimeStampFlag){		
TimeStamp		TimeStampType
}		
}		

4.5.3.3 Semantics

Semantics of the SensedInfoListType:

<i>Name</i>	<i>Definition</i>
SensedInfoBaseType	Provides the topmost type of the base type hierarchy which each individual sensed information can inherit.
sensedInfoBaseAttributes	Describes a group of attributes for the sensed information.
TimeStamp	Provides the time information at which the sensed information is acquired. As defined in ISO/IEC 23005-6, there is a choice of selection among three timing schemes, which are absolute time, clocktick time, and delta of clock tick time.

Name	Definition
TimeStampFlag	This field, which is only present in the binary representation, signals the presence of the TimeStamp element. A value of "1" means the element shall be used and "0" means the element shall not be used.

4.5.4 Sensed information base attributes

4.5.4.1 Syntax

```

<!-- ##### -->
<!-- Definition of Sensed Information Base Attributes -->
<!-- ##### -->
<attributeGroup name="sensedInfoBaseAttributes">
  <attribute name="id" type="ID" use="optional"/>
  <attribute name="sensorIdRef" type="anyURI" use="optional"/>
  <attribute name="linkedlist" type="anyURI" use="optional"/>
  <attribute name="groupId" type="anyURI" use="optional"/>
  <attribute name="activate" type="boolean" use="optional"/>
  <attribute name="priority" type="nonNegativeInteger" use="optional"
default="0"/>
</attributeGroup>

```

4.5.4.2 Binary representation syntax

SensedInfoBaseAttributesType{	Number of bits	Mnemonic
idFlag	1	bslbf
sensorIdRefFlag	1	bslbf
linkedlistFlag	1	bslbf
groupIdFlag	1	bslbf
priorityFlag	1	bslbf
activateFlag	1	bslbf
If(idFlag) {		
id	See ISO/IEC 10646	UTF-8
}		
if(sensorIdRefFlag) {		
sensorIdRef	See ISO/IEC 10646	UTF-8
}		
if(linkedlistFlag) {		

linkedList	See ISO/IEC 10646	UTF-8
}		
if(groupIdFlag) {		
groupId	See ISO/IEC 10646	UTF-8
}		
if(priorityFlag) {		
priority	32	uimsbf
}		
if(activateFlag) {		
activate	1	bslbf
}		
}		

4.5.4.3 Semantics

Semantics of the sensedInfoBaseAttributes:

<i>Name</i>	<i>Definition</i>
sensedInfoBaseAttributes	Describes a group of attributes for the commands.
id	Unique identifier for identifying individual sensed information
sensorIdRef	References a sensor that has generated the information included in this specific sensed information.
linkedList	Describes the multi-sensor structure that consists of a group of sensors in a way that each record contains a reference to the ID of the next sensor.
groupId	Identifier for a group multi-sensor structure to which this specific sensor belongs.
activate	Describes whether the sensor shall be activated. A value of "true" means the sensor shall be activated and "false" means the sensor shall be deactivated. In the binary representation, A value of "1" means the sensor shall be activated and "0" means the sensor shall be deactivated.

Name	Definition
priority	Describes a priority for sensed information with respect to other sensed information sharing the same point in time when the sensed information becomes adapted. A value of one indicates the highest priority and larger values indicate lower priorities. The default value of the priority is one. If there are more than one sensed information with the same priority, the order of process can be determined by the Adaptation engine itself. NOTE The priority might be used to apply the sensed information on the virtual world object characteristics – defined within a group of sensors – according to the capabilities of the adaptation VR. EXAMPLE The adaptation RV processes the individual sensed information of a group of sensors according to their priority in descending order due to its limited capabilities. That is, the sensed information with the lower priority might get lost.
SensedInfoBaseAttributes Type	Tool for describing sensed information base attributes.
IDFlag	This field, which is only present in the binary representation, signals the presence of the ID attribute. A value of “1” means the attribute shall be used and “0” means the attribute shall not be used.
sensorIdRefFlag	This field, which is only present in the binary representation, signals the presence of the sensor ID reference attribute. A value of “1” means the attribute shall be used and “0” means the attribute shall not be used.
linkedlistFlag	This field, which is only present in the binary representation, signals the presence of the linked list attribute. A value of “1” means the attribute shall be used and “0” means the attribute shall not be used.
groupIDFlag	This field, which is only present in the binary representation, signals the presence of the group ID attribute. A value of “1” means the attribute shall be used and “0” means the attribute shall not be used.
priorityFlag	This field, which is only present in the binary representation, signals the presence of the priority attribute. A value of “1” means the attribute shall be used and “0” means the attribute shall not be used.
activateFlag	This field, which is only present in the binary representation, signals the presence of the activation attribute. A value of “1” means the attribute shall be used and “0” means the attribute shall not be used.

4.5.4.4 Examples

The example of the BaseAttributes is given in the examples of sensed information vocabulary.

5 Device command vocabulary

5.1 General

This Clause describes syntax and semantics of the device command vocabulary to implement commanding of individual devices.

This Clause also describes the binary representation of each individual device command. There are two possible modes for the devices requiring a high speed update rate and large data, such as color correction type, rigid body motion type, and tactile type, can utilize the update mode in addition to the normal mode. The device commands with the update mode parse the elements, which values are different from their corresponding values in the previous device command.

5.2 Schema wrapper conventions

The syntax defined in this Clause assumes the following schema wrapper to form a valid XML schema document.

```
<schema xmlns="http://www.w3.org/2001/XMLSchema"
  xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004" xmlns:dcv="urn:mpeg:mpeg-v:2018:01-DCV-
  NS" xmlns:iidl="urn:mpeg:mpeg-v:2018:01-IIDL-NS" xmlns:mpegvct="urn:mpeg:mpeg-
  v:2017:01-CT-NS" targetNamespace="urn:mpeg:mpeg-v:2018:01-DCV-NS"
  elementFormDefault="qualified" attributeFormDefault="unqualified"
  version="ISO/IEC 23005-5" id="MPEG-V-DCV.xsd">
  <import namespace="urn:mpeg:mpeg-v:2018:01-IIDL-NS"
  schemaLocation="http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-
  V_schema_files/MPEG-V-IIDL.xsd"/>
  <import namespace="urn:mpeg:mpeg7:schema:2004"
  schemaLocation="http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-
  7_schema_files/mpeg7-v2.xsd"/>
  <import namespace="urn:mpeg:mpeg-v:2018:01-CT-NS"
  schemaLocation="http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-
  V_schema_files/MPEG-V-CT.xsd"/>
```

Additionally, the following line should be appended to the resulting schema document in order to obtain a well-formed XML document.

```
</schema>
```

5.3 Light type

5.3.1 General

This subclause specifies a device command type which can generate a light effect. The properties of the command can be generated by the adaptation engine, which is combining the light effect specified by ISO/IEC 23005-3 with the user preference toward the light effect and the light device capabilities specified by ISO/IEC 23005-2.

5.3.2 Syntax

```

<!-- ##### -->
<!-- Definition of DCV light type -->
<!-- ##### -->
<complexType name="LightType">
  <complexContent>
    <extension base="iidl:DeviceCommandBaseType">
      <attribute name="color" type="mpegvct:colorType" use="optional"/>
      <attribute name="intensity" type="integer" use="optional"/>
    </extension>
  </complexContent>
</complexType>

```

5.3.3 Binary representation syntax

LightType{	Number of bits	Mnemonic
colorFlag	1	bslbf
intensityFlag	1	bslbf
DeviceCommandBase		DeviceCommandBaseType
if(colorFlag) {		
color	8	colorType
}		
if(intensityFlag) {		
intensity	7	uimsbf
}		
}		

colorType {	Number of bits	Mnemonic
NamedcolorFlag	1	
If(NamedcolorFlag) {		
NamedColorType	9	bslbf
} else {		
colorRGBType	6	Bslbf
}		
}		

5.3.4 Semantics

Semantics of the LightType:

Name	Definition
LightType	Tool for describing a command for a lighting device to follow.
color	Describes the list of colors, which the lighting device can provide, that shall be used either as a reference to a classification scheme term using the mpeg7:termReferenceType defined in ISO/IEC 15938-5:2003, 7.6 or as RGB value. A CS that may be used for this purpose is the ColorCS defined in ISO/IEC 23005-6:—, A.2.2. The binary representation of the ColorCS is defined in ISO/IEC 23005-6:—, A.2.2. EXAMPLE 1 urn:mpeg:mpeg-v:01-SI-ColorCS-NS:alice_blue would describe the color Alice blue. EXAMPLE 2 The RGB representation of the color Alice blue is #F0F8FF.
	Describes the intensity that the lighting device shall emit in percentage with respect to the maximum intensity that the specific device can generate.
colorFlag	This field, which is only present in the binary representation, signals the presence of color attribute. A value of “1” means the attribute shall be used and “0” means the attribute shall not be used.
intensityFlag	This field, which is only present in the binary representation, signals the presence of device command attribute. A value of “1” means the attribute shall be used and “0” means the attribute shall not be used.
DeviceCommandBase	Provides the topmost type of the base type hierarchy which each individual device command can inherit.
NamedcolorFlag	This field, which is only present in the binary representation, indicates a choice of the color descriptions. If it is 1 then the color is described by mpeg7:termReferenceType, otherwise the color is described by colorRGBType.
NamedColorType	This field, which is only present in the binary representation, describes color in terms of ColorCS Flag defined in ISO/IEC 23005-6:—, A.2.2.
colorRGBType	This field, which is only present in the binary representation, describes color in terms of colorRGBType.

5.3.5 Examples

This example shows the description of a device command of light effect with the following semantics. The displaying device for the light effect is “light1”. The intensity shall be 5 % with the color “red” from the classification scheme described in ISO/IEC 23005-6:—, A.2.2.

```

<iidl:InteractionInfo>
  <iidl:DeviceCommandList>
    <iidl:DeviceCommand xsi:type="dcv:LightType" id="light1"
color="urn:mpeg:mpeg-v:01-SI-ColorCS-NS:red" intensity="5">
      <iidl:TimeStamp xsi:type="mpegvct:AbsoluteTimeType" absTime="1:30:23"/>
    </iidl:DeviceCommand>
  </iidl:DeviceCommandList>
</iidl:InteractionInfo>

```

5.4 Flash type

5.4.1 General

This subclause specifies a device command type which can generate a flash effect. The properties of the command can be generated by the adaptation engine, which is combining the flash effect specified by ISO/IEC 23005-3 with the user preference toward the flash effect and the flash device capabilities specified by ISO/IEC 23005-2.

5.4.2 Syntax

```

<!-- ##### -->
<!-- Definition of DCV flash type -->
<!-- ##### -->
<complexType name="FlashType">
  <complexContent>
    <extension base="dcv:LightType">
      <attribute name="frequency" type="positiveInteger" use="optional"/>
    </extension>
  </complexContent>
</complexType>

```

5.4.3 Binary representation syntax

FlashType{	<i>Number of bits</i>	<i>Mnemonic</i>
frequencyFlag	1	Bslbf
Light		LightType
if(frequencyFlag) {		
frequency	7	Uimsbf
}		
}		

5.4.4 Semantics

Semantics of the FlashType:

Name	Definition
FlashType	Tool for describing a flash device command.
intensity	Describes the intensity of the flash effect in terms of illumination in percentage with respect to the maximum light intensity that the specific device can generate.
frequency	Describes the number of flickering in percentage with respect to the maximum frequency that the specific flash device can generate.
Color	Describes the color of the flash effect as a reference to a classification scheme term or as RGB. A CS that may be used for this purpose is the ColorCS defined in ISO/IEC 23005-6:—, A.2.2. The binary representation of the ColorCS is defined in ISO/IEC 23005-6:—, A.2.2. EXAMPLE 1 urn:mpeg:mpeg-v:01-SI-ColorCS-NS:alice_blue would describe the color Alice blue. EXAMPLE 2 The RGB representation of the color Alice blue is #F0F8FF.
frequencyFlag	This field, which is only present in the binary representation, signals the presence of frequency. A value of "1" means the attribute shall be used and "0" means the attribute shall not be used.

5.4.5 Examples

This example shows the description of a device command of flash effect with the following semantics. The displaying device for the flash effect is "flash1". The intensity shall be 5% of the maximum intensity of "flash1", while the frequency is 10 % of the maximum frequency of "flash1".

```
<InteractionInfo>
  <iidl:DeviceCommandList>
    <iidl:DeviceCommand xsi:type="dvc:FlashType" id="flash1"
      color="urn:mpeg:mpeg-v:01-SI-ColorCS-NS:red" intensity="5"
      frequency="10">
      <iidl:TimeStamp xsi:type="mpegvct:AbsoluteTimeType" absTime="1:30:23"/>
    </iidl:DeviceCommand>
  </iidl:DeviceCommandList>
</InteractionInfo>
```

5.5 Heating type

5.5.1 General

This subclause specifies a device command type which can generate a heating effect. The properties of the command can be generated by the adaptation engine, which is combining the heating effect specified by ISO/IEC 23005-3 with the user preference toward the heating effect and the heating device capabilities specified by ISO/IEC 23005-2.

5.5.2 Syntax

```

<!-- ##### -->
<!-- Definition of DCV heating type -->
<!-- ##### -->
<complexType name="HeatingType">
  <complexContent>
    <extension base="iidl:DeviceCommandBaseType">
      <attribute name="intensity" type="integer" use="optional"/>
    </extension>
  </complexContent>
</complexType>

```

5.5.3 Binary representation syntax

HeatingType{	Number of bits	Mnemonic
intensityFlag	1	bslbf
DeviceCommandBase		DeviceCommandBaseType
if(intensityFlag) {		
intensity	7	uimsbf
}		
}		

5.5.4 Semantics

Semantics of the HeatingType:

Name	Definition
HeatingType	Tool for describing a command for heating device.
intensity	Describes the intensity of the temperature effect of heating in percentage with respect to the capable range of temperature control. If the intensity is not specified, this command shall be interpreted as turning on at the maximum intensity. EXAMPLE If the device can control temperature between 20 and 40 °C, intensity of 20 % means the intensity of 24 °C.
intensityFlag	This field, which is only present in the binary representation, signals the presence of device command attribute. A value of "1" means the attribute shall be used and "0" means the attribute shall not be used.
DeviceCommandBase	Provides the topmost type of the base type hierarchy which each individual device command can inherit.

5.5.5 Examples

This example shows the description of a device command of heating effect with the following semantics. The identifier for this command is "heater1" and the identifier for the heating device for which this command is issued is "heater001". The intensity shall be 28 % of the maximum intensity of "heater001."

```
<iidl:InteractionInfo>
  <iidl:DeviceCommandList>
    <iidl:DeviceCommand xsi:type="dcv:HeatingType" id="heater1"
      deviceIdRef="heater001" activate="true" intensity="28">
      <iidl:TimeStamp xsi:type="mpegvct:AbsoluteTimeType" absTime="1:30:23"/>
    </iidl:DeviceCommand>
  </iidl:DeviceCommandList>
</iidl:InteractionInfo>
```

5.6 Cooling type

5.6.1 General

This subclause specifies a device command type which can generate a cooling effect. The properties of the command can be generated by the adaptation engine, which is combining the cooling effect specified by ISO/IEC 23005-3 with the user preference toward the cooling effect and the cooling device capabilities specified by ISO/IEC 23005-2.

5.6.2 Syntax

```
<!-- ##### -->
<!-- Definition of DCV cooling type -->
<!-- ##### -->
<complexType name="CoolingType">
  <complexContent>
    <extension base="iidl:DeviceCommandBaseType">
      <attribute name="intensity" type="integer" use="optional"/>
    </extension>
  </complexContent>
</complexType>
```

5.6.3 Binary representation syntax

CoolingType{	Number of bits	Mnemonic
intensityFlag	1	bslbf
DeviceCommandBase		DeviceCommandBaseType
if(intensityFlag) {		
intensity	7	uimsbf
}		
}		

5.6.4 Semantics

Semantics of the CoolingType:

Name	Definition
CoolingType	Tool for describing a command for cooling device
intensity	Describes the intensity of the temperature effect of cooling in percentage with respect to the capable range of temperature control. The larger intensity value the CoolingType description has, the cooler the environment is intended to be driven. If the intensity is not specified, this command shall be interpreted as turning on at the maximum intensity. EXAMPLE If the device can create cooling effect from 30 to 10 °C, intensity of 20 % means the intensity of 26 °C.
intensityFlag	This field, which is only present in the binary representation, signals the presence of device command attribute. A value of "1" means the attribute shall be used and "0" means the attribute shall not be used.
DeviceCommandBase	Provides the topmost type of the base type hierarchy which each individual device command can inherit.

5.6.5 Examples

This example shows the description of a device command of cooling effect with the following semantics. The identifier for this command is "cooling01" and the identifier for the cooling device for which this command is issued is "cooler001". The intensity shall be 40 % of the maximum intensity of "cooler001."

```
<iidl:InteractionInfo>
  <iidl:DeviceCommandList>
    <iidl:DeviceCommand xsi:type="dvc:CoolingType" id="cooling01"
      deviceIdRef="cooler001" activate="true" intensity="40">
      <iidl:TimeStamp xsi:type="mpegvct:AbsoluteTimeType" absTime="1:30:23"/>
    </iidl:DeviceCommand>
  </iidl:DeviceCommandList>
</iidl:InteractionInfo>
```

5.7 Wind type

5.7.1 General

This subclause specifies a device command type which can generate a wind effect. The properties of the command can be generated by the adaptation engine, which is combining the wind effect specified by ISO/IEC 23005-3 with the user preference toward the wind effect and the wind device capabilities specified by ISO/IEC 23005-2.

5.7.2 Syntax

```

<!-- ##### -->
<!-- Definition of DCV wind type -->
<!-- ##### -->
<complexType name="WindType">
  <complexContent>
    <extension base="iidl:DeviceCommandBaseType">
      <attribute name="intensity" type="integer" use="optional"/>
    </extension>
  </complexContent>
</complexType>

```

5.7.3 Binary representation syntax

WindType{	<i>Number of bits</i>	<i>Mnemonic</i>
intensityFlag	1	bslbf
DeviceCommandBase		DeviceCommandBaseType
if(intensityFlag) {		
intensity	7	uimsbf
}		
}		

5.7.4 Semantics

Semantics of the WindType:

<i>Name</i>	<i>Definition</i>
WindType	Tool for describing a wind device command.
intensity	Describes the intensity of the wind effect in terms of strength in percentage with respect to the maximum intensity of the specified device. If the intensity is not specified, this command shall be interpreted as turning on at the maximum intensity.
intensityFlag	This field, which is only present in the binary representation, signals the presence of device command attribute. A value of "1" means the attribute shall be used and "0" means the attribute shall not be used.
DeviceCommandBase	Provides the topmost type of the base type hierarchy which each individual device command can inherit.

5.7.5 Examples

This example shows the description of a device command of wind effect with the following semantics. The identifier for this command is "wind01" and the identifier for the wind device for which this command is issued is "wind001". The intensity shall be 30 % of the maximum intensity of "wind001".

```
<iidl:InteractionInfo>
  <iidl:DeviceCommandList>
    <iidl:DeviceCommand xsi:type="dcv:WindType" id="wind01"
      deviceIdRef="wind001" activate="true" intensity="30">
      <iidl:TimeStamp xsi:type="mpegvct:AbsoluteTimeType" absTime="1:30:23"/>
    </iidl:DeviceCommand>
  </iidl:DeviceCommandList>
</iidl:InteractionInfo>
```

5.8 Vibration type

5.8.1 General

This subclause specifies a device command type which can generate a vibration effect. The properties of the command can be generated by the adaptation engine, which is combining the vibration effect specified by ISO/IEC 23005-3 with the user preference toward the vibration effect and the vibration device capabilities specified by ISO/IEC 23005-2.

5.8.2 Syntax

```
<!-- ##### -->
<!-- Definition of DCV vibration type -->
<!-- ##### -->
<complexType name="VibrationType">
  <complexContent>
    <extension base="iidl:DeviceCommandBaseType">
      <attribute name="intensity" type="integer" use="optional"/>
    </extension>
  </complexContent>
</complexType>
```

5.8.3 Binary representation syntax

VibrationType{	Number of bits	Mnemonic
intensityFlag	1	bslbf
DeviceCommandBase		DeviceCommandBaseType
if(intensityFlag) {		
intensity	7	uimsbf
}		
}		

5.8.4 Semantics

Semantics of the VibrationType:

Name	Definition
VibrationType	Tool for describing a vibration device command.
intensity	Describes the intensity of the vibration effect in terms of strength in percentage with respect to the maximum intensity of the specified device. If the intensity is not specified, this command shall be interpreted as turning on at the maximum intensity.
intensityFlag	This field, which is only present in the binary representation, signals the presence of device command attribute. A value of "1" means the attribute shall be used and "0" means the attribute shall not be used.
DeviceCommandBase	Provides the topmost type of the base type hierarchy which each individual device command can inherit.

5.8.5 Examples

This example shows the description of a device command of vibration effect with the following semantics. The identifier for this command is "vibe01" and the identifier for the vibration device for which this command is issued is "vibe001". The intensity shall be 60 % of the maximum intensity of "vibe001".

```
<iidl:InteractionInfo>
  <iidl:DeviceCommandList>
    <iidl:DeviceCommand xsi:type="dvc:VibrationType" id="vibe01"
      deviceIdRef="vibe001" activate="true" intensity="60">
      <iidl:TimeStamp xsi:type="mpegvct:AbsoluteTimeType" absTime="1:30:23"/>
    </iidl:DeviceCommand>
  </iidl:DeviceCommandList>
</iidl:InteractionInfo>
```

5.9 Sprayer type

5.9.1 General

This Subclause specifies a device command type which can generate a spraying effect. The properties of the command can be generated by the adaptation engine, which is combining the spraying effect specified by ISO/IEC 23005-3 with the user preference toward the spraying effect and the spraying device capabilities specified by ISO/IEC 23005-2.

5.9.2 Syntax

```
<!-- ##### -->
<!-- Definition of DCV sprayer type -->
<!-- ##### -->
<complexType name="SprayerType">
  <complexContent>
    <extension base="iidl:DeviceCommandBaseType">
      <attribute name="sprayingType" type="mpeg7:termReferenceType"/>
      <attribute name="intensity" type="integer" use="optional"/>
    </extension>
  </complexContent>
</complexType>
```

5.9.3 Binary representation syntax

SprayerType{	<i>Number of bits</i>	<i>Mnemonic</i>
sprayingFlag	1	bslbf
intensityFlag	1	bslbf
DeviceCommandBase		DeviceCommandBaseType
if(sprayingFlag) {		
sprayingType	8	bslbf
}		
if(intensityFlag) {		
intensity	7	Uimsbf
}		
}		

5.9.4 Semantics

Semantics of the SprayerType:

<i>Name</i>	<i>Definition</i>
SprayerType	Tool for describing a liquid spraying device command.
sprayingType	Describes the type of the sprayed material that shall be used as a reference to a classification scheme term using the <code>mpeg7:termReferenceType</code> defined in ISO/IEC 15938-5:2003, 7.6. A CS that may be used for this purpose is the <code>SprayingTypeCS</code> defined in ISO/IEC 23005-6:—, A.2.7. The binary representation of the <code>SprayingTypeCS</code> is defined in ISO/IEC 23005-6:—, A.2.7.
intensity	Describes the intensity that the liquid is sprayed in percentage with respect to the maximum intensity described in the device capability. If the intensity is not specified, this command shall be interpreted as turning on at the maximum intensity.
sprayingFlag	This field, which is only present in the binary representation, signals the presence of device command attribute. A value of “1” means the attribute shall be used and “0” means the attribute shall not be used.
intensityFlag	This field, which is only present in the binary representation, signals the presence of device command attribute. A value of “1” means the attribute shall be used and “0” means the attribute shall not be used.
DeviceCommandBase	Provides the topmost type of the base type hierarchy which each individual device command can inherit.

5.9.5 Examples

This example shows the description of a device command of sprayer effect with the following semantics. The identifier for this command is "sprayer01" and the identifier for the sprayer device for which this command is issued is "sprayer001". The intensity shall be 50 % of the maximum intensity of "sprayer001." The material to be sprayed is pure water as specified in the SprayingTypeCS of ISO/IEC 23005-6:—, A.2.7.

```
<iidl:InteractionInfo>
  <iidl:DeviceCommandList>
    <iidl:DeviceCommand xsi:type="dcv:SprayerType" id="sprayer01"
      deviceIdRef="sprayer001" activate="true" intensity="50"
      sprayingType="urn:mpeg:mpeg-v:01-SI-SprayingTypeCS-NS:water">
      <iidl:TimeStamp xsi:type="mpegvct:AbsoluteTimeType" absTime="1:30:23"/>
    </iidl:DeviceCommand>
  </iidl:DeviceCommandList>
</iidl:InteractionInfo>
```

5.10 Scent type

5.10.1 General

This Subclause specifies a device command type which can generate a scent effect. The properties of the command can be generated by the adaptation engine, which is combining the scent effect specified by ISO/IEC 23005-3 with the user preference toward the scent effect and the scent device capabilities specified by ISO/IEC 23005-2.

5.10.2 Syntax

```
<!-- ##### -->
<!-- Definition of DCV scent type -->
<!-- ##### -->
<complexType name="ScentType">
  <complexContent>
    <extension base="iidl:DeviceCommandBaseType">
      <attribute name="scent" type="mpeg7:termReferenceType" use="optional"/>
      <attribute name="intensity" type="integer" use="optional"/>
    </extension>
  </complexContent>
</complexType>
```

5.10.3 Binary representation syntax

ScentType{	Number of bits	Mnemonic
scentFlag	1	bslbf
intensityFlag	1	bslbf
DeviceCommandBase		DeviceCommandBaseType
if(scentFlag) {		
scent	9	bslbf

}		
if(intensityFlag) {		
intensity	7	uimsbf
}		
}		

5.10.4 Semantics

Semantics of the ScentType:

Name	Definition
ScentType	Tool for describing a scent device command.
intensity	Describes the intensity of the scent effect in percentage with respect to the maximum intensity described in the device capability. If the intensity is not specified, this command shall be interpreted as turning on at the maximum intensity.
scent	Describes the scent that shall be used as a reference to a classification scheme term using the mpeg7:termReferenceType defined in ISO/IEC 15938-5:2003, 7.6. A CS that may be used for this purpose is the ScentCS defined in ISO/IEC 23005-6:—, A.2.4. The binary representation of the ScentCS is defined in ISO/IEC 23005-6:—, A.2.4.
scentFlag	This field, which is only present in the binary representation, signals the presence of device command attribute. A value of “1” means the attribute shall be used and “0” means the attribute shall not be used.
intensityFlag	This field, which is only present in the binary representation, signals the presence of device command attribute. A value of “1” means the attribute shall be used and “0” means the attribute shall not be used.
DeviceCommandBase	Provides the topmost type of the base type hierarchy which each individual device command can inherit.

5.10.5 Examples

This example shows the description of a device command of scent effect with the following semantics. The identifier for this command is “scent01” and the identifier for the sprayer device for which this command is issued is “scentdevice001”. The intensity shall be 30 % of the maximum intensity of “scentdevice001”. The scent is defined to be the scent of acacia according to the definition of ScentCS in ISO/IEC 23005-6:—, A.2.4.

```
<iidl:InteractionInfo>
  <iidl:DeviceCommandList>
    <iidl:DeviceCommand xsi:type="dcv:ScentType" id="scent01"
      deviceIdRef="scentdevice001" activate="true" intensity="30"
      scent="urn:mpeg:mpeg-v:01-SI-ScentCS-NS:acacia">
      <iidl:TimeStamp xsi:type="mpegvct:AbsoluteTimeType" absTime="1:30:23"/>
    </iidl:DeviceCommand>
  </iidl:DeviceCommandList>
</iidl:InteractionInfo>
```

5.11 Fog type

5.11.1 General

This Subclause specifies a device command type which can generate a fog effect. The properties of the command can be generated by the adaptation engine, which is combining the fog effect specified by ISO/IEC 23005-3 with the user preference toward the fog effect and the fog device capabilities specified by ISO/IEC 23005-2.

5.11.2 Syntax

```
<!-- ##### -->
<!-- Definition of DCV fog type -->
<!-- ##### -->
<complexType name="FogType">
  <complexContent>
    <extension base="idl:DeviceCommandBaseType">
      <attribute name="intensity" type="integer" use="optional"/>
    </extension>
  </complexContent>
</complexType>
```

5.11.3 Binary representation syntax

FogType{	<i>Number of bits</i>	<i>Mnemonic</i>
intensityFlag	1	bslbf
DeviceCommandBase		DeviceCommandBaseType
if(intensityFlag) {		
intensity	7	uimsbf
}		
}		

5.11.4 Semantics

Semantics of the FogType:

<i>Name</i>	<i>Definition</i>
FogType	Tool for describing a fog device command.
intensity	Describes the intensity of the fog effect in percentage with respect to the maximum intensity described in the device capability. If the intensity is not specified, this command shall be interpreted as turning on at the maximum intensity.
intensityFlag	This field, which is only present in the binary representation, signals the presence of device command attribute. A value of "1" means the attribute shall be used and "0" means the attribute shall not be used.
DeviceCommandBase	Provides the topmost type of the base type hierarchy which each individual device command can inherit.

5.11.5 Examples

This example shows the description of a device command of fog effect with the following semantics. The identifier for this command is "fog01" and the identifier for the sprayer device for which this command is issued is "fog001". The intensity shall be 50 % of the maximum intensity of "fog001".

```
<iidl:InteractionInfo>
  <iidl:DeviceCommandList>
    <iidl:DeviceCommand xsi:type="dcv:FogType" id="fog01" deviceIdRef="fog001"
      activate="true" intensity="50">
      <iidl:TimeStamp xsi:type="mpegvct:AbsoluteTimeType" absTime="1:30:23"/>
    </iidl:DeviceCommand>
  </iidl:DeviceCommandList>
</iidl:InteractionInfo>
```

5.12 Color correction type

5.12.1 General

This subclause specifies a device command type which can generate a color correction effect. The properties of the command can be generated by the adaptation engine, which is combining the color correction effect specified by ISO/IEC 23005-3 with the user preference toward the color correction effect and the color correction device capabilities specified by ISO/IEC 23005-2.

5.12.2 Syntax

```
<!-- ##### -->
<!-- Definition of DCV color correction type -->
<!-- ##### -->
<complexType name="ColorCorrectionType">
  <complexContent>
    <extension base="iidl:DeviceCommandBaseType">
      <sequence minOccurs="0" maxOccurs="unbounded">
        <element name="SpatialLocator" type="mpeg7:RegionLocatorType"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
```

5.12.3 Binary representation syntax

ColorCorrectionType{	Number of bits	Mnemonic
SpatialLocatorFlag	1	bslbf
DeviceCommandBase		DeviceCommandBaseType
if (SpatialLocatorFlag) {		
LoopSpatialLocator		vluimsbf5
for(k=0;k< LoopSpatialLocator;k++){		
SpatialLocator[k]		mpeg7:RegionLocatorType
}		

}		
}		

5.12.4 Semantics

Semantics of the ColorCorrectionType:

<i>Name</i>	<i>Definition</i>
ColorCorrectionType	Tool for commanding a display device to perform color correction.
SpatialLocator	Describes the spatial localization of the still region using SpatialLocatorType (optional), which indicates the regions in a video segment where the color correction effect is applied. The SpatialLocatorType shall be used as defined in ISO/IEC 15938-5.
DeviceCommandBase	Provides the topmost type of the base type hierarchy which each individual device command can inherit.
LoopSpatialLocator	This field, which is only present in the binary representation, specifies the number of SpatialLocator contained in the description.
SpatialLocatorFlag	This field, which is only present in the binary representation, specifies if SpatialLocator field is present in this description.

5.12.5 Examples

This example shows the description of a device command of color correction effect with the following semantics. The displaying device for the color correction effect is "tv1". The color correction effect is applied only to the region defined by the SpatialLocator.

```
<iidl:InteractionInfo>
  <iidl:DeviceCommandList>
    <iidl:DeviceCommand xsi:type="dcv:ColorCorrectionType" id="tv1"
      activate="true">
      <iidl:TimeStamp xsi:type="mpegvct:AbsoluteTimeType" absTime="1:30:23"/>
      <dcv:SpatialLocator>
        <mpeg7:Polygon>
          <mpeg7:Coords mpeg7:dim="8">5 25 0 -2 15 0 0 2 </mpeg7:Coords>
        </mpeg7:Polygon>
      </dcv:SpatialLocator>
    </iidl:DeviceCommand>
  </iidl:DeviceCommandList>
</iidl:InteractionInfo>
```

5.13 Initialize color correction parameter type

5.13.1 General

This command delivers the parameters supporting the color correction effect to devices.

5.13.2 Syntax

```
<!-- ##### -->
<!-- Definition of initialize color correction parameter Type -->
<!-- ##### -->
<complexType name="InitializeColorCorrectionParameterType">
  <complexContent>
    <extension base="iidl:DeviceCommandBaseType">
      <sequence>
        <element name="ToneReproductionCurves"
          type="mpegvct:ToneReproductionCurvesType" minOccurs="0"/>
        <element name="ConversionLUT" type="mpegvct:ConversionLUTType"/>
        <element name="ColorTemperature" type="mpegvct:IlluminantType"
          minOccurs="0"/>
        <element name="InputDeviceColorGamut"
          type="mpegvct:InputDeviceColorGamutType" minOccurs="0"/>
        <element name="IlluminanceOfSurround" type="mpeg7:unsigned12"
          minOccurs="0"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
```

5.13.3 Binary representation syntax

InitializeColorCorrectinParameterType{	Number of bits	Mnemonic
ToneReproductionCurvesFlag	1	bslbf
ConversionLUTFlag	1	bslbf
ColorTemperatureFlag	1	bslbf
InputDeviceColorGamutFlag	1	bslbf
IlluminanceOfSurroundFlag	1	bslbf
DeviceCommandBase		DeviceCommandBaseType
if(ToneReproductionCurvesFlag) {		
ToneReproductionCurves		ToneReproductionCurvesType
}		
ConversionLUT		ConversionLUTType
if(ColorTemperatureFlag) {		
ColorTemperature		IlluminantType

}		
if(InputDeviceColorGamutFlag) {		
InputDeviceColorGamut		InputDeviceColorGamutType
}		
if(IlluminanceOfSurroundFlag) {		
IlluminanceOfSurround	12	uimsbf
}		
}		

ToneReproductionCurvesType {	Number of bits	Mnemonic
NumOfRecords	8	uimsbf
for(i=0;i< NumOfRecords;i++){		
DAC_Value	8	mpeg7:unsigned8
RGB_Value	32*3	mpeg7:doubleVector
}		
}		

ConversionLUTType {	Number of bits	Mnemonic
RGB2XYZ_LUT	32*3*3	mpeg7:DoubleMatrixType
RGBScalar_Max	32*3	mpeg7:doubleVector
Offset_Value	32*3	mpeg7:doubleVector
Gain_Offset_Gamma	32*3*3	mpeg7:DoubleMatrixType
InverseLUT	32*3*3	mpeg7:DoubleMatrixType
}		

IlluminantType {	Number of bits	Mnemonic
ElementType	1	bslbf

if(ElementType==00){		
xy_Value	32*2	dia:ChromaticityType
Y_Value	7	uimsbf
}else if(ElementType==01){		
Correlated_CT	8	uimsbf
}		
}		

InputDeviceColorGamutType {	Number of bits	Mnemonic
typeLength		vluimsbf5
IDCG_Type	8 * typeLength	bslbf
IDCG_Value	32*3*2	mpeg7:DoubleMatrixType
}		

5.13.4 Semantics

Semantics of the InitializeColorCorrectionParameterType:

<i>Name</i>	<i>Definition</i>
InitializeColorCorrectionParameterType	Tool for describing an initialize color correction parameter command.
ToneReproductionCurves	This curve shows the characteristics (e.g., gamma curves for R, G and B channels) of the input display device.
ConversionLUT	A look-up table (matrix) converting an image between an image color space (e.g. RGB) and a standard connection space (e.g. CIE XYZ).
ColorTemperature	An element describing a white point setting (e.g., D65, D93) of the input display device.
InputDeviceColorGamut	An element describing an input display device color gamut, which is represented by chromaticity values of R, G, and B channels at maximum DAC values.
IlluminanceOfSurround	An element describing an illuminance level of viewing environment. The illuminance is represented by lux.
ToneReproductionCurvesFlag	This field, which is only present in the binary representation, signals the presence of device command attribute. A value of "1" means the attribute shall be used and "0" means the

<i>Name</i>	<i>Definition</i>
	attribute shall not be used.
ConversionLUTFlag	This field, which is only present in the binary representation, signals the presence of device command attribute. A value of “1” means the attribute shall be used and “0” means the attribute shall not be used.
ColorTemperatureFlag	This field, which is only present in the binary representation, signals the presence of device command attribute. A value of “1” means the attribute shall be used and “0” means the attribute shall not be used.
InputDeviceColorGamutFlag	This field, which is only present in the binary representation, signals the presence of device command attribute. A value of “1” means the attribute shall be used and “0” means the attribute shall not be used.
IlluminanceOfSurroundFlag	This field, which is only present in the binary representation, signals the presence of device command attribute. A value of “1” means the attribute shall be used and “0” means the attribute shall not be used.
DeviceCommandBase	Provides the topmost type of the base type hierarchy which each individual device command can inherit.

Semantics of the ToneReproductionCurvesType:

<i>Names</i>	<i>Description</i>
NumOfRecords	This field, which is only present in the binary representation, specifies the number of record (DAC and RGB value) instances accommodated in the ToneReproductionCurves.
DAC_Value	An element describing discrete DAC values of input device.
RGB_Value	An element describing normalized gamma curve values with respect to DAC values. The order of describing the RGB_Value is R_n, G_n, B_n .

Semantics of the ConversionLUTType:

<i>Names</i>	<i>Description</i>
RGB2XYZ_LUT	This look-up table (matrix) converts an image from RGB to CIE XYZ. The size of the conversion matrix is 3×3 such as $\begin{pmatrix} R_x & G_x & B_x \\ R_y & G_y & B_y \\ R_z & G_z & B_z \end{pmatrix}$. The way of describing the values in the binary representation is in the order of $[R_x, G_x, B_x, R_y, G_y, B_y, R_z, G_z, B_z]$.
RGBScalar_Max	An element describing maximum RGB scalar values for GOG transformation.

	The order of describing the RGBScalar_Max is $R_{\max}$, $G_{\max}$, $B_{\max}$.						
Offset_Value	An element describing offset values of input display device when the DAC is 0. The value is described in CIE XYZ form. The order of describing the Offset_Value is X, Y, Z.						
Gain_Offset_Gamma	An element describing the gain, offset, gamma of RGB channels for GOG transformation. The size of the Gain_Offset_Gamma matrix is 3×3 such as $\begin{bmatrix} Gain_r & Gain_g & Gain_b \\ Offset_r & Offset_g & Offset_b \\ Gamma_r & Gamma_g & Gamma_b \end{bmatrix}.$ The way of describing the values in the binary representation is in the order of $[Gain_r, Gain_g, Gain_b; Offset_r, Offset_g, Offset_b; Gamma_r, Gamma_g, Gamma_b]$.						
InverseLUT	This look-up table (matrix) converts an image form CIE XYZ to RGB. The size of the conversion matrix is 3×3 such as $\begin{pmatrix} R_x^l & G_x^l & B_x^l \\ R_y^l & G_y^l & B_y^l \\ R_z^l & G_z^l & B_z^l \end{pmatrix}$. The way of describing the values in the binary representation is in the order of $[R_x^l, G_x^l, B_x^l; R_y^l, G_y^l, B_y^l; R_z^l, G_z^l, B_z^l]$.						
Semantics of the IlluminantType:							
Names	Description						
ElementType	This field, which is only present in the binary representation, describes which Illuminant scheme shall be used. In the binary description, the following mapping table is used, <table border="1"> <thead> <tr> <th>Illuminant</th><th>IlluminantType</th></tr> </thead> <tbody> <tr> <td>00</td><td>xy and Y value</td></tr> <tr> <td>01</td><td>Correlated_CT</td></tr> </tbody> </table>	Illuminant	IlluminantType	00	xy and Y value	01	Correlated_CT
Illuminant	IlluminantType						
00	xy and Y value						
01	Correlated_CT						
xy_Value	An element describing the chromaticity of the light source. The ChromaticityType is specified in ISO/IEC 21000-7.						
Y_Value	An element describing the luminance of the light source between 0 and 100.						
Correlated_CT	Indicates the correlated color temperature of the overall illumination. The value expression is obtained through quantizing the range [1667, 25000] into 28 bins in a non-uniform way as specified in ISO/IEC 15938-5.						