INTERNATIONAL STANDARD

ISO/IEC 23005-3

First edition
2011-08-01

Information technology — Media context and control —

Part 3: Sensory information

Technologies de l'information — Contrôle et contexte de supports —

Partie 3: Information sensorielle

Reference number
ISO/IEC 23005-3:2011(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

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. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

ISO/IEC 23005-3 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

ISO/IEC 23005 consists of the following parts, under the general title *Information technology — Media context and control*:

— *Part 1: Architecture*

— *Part 2: Control information*

— *Part 3: Sensory information*

— *Part 4: Virtual world object characteristics*

— *Part 5: Data formats for interaction devices*

— *Part 6: Common types and tools*

— *Part 7: Conformance and reference software*

Introduction

The usage of multimedia content is becoming omnipresent in our everyday life, in terms of both consumption and production. On the one hand, professional content is provided to the end user in high-definition quality, streamed over heterogeneous networks, and consumed on a variety of different devices. On the other hand, user-generated content overwhelms the Internet with multimedia assets being uploaded to a wide range of available Web sites. That is, the transparent access to multimedia content, which is also referred to as Universal Multimedia Access (UMA), seems to be technically feasible. However, UMA mainly focuses on the end-user devices and network connectivity issues, but it is the user who ultimately consumes the content. Hence, the concept of UMA has been extended to take the user into account, which is generally referred to as Universal Multimedia Experience (UME).

However, the consumption of multimedia assets can also stimulate senses other than vision or hearing, e.g., olfaction, mechanoreception, equilibrioception, or thermoception. That is, in addition to the audio-visual content of, e.g., a movie, other senses shall also be stimulated giving her/him the sensation of being part of the particular media which shall result in a worthwhile, informative user experience.

This motivates the annotation of the media resources with metadata as defined in this part of ISO/IEC 23005, which steers appropriate devices capable of stimulating these other senses.

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

ISO and the IEC take no position concerning the evidence, validity and scope of those patent rights.

The holders of these patent rights have assured ISO and the IEC that they are willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statements of the holders of these patent rights are registered with ISO and the IEC. Information may be obtained from the companies listed in Annex C.

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 in Annex C. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

Information technology — Media context and control —

Part 3:
Sensory information

1 Scope

This part of ISO/IEC 23005 specifies the syntax and semantics of description schemes and descriptors that represent sensory information. Its purpose is to enhance the experience of users while consuming media resources.

The system architecture is depicted in Figure 1 and the scope of this part of ISO/IEC 23005 is highlighted. That is, only the information representation that acts as an input to the possible Adaptation VR, as defined in ISO/IEC 23005-1, is specified in this part of ISO/IEC 23005.

NOTE 1 The actual Adaptation VR is deliberately informative and left open for industry competition.

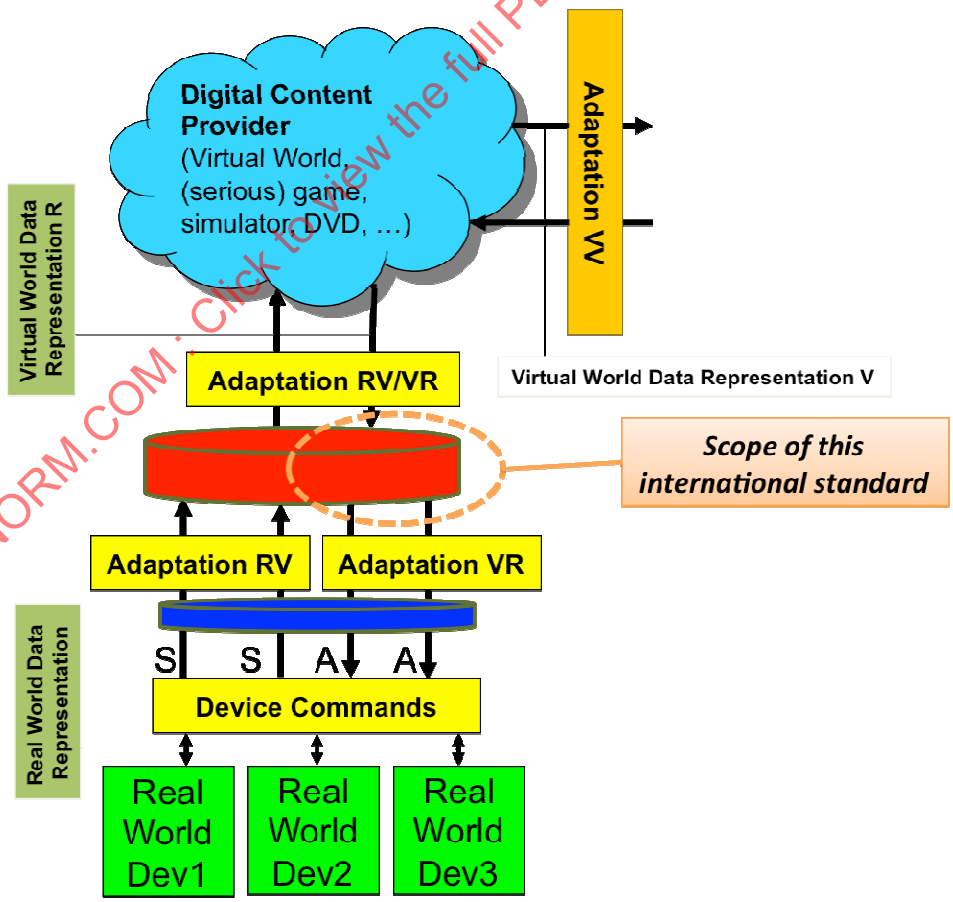

Figure 1 — System Architecture

NOTE 2 Additional informative information can be found in Annex A.

2 Normative references

The following referenced documents are indispensable for the specification 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, *Information technology — Multimedia content description interface — Part 5: Multimedia description schemes*

ISO/IEC 21000-7:2007, *Information technology — Multimedia framework (MPEG-21) — Part 7: Digital Item Adaptation*

ISO/IEC 23005 (all parts), *Information technology — Media context and control*

IETF RFC 2045, *Multipurpose Internet Mail Extensions (MIME) Part One: Format of Internet Message Bodies*, IETF Request for Comments: 2045, November 1996

IETF RFC 3986, *Uniform Resource Identifier (URI): Generic Syntax*, IETF Request For Comments: 3986, January 2005

W3C XML, *Extensible Markup Language (XML) 1.1, Second Edition*, W3C Recommendation 16 August 2006, edited in place 29 September 2006

W3C XMLSCHEMA, *XML Schema Part 1: Structures and XML Schema*, Second Edition W3C Recommendation, 28 October 2004

W3C XMLSCHEMA, *XML Schema Part 2: Datatypes*, Second Edition W3C Recommendation, 28 October 2004

3 Terms, definitions, symbols, and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions in ISO/IEC 23005 (all parts) and the following apply.

3.1.1
digital content provider
entity that acts as the source of digital information of various nature

NOTE The digital content may be provided in real-time or non real-time.

EXAMPLE Digital content from an on-line virtual world, simulation environment, multi user game, broadcasted multimedia production, peer-to-peer multimedia production, or packaged content like a DVD or game.

3.1.2
sensory information
standardized representation format of ISO/IEC 23005 in the standardization area B as defined in ISO/IEC 23005-1

EXAMPLE Sensory effect metadata, haptic (kinesthetic/tactile) information, emotion information, avatar information.

3.1.3
sensory effect metadata
defines the description schemes and descriptors to represent **sensory effects**

3.1.4
sensory effect
effect to augment perception by stimulating human senses in a particular scene of a multimedia application

EXAMPLE Scent, wind, light, haptic (kinesthetic-force, stiffness, weight, friction, texture, widget (button, slider, joystick); tactile: air-jet, suction pressure, thermal, current, vibration. Combinations of tactile display can also provide directional, shape information.

3.1.5
adaptation VR
entity that can process the **sensory information** in order to be consumed within the real world's context

NOTE This may include the adaptation or transformation of the sensory information according to the capabilities of real world devices or the preferences of the user. A specification of these capabilities and preferences can be found in ISO/IEC 23005-2.

3.2 Symbols and abbreviated terms

For the purpose of this document, the symbols and abbreviated terms given in the following apply:

DIA	digital item adaptation (ISO/IEC 21000-7)
MPEG-21	multimedia framework (ISO/EC 21000)
MPEG-7	multimedia content description interface (ISO/IEC 15938)
SEDL	sensory effects description language
SEM	sensory effect metadata
SEV	sensory effects vocabulary
UMA	universal multimedia access
UME	universal multimedia experience
XML	extensible mark-up language
XSI	XML streaming instructions

4 Schema documents

In the main text of this specification, the syntax of description schemes and descriptors is provided whenever possible as a single schema document.

In some cases though, and in particular for the clause 5, the syntax of description schemes and descriptors is provided as a collection of schema snippets imbricated with other text. In order to form a valid schema document, these schema components should be gathered in a same document with the schema wrapper provided at the head of the clause. For better readability, the relevant schema documents are provided in the Annex B, but as non-normative information.

In all cases, each schema document has a `version` attribute, the value of which is "ISO/IEC 23005-3". Furthermore, an informative identifier is given as the value of the `id` attribute of the `schema` component. This identifier is non-normative and used as a convention in this specification to reference another schema document. In particular, it is used for the `schemaLocation` attribute of the `include` and `import` schema components.

4.1 Use of prefixes

For clarity, throughout this Part of ISO/IEC 23005, 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 [1]. 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 the following table.

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

Prefix	Corresponding namespace
ct	urn:mpeg:mpeg-v:2010:01-CT-NS
sedl	urn:mpeg:mpeg-v:2010:01-SEDL-NS
sev	urn:mpeg:mpeg-v:2010:01-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

Unlike the informative descriptions examples, the normative specification of the syntax of tools in XML Schema follows the namespace binding context defined in the relevant schema declaration such as the one defined in 5.3.

4.2 Sensory effects description language

4.3 Introduction

This Clause specifies the syntax and semantics of the sensory effects description language (SEDL) which provides basic building blocks for the authoring of sensory effect metadata.

4.4 Validation

Validating a document against the SEDL schema (as specified in W3C XMLSCHEMA) is necessary, but not sufficient, to determine its validity with respect to SEDL. After a document is validated against the SEDL schema, it shall also be subjected to additional validation rules. These additional rules are given below in the descriptions of the elements to which they pertain.

4.5 Processing

The processing model for the sensory effect metadata is defined as an XML processor (as specified by W3C XML) and the utilization of the elements and attributes as defined in the subsequent (Sub)clauses.

NOTE The processing of the sensory effect metadata may follow existing XML decoding/parsing models such as the Document Object Model (DOM) or the Simple API for XML (SAX).

The time information that may be associated to sensory effects may be used for the synchronization with respect to other media assets.

EXAMPLE These other media assets may be video and/or audio.

4.6 Basic building blocks

4.6.1 Introduction

This Subclause specifies the syntax and semantics of the basic building blocks for authoring sensory effect metadata.

This Part of ISO/IEC 23005 adopts the XML streaming instructions (XSI) as defined in ISO/IEC 21000-7 for the purpose of identifying process units and associating time information to them. In this context, a process unit is defined as a well-formed fragment of XML-based metadata that can be consumed as such and to which time information may be attached, indicating the point in time when it becomes available for consumption. A process unit is specified by one element named anchor element and by a process unit mode indicating how other connected elements are aggregated to this anchor to compose the process unit. Depending on the mode, the anchor element is not necessarily the root of the process unit. Anchor elements are ordered according to the navigation path of the XML document. Process units may overlap, i.e. some elements (including anchor elements) may belong to several process units. Additionally, the content provider may require that a given process unit be encoded as a random access point, i.e. that the resulting access unit does not require any other access units to be decoded. The syntax and semantics of the XML streaming instructions is fully specified in 8.6 of ISO/IEC 21000-7:2007.

In addition to the XML streaming instructions, this standard adopts the following basic time model for sensory effects metadata which is depicted in Figure 2.

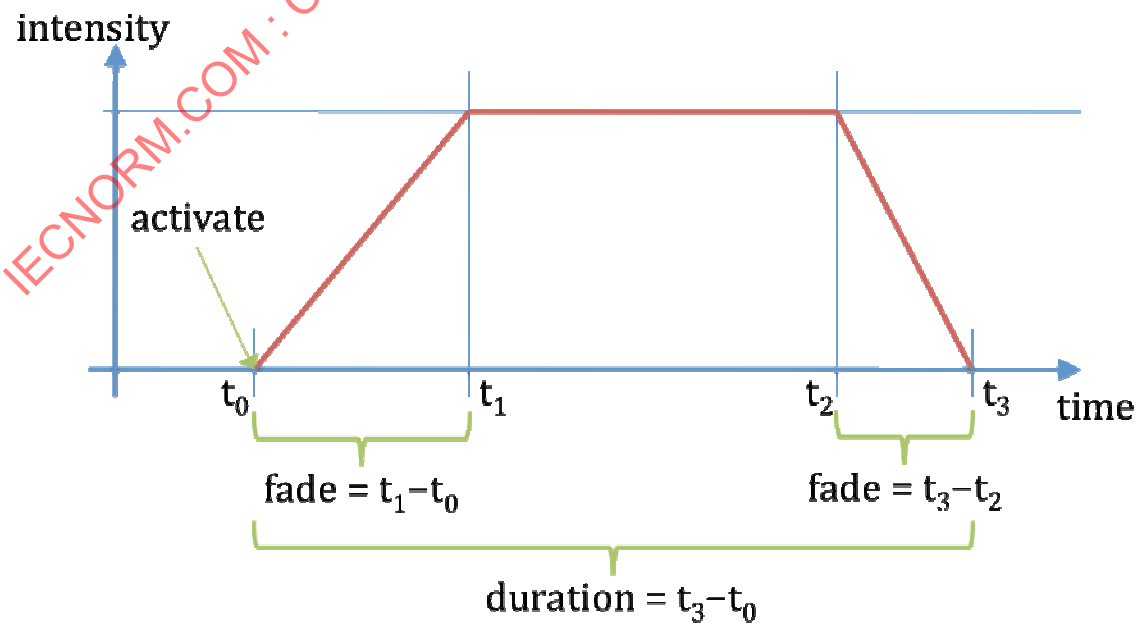

Figure 2 — Time model for sensory effect metadata

Each effect may be activated (i.e., t_0) and deactivated (i.e., t_3) at certain points in time. The deactivation of an effect may be explicitly defined (i.e., `activate="false"`) or indicated by means of a duration attribute during activation (i.e., t_3-t_0). Furthermore, each effect may specify a fade-in (i.e., t_1-t_0) or fade-out (i.e., t_3-t_2) time within which the corresponding effect shall reach its specified intensity.

NOTE The actual implementation of some effects may require one or more elements as defined in the following. An example implementation of Figure 2 using the syntax as defined in the following is provided in 4.6.12.

4.6.2 Schema wrapper

The syntax of description tools specified in this clause is provided as a collection of schema components, consisting notably in type definitions and element declarations. In order to form a valid schema document, these schema components should be gathered in a same document with the following declaration defining in particular the target namespace and the namespaces prefixes.

```
<?xml version="1.0"?>
<schema
  xmlns="http://www.w3.org/2001/XMLSchema"
  xmlns:sedl="urn:mpeg:mpeg-v:2010:01-SEDL-NS"
  xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004"
  xmlns:si="urn:mpeg:mpeg21:2003:01-DIA-XSI-NS"
  xmlns:dia="urn:mpeg:mpeg21:2003:01-DIA-NS"
  xmlns:ct="urn:mpeg:mpeg-v:2010:01-CT-NS"
  targetNamespace="urn:mpeg:mpeg-v:2010:01-SEDL-NS"
  elementFormDefault="qualified" attributeFormDefault="unqualified"
  version="ISO/IEC 23005-3" id="MPEG-V-SEDL.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:mpeg21:2003:01-DIA-XSI-NS"
schemaLocation="http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-
21_schema_files/dia-2nd/XSI-2nd.xsd"/>
  <import namespace="urn:mpeg:mpeg21:2003:01-DIA-NS"
schemaLocation="http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-
21_schema_files/dia-2nd/UED-2nd.xsd"/>
  <import namespace="urn:mpeg:mpeg-v:2010:01-CT-NS" schemaLocation="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>
```

4.6.3 Base datatypes and elements

4.6.3.1 Syntax

```
<!-- ################################################ -->
<!--  SEM Base Attributes                             -->
<!-- ################################################ -->
<attributeGroup name="SEMBaseAttributes">
  <attribute name="activate" type="boolean" use="optional" />
  <attribute name="duration" type="positiveInteger" use="optional" />
  <attribute name="fade" type="positiveInteger" use="optional" />
  <attribute name="alt" type="anyURI" use="optional" />
  <attribute name="priority" type="positiveInteger" use="optional" />
  <attribute name="location" type="mpeg7:termReferenceType"
     use="optional"/>
  <attributeGroup ref="sedl:SEMAdaptabilityAttributes"/>
</attributeGroup>
<simpleType name="intensityValueType">
  <restriction base="float"/>
</simpleType>
<simpleType name="intensityRangeType">
  <restriction>
    <simpleType>
      <list itemType="float"/>
    </simpleType>
    <length value="2" fixed="true"/>
  </restriction>
</simpleType>

<!-- ################################################ -->
<!--  SEM Adaptability Attributes                     -->
<!-- ################################################ -->
<attributeGroup name="SEMAdaptabilityAttributes">
  <attribute name="adaptType" type="sedl:adaptTypeType" use="optional"/>
  <attribute name="adaptRange" type="sedl:adaptRangeType" default="10"
             use="optional"/>
</attributeGroup>
<simpleType name="adaptTypeType">
  <restriction base="NMTOKEN">
    <enumeration value="strict"/>
    <enumeration value="under"/>
    <enumeration value="over"/>
    <enumeration value="both"/>
  </restriction>
</simpleType>
<simpleType name="adaptRangeType">
  <restriction base="unsignedInt">
    <minInclusive value="0"/>
    <maxInclusive value="100"/>
  </restriction>
</simpleType>

<!-- ################################################ -->
<!--  SEM Base Elements                               -->
<!-- ################################################ -->
<element name="Declarations" type="sedl:DeclarationsType" />
<element name="GroupOfEffects" type="sedl:GroupOfEffectsType" />
<element name="Effect" type="sedl:EffectBaseType" />
<element name="ReferenceEffect" type="sedl:ReferenceEffectType" />
```

```
<element name="Parameter" type="sedl:ParameterBaseType"/>

<!-- ################################################ -->
<!--  SEM Base type                                   -->
<!-- ################################################ -->
<complexType name="SEMBaseType" abstract="true">
  <complexContent>
    <restriction base="anyType">
      <attribute name="id" type="ID" use="optional"/>
    </restriction>
  </complexContent>
</complexType>
```

4.6.3.2 Semantics

Semantics of the `SEMBaseAttributes`:

Name	*Definition*
`activate`	Describes whether the sensory effect shall be activated. A value of `true` means the sensory effect shall be activated and `false` means the sensory effect shall be deactivated.
`duration`	Describes the duration according to the time scheme used. The time scheme used shall be identified by means of the `si:absTimeScheme` and `si:timeScale` attributes respectively.
`fade`	Describes the fade time according to the time scheme used within which the defined `intensity` shall be reached. The time scheme used shall be identified by means of the `si:absTimeScheme` and `si:timeScale` attributes respectively.
`alt`	Describes an alternative sensory effect identified by URI. NOTE 1 The alternative might point to a sensory effect – or list of sensory effects – within the same description or an external description. NOTE 2 The alternative might be used in case the original sensory effect cannot be processed. EXAMPLE 1 The alternative sensory effect is chosen because the original intended sensory effect cannot be processed due to lack of devices supporting this sensory effect.
`priority`	Describes the priority for sensory effects with respect to other sensory effects in the same group of sensory effects sharing the same point in time when they should become available for consumption. A value of one indicates the highest priority and larger values indicate lower priorities. NOTE 3 The priority might by used to process sensory effects – defined within a group of sensory effects – according to the capabilities of the adaptation VR. EXAMPLE 2 The adaptation VR processes the individual sensory effects of a group of sensory effects according to their priority in descending order due to its limited capabilities. That is, sensory effects with low priority might get lost.

Name	*Definition*
`location`	Describes the location from where the sensory effect is expected to be received from the user's perspective according to the x-, y-, and z-axis as depicted in Figure 3.

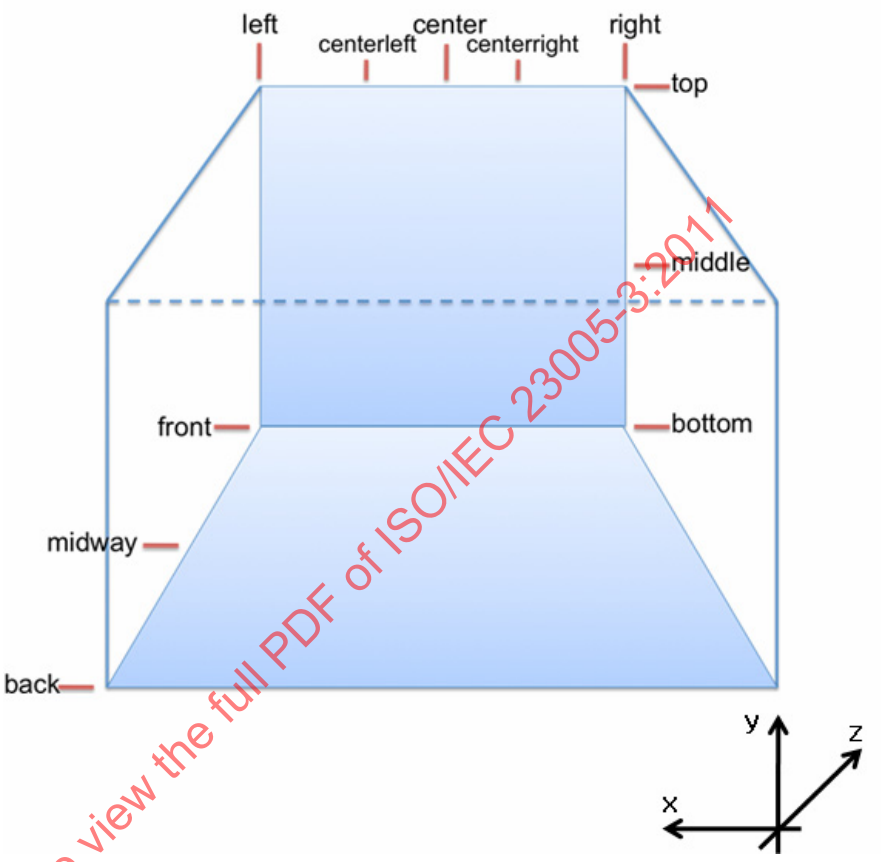

Figure 3 — Location model for sensory effect metadata and reference coordinate system

A classification scheme that may be used for this purpose is the `LocationCS` as defined in Annex A of ISO/IEC 23005-6. The terms from the `LocationCS` shall be concatenated with the "`:`" sign in order of the x-, y-, and z-axis to uniquely define a location within the three-dimensional space.

For referring to a group of locations, a wild card mechanism may be employed using the "`*`" sign.

EXAMPLE 4 `urn:mpeg:mpeg-v:01-SI-LocationCS-NS:center:middle:front` defines the location as follows: center on the x-axis, middle on the y-axis, and front on the z-axis. That is, it describes all sensory effects at the center, middle, front side of the user.

EXAMPLE 5 `urn:mpeg:mpeg-v:01-SI-LocationCS-NS:left:*:midway` defines the location as follows: left on the x-axis, any location on the y-axis, and midway on the z-axis. That is, it describes all sensory effects at the left, midway side of the user.

EXAMPLE 6 `urn:mpeg:mpeg-v:01-SI-LocationCS-NS:*:*:back` defines the location as follows: any location on the x-axis, any location on the y-axis, and back on the z-axis. That is, it describes all sensory effects at the back of the user.

Semantics of the `intensityValueType` and `intensityRangeType`:

Name	*Definition*
`intensityValueType`	Tool for describing the intensity of the sensory effect. Each sensory effect must define its intensity value using this datatype.
`intensityRangeType`	Tool for describing the intensity range of the sensory effect. Each sensory effect must define its intensity range using this datatype.

Semantics of the `SEMAdaptabilityAttributes`:

Name	*Definition*
`adaptType`	Describes the preferred type of adaptation with the following possible instantiations: — `strict`: An adaptation by approximation may not be performed. — `under`: An adaptation by approximation may be performed with a smaller effect value than the specified effect value. NOTE 1 (1 – adaptRange) x intensity ~ intensity. — `over`: An adaptation by approximation may be performed with a greater effect value than the specified effect value. NOTE 2 intensity ~ (1 + adaptRange) x intensity. — `both`: An adaptation by approximation may be performed between the upper and lower bound specified by `adaptRange`. NOTE 3 (1 – adaptRange) x intensity ~ (1 + adaptRange) x intensity.
`adaptRange`	Describes the upper and lower bound in percentage for the `adaptType`. If the `adaptType` is not present, `adaptRange` shall be ignored.

Semantics of the SEM base elements:

Name	*Definition*
`Declarations`	Describes a declaration of sensory effects, group of sensory effects, or parameters. NOTE 1 The declarations may be used by reference using the `ReferenceEffect` element.
`Effect`	Describes a sensory effect.
`GroupOfEffects`	Describes a group of sensory effects. NOTE 2 The purpose of grouping is to remove some redundancy from its child elements. All attributes included here are inherited to its child elements.

Name	*Definition*
ReferenceEffect	Describes a reference to a sensory effect, group of sensory effects, or parameter. NOTE 3 The reference may point to a sensory effect, group of sensory effects, or parameter as defined within the same description or an external description by means of the Declarations element.
Parameter	Describes a parameter for a sensory effect. NOTE 4 The parameter may be used to declare complex properties to be used within sensory effects. As such, it shall be defined within the Declarations element.

Semantics of the SEMBaseType:

Name	*Definition*
SEMBaseType	Provides the topmost type of the base type hierarchy.
id	Identifies the id of the SEMBaseType.

4.6.4 Root element

4.6.4.1 Syntax

```
<!-- ################################################ -->
<!--  Definition of the SEM root element              -->
<!-- ################################################ -->
<element name="SEM">
  <complexType>
    <sequence>
      <element name="DescriptionMetadata"
           type="sedl:DescriptionMetadataType"
           minOccurs="0" maxOccurs="1"/>
      <choice maxOccurs="unbounded">
        <element ref="sedl:Declarations" />
        <element ref="sedl:GroupOfEffects" />
        <element ref="sedl:Effect" />
        <element ref="sedl:ReferenceEffect" />
      </choice>
    </sequence>
    <attribute name="autoExtraction" type="sedl:autoExtractionType"/>
    <anyAttribute namespace="##other" processContents="lax"/>
  </complexType>
</element>

<simpleType name="autoExtractionType">
  <restriction base="string">
    <enumeration value="audio"/>
    <enumeration value="visual"/>
    <enumeration value="both"/>
  </restriction>
</simpleType>
```

4.6.4.2 Semantics

Semantics of the `SEM` root element:

Name	*Definition*
`SEM`	Serves as the root element for sensory effects metadata.
`DescriptionMetadata`	Describes general information about the sensory effects metadata. EXAMPLE 1 Creation information or Classification Scheme Alias.
`Declarations`	See semantics of the SEM base elements.
`Effect`	See semantics of the SEM base elements.
`GroupOfEffects`	See semantics of the SEM base elements.
`ReferenceEffect`	See semantics of the SEM base elements.
`autoExtraction`	Describes whether an automatic extraction of sensory effects from the media resource, which is described by this sensory effect metadata, is preferable. The following values are available: — `audio`: the automatic extraction of sensory effects from the audio part of the media resource, which is described by this sensory effect metadata, is preferable. — `visual`: the automatic extraction of sensory effects from the visual part of the media resource, which is described by this sensory effect metadata, is preferable. — `both`: the automatic extraction of sensory effects from both the audio and visual part of the media resource, which is described by this sensory effect metadata, is preferable.
`anyAttribute`	Provides an extension mechanism for including attributes from namespaces other than the target namespace. Attributes that shall be included are the XML streaming instructions as defined in ISO/IEC 21000-7 for the purpose of identifying process units and associating time information to them. EXAMPLE 2 `si:timeScale` describes the time scale to be used.

4.6.5 Description metadata

4.6.5.1 Syntax

```
<!-- ################################################ -->
<!--  Definition of Description Metadata Type         -->
<!-- ################################################ -->
<complexType name="DescriptionMetadataType">
  <complexContent>
    <extension base="mpeg7:DescriptionMetadataType">
      <sequence>
        <element name="ClassificationSchemeAlias" minOccurs="0"
```

```
            maxOccurs="unbounded">
          <complexType>
            <complexContent>
              <extension base="sedl:SEMBaseType">
                <attribute name="alias" type="NMTOKEN" use="required"/>
                <attribute name="href" type="anyURI" use="required"/>
              </extension>
            </complexContent>
          </complexType>
        </element>
      </sequence>
    </extension>
  </complexContent>
</complexType>
```

4.6.5.2 Semantics

Semantics of the `DescriptionMetadata`:

Name	*Definition*
`DescriptionMetadataType`	`DescriptionMetadataType` extends `mpeg7:DescriptionMetadataType` and provides a sequence of classification schemes for usage in the `SEM` description.
`ClassificationSchemeAlias`	Describes an `alias` for a classification scheme referenced by URI.
`alias`	Describes the alias assigned to the `ClassificationScheme`. The scope of the alias assigned shall be the entire description regardless of where the `ClassificationSchemeAlias` appears in the description.
`href`	Describes a reference to the classification scheme that is being aliased using a URI. The classification schemes defined in this part of the ISO/IEC 23005, whether normative of informative, shall be referenced by the `uri` attribute of the `ClassificationScheme` for that classification scheme.

4.6.6 Declarations

4.6.6.1 Syntax

```
<!-- ################################################ -->
<!--  Declarations type                               -->
<!-- ################################################ -->
<complexType name="DeclarationsType">
  <complexContent>
    <extension base="sedl:SEMBaseType">
      <choice maxOccurs="unbounded">
        <element ref="sedl:GroupOfEffects" />
        <element ref="sedl:Effect" />
        <element ref="sedl:Parameter" />
      </choice>
```

```
      </extension>
    </complexContent>
  </complexType>
```

4.6.6.2 Semantics

Semantics of the `DeclarationsType`:

Name	*Definition*
`DeclarationsType`	Tool for describing a declaration of sensory effects, group of sensory effects, or parameters. NOTE The declarations may be used by reference using the `ReferenceEffect` element.
`Effect`	See semantics of the SEM base elements.
`GroupOfEffects`	See semantics of the SEM base elements.
`Parameter`	See semantics of the SEM base elements.

4.6.7 Group of effects

4.6.7.1 Syntax

```
<!-- ################################################ -->
<!--  Group of Effects type                           -->
<!-- ################################################ -->
<complexType name="GroupOfEffectsType">
  <complexContent>
    <extension base="sedl:SEMBaseType">
      <choice minOccurs="2" maxOccurs="unbounded">
        <element ref="sedl:Effect"/>
        <element ref="sedl:ReferenceEffect"/>
      </choice>
      <attributeGroup ref="sedl:SEMBaseAttributes"/>
      <anyAttribute namespace="##other" processContents="lax"/>
    </extension>
  </complexContent>
</complexType>
```

4.6.7.2 Semantics

Semantics of the `GroupOfEffectsType`:

Name	*Definition*
`GroupOfEffectsType`	Tool for describing a group of two or more sensory effects.
`Effect`	See semantics of the SEM base elements.

Name	*Definition*
`SEMBaseAttributes`	Describes a group of attributes for the group of sensory effects.
`anyAttribute`	Provides an extension mechanism for including attributes from namespaces other than the target namespace. Attributes that shall be included are the XML streaming instructions as defined in ISO/IEC 21000-7 for the purpose of identifying process units and associating time information to them. EXAMPLE `si:pts` describes the point in time when the associated information shall become available to the application for processing.

4.6.8 Effect

4.6.8.1 Syntax

```
  <!-- ################################################ -->
  <!--  Effect base type                                -->
  <!-- ################################################ -->
  <complexType name="EffectBaseType" abstract="true">
    <complexContent>
      <extension base="sedl:SEMBaseType">
        <sequence minOccurs="0">
          <element name="SupplementalInformation"
type="sedl:SupplementalInformationType" minOccurs="0"/>
        </sequence>
        <attribute name="autoExtraction" type="sedl:autoExtractionType"/>
        <attributeGroup ref="sedl:SEMBaseAttributes"/>
        <anyAttribute namespace="##other" processContents="lax"/>
      </extension>
    </complexContent>
  </complexType>

  <complexType name="SupplementalInformationType">
    <sequence>
      <element name="ReferenceRegion" type="mpeg7:SpatioTemporalLocatorType"/>
      <element name="Operator" type="sedl:OperatorType" minOccurs="0"/>
    </sequence>
  </complexType>
  <simpleType name="OperatorType">
    <restriction base="NMTOKEN">
      <enumeration value="average"/>
      <enumeration value="dominant"/>
    </restriction>
  </simpleType>
```


4.6.8.2 Semantics

Semantics of the `EffectBaseType`:

Name	*Definition*
`EffectBaseType`	`EffectBaseType` extends `SEMBaseType` and provides a base abstract type for a subset of types defined as part of the sensory effects metadata types.
`SEMBaseAttributes`	Describes a group of attributes for the sensory effects.
`anyAttribute`	Provides an extension mechanism for including attributes from namespaces other than the target namespace. Attributes that shall be included are the XML streaming instructions as defined in ISO/IEC 21000-7 for the purpose of identifying process units and associating time information to them. EXAMPLE `si:pts` describes the point in time when the associated information shall become available to the application for processing.

Semantics of the `SupplementalInformationType`:

Name	*Definition*
`SupplementalInformationType`	Tool for describing supplemental information.
`ReferenceRegion`	Describes the reference region for automatic extraction from video. If the `autoExtraction` is not present or is not equal to video, this element shall be ignored. The localization scheme used is identified by means of the `mpeg7:SpatioTemporalLocatorType` that is defined in ISO/IEC 15938-5.
`Operator`	Describes the preferred type of operator for extracting sensory effects from the reference region of video with the following possible instantiations. — `average`: extracts sensory effects from the reference region by calculating average value. — `dominant`: extracts sensory effects from the reference region by calculating dominant value.

4.6.9 Reference effect

4.6.9.1 Syntax

```
<!-- ################################################ -->
<!--  Reference Effect type                           -->
<!-- ################################################ -->
<complexType name="ReferenceEffectType">
  <complexContent>
    <extension base="sedl:SEMBaseType">
      <attribute name="uri" type="anyURI" use="required" />
      <attributeGroup ref="sedl:SEMBaseAttributes"/>
      <anyAttribute namespace="##other" processContents="lax" />
    </extension>
  </complexContent>
</complexType>
```

4.6.9.2 Semantics

Semantics of the `ReferenceEffectType`:

Name	*Definition*
`ReferenceEffectType`	Tool for describing a reference to a sensory effect, group of sensory effects, or parameter.
`uri`	Describes a reference to a sensory effect, group of sensory effects, or parameter by an Uniform Resource Identifier (URI). Its target type must be one – or derived – of `sedl:EffectBaseType`, `sedl:GroupOfEffectType`, or `sedl:ParameterBaseType`.
`SEMBaseAttributes`	Describes a group of attributes for the effects.
`anyAttribute`	Provides an extension mechanism for including attributes from namespaces other than the target namespace. Attributes that shall be included are the XML streaming instructions as defined in ISO/IEC 21000-7 for the purpose of identifying process units and associating time information to them. Attributes included here override the attribute values possibly defined within the sensory effect, group of effects or parameter referenced by the `uri`. EXAMPLE `si:pts` describes the point in time when the associated information shall become available to the application for processing.

4.6.10 Parameters

4.6.10.1 Syntax

```
<!-- ################################################ -->
<!--  Parameter Base type                             -->
<!-- ################################################ -->
<complexType name="ParameterBaseType" abstract="true">
  <complexContent>
    <extension base="sedl:SEMBaseType"/>
  </complexContent>
</complexType>

<!-- ################################################ -->
<!-- Definition of Color Correction Parameter type    -->
<!-- ################################################ -->
<complexType name="ColorCorrectionParameterType">
  <complexContent>
    <extension base="sedl:ParameterBaseType">
      <sequence>
        <element name="ToneReproductionCurves"
          type="ct:ToneReproductionCurvesType" minOccurs="0"/>
        <element name="ConversionLUT"
          type="ct:ConversionLUTType"/>
        <element name="ColorTemperature" type="ct:IlluminantType"
          minOccurs="0"/>
        <element name="InputDeviceColorGamut"
          type="ct:InputDeviceColorGamutType" minOccurs="0"/>
        <element name="IlluminanceOfSurround" type="mpeg7:unsigned12"
```

```
            minOccurs="0"/>
        </sequence>
      </extension>
    </complexContent>
  </complexType>
```

4.6.10.2 Semantics

Semantics of the `ParameterBaseType`:

Name	*Definition*
`ParameterBaseType`	Provides the topmost type of the parameter base type hierarchy.

Semantics of the `ColorCorrectionParameterType`:

Name	*Definition*
`ColorCorrectionParameterType`	A type defining the schema of the color correction effect.
`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.

4.6.11 Additional validation rules

4.6.11.1 Introduction

For the purpose of referencing the additional validation rules are numbered.

4.6.11.2 The `SEM` element shall have a `si:timeScale` attribute.

4.6.11.3 The following rules shall apply on the `GroupOfEffects`.

4.6.11.3.1 A `GroupOfEffects` shall have a timestamp (i.e., `pts`, `ptsDelta`, or `absTime`).

4.6.11.3.2 A `GroupOfEffects` outside of a `Declarations` shall not have both a `pts` and an `absTime` at the same time.

4.6.11.3.3 A `GroupOfEffects` within a `Declarations` shall have only a `ptsDelta` for a timestamp.

4.6.11.4 The following rules shall apply on the `Effect`.

4.6.11.4.1 At least `activate`, `duration`, or `fade` shall be defined.

4.6.11.4.2 An `Effect` outside of a `GroupOfEffects` shall have a timestamp (i.e., `pts`, `ptsDelta`, or `absTime`).

4.6.11.4.3 An `Effect` within a `GroupOfEffects` shall have only a `ptsDelta` for a timestamp.

4.6.11.4.4 An `Effect` shall not have both a `pts` and an `absTime` at the same time.

4.6.11.4.5 An `Effect` within a `Declarations` shall have only a `ptsDelta` for a timestamp.

4.6.11.4.6 If `duration` is defined `activate` may not be defined.

4.6.11.4.7 If `fade` and `duration` are defined `activate` may not be defined.

4.6.11.4.8 If `fade` is defined intensity shall be defined.

NOTE The actual intensity is defined within the individual effecs by defining its value and range as an extension of `intensityValueType` and `intensityRangeType` respectively.

EXAMPLE `intensity-value` and `intensity-range`.

4.6.11.4.9 If two (or more) consecutive `Effect` elements of the same type share the same timestamp (i.e., `pts`, `ptsDelta`, or `absTime`) and the same location or overlap in time (i.e., `location`, `duration`, `activate` set to `true`/`false` resulting in overlap) only the latest in their order of appearance shall be used while retaining the semantics of the `priority` attribute.

NOTE It is possible to remove the other `Effect` elements from the description.

4.6.11.4.10 If `fade` and `duration` are defined `fade` must be less or equal to `duration`.

4.6.11.5 The following rules shall apply on the `ReferenceEffect`.

4.6.11.5.1 A `ReferenceEffect` outside of a `GroupOfEffects` shall have a timestamp (i.e., `pts`, `ptsDelta`, or `absTime`).

4.6.11.5.2 A `ReferenceEffect` within a `GroupOfEffects` shall have only a `ptsDelta` for a timestamp.

4.6.11.5.3 A `ReferenceEffect` shall not have both a `pts` and an `absTime` at the same time.

4.6.11.5.4 A `ReferenceEffect` within `Declarations` shall have only a `ptsDelta` for a timestamp.

4.6.12 Examples

EXAMPLE 1 The following example shows a possible usage of the basic building blocks.

```
<SEM>
  <DescriptionMetadata>
    <ClassificationSchemeAlias alias="..." href="..."/>
  </DescriptionMetadata>

  <Declarations>
    <!-- some declarations to be used here -->
  </Declarations>

  <GroupOfEffects ...>
    <Effect .../>
    <Effect .../>
  </GroupOfEffects>
  <ReferenceEffect uri="#eff1" .../>
  <Effect .../>
  <GroupOfEffects ...>
    <Effect .../>
    <Effect .../>
    <Effect .../>
  </GroupOfEffects>
  <ReferenceEffect uri="#eff1" .../>
  <!-- and so on -->
</SEM>
```

EXAMPLE 2 The following example shows a possible abstract implementation of Figure 2. Note that the example is declared as abstract because the attribute values refer to variables introduced in Figure 2 instead of using real values.

```
<Effect si:pts="t0" activate="true" fade="t1-t0"
  intensity-value="float" intensity-range="float float"/>
<Effect si:pts="t2" activate="false" fade="t3-t2"
  intensity-value="0.0" intensity-range="0.0 100.0"/>
```

5 Sensory effect vocabulary

5.1 Introduction

This Clause specifies syntax and semantics of the sensory effect vocabulary which comprises the following effects:

— Light, colored light, flash light;

— Temperature;

— Wind;

— Vibration;

— Water sprayer;

— Scent;

— Fog;

— Color correction;

— Rigid body motion;

— Passive kinesthetic motion;

— Passive kinesthetic force;

— Active kinesthetic;

— Tactile;

NOTE SEV has been designed in an extensible way and additional sensory effects can be added easily.

EXAMPLE Additional sensory effects may be added as extensions to `sedl:EffectBaseType` and conformance to SEDL.

5.2 Validation

Validating a document against the SEV schema (as specified in W3C XMLSCHEMA) is necessary, but not sufficient, to determine its validity with respect to SEV. After a document is validated against the SEV schema, it shall also be subjected to additional validation rules. These additional rules are given below in the descriptions of the elements to which they pertain.

5.3 Schema wrapper

The syntax of description tools specified in this clause is provided as a collection of schema components, consisting notably in type definitions and element declarations. In order to form a valid schema document, these schema components should be gathered in a same document with the following declaration defining in particular the target namespace and the namespaces prefixes.

```
<?xml version="1.0"?>
<schema
  xmlns="http://www.w3.org/2001/XMLSchema"
  xmlns:sedl="urn:mpeg:mpeg-v:2010:01-SEDL-NS"
  xmlns:sev="urn:mpeg:mpeg-v:2010:01-SEV-NS"
```

```
  xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004"
  targetNamespace="urn:mpeg:mpeg-v:2010:01-SEV-NS"
  elementFormDefault="qualified" attributeFormDefault="unqualified"
  version="ISO/IEC 23005-3" id="MPEG-V-SEV.xsd">

  <import namespace="urn:mpeg:mpeg-v:2010:01-SEDL-NS" schemaLocation="MPEG-V-
SEDL.xsd"/>
  <import namespace="urn:mpeg:mpeg7:schema:2004"
schemaLocation="http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-
7_schema_files/mpeg7-v2.xsd"/>
```

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

```
</schema>
```

5.4 Light effect

5.4.1 Introduction

This Subclause specifies syntax and semantics of a light effect.

5.4.2 Syntax

```
  <!-- ################################################ -->
  <!--  SEV Light type                                  -->
  <!-- ################################################ -->
  <complexType name="LightType">
    <complexContent>
      <extension base="sedl:EffectBaseType">
        <attribute name="color" type="sev:colorType" use="optional"/>
        <attribute name="intensity-value" type="sedl:intensityValueType"
           use="optional"/>
        <attribute name="intensity-range" type="sedl:intensityRangeType"
           use="optional"/>
      </extension>
    </complexContent>
  </complexType>

  <simpleType name="colorType">
    <union memberTypes="mpeg7:termReferenceType sev:colorRGBType"/>
  </simpleType>

  <simpleType name="colorRGBType">
    <restriction base="NMTOKEN">
      <whiteSpace value="collapse"/>
      <pattern value="#[0-9A-Fa-f]{6}"/>
    </restriction>
  </simpleType>
```

5.4.3 Semantics

Semantics of the `LightType`:

Name	*Definition*
`LightType`	Tool for describing a light effect.
`color`	Describes the color of the light effect as a reference to a classification scheme term or as RGB value. A CS that may be used for this purpose is the `ColorCS` defined in Annex A of ISO/IEC 23005-6. EXAMPLE 1 `urn:mpeg:mpeg-v:01-SI-ColorCS-NS:alice_blue` would describe the color Alice blue.
`intensity-value`	Describes the intensity of the light effect in terms of illumination in lux.
`intensity-range`	Describes the range of the intensity value. EXAMPLE 2 [10.0^{-5} lux, 130.0 klx].

Semantics of the `colorRGBType`:

Name	*Definition*
`colorRGBType`	Tool for describing a color as RGB. EXAMPLE 3 `#F0F8FF` would describe the color Alice blue.
`fade`	In addition to the semantics as defined in 4.6.3.2, the following semantics apply: If `fade` and `intensity` is provided, the fading shall be performed to the intensity defined in the `intensity` attribute. NOTE This is basically covered by the semantics as defined in 4.3.3.2 but repeated here fore better readability. — If `fade` and `color` is provided, the fading shall be performed to the color defined in the `color` attribute. — If `fade`, `intensity`, and `color` is provided, the fading shall be performed to the intensity and color defined in the `intensity` and `color` attributes respectively.

5.4.4 Additional validation rules

5.4.4.1 Introduction

For the purpose of referencing the additional validation rules are numbered.

5.4.4.2 If `intensity-value` is present, `intensity-range` must be present and vice versa.

5.4.4.3 The `intensity-value` must be within the `intensity-range`.

5.4.5 Example

EXAMPLE 1 This example shows the description of a light effect with the following semantics. The intensity is 50.0 lux (within a range of [10^{-5},32000] lux), i.e., approximately a family living room, with the color #FF0000. The light effect is activated at si:pts="0" and deactivated at si:pts="28".

```
<Effect xsi:type="sev:LightType" intensity-value="50.0" intensity-range="0.00001
32000.0" activate="true" color="#FF0000" si:pts="0"/>
...
<Effect xsi:type="sev:LightType" activate="false" color="#FF0000" si:pts="28"/>
```

EXAMPLE 2 This example shows the description of a light effect which uses the color scheme where the color is defined as a reference to the color classification scheme.

```
<DescriptionMetadata>
 <ClassificationSchemeAlias href="urn:mpeg:mpeg-v:01-SI-ColorCS-NS"
alias="COLOR"/>
</DescriptionMetadata>
<Effect xsi:type="sev:LightType" intensity-value="50.0" intensity-range="0.00001
32000.0" duration="28" color=":COLOR:amber" si:pts="0"/>
```

EXAMPLE 3 This example shows the description of a light effect which disables the light effect on the left:middle:front only.

```
<DescriptionMetadata>
 <ClassificationSchemeAlias href="urn:mpeg:mpeg-v:01-SI-LocationCS-NS"
alias="WCS"/>
</DescriptionMetadata>
<Effect xsi:type="sev:LightType" location=":WCS:left:middle:front"
activate="false" si:pts="40" fade="1"/>
```

5.5 Flash effect

5.5.1 Introduction

This Subclause specifies syntax and semantics of a flash effect.

5.5.2 Syntax

```
  <!-- ################################################ -->
  <!--  SEV Flash type                                  -->
  <!-- ################################################ -->
  <complexType name="FlashType">
    <complexContent>
      <extension base="sev:LightType">
        <attribute name="frequency" type="positiveInteger" use="optional"/>
      </extension>
    </complexContent>
  </complexType>
```

5.5.3 Semantics

Semantics of the `FlashType`:

Name	*Definition*
`FlashType`	Tool for describing a flash effect.
`frequency`	Describes the number of flickering in times per second. EXAMPLE The value 10 means it will flicker 10 times for each second.

5.5.4 Example

EXAMPLE This example shows the description of a flash effect with the following semantics. The intensity is 20.0 klx (within a range of [10^{-5},32000] lux), i.e., approximately full daylight (but not direct sunlight) with a duration of 5 seconds. The light flickers 10 times per second and the effect starts at si:pts="0".

```
<Effect xsi:type="sev:FlashType" intensity-value="20000.0" intensity-
range="0.00001 32000.0" duration="5" frequency="10" si:pts="0"/>
```

5.6 Temperature effect

5.6.1 Introduction

This Subclause specifies syntax and semantics of a temperature effect.

5.6.2 Syntax

```
<!-- ################################################ -->
<!--  SEV Temperature type                            -->
<!-- ################################################ -->
<complexType name="TemperatureType">
  <complexContent>
    <extension base="sedl:EffectBaseType">
      <attribute name="intensity-value" type="sedl:intensityValueType"
         use="optional"/>
      <attribute name="intensity-range" type="sedl:intensityRangeType"
         use="optional"/>
    </extension>
  </complexContent>
</complexType>
```

5.6.3 Semantics

Semantics of the `TemperatureType`:

Name	*Definition*
`TemperatureType`	Tool for describing a temperature effect.
`intensity-value`	Describes the intensity of the temperature effect in terms of heating/cooling in Celsius.
`intensity-range`	Describes the range of the intensity value. EXAMPLE [0.0, 100.0] on the Celsius scale.

5.6.4 Additional validation rules

5.6.4.1 Introduction

For the purpose of referencing the additional validation rules are numbered.

5.6.4.2 If `intensity-value` is present, `intensity-range` must be present and vice versa.

5.6.4.3 The `intensity-value` must be within the `intensity-range`.

5.6.5 Example

EXAMPLE This example shows the description of a temperature effect with the following semantics. The intensity is 10° (within a range of [-10.0,100.0]°), i.e., relatively cold, with a duration of 2 seconds and the effect starts at si:pts="0".

```
<Effect xsi:type="sev:TemperatureType" intensity-value="10.5" intensity-range="-
10.0 100.0" duration="2" si:pts="0"/>
```

5.7 Wind effect

5.7.1 Introduction

This Subclause specifies syntax and semantics of a wind effect.

5.7.2 Syntax

```
<!-- ################################################ -->
<!--  SEV Wind type                                   -->
<!-- ################################################ -->
<complexType name="WindType">
  <complexContent>
    <extension base="sedl:EffectBaseType">
      <attribute name="intensity-value" type="sedl:intensityValueType"
         use="optional"/>
      <attribute name="intensity-range" type="sedl:intensityRangeType"
         use="optional"/>
    </extension>
  </complexContent>
</complexType>
```

5.7.3 Semantics

Semantics of the `WindType`:

Name	*Definition*
`WindType`	Tool for describing a wind effect.
`intensity-value`	Describes the intensity of the wind effect in terms of strength in Beaufort.
`intensity-range`	Describes the range of the intensity value. EXAMPLE [0.0, 12.0] on the Beaufort scale.

5.7.4 Additional validation rules

5.7.4.1 Introduction

For the purpose of referencing the additional validation rules are numbered.

5.7.4.2 If `intensity-value` is present, `intensity-range` must be present and vice versa.

5.7.4.3 The `intensity-value` must be within the `intensity-range`.

5.7.5 Example

EXAMPLE This example shows the description of a wind effect with the following semantics. The intensity is 3.0 according to the Beaufort scale (within a range of [0.0 12.0] Beaufort), i.e., approximately a gently breeze, with a fade-in time of 5 seconds and the effect is activated at si:pts="0".

```
<DescriptionMetadata>
 <ClassificationSchemeAlias alias="WCS" href="urn:mpeg:mpeg-v:01-SI-LocationCS-
NS"/>
</DescriptionMetadata>
<Effect xsi:type="sev:WindType" fade="5" location=":WCS:*:*:front" intensity-
value="3.0" intensity-range="0.0 12.0" activate="true" si:pts="0"/>
```

5.8 Vibration effect

5.8.1 Introduction

This Subclause specifies syntax and semantics of a vibration effect.

5.8.2 Syntax

```
  <!-- ################################################ -->
  <!--  SEV Vibration type                              -->
  <!-- ################################################ -->
  <complexType name="VibrationType">
    <complexContent>
      <extension base="sedl:EffectBaseType">
        <attribute name="intensity-value" type="sedl:intensityValueType"
```

```
          use="optional"/>
        <attribute name="intensity-range" type="sedl:intensityRangeType"
          use="optional"/>
      </extension>
    </complexContent>
  </complexType>
```

5.8.3 Semantics

Semantics of the `VibrationType`:

Name	*Definition*
`VibrationType`	Tool for describing a vibration effect.
`intensity-value`	Describes the intensity of the vibration effect in terms of strength according to the Richter scale.
`intensity-range`	Describes the range of the intensity value. EXAMPLE [0.0, 10.0] on the Richter magnitude scale.

5.8.4 Additional validation rules

5.8.4.1 Introduction

For the purpose of referencing the additional validation rules are numbered.

5.8.4.2 If `intensity-value` is present, `intensity-range` must be present and vice versa.

5.8.4.3 The `intensity-value` must be within the `intensity-range`.

5.8.5 Example

EXAMPLE This example shows the description of a vibration effect with the following semantics. The intensity is 4.1 according to the Richter magnitude scale (within a range of [0.0,10.0]), i.e., noticeable shaking items and rattling noises, with a duration of 7 seconds. The vibration has a fade-out time of 3 second and the effect starts at si:pts="0".

```
<Effect xsi:type="sev:VibrationType" intensity-value="4.1" intensity-range="0.0
10.0" duration="7" fade="3" si:pts="0"/>
```

5.9 Spraying effect

5.9.1 Introduction

This Subclause specifies syntax and semantics of a spraying effect.

5.9.2 Syntax

```
<!-- ################################################ -->
<!--  Definition of Spraying type                     -->
<!-- ################################################ -->
<complexType name="SprayingType">
  <complexContent>
    <extension base="sedl:EffectBaseType">
      <attribute name="intensity-value" type="sedl:intensityValueType"
         use="optional"/>
      <attribute name="intensity-range" type="sedl:intensityRangeType"
         use="optional"/>
      <attribute name="sprayingType" type="mpeg7:termReferenceType"/>
    </extension>
  </complexContent>
</complexType>
```

5.9.3 Semantics

Semantics of the `SprayingType`:

Name	*Definition*
`SprayingType`	Tool for describing a spraying effect.
`intensity-value`	Describes the intensity of the spraying effect in terms in ml/h.
`intensity-range`	Describes the range of the intensity value. EXAMPLE [0.0, 10.0] ml/h.
`sprayingType`	Describes the type of the spraying effect as a reference to a classification scheme term. A CS that may be used for this purpose is the `SprayingTypeCS` defined in Annex A of ISO/IEC 23005-6.

5.9.4 Additional validation rules

5.9.4.1 Introduction

For the purpose of referencing the additional validation rules are numbered.

5.9.4.2 If `intensity-value` is present, `intensity-range` must be present and vice versa.

5.9.4.3 The `intensity-value` must be within the `intensity-range`.

5.9.5 Example

EXAMPLE This example shows the description of a water sprayer effect with the following semantics. The intensity is 0.7 ml/h (within a range of [0.0,10.0] ml/h) with a duration of 2 seconds and the effect starts at si:pts="0".

```
<Effect xsi:type="sev:SprayingType" intensity-value="0.7" intensity-range="0.0
10.0" duration="2" si:pts="0"/>
```

5.10 Scent effect

5.10.1 Introduction

This Subclause specifies syntax and semantics of a scent effect.

5.10.2 Syntax

```
<!-- ################################################ -->
<!--  Definition of Scent type                        -->
<!-- ################################################ -->
<complexType name="ScentType">
  <complexContent>
    <extension base="sedl:EffectBaseType">
      <attribute name="scent" type="mpeg7:termReferenceType"
        use="optional"/>
      <attribute name="intensity-value" type="sedl:intensityValueType"
         use="optional"/>
      <attribute name="intensity-range" type="sedl:intensityRangeType"
         use="optional"/>
    </extension>
  </complexContent>
</complexType>
```

5.10.3 Semantics

Semantics of the `ScentType`:

Name	*Definition*
`ScentType`	Tool for describing a scent effect.
`scent`	Describes the scent to use. A CS that may be used for this purpose is the `ScentCS` defined in Annex A of ISO/IEC 23005-6.
`intensity-value`	Describes the intensity of the scent effect in ml/h.
`intensity-range`	Describes the range of the intensity value. EXAMPLE [0.0, 10.0] ml/h.

5.10.4 Additional validation rules

5.10.4.1 Introduction

For the purpose of referencing the additional validation rules are numbered.

5.10.4.2 If `intensity-value` is present, `intensity-range` must be present and vice versa.

5.10.4.3 The `intensity-value` must be within the `intensity-range`.

5.10.5 Example

EXAMPLE This example shows the description of a scent effect with the following semantics. The scent is lilac according to the classification scheme, the intensity is 0.1 ml/h (within a range of [0.0,10.0] ml/h) with a duration of 10 seconds and the effect starts at si:pts="0".

```
<DescriptionMetadata>
 <ClassificationSchemeAlias alias="SCENT" href="urn:mpeg:mpeg-v:01-SI-ScentCS-
NS"/>
</DescriptionMetadata>
<Effect xsi:type="sev:ScentType" intensity-value="0.1" intensity-range="0.0 10.0"
duration="10" scent=":SCENT:lilac" si:pts="0"/>
```

5.11 Fog effect

5.11.1 Introduction

This Subclause specifies syntax and semantics of a fog effect.

5.11.2 Syntax

```
  <!-- ################################################ -->
  <!--  Definition of Fog type                          -->
  <!-- ################################################ -->
  <complexType name="FogType">
    <complexContent>
      <extension base="sedl:EffectBaseType">
        <attribute name="intensity-value" type="sedl:intensityValueType"
           use="optional"/>
        <attribute name="intensity-range" type="sedl:intensityRangeType"
           use="optional"/>
      </extension>
    </complexContent>
  </complexType>
```

5.11.3 Semantics

Semantics of the `FogType`:

Name	*Definition*
`FogType`	Tool for describing a fog effect.
`intensity-value`	Describes the intensity of the fog effect in ml/h.
`intensity-range`	Describes the range of the intensity value. EXAMPLE [0.0, 10.0] ml/h.

5.11.4 Additional validation rules

5.11.4.1 Introduction

For the purpose of referencing the additional validation rules are numbered.

5.11.4.2 If `intensity-value` is present, `intensity-range` must be present and vice versa.

5.11.4.3 The `intensity-value` must be within the `intensity-range`.

5.11.5 Example

EXAMPLE This example shows the description of a fog effect with the following semantics. The intensity is 1.5 ml/h (within a range of [0.0,10.0] ml/h) with a duration of 20 seconds and the effect starts at si:pts="0".

```
<Effect xsi:type="sev:FogType" intensity-value="1.5" intensity-range="0.0 10.0"
duration="20" si:pts="0"/>
```

5.12 Color correction effect

5.12.1 Introduction

This Subclause specifies syntax and semantics of a color correction effect.

5.12.2 Syntax

```
  <!-- ################################################ -->
  <!--  Definition of Color Correction type             -->
  <!-- ################################################ -->
  <complexType name="ColorCorrectionType">
    <complexContent>
      <extension base="sedl:EffectBaseType">
        <choice minOccurs="0">
          <element name="SpatioTemporalLocator"
type="mpeg7:SpatioTemporalLocatorType"/>
          <element name="SpatioTemporalMask"
type="mpeg7:SpatioTemporalMaskType"/>
        </choice>
        <attribute name="intensity-value" type="sedl:intensityValueType"
           use="optional"/>
        <attribute name="intensity-range" type="sedl:intensityRangeType"
           use="optional" fixed="0 1"/>
      </extension>
    </complexContent>
  </complexType>
```

5.12.3 Semantics

Semantics of the `ColorCorrectionType`:

Name	*Definition*
`ColorCorrectionType`	Tool for describing a color correction effect.
`intensity-value`	Describes the intensity of the color correction effect in terms of "on" and "off" with respect to 1(on) and 0(off).
`intensity-range`	Describes the range of the intensity value, i.e., 1 (on) and 0 (off).
`SpatioTemporalLocator`	Describes the spatio-temporal localization of the moving region using `mpeg7:SpatioTemporalLocatorType` (optional), which indicates the regions in a video segment where the color correction effect is applied. The `mpeg7:SpatioTemporalLocatorType` is defined in ISO/IEC 15938-5.
`SpatioTemporalMask`	Describes a spatio-temporal mask that defines the spatio-temporal composition of the moving region (optional), which indicates the masks in a video segment where the color correction effect is applied. The `mpeg7:SpatioTemporalMaskType` is defined in ISO/IEC 15938-5.

5.12.4 Additional validation rules

5.12.4.1 Introduction

For the purpose of referencing the additional validation rules are numbered.

5.12.4.2 If `intensity-value` is present, `intensity-range` must be present and vice versa.

NOTE `intensity-range` has a `fixed` attribute and, thus, it must not be present explicitly as it is present implicitly.

5.12.4.3 The `intensity-value` must be within the `intensity-range`.

5.12.5 Example

EXAMPLE The following example shows a possible usage of the color correction effect applied to spatio-temporal regions as depicted in Figure 4.

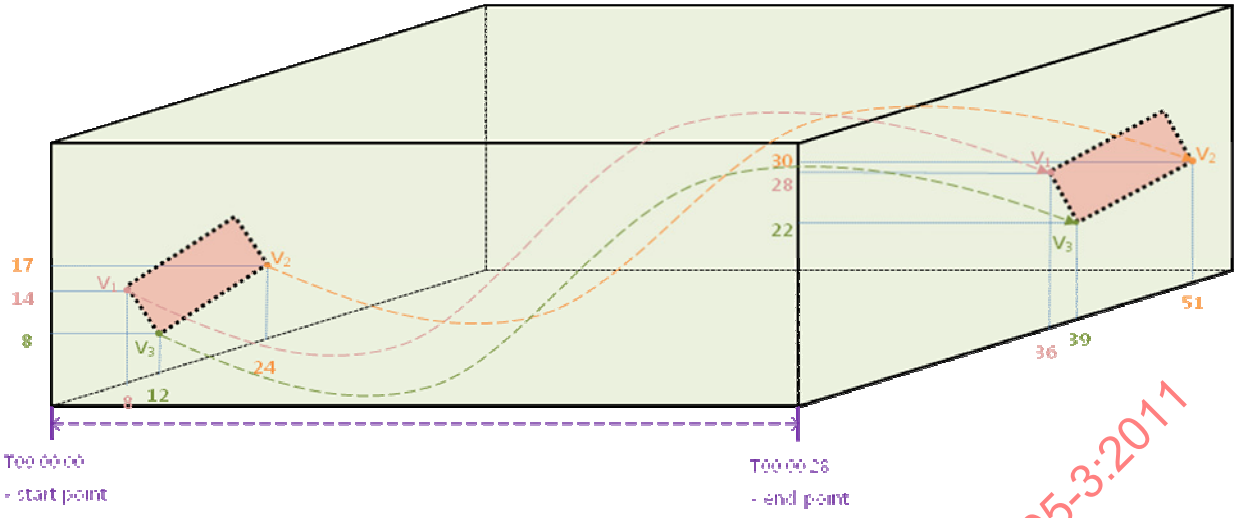

Figure 4 — Color correction effect applied to spatio-temporal regions

```
<Effect intensity-value="1" intensity-range="0 1" duration="28" si:pts="12000">
  <sev:SpatioTemporalLocator>
    <mpeg7:FigureTrajectory type="rectangle">
      <mpeg7:MediaTime>
        <mpeg7:MediaTimePoint>T00:00:00</mpeg7:MediaTimePoint>
        <mpeg7:MediaDuration>PT28S</mpeg7:MediaDuration>
      </mpeg7:MediaTime>
      <!-- Vertex 1 -->
      <mpeg7:Vertex>
        <mpeg7:KeyTimePoint>
          <mpeg7:MediaTimePoint>T00:00:00</mpeg7:MediaTimePoint>
          <mpeg7:MediaTimePoint>T00:00:28</mpeg7:MediaTimePoint>
        </mpeg7:KeyTimePoint>
        <!-- x coordinate -->
        <mpeg7:InterpolationFunctions>
          <mpeg7:KeyValue type="startPoint">8</mpeg7:KeyValue>
          <mpeg7:KeyValue type="secondOrder" param="1.0">36</mpeg7:KeyValue>
        </mpeg7:InterpolationFunctions>
        <!-- y coordinate -->
        <mpeg7:InterpolationFunctions>
          <mpeg7:KeyValue>14</mpeg7:KeyValue>
          <mpeg7:KeyValue>28</mpeg7:KeyValue>
        </mpeg7:InterpolationFunctions>
      </mpeg7:Vertex>
      <!-- Vertex 2 -->
      <mpeg7:Vertex>
        <mpeg7:KeyTimePoint>
          <mpeg7:MediaTimePoint>T00:00:00</mpeg7:MediaTimePoint>
          <mpeg7:MediaTimePoint>T00:00:28</mpeg7:MediaTimePoint>
        </mpeg7:KeyTimePoint>
        <!-- x coordinate -->
        <mpeg7:InterpolationFunctions>
          <mpeg7:KeyValue type="startPoint">24</mpeg7:KeyValue>
          <mpeg7:KeyValue type="secondOrder" param="1.0">51</mpeg7:KeyValue>
        </mpeg7:InterpolationFunctions>
        <!-- y coordinate -->
        <mpeg7:InterpolationFunctions>
          <mpeg7:KeyValue>17</mpeg7:KeyValue>
          <mpeg7:KeyValue>30</mpeg7:KeyValue>
        </mpeg7:InterpolationFunctions>
```

```
      </mpeg7:Vertex>
      <!-- Vertex 3 -->
      <mpeg7:Vertex>
        <mpeg7:KeyTimePoint>
          <mpeg7:MediaTimePoint>T00:00:00</mpeg7:MediaTimePoint>
          <mpeg7:MediaTimePoint>T00:00:28</mpeg7:MediaTimePoint>
        </mpeg7:KeyTimePoint>
        <!-- x coordinate -->
        <mpeg7:InterpolationFunctions>
          <mpeg7:KeyValue type="startPoint">12</mpeg7:KeyValue>
          <mpeg7:KeyValue type="secondOrder" param="1.0">39</mpeg7:KeyValue>
        </mpeg7:InterpolationFunctions>
        <!-- y coordinate -->
        <mpeg7:InterpolationFunctions>
          <mpeg7:KeyValue>8</mpeg7:KeyValue>
          <mpeg7:KeyValue>22</mpeg7:KeyValue>
        </mpeg7:InterpolationFunctions>
      </mpeg7:Vertex>
    </mpeg7:FigureTrajectory>
  </sev:SpatioTemporalLocator>
</Effect>
```

5.13 Rigid body motion effect

5.13.1 Introduction

This Subclause specifies syntax and semantics of a rigid body motion effect.

5.13.2 Syntax

```
  <!-- ################################################ -->
  <!--  Definition of Rigid Body Motion type            -->
  <!-- ################################################ -->
  <complexType name="RigidBodyMotionType">
    <complexContent>
      <extension base="sedl:EffectBaseType">
        <sequence>
          <element name="MoveToward" type="sev:MoveTowardType"
                   minOccurs="0"/>
          <element name="TrajectorySamples" type="mpeg7:FloatMatrixType"
                   minOccurs="0" maxOccurs="unbounded"/>
          <element name="Incline" type="sev:InclineType" minOccurs="0"/>
          <element name="Shake" type="sev:ShakeType" minOccurs="0"/>
          <element name="Wave" type="sev:WaveType" minOccurs="0"/>
          <element name="Spin" type="sev:SpinType" minOccurs="0"/>
          <element name="Turn" type="sev:TurnType" minOccurs="0"/>
          <element name="Collide" type="sev:CollideType" minOccurs="0"/>
        </sequence>
      </extension>
    </complexContent>
  </complexType>

  <!-- ################################################ -->
  <!--  Definition of Move Toward type                  -->
  <!-- ################################################ -->
  <complexType name="MoveTowardType">
    <attribute name="speed" type="float" use="optional"/>
```

```
    <attribute name="acceleration" type="float" use="optional"/>
    <attribute name="directionV" type="sev:MoveTowardAngleType" use="optional"
default="0"/>
    <attribute name="directionH" type="sev:MoveTowardAngleType" use="optional"
default="0"/>
    <attribute name="distance" type="float" use="optional"/>
  </complexType>

  <!-- ################################################ -->
  <!--  Definition of Incline type                      -->
  <!-- ################################################ -->
  <complexType name="InclineType">
    <attribute name="pitchSpeed" type="float" use="optional"/>
    <attribute name="pitchAcceleration" type="float" use="optional"/>
    <attribute name="rollSpeed" type="float" use="optional"/>
    <attribute name="rollAcceleration" type="float" use="optional"/>
    <attribute name="yawSpeed" type="float" use="optional"/>
    <attribute name="yawAcceleration" type="float" use="optional"/>
    <attribute name="pitch" type="sev:InclineAngleType" use="optional"
default="0"/>
    <attribute name="roll" type="sev:InclineAngleType" use="optional"
default="0"/>
    <attribute name="yaw" type="sev:InclineAngleType" use="optional"
default="0"/>
  </complexType>

  <!-- ################################################ -->
  <!--  Definition of Shake type                        -->
  <!-- ################################################ -->
  <complexType name="ShakeType">
    <attribute name="direction" type="mpeg7:termReferenceType"
               use="optional"/>
    <attribute name="count" type="float" use="optional"/>
    <attribute name="distance" type="float" use="optional"/>
    <attribute name="interval" type="positiveInteger" use="optional"/>
  </complexType>

  <!-- ################################################ -->
  <!--  Definition of Wave type                         -->
  <!-- ################################################ -->
  <complexType name="WaveType">
    <attribute name="direction" type="mpeg7:termReferenceType"
               use="optional"/>
    <attribute name="startDirection" type="mpeg7:termReferenceType"
               use="optional"/>
    <attribute name="count" type="float" use="optional"/>
    <attribute name="distance" type="float" use="optional"/>
    <attribute name="interval" type="positiveInteger" use="optional"/>
  </complexType>

  <!-- ################################################ -->
  <!--  Definition of Spin type                         -->
  <!-- ################################################ -->
  <complexType name="SpinType">
    <attribute name="direction" type="mpeg7:termReferenceType"
               use="optional"/>
    <attribute name="count" type="float" use="optional"/>
   <attribute name="interval" type="positiveInteger" use="optional"/>
  </complexType>
```

```
<!-- ################################################ -->
<!--  Definition of Turn type                         -->
<!-- ################################################ -->
<complexType name="TurnType">
  <attribute name="direction" type="sev:TurnAngleType" use="optional"/>
  <attribute name="speed" type="float" use="optional"/>
</complexType>

<!-- ################################################ -->
<!--  Definition of Collide type                      -->
<!-- ################################################ -->
<complexType name="CollideType">
  <attribute name="directionH" type="sev:MoveTowardAngleType"
             use="optional" default="0"/>
  <attribute name="directionV" type="sev:MoveTowardAngleType"
             use="optional" default="0"/>
  <attribute name="speed" type="float" use="optional"/>
</complexType>

<!-- ################################################ -->
<!--  Definition of Rigid Body Motion base type       -->
<!-- ################################################ -->
<simpleType name="TurnAngleType">
  <restriction base="integer">
    <minInclusive value="-180"/>
    <maxInclusive value="180"/>
  </restriction>
</simpleType>
<simpleType name="InclineAngleType">
  <restriction base="integer">
    <minInclusive value="-359"/>
    <maxInclusive value="359"/>
  </restriction>
</simpleType>
<simpleType name="MoveTowardAngleType">
  <restriction base="integer">
    <minInclusive value="0"/>
    <maxInclusive value="359"/>
  </restriction>
</simpleType>
```

5.13.3 Semantics

Semantics of the `RigidBodyMotionType`:

Name	*Definition*
`MoveToward`	This pattern covers three dimensional movement of 6DoF (cf. Figure 5), which means changing the location without rotation. The type is `sev:MoveTowardType`.

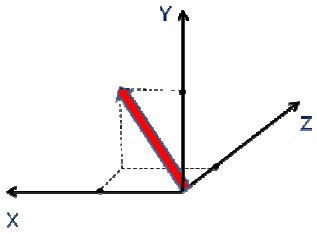

Figure 5 — MoveToward pattern.

`TrajectorySamples`	This pattern describes a set of position and orientation samples that the rigid body will follow (cf. Figure 6). The type is `mpeg7:FloatMatrixType`.

Figure 6 — TrajectorySamples pattern.

`Incline`	This pattern covers pitching, yawing, and rolling motion of 6 DoF, which means changing the rotation without changing the location (cf. Figure 7). The type is `sev:InclineType`.

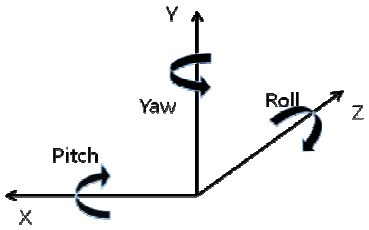

Figure 7 — Incline pattern.

Shake	This pattern is a continuous motion moving from one side to opposite side repeatedly (cf. Figure 8). This is an abstracted motion pattern which can be alternatively expressed by repetition of Move pattern. The type is `sev:ShakeType`.

Figure 8 — Shake pattern.

Wave	This pattern is a continuous motion from side-up to side-down like the surface of water (cf. Figure 9). This is an abstracted motion pattern which can be alternatively expressed by repetition of rolling or pitching of Incline pattern. The type is `sev:WaveType`.

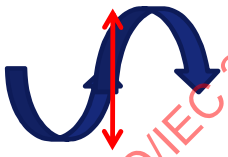

Figure 9 — Wave pattern.

Spin	This pattern is a continuous turning based on a central point inside without change the place (cf. Figure 10). This is an abstracted motion pattern which can be alternatively expressed by repetition of yawing of Incline pattern. The type is `sev:SpinType`.

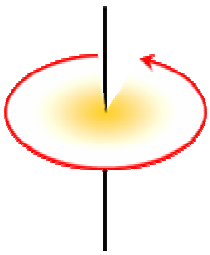

Figure 10 — Spin pattern.

Turn	This pattern is a motion of moving towards some direction (cf. Figure 11). This is an abstracted motion pattern which can be alternatively expressed by repetition of Move and Incline pattern. The type is `sev:TurnType`.

Figure 11 — Turn pattern.

Collide	This pattern is a motion of moving object collides against something (cf. Figure 12). This is an abstracted motion pattern which can be alternatively expressed by repetition of Move and Incline pattern. The type is sev:CollideType.

Figure 12 — Collide pattern.

Semantics of the MoveTowardType:

Name	*Definition*
Speed	Describes the moving speed in terms of centimeter per second.
Acceleration	Describes the acceleration in terms of centimeter per square second.
directionH	Describes the horizontal direction of moving in terms of angle. The type is sev:MoveTowardAngleType. The angle starts from the front-center of the rigid body and increases with CCW (Counter Clock Wise) as depicted in Figure 13.

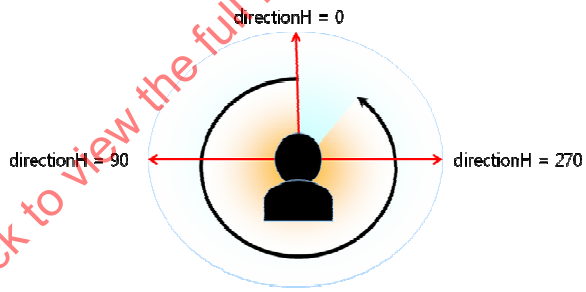

Figure 13 — Horizontal direction model for MoveToward pattern.

directionV	Describes the vertical direction of moving in terms of angle. The type is sev:MoveTowardAngleType. The angle starts from the front-center of rigid body and increases with CCW as depicted in Figure 14.

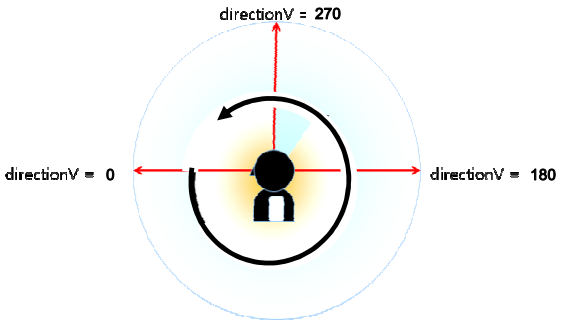

Figure 14 — Vertical direction model for MoveToward pattern.

distance	Describes the distance between the origin and destination in terms of centimeter.

Semantics of the InclineType:

Name	*Definition*
PitchSpeed	Describes the rotation speed based on X-axis in terms of degree per second.
PitchAcceleration	Describes the acceleration based on X-axis in terms of degree per square second.
RollSpeed	Describes the rotation speed based on Z-axis in terms of degree per second.
RollAcceleration	Describes the acceleration based on Z-axis in terms of degree per square second.
YawSpeed	Describes the rotation speed based on Y-axis in terms of degree per second.
YawAcceleration	Describes the acceleration based on Y-axis in terms of degree per square second.
pitch	Describes the rotation based on X-axis in terms of angle. Positive value means the rotation angle in the direction of pitch arrow as depicted in the Figure 15.
roll	Describes the rotation based on Z-axis in terms of angle. Positive value means the rotation angle in the direction of roll arrow as depicted in the Figure 15.

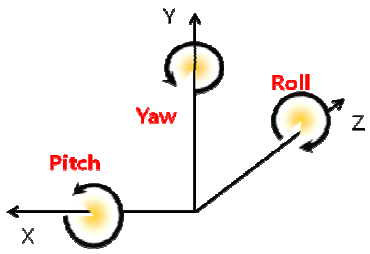

Figure 15 — Direction model for Incline pattern.

NOTE The pitch angle is increased with counter-clock wise.

NOTE The roll angle is increased with counter-clock wise.

yaw	Describes the rotation based on Y-axis in terms of angle. Positive value means the rotation angle in the direction of yaw arrow as depicted in the Figure 15. NOTE The yaw angle is increased with counter-clock wise.

Semantics of the ShakeType:

Name	*Definition*
direction	Describes the direction of the shake motion (cf. Figure 16). A CS that may be used for this purpose is the ShakeDirectionCS defined in Annex A of ISO/IEC 23005-6.

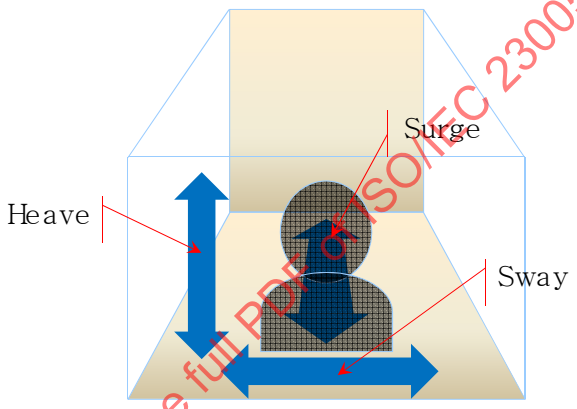

Figure 16 — Direction model for Shake pattern.

count	Describes the times to shake during the duration time.
distance	Describes the distance between the two ends of the shaking motion in terms of centimeter (cf. Figure 17).

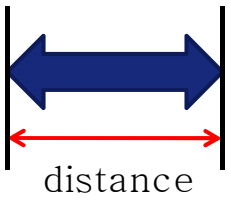

Figure 17 — Distance for shaking motion.

interval	Describes a break time in the intervals of shake motions according to the time scheme used. The time scheme used shall be identified by means of the si:absTimeScheme and si:timeScale attributes respectively. NOTE The interval is illustrated in Figure 18.

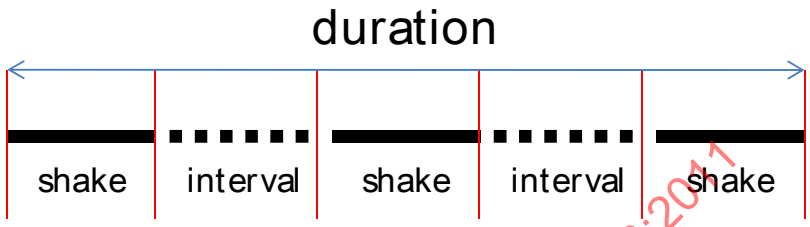

Figure 18 — Illustration of interval.

Semantics of the WaveType:

Name	*Definition*
direction	Describes the direction of the wave motion (cf. Figure 19). A CS that may be used for this purpose is the WaveDirectionCS defined in Annex A of ISO/IEC 23005-6.

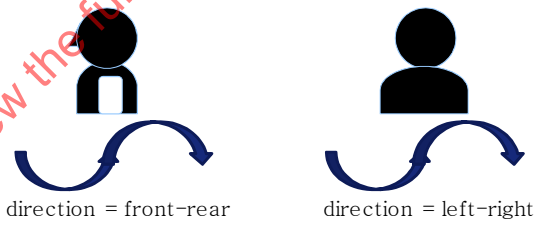

Figure 19 — Direction for waving motion.

startDirection	Describes whether it starts towards up direction or down direction (cf. Figure 20). A CS that may be used for this purpose is the WaveStartDirectionCS defined in Annex A of ISO/IEC 23005-6.

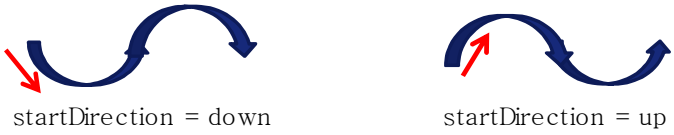

Figure 20 — Start direction for waving motion.

count	Describes the times to wave during the duration time.

distance	Describes the distance between the top and the bottom of the wave motion in centimeter (cf. Figure 21).

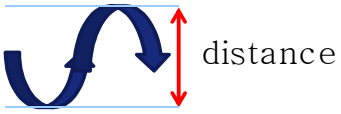

Figure 21 — Distance for waving motion.

interval	Describes a break time in the intervals of wave motions according to the time scheme used. The time scheme used shall be identified by means of the si:absTimeScheme and si:timeScale attributes respectively.

Semantics of the TurnType:

Name	*Definition*
direction	Describes the turning direction in terms of angle. The type is sev:TurnAngleType. (cf. Figure 22).

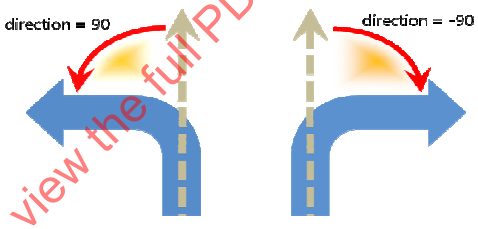

Figure 22 — Direction for turn pattern.

speed	Describes the turning speed in degree per second.

Semantics of the SpinType:

Name	*Definition*
direction	Describes the direction of the spinning based on the 3 axes. A CS that may be used for this purpose is the SpinDirectionCS defined in Annex A of ISO/IEC 23005-6. NOTE 1 Forward-spin based on x axis (which is “xf” in the classification scheme) indicates the spinning direction by the pitch arrow depicted in the Figure 15. Otherwise, backward-spin based on x axis (which is “xb" in the classification scheme) indicates the opposite spinning direction of “xf”.
count	Describes the times to spin during the duration time.

interval	Describes a break time in the intervals of spin motions according to the time scheme used. The time scheme used shall be identified by means of the si:absTimeScheme and si:timeScale attributes respectively.

Semantics of the CollideType:

Name	*Definition*
directionH	Describes the horizontal direction of receiving impact in terms of angle. The type is sev:MoveTowardAngleType. The angle starts from the front-center of the rigid body and increases with CCW as depicted in Figure 23.

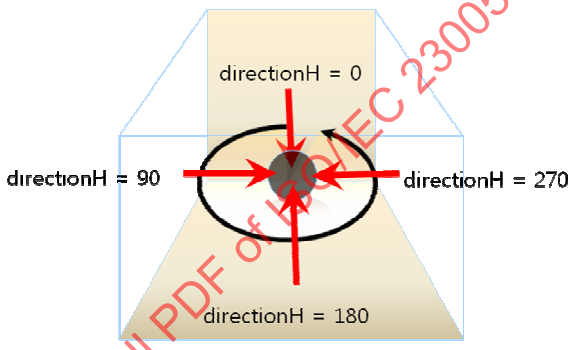

Figure 23 — Horizontal direction model for collide pattern.

directionV	Describes the vertical direction of receiving impact in terms of angle. The type is sev:TowardAngleType. The angle starts from the front-center of rigid body and increases with CCW as depicted in Figure 24.

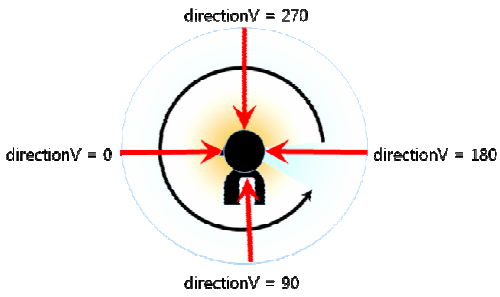

Figure 24 — Vertical direction model for collide pattern.

speed	Describes the speed of colliding object in terms of centimeter per second.

5.13.4 Examples

EXAMPLE 1 This example shows the description of a movetoward effect with the following semantics. The distance to the target position is 6 cm, and the direction is 30 degrees in the vertical angle and 50 degrees in the horizontal angle. The moving speed is 3 cm per second and the duration is 2 seconds. The rigid body starts to move towards target position at si:pts="0" and stays at the target position until the duration time.

```
<Effect xsi:type="sev:RigidBodyMotionType" duration="2" si:pts="0">
  <sev:MoveToward directionV="30" directionH="50" distance="6"
     speed="3"/>
</Effect>
```

It is possible to describe acceleration instead of speed.

```
<Effect xsi:type="sev:RigidBodyMotionType"> duration="2" si:pts="0"
  <sev:MoveToward directionV="30" directionH="50" distance="6"
     acceleration="3"/>
</Effect>
```

It is also possible to describe without speed or acceleration. In this case the semantics is that the rigid body starts to movetoward at si:pts="0" and should reach at the target position within the duration time, which implies that the speed is decided by the duration and the distance. According to the below example, the implied speed is 3 cm/s.

```
<Effect xsi:type="sev:RigidBodyMotionType" duration="2" si:pts="0">
  <sev:MoveToward directionV="30" directionH="50" distance="6"/>
</Effect>
```

EXAMPLE 2 This example shows the description of an incline effect with the following semantics. The target pitch angle is 30 degrees. The rotation speed is 10 degrees per second and the duration is 5 seconds. The rigid body starts to rotate towards target angle at si:pts="0" and stays at the target angle until the duration time.

```
<Effect xsi:type="sev:RigidBodyMotionType" duration="5" si:pts="0">
  <sev:Incline pitch="30" pitchSpeed="3.0"/>
</Effect>
```

It is possible to describe acceleration instead of speed.

```
<Effect xsi:type="sev:RigidBodyMotionType" duration="5" si:pts="0">
  <sev:Incline pitch="30" pitchAcceleration="3.0"/>
</Effect>
```

It is also possible to describe without speed or acceleration. In this case the semantics is that the rigid body starts to incline at si:pts="0" and should finish this motion during the duration time, which implies that the speed is decided by the duration and the angle.

```
<Effect xsi:type="sev:RigidBodyMotionType" duration="5" si:pts="0">
  <sev:Incline pitch="30"/>
</Effect>
```

EXAMPLE 3 This example shows the description of a shake effect with the following semantics. The moving direction is sway which means moving left and right repeatedly. The end-to-end distance is 10 cm and the duration is 5 seconds. The rigid body starts to shake at si:pts="0" and shake 5 times until the duration time.

```
<DescriptionMetadata>
  <ClassificationSchemeAlias alias="SHAKE"
     href="urn:mpeg:mpeg-v:01-SI-ShakeDirectionCS-NS"/>
</DescriptionMetadata>
<Effect xsi:type="sev:RigidBodyMotionType" duration="5" si:pts="0">
  <sev:Shake direction=":SHAKE:sway" distance="5" count="5"/>
</Effect>
```

EXAMPLE 4 This example shows the description of a wave effect with the following semantics. The wave direction is left-right and the distance is 10 cm, and the duration is 5 seconds. The rigid body starts to wave with the left side up at si:pts="0" and wave 5 times until the duration time.

```
<DescriptionMetadata>
  <ClassificationSchemeAlias alias="WAVE"
     href="urn:mpeg:mpeg-v:01-SI-WaveDirectionCS-NS"/>
<ClassificationSchemeAlias alias="WAVESTR"
     href="urn:mpeg:mpeg-v:01-SI-WaveStartDirectionCS-NS"/>
</DescriptionMetadata>
<Effect xsi:type="sev:RigidBodyMotionType" duration="5" si:pts="0">
  <sev:Wave direction=":WAVE:left-right"
        startDirection=":WAVESTR:up" count="5" distance="10"/>
</Effect>
```

EXAMPLE 5 This example shows the description of a turn effect with the following semantics. The turn direction is 30 degree and the turning speed is 10 degree per seconds. The rigid body starts to turn (including move towards) in the right direction with the speed at si:pts="0" and stays during the duration time.

```
<Effect xsi:type="sev:RigidBodyMotionType" duration="5" si:pts="0">
  <Turn direction="30" speed="10"/>
</Effect>
```

It is also possible to describe without speed. In this case the semantics is that the rigid body starts to turn in the right direction at si:pts="0" and should finish this motion during the duration time.

```
<Effect xsi:type="sev:RigidBodyMotionType" duration="5" si:pts="0">
  <sev:Turn direction="90"/>
</Effect>
```

EXAMPLE 6 This example shows the description of a spin effect with the following semantics. The spinning direction is “xf” which means forward spin based on x-axis. The spinning count is 5 times and the duration is 6 seconds which means the rigid body starts to spin at si:pts="0" and repeats 5 times for 6 seconds.

```
<DescriptionMetadata>
  <ClassificationSchemeAlias alias="SPIN"
     href="urn:mpeg:mpeg-v:01-SI-SpinDirectionCS-NS"/>
</DescriptionMetadata>
<Effect xsi:type="sev:RigidBodyMotionType" duration="6" si:pts="0">
  <sev:Spin direction=":SPIN:xf" count="6"/>
</Effect>
```

EXAMPLE 7 This example shows the description of a collide effect with the following semantics. The rigid body receives the colliding impact from the horizontal angle 90 degrees and vertical angle 30 degrees with the speed 220 cm per second.

```
<Effect xsi:type="sev:RigidBodyMotionType" si:pts="0">
  <sev:Collide directionH="90" directionV="30" speed="220"/>
</Effect>
```

5.14 Passive kinesthetic motion effect

5.14.1 Introduction

This Subclause specifies syntax and semantics of a passive kinesthetic motion effect.

5.14.2 Syntax

```
<!-- ################################################ -->
<!--  SEV Passive Kinesthetic Motion type             -->
<!-- ################################################ -->
<complexType name="PassiveKinestheticMotionType">
  <complexContent>
    <extension base="sev:RigidBodyMotionType">
      <attribute name="timeSamples" type="positiveInteger" use="required"/>
    </extension>
  </complexContent>
</complexType>
```

5.14.3 Semantics

Semantics of the `PassiveKinestheticMotionType`:

Name	*Definition*
`PassiveKinestheticMotionType`	Tool for describing a passive kinesthetic motion effect. This type defines a passive kinesthetic motion mode. In this mode, a user holds the kinesthetic device softly and the kinesthetic device guides the user's hand according to the recorded motion trajectories that are specified by three positions and three orientations.
`TrajectorySamples`	Tool for describing a passive kinesthetic interaction. The passive kinesthetic motion data is comprised with 6 by m matrix, where 6 rows contain three positions (Px, Py, Pz in millimeters) and three orientations (Ox, Oy, Oz in degrees) and where m columns contain timeSamples data points. These six data are updated with the same *m* timeSamples.
`timeSamples`	Describes a number of data update times per second. EXAMPLE The value 20 means that the kinesthetic device will move to 20 different positions and orientations for each second.

5.14.4 Additional validation rules

5.14.4.1 Introduction

For the purpose of referencing the additional validation rules are numbered.

5.14.4.2 A number of `TrajectorySamples` must be in multiples of 6 since 6 samples include three positions and three orientations at each period Therefore number of rows is fixed to 6.

5.14.4.3 A number of `TrajectorySamples` at an update period must not exceed the `duration` therefore `timeSamples` attribute should be set.

5.14.5 Examples

EXAMPLE This example shows the description of a passive kinesthetic motion effect with the following semantics. The kinesthetic device moves to new positions and orientations according to the timeSamples. If 3 position and orientation data are given and timeSamples is 3, then the kinesthetic device guides user's hand to three different positions and orientations for 1 second since 3 samples for position and orientation data are provided. Note that the passive kinesthetic motion effect is activated at si:pts="5".

```
<Effect xsi:type="sev:PassiveKinestheticMotionType" timeSamples="3" si:pts="5">
  <sev:TrajectorySamples mpeg7:dim="6 3">
     15 0  20
     10 30 10
     20 11 50
     30 10  0
      0 10 10
     10  0 15
  </sev:TrajectorySamples>
</Effect>
```

5.15 Passive kinesthetic force effect

5.15.1 Introduction

This Subclause specifies syntax and semantics of a passive kinesthetic force effect.

5.15.2 Syntax

```
  <!-- ################################################ -->
  <!--  SEV Passive Kinesthetic Force type              -->
  <!-- ################################################ -->
  <complexType name="PassiveKinestheticForceType">
    <complexContent>
      <extension base="sedl:EffectBaseType">
        <sequence>
          <element name="PassiveKinestheticForce"
                   type="mpeg7:FloatMatrixType"/>
        </sequence>
        <attribute name="timeSamples" type="positiveInteger" use="required"/>
      </extension>
    </complexContent>
  </complexType>
```

5.15.3 Semantics

Semantics of the `PassiveKinestheticForceType`:

Name	*Definition*
`PassiveKinestheticForceType`	Tool for describing a passive kinesthetic force/torque effect. This type defines a passive kinesthetic force/torque mode. In this mode, a user holds the kinesthetic device softly and the kinesthetic device guides the user's hand according to the recorded force/toque histories.
`PassiveKinestheticForce`	Describes a passive kinesthetic force/torque sensation. The passive kinesthetic force/torque data are comprised with 6 by m matrix, where 6 rows contain three forces (Fx, Fy, Fz in Newton) and three torques (Tx, Ty, Tz in Newton-millimeter) for force/torque trajectories. These six data are updated with the same timeSamples.
`timeSamples`	Describes a number of data update times per second.

5.15.4 Additional validation rules

5.15.4.1 Introduction

For the purpose of referencing the additional validation rules are numbered.

5.15.4.2 A data number of `PassiveKinestheticForce` must be in multiples of 6 since 6 samples include three forces and three torques at each period. Therefore number of rows is fixed to 6.

5.15.4.3 `PassiveKinestheticForce` effect element must have `timeSamples` attribute in parent element, but `duration` attribute must not be described.

5.15.4.4 `PassiveKinestheticForce` effect element must not be described with `ActiveKinesthetic` effect at the same time.

5.15.5 Examples

EXAMPLE This example shows the description of a passive kinesthetic force effect with the following semantics. The kinesthetic device produces new forces and torques according to the update rate. If 3 forces and torques data are given and timeSamples is 3, then the kinesthetic device produces forces and torques for 1 second since 3 samples for position and orientation data are provided. Note that the passive kinesthetic force effect is activated at si:pts="2".

```
<Effect xsi:type="sev:PassiveKinestheticForceType" timeSamples="3" si:pts="2">
  <sev:PassiveKinestheticForce mpeg7:dim="6 3">
     3  0 0
     0  3 0
     0  0 3
     2  0 0
     0  0 3
     0 10 5
  </sev:PassiveKinestheticForce>
</Effect>
```

5.16 Active kinesthetic effect

5.16.1 Introduction

This Subclause specifies syntax and semantics of an active kinesthetic effect.

5.16.2 Syntax

```
<!-- ################################################ -->
<!--  SEV Active  Kinesthetic type                    -->
<!-- ################################################ -->
<complexType name="ActiveKinestheticType">
  <complexContent>
    <extension base="sedl:EffectBaseType">
      <sequence>
        <element name="ActiveKinesthetic"
                 type="sev:ActiveKinestheticForceType"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
<complexType name="ActiveKinestheticForceType">
  <attribute name="fx" type="float" use="optional"/>
  <attribute name="fy" type="float" use="optional"/>
  <attribute name="fz" type="float" use="optional"/>
  <attribute name="tx" type="float" use="optional"/>
  <attribute name="ty" type="float" use="optional"/>
  <attribute name="tz" type="float" use="optional"/>
</complexType>
```

5.16.3 Semantics

Semantics of the `ActiveKinestheticType`:

Name	*Definition*
`ActiveKinestheticType`	Tool for describing an active kinesthetic effect. This type defines an active kinesthetic interaction mode. In this mode, when a user touches an object by his/her will, then the computed contact forces and torques are provided.
`ActiveKinesthetic`	Describes an active kinesthetic interaction.
`ActiveKinestheticForceType`	Tool for describing three forces (fx, fy, fz) and torques (tx, ty, tz) for each axis in an active kinesthetic mode. Force is represented in the unit of N (Newton) and torque is represented in the unit of Nmm (Newton-millimeter).

5.16.4 Examples

EXAMPLE This example shows the description of an active kinesthetic effect with the following semantics. Forces and torques are given with the computed values by a user's input, where unit of force is N(newton) and unit of torque is Nmm.

```
<Effect xsi:type="sev:ActiveKinestheticType">
   <sev:ActiveKinesthetic  fx="1.0" fy="2.0" fz="1.5" tx="200" ty="170"
tz="300"/>
</Effect>
```

5.17 Tactile effect

5.17.1 Introduction

This Subclause specifies syntax and semantics of a tactile effect.

5.17.2 Syntax

```
<!-- ################################################ -->
<!--  SEV Tactile type                                -->
<!-- ################################################ -->
<complexType name="TactileType">
  <complexContent>
    <extension base="sedl:EffectBaseType">
      <sequence>
        <choice>
          <element name="ArrayIntensity" type="mpeg7:FloatMatrixType"/>
          <element name="TactileResource" type="sev:TactileResourceType"/>
        </choice>
      </sequence>
      <attribute name="tactileEffect" type="mpeg7:termReferenceType"
                 use="required"/>
      <attribute name="timeSamples" type="positiveInteger" use="optional"/>
    </extension>
  </complexContent>
</complexType>

<!-- ################################################ -->
<!--  SEV TactileResource type                        -->
<!-- ################################################ -->
<complexType name="TactileResourceType">
  <attribute name="type" type="string" use="required"/>
  <attribute name="ref" type="anyURI" use="required"/>
</complexType>
```

5.17.3 Semantics

Semantics of the `TactileType`:

Name	*Definition*
`TactileType`	Tool for describing a tactile effect. Tactile effects can provide vibrations, pressures, temperature, etc, directly onto some areas of human skin through many types of actuators such as vibration motors, air-jets, piezo-actuators, thermal actuators. A tactile effect may effectively be represented by an ArrayIntensity or by a TactileVideo, all of which can be composed of m by n matrix that is mapped to m by n actuators in a tactile device. A Tactile Video is defined as a grayscale video formed with m-by-n pixels matched to the m-by-n tactile actuator array.
`ArrayIntensity`	Describes intensities in terms of physical quantities for all elements of m by n matrix of the tactile actuators. For temperature tactile effect, for example, intensity is specified in the unit of Celsius. For vibration tactile effect, intensity is specified in the unit of mm (amplitude). For pressure tactile effect, intensity is specified in the unit of Newton/mm^2.
`TactileResource`	Describes intensities in terms of a resource.
`tactileEffect`	Describes the tactile effect to use. A CS that may be used for this purpose is the `TactileEffectCS` defined in Annex A of ISO/IEC 23005-6. This refers the preferable tactile effects.
`timeSamples`	Describes a number of data update times per second.

Semantics of the `TactileResourceType`:

Name	*Definition*
`TactileResourceType`	Tool for describing intensities in terms of a resource. EXAMPLE 1 A grayscale (0-255) video of tactile information. This grayscale value (0-255) can be divided into several levels according to the number of levels that a device produces. EXAMPLE 2 An audio file containing the waveform of a tactile vibration effect.
`type`	Describes the data type of the resource as a concatenation of MIME media-type, sub-type, and parameters, as defined in IETF RFC 2045.
`ref`	Describes the URI value that identifies the resource, as defined in IETF RFC 3986.

5.17.4 Example

EXAMPLE 1 This example shows the description of Tactile effect with ArrayIntensity by the following semantics. A set of intensity is provided by a set of intensity values with timeSamples. When a 3-by-3 array of data is given, these data are mapped to tactile devices (note that if a device is formed with i-by-j array, 3-by-3 array of data is resized (upsizing/downsizing). The tactile effect is activated at si:pts="5" and the preferable tactile effect is pressure.

```
<DescriptionMetadata>
 <ClassificationSchemeAlias alias="TACTILEEFFECT" href="urn:mpeg:mpeg-v:01-SI-
TactileEffectCS-NS"/>
</DescriptionMetadata>
<Effect xsi:type="sev:TactileType" timeSamples="2"
tactileEffect=":TACTILEEFFECT:pressure" si:pts="5">
    <sev:ArrayIntensity mpeg7:dim="3 3">250 250 250 0 0 0 150 120 150
</sev:ArrayIntensity>
</Effect>
```

EXAMPLE 2 This example shows the description of a Tactile effect with TactileResource by the following semantics. A set of intensity is provided by a tactile video from the link "http://www.haptic.kr/tactile/sample1.mp4", and 30 frames of greyscale tactile information are given per second. The tactile effect is activated at si:pts="1" and the preferable tactile effect is vibration.

```
<DescriptionMetadata>
 <ClassificationSchemeAlias alias="TACTILEEFFECT" href="urn:mpeg:mpeg-v:01-SI-
TactileEffectCS-NS"/>
</DescriptionMetadata>
<Effect xsi:type="sev:TactileType" timeSamples="30"
tactileEffect=":TACTILEEFFECT:vibration" si:pts="1">
  <sev:TactileResource type="video/mp4"
ref="http://www.haptic.kr/tactile/sample1.mp4"/>
</Effect>
```

This tactile resource refers a greyscale video including intensity information for array type tactile effect. The resolution of the tactile resource is relatively low and intended to match the physical resolution (the number of individual output devices, or tactors) of a tactile display device. The intensity of each grayscale value determines the magnitude of the cue to be delivered to each tactor. Any resolution differences between the stored video and that supported by a viewer's tactile device can be resolved through basic image resizing operations at viewing time.

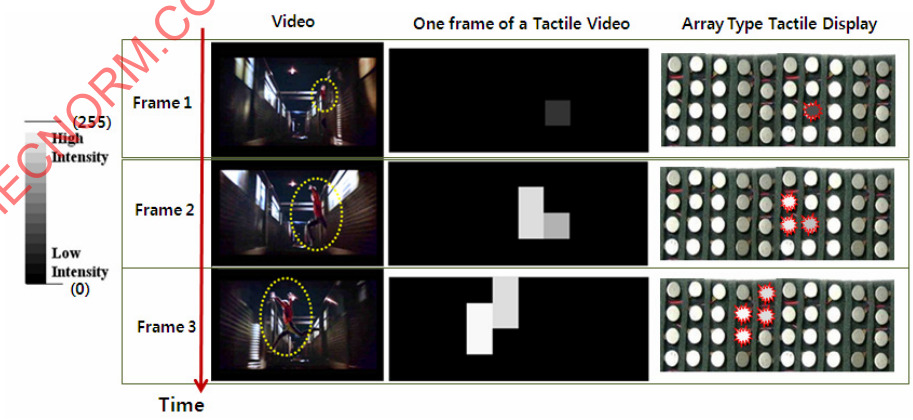

Figure 25 — Excerpt of example tactile resource