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Information technology — Multimedia framework (MPEG-21) —

Part 22: User description

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Foreword

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

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

This third edition cancels and replaces the second edition (ISO/IEC 21000-22:2019), which has been technically revised.

The main changes are as follows:

— technologies related to vibro-haptic devices, that convey enriched information of consecutive vibrations to help elderly/fragilized persons, like load guidance or emergency warnings, for instance.

A list of all parts in the ISO/IEC 21000 series can be found on the ISO and IEC websites.

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

Introduction

The four data formats standardized in this document are represented in Figure 1: User Description (UD), Context Description (CD), Service Description (SD), and Recommendation Description (RD), where UD/CD/SD/RD indicate the formats specified by MPEG-21 User Description.

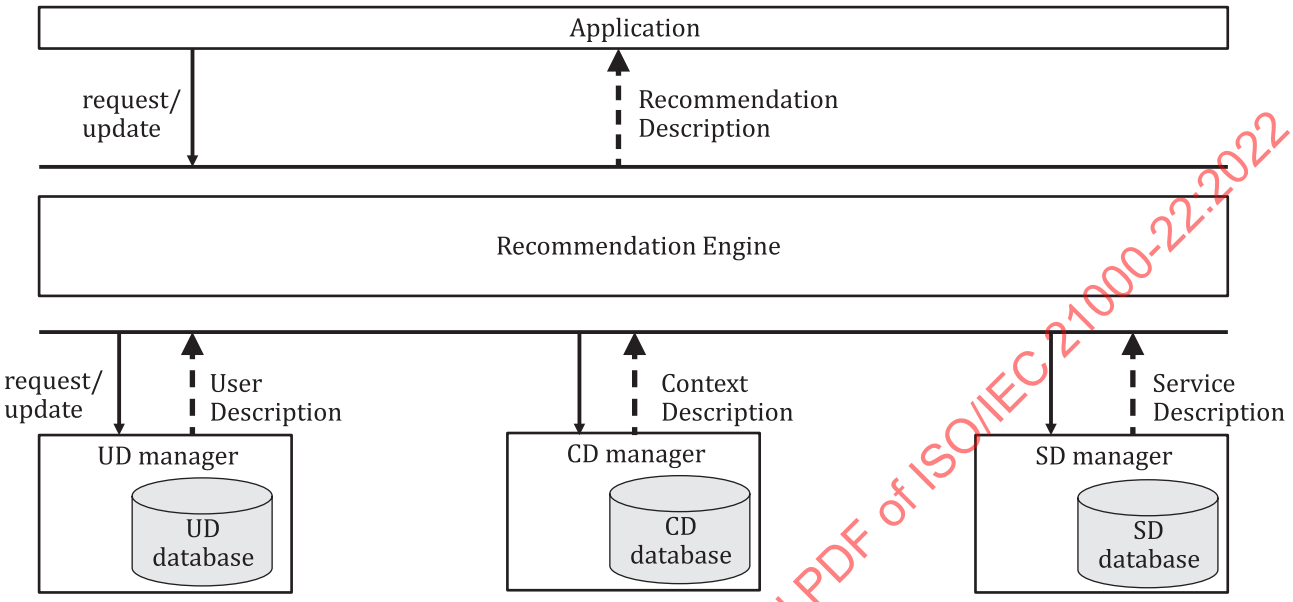

Figure 1 — Conceptual Model of MPEG-21 User Description

This document specifies User Description, Context Description, Service Description and Recommendation Description. Description Managers, Recommendation Engine and Application (in black in the figure) are outside of the scope of this document. The description managers of figure 1 are in charge of:

1) Updating UD, CD and SD e.g. as a result of a User selection

2) Providing UD, CD and SD in response to requests coming from the Recommendation Engine.

Recommendation Engines process UD, CD and SD and provide Recommendations in the form of Recommendation Description (RD) typically to an Application.

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Information technology — Multimedia framework (MPEG-21) —

Part 22: User description

1 Scope

This document specifies four data formats: User Description (UD), Context Description (CD), Service Description (SD), and Recommendation Description (RD). This document also specifies technologies related to consecutive vibration.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
MPEG-21 UD
four standard descriptions that contain information about user, context, service and recommendation

3.2
user description
UD
set of data which may contain static and/or dynamic information about the user

EXAMPLE Identity, interactions, preferences, security settings.

3.3
context description
CD
set of data that describes the context and environmental situation in which the user is located,

EXAMPLE Device in use, physical position, environmental variables (such as temperature and humidity), traffic conditions, security settings.

3.4
service description
SD
set of data containing pertinent information (including security settings) about services (or a set of sub-services)

3.5
recommendation description
RD
set of recommendation data, containing subsets from *UD* (3.2), *CD* (3.3), *SD* (3.4) and additional logical relations and metadata related to the subsets

3.6
user
human or software agent, industrial process or device that is performing autonomous activities

3.7
service
independent, value-adding operation, which brings values to users, or applications providing benefits responding to user's needs

3.8
context
environmental situation for the user

EXAMPLE Device in use, physical location, etc.

3.9
application
entity in charge of responding to the users' requests

EXAMPLE An interface allowing users to choose their preferred programs on a smart TV.

3.10
manager
<UD/CD/SD> entities that provide functionalities of filtering, accessing, storing, editing, updating and securing *UD* (3.2), *CD* (3.3) and *SD* (3.4)

3.11
recommendation engine
process (or a set of processes) in charge of exploiting all available information contained in *UD* (3.2), *CD* (3.3) and *SD* (3.4) to produce a recommendation, i.e. *RD* (3.5), for an enriched user experience

4 General description

Clauses 5, 6, 7, 8 and 9 present the specification of the general description, and of the UD, CD, SD and RD, respectively. Schemes for all these descriptions shall be as provided in Annex A. Classification schemes shall be as provided in Annex B.

4.1 commonAttributes

This `commonAttributes` describes basic properties of each sub element for UD, CD, SD and RD.

4.1.1 Syntax

```
<attributeGroup name="commonAttributes">
   <attribute name="generatedTime" type="dateTime"/>
   <attribute name="descriptionID" type="anyURI" use="required"/>
</attributeGroup>
```

4.1.2 Semantics

Name	*Definition*
`commonAttributes`	Describes properties of each sub element for UD, CD, SD and RD.

Name	*Definition*
generatedTime	Specifies generated time of description.
descriptionID	Indicates the ID of the description. This information can be a combination of numbers, alphabets, etc. All description need to have the unique descriptionID.

4.1.3 Examples

```
<ud:UD generatedTime="2015-0-25T09:30:47Z" descriptionID="UD1234">
   <ud:UserID>ID_132534</ud:UserID>
</ud:UD>
```

4.2 ValueTypes

Several value types can be used to precisely express the data according to various conditions. These simple types define a basic scale type and specify the constraints and information.

4.2.1 Syntax

```
<simpleType name="valueByNominal">
   <restriction base="NMTOKEN"/>
</simpleType>
<simpleType name="valueByOrdinal">
   <restriction base="integer"/>
</simpleType>
<simpleType name="valueByInterval">
   <restriction base="float"/>
</simpleType>
<simpleType name="valueByRatio">
   <restriction base="float"/>
</simpleType>
<simpleType name="valueByAll">
   <union memberTypes="ct:valueByNominal ct:valueByOrdinal ct:valueByInterval
ct:valueByRatio"/>
</simpleType>
<simpleType name="ZeroToOneRatioType">
   <restriction base="ct:valueByRatio">
      <minInclusive value="0"/>
      <maxInclusive value="1.0"/>
   </restriction>
</simpleType>
<simpleType name="ZeroToOnehundredRatioType">
   <restriction base="ct:valueByRatio">
      <minInclusive value="0"/>
      <maxInclusive value="100.0"/>
   </restriction>
</simpleType>
<simpleType name="ZeroToTenOrdinalType">
   <restriction base="ct:valueByOrdinal">
      <minInclusive value="0"/>
      <maxInclusive value="10"/>
   </restriction>
</simpleType>
```

```
<simpleType name="ZeroToOnehundredOrdinalType">
   <restriction base="ct:valueByOrdinal">
      <minInclusive value="0"/>
      <maxInclusive value="100"/>
   </restriction>
</simpleType>
<complexType name="normalizedRatioValueType">
   <choice>
      <element name="ZeroToOneRatio" type="ct:ZeroToOneRatioType"/>3D
      <element name="ZeroToOnehundredRatio" type="ct:ZeroToOnehundredRatioType"/>    </
choice>
</complexType>
<complexType name="normalizedOrdinalValueType">
   <choice>
      <element name="ZeroToTenOrdinal" type="ct:ZeroToTenOrdinalType"/>
      <element name="ZeroToOnehundredOrdinal" type="ct:ZeroToOnehundredOrdinalType"/>
   </choice>
</complexType>
```

4.2.2 Semantics

Name	*Definition*
valueByNominal	Describes categorically discrete value such as type of car, name of interest or type of personality. This one is easy to remember and describe. But it is difficult to standardize an internal name or naming convention.
valueByOrdinal	Describes a natural ordering value such as ranking of priorities, the order of people placed in a line, the choice on a rating scale from 1 to 100. In ordinal measurement, the attributes can be rank-ordered. The interval between values is not interpretable in an ordinal measure. On a 10-point scale, the difference between a 9 and a 10 is not necessarily the same as the difference between a 1 and a 2.
valueByInterval	Describes interval data. Interval data is like ordinal except it is clearly defined that the intervals between each value are equally split. The most common example is temperature in degrees Celsius or Fahrenheit. The difference between 10° and 150° is the same as the difference between 30° and 170°. In interval scales, it is possible to add, subtract and average, but multiplication and division are not possible.
valueByRatio	Describes the ratio value that can be divided and multiplied. For example, weight and height are ratio values, and these variables can be meaningfully added, subtracted, multiplied and divided.
valueByAll	Describes the value including nominal, ordinal, interval and ratio value type.
ZeroToOneRatioType	Describes the ratio value type of which the range is from 0 to 1. The value shall be a floating point number and cannot be lower than 0 or greater than 1.
ZeroToOnehundredRatioType	Describes the ratio value type of which the range is from 0 to 100. The value shall be a floating point number and cannot be lower than 0 or greater than 100.
ZeroToTenOrdinalType	Describes the ordinal value type of which the range is from 0 to 10. The value shall be an integer number and cannot be lower than 0 or greater than 10.
ZeroToOnehundredOrdinalType	Describes the ordinal value type of which the range is from 0 to 100. The value shall be an integer number and cannot be lower than 0 or greater than 100.
normalizedRatioValueType	Describes the normalized ratio value. Based on this type, only one of ZeroToOneRatio or ZeroToOnehundredRatio element shall be instantiated.
normalizedOrdinalValueType	Describes the normalized ordinal value. Based on this type, only one of ZeroToTenOrdinal or ZeroToOnehundredOrdinal element shall be instantiated.

4.2.3 Examples

```
<ud:value>
   <ct:ZeroToOneRatio>0.5</ct:ZeroToOneRatio>
</ud:value>
-------------
<ud:value>
   <ct: ZeroToTenOrdinalType >3</ct: ZeroToTenOrdinalType >
</ud:value>
```

4.3 TimeType

`TimeType` describes a specific time point or a period of time, such as the starting and the ending time.

4.3.1 Syntax

```
<complexType name="TimeType">
   <sequence>
      <element name="startTime" type="dateTime"/>
      <choice minOccurs="0">
         <element name="endTime" type="dateTime"/>
         <element name="duration" type="duration"/>
      </choice>
   </sequence>
</complexType>
```

4.3.2 Semantics

Name	*Definition*
`TimeType`	Specifies a time point and duration to describe the specific time information. It describes start time and end time or duration.
`startTime`	Describes a start time point based on dateTime type defined in the XML Schema Part 2 (XML Schema). When neither endTime nor duration is defined, the startTime denotes a specific time point.
`endTime`	Describes an end time point based on dateTime type.
`duration`	Describes a duration time based on duration type.

4.3.3 Examples

```
<ud:PeriodOfOccurrence>
   <ct:startTime>2015-06-04T18:13:51.0Z</ct:startTime>
   <ct:endTime>2015-06-04T18:14:51.0Z</ct:endTime>
</ud:PeriodOfOccurrence>
```

4.4 ExtendedTimeType

The `ExtendedTimeType` can be used to describe added time information. The time interval may recur periodically, as indicated by the `recurrence` and `numOfRecurrences` attributes. The `ExtendedTimeType` can be used to describe a repetitive task.

4.4.1 Syntax

```
<complexType name="ExtendedTimeType">
```

```
   <complexContent>
      <extension base="ct:TimeType">
         <attribute name="recurrence" default="none">
            <simpleType>
               <restriction base="NMTOKEN">
                  <enumeration value="none"/>
                  <enumeration value="daily"/>
                  <enumeration value="weekly"/>
                  <enumeration value="monthly"/>
                  <enumeration value="annually"/>
               </restriction>
            </simpleType>
         </attribute>
         <attribute name="numOfRecurrences" type="positiveInteger"/>
      </extension>
   </complexContent>
</complexType>
```

4.4.2 Semantics

Name	*Definition*
`ExtendedTimeType`	Describes added time information. The time interval may recur periodically, as indicated by the `Recurrence` and `numOfRecurrences` attributes.
`Recurrence`	Indicates whether the time interval recurs periodically, and the recurrence frequency. The values allowed are defined as follows: — none: indicates that the associated temporal interval is nonrecurring; — daily: indicates that the associated temporal interval recurs on a daily basis; — weekly: indicates that the associated temporal interval recurs on a weekly basis; — monthly: indicates that the associated temporal interval recurs on a monthly basis; — annually: indicates that the associated temporal interval recurs on an annual basis. Other values that are datatype-valid with respect to string (XML Schema Part 2) are reserved. By default, the time interval is non-recurring. If the value of this attribute is not "none", the date and time given in this description specifies the date and time of the first occurrence of the event.
`numOfRecurrences`	Indicates how many times the time interval recurs (optional). For example, when `Recurrence`="daily", the value of `numOfRecurrences` denotes the number of days that the `PreferenceCondition` shall be in effect. This attribute shall not be used when the time interval is not recurring (`Recurrence`="none"). When a time interval recurs (as indicated by the recurrence attribute) and the `numOfRecurrences` attribute is not present, the time interval when the `PreferenceCondition` shall be in effect recurs indefinitely. When the time interval recurs and the `numOfRecurrences` attribute is present, the time interval indicated by the Time element is the first interval in the sequence of time intervals when the `PreferenceCondition` shall be in effect. In this case, the `Time` element shall include a specific time instant (date and time) that specifies the start of the first interval.

4.4.3 Examples

```
<ud:Schedule>
   <ud:ScheduleEvent xmlns:ct="urn:mpeg:mpeg-ud:2014:01-CT-NS"
descriptionMethod="byAgent" eventName="103rd Meeting" startTime="2015-09-30T10:00:00Z">
      <ud:RecurrenceInfo>
         <ct:startTime>2015-09-30T10:00:00Z</ct:startTime>
         <ct:duration>P10D</ct:duration>
      </ud:RecurrenceInfo>
   </ud:ScheduleEvent>
</ud:Schedule>
```

4.5 LocationType

This subclause describes a structure of `LocationType` element. `LocationType` include `Location` and `SemanticLocation` elements.

4.5.1 Syntax

```
<complexType name="LocationType">
   <sequence>
      <element name="GeographicLocation" type="mpeg7:PlaceType" minOccurs="0"/>
      <element name="SemanticLocation" type="mpeg7:SemanticPlaceType" minOccurs="0"/>
   </sequence>
</complexType>
```

4.5.2 Semantics

Name	*Definition*
`LocationType`	This data type represents geographical and semantic location of the user.
`GeographicLocation`	Describes a geographical location.
`SemanticLocation`	Describes a semantic location.

4.5.3 Examples

This example indicated use of `Location`. In this case, the place is a university in Madrid, Spain.

```
<cd:Location>
   <ct:GeographicLocation>
      <mpeg7:Name xml:lang="en">Madrid</mpeg7:Name>
      <mpeg7:GeographicPosition datum="itrf">
         <mpeg7:Point latitude="35.5" longitude="135.75" altitude="100"/>
      </mpeg7:GeographicPosition>
      <mpeg7:AdministrativeUnit type="city">Madrid</mpeg7:AdministrativeUnit>
      <mpeg7:PostalAddress>
         <mpeg7:AddressLine>E.T.S.Ing. Telecommunication</mpeg7:AddressLine>
         <mpeg7:AddressLine>Universidad Politecnica de Madrid</mpeg7:AddressLine>
         <mpeg7:AddressLine>Ciudad Universitaria s/n</mpeg7:AddressLine>
         <mpeg7:PostingIdentifier>E-2804</mpeg7:PostingIdentifier>
      </mpeg7:PostalAddress>
   </ct:GeographicLocation>
</cd:Location>
```

4.6 ClassificationSchemeAliasType

The `ClassificationSchemeAliasType` assigns an alias to a classification scheme. When a classification scheme is referenced, an abbreviated reference form can be used.

4.6.1 Syntax

```
<complexType name="ClassificationSchemeAliasType">
   <complexContent>
      <extension base="anyType">
         <attribute name="alias" type="NMTOKEN" use="required"/>
         <attribute name="href" type="anyURI" use="required"/>
      </extension>
   </complexContent>
</complexType>
```

4.6.2 Semantics

Name	*Definition*
`ClassificationScemeAliasType`	Describes an alias for a `ClassificationScheme` referenced by a URI
`alias`	Describes the alias assigned to the classification scheme. 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 shall be referenced using the identifying value defined by the uri attribute of the `ClassificationScheme`.

4.6.3 Examples

```
<!-- Define schema aliases --> <ClassificationSchemeAlias alias="s1"
href="urn:mpeg: mpeg21:UD:CS:DeviceCategoryCS:2016"/>

<!-- Refer to the term using the schema aliases -->
<ud:DeviceCategory>:S1:1</ud:DeviceCategory> <!-- :S1:1 means watch --
>
```

4.7 ObjectType

This `ObjectType` describes the object which is used by user, service provider and recommendation engine.

4.7.1 Syntax

```
<complexType name="ObjectType">
   <sequence>
      <element name="ObjectID" type="ID" minOccurs="0"/>
      <element name="ObjectName" type="Name" minOccurs="0"/>
      <element name="ObjectActivity" type="mpeg7:ControlledTermUseType" minOccurs="0"
maxOccurs="unbounded"/>
      <element name="ObjectCategory" type="mpeg7:ControlledTermUseType" minOccurs="0"/>
      <element name="ObjectInformationURI" type="anyURI" minOccurs="0"/>
      <element name="ObjectLocation" type="ct:LocationType" minOccurs="0"/>
   </sequence>
```

```
   <attribute name="ObjectFormat" use="optional">
      <simpleType>
         <restriction base="NMTOKEN">
            <enumeration value="Visual"/>
            <enumeration value="Audio"/>
            <enumeration value="Video"/>
            <enumeration value="Text"/>
            <enumeration value="Image"/>
         </restriction>
      </simpleType>
   </attribute>
</complexType>
```

4.7.2 Semantics

Name	*Definition*
ObjectType	This data type describes the objects offered by the service. All kind of items that are provided by a service provider can be an object.
ObjectID	Describes an object ID used for identifying an object in ObjectType.
ObjectName	Describes the name of the object.
ObjectActivity	Describes the activity of the object intended by the user. In case of visual object, value for this element can be vibrating, flickering, appearing and disappearing.
ObjectCategory	Describes the category of the object, such as similar object's representative name. Terms for the ObjectCategory are specified by the ObjectCategoryCS (urn:mpeg:mpeg21:UD:CS:ObjectCategoryCS:2016).
ObjectInformationURI	Describes the information about URI associated with the object, if the object contains additional information for the other objects or services.
ObjectLocation	Describes the geographic location of the real-world location for the object (e.g. GPS).
ObjectFormat	Describes type for the media format of the object. (e.g. visual, audio, video, text, image).

4.7.3 Examples

```
<sd:ServiceObjectInformation ObjectFormat="Visual">
   <ct:ObjectID>ID195</ct:ObjectID> <ct:ObjectName>Burger_King</ct:ObjectName>
   <ct:ObjectCategory href="urn:mpeg:mpeg21:DU:CS:ObjectCategoryCS:2016:0203
"><Name>fast_food</Name></ct:ObjectCategory>
   <ct:ObjectInformationURI>http://www.mpeg-ud.com/</ct:ObjectInformationURI>
<ct:ObjectLocation>
      <ct:GeographicLocation>
         <GeographicPosition datum="itif">
            <Point longitude="-110" latitude="20" altitude="50"/>
         </GeographicPosition>
      </ct:GeographicLocation>
   </ct:ObjectLocation>
</sd:ServiceObjectInformation>
```

4.8 InformationAccessUserGroup

4.8.1 Syntax

This Syntax is `InformationAccessUserGroup` type.

```
<complexType name="InformationAccessUserGroup">
   <sequence>
      <element name="UserID" type="mpeg7:UserIdentifierType" maxOccurs="unbounded"/>
   </sequence>
   <attribute name="GroupID" type="anyURI"/>
</complexType>
```

`InformationAccessUserGroup` type has `InformationAccessID` type. `InformationAccessID` describes the list of other users who can access private information.

4.8.2 Semantics

Name	*Definition*
`InformationAccessUserGroup`	Describes the group of other users who can access private information.
`UserID`	Specifies the list of user's ID belonging to the group that can access private information.
`GroupID`	Specifies the identifier of the group.

5 User description

5.1 UserDescriptionType

This clause specifies User Description (UD) which contains root elements at the basis of individual use cases.

5.1.1 Syntax

```
<complexType name="UD">
   <complexContent>
      <extension base="ud:BaseUserType">
           <sequence>
            <element name="InformationAccessGroup" type="ct:InformationAccessUserGroup"
minOccurs="0" maxOccurs="unbounded"/>
               <element name="ClassificationSchemeAlias" type="ct:ClassificationSchemeAli
asType" minOccurs="0" maxOccurs="unbounded"/>
               <element name="UserID" type="mpeg7:UniqueIDType"/>
               <element name="UserProfile" type="ud:UserProfileType" minOccurs="0"/>
               <element name="UsageHistory" type="ud:UsageHistoryType" minOccurs="0"/>
               <element name="Preference" type="ud:PreferenceType" minOccurs="0"/>
               <element name="Emotion" type="ud:EmotionType" minOccurs="0"/>
               <element name="Schedule" type="ud:ScheduleType" minOccurs="0"/>
               <element name="Activity" type="ud:ActivityType" minOccurs="0"/>
               <element name="Representation" type="ct:ObjectType" minOccurs="0"/>
               <element name="Intention" type="ud:IntentionType" minOccurs="0"/>
               <element name="Knowledge" type="ud:KnowledgeType" minOccurs="0"/>
               <element name="ObjectSharing" type="ud:ObjectSharingType" minOccurs="0"/>
```

```
                <element name="ServiceUsagePattern" type="ud:UsagePatternType"
minOccurs="0"/>
            <element name="LoudnessPreferences" type="ud:LoudnessPreferencesType"/>
            <element name="VisualExpressionPreference" type="ud: VisualExpressionPreferenc
eType"/>
            <element name="ConsecutiveVibrationPreference" type="ud: ConsecutiveVibrationP
referenceType"/>
        </sequence>
        <attributeGroup ref="ct:commonAttributes"/>
      </extension>
   </complexContent>
</complexType>
```

5.1.2 Semantics

Name	*Definition*
UD	Serves as the root element of the MPEG-21 UD Format. The UD element shall be used as the topmost element to make user description in an instance of MPEG-21 UD Format.
UserDescriptionType	Specifies the syntax of the root element. This datataype is a set of descriptions which may contain static and dynamic information about user. Within this Type, UserProfile, Preference, Emotion, Schedule or Activity element shall be instantiated.
InformationAccessGroup	Describes the group of other users who can access private information.
ClassificationSchemeAlias	Specifies an alias for a ClassificationScheme to be referenced within the UserDescriptionType by a simplified URI.
UserID	Describes the unique identifier of a user.
UserProfile	Describes user profile based on UserProfileType
UsageHistory	Describes usage history based on UsageHistoryType. This element can represent user's history for a given service, such as searching or movie recommendations.
Preference	Describes preference based on PreferenceType.
Emotion	Describes emotion based on EmotionType. This type represents user's emotion, including its changes over time.
Schedule	Describes schedule based on ScheduleType.
Activity	Describes user activity based on ActivityType.
Representation	Describes the representation such as user character and image used by the user. This element can be used to describe user character on the social network.
Intention	Describes a list of intentions related to specific actions which a given user may perform with a multimedia object.
Knowledge	Describes a piece of knowledge that the user wants to share for recommendation purposes.
ObjectSharing	Describes the condition of authority (e.g. ID, ownership and accessibility of object) for the sharing and accessing of object to user or external service.
UsagePattern	Describes various patterns about usage of user based on UsagePatternType. Users use a lot of applications and services for a variety of reasons. UsagePattern might be used to figure out user's characteristics.
commonAttributes	Describes a group of attributes for the CommonAttributes. The syntax and semantics of commonAttributes are specified in General Description.
ServiceUsagePattern	Describes various patterns about usage of service by the user.
LoudnessPreferences	Describes static or dynamic personal and group audio preferences (e.g. audio levels, audio level history, and song preferences) and the usage history which helps with selecting appropriate audio service.

Name	*Definition*
VisualExpressionPreference	A set of data edited by user's intention/emotion or created by recognizing user's situation/condition.
ConsecutiveVibrationPreference	Describes preferred duration/interval/period/amplitude/ frequency of consecutive vibration

5.2 UserProfileType

The UserProfileType represents the abstract concept of a "user". Concretely, a user can be a person, an organization (e.g. a company), a group of persons (e.g. a musical ensemble), a device or other mixed user (e.g. a cat and a person).

5.2.1 Syntax

```
<complexType name="UserProfileType" abstract="true">
   <complexContent>
      <extension base="ud:BaseUserType">
         <sequence>
            <element name="Specialty" type="mpeg7:termReferenceListType" minOccurs="0" />
         </sequence>
      </extension>
   </complexContent>
</complexType>
```

5.2.2 Semantics

Name	*Definition*
UserProfileType	Describes a basic entity of user information (abstract). The User Profile entity shall correspond to one of a variety of a user including a person, a person group, an organization, a device, a mixed user and so forth.
Specialty	Describes a specialty that this user has in various fields.

5.2.3 Examples

```
<ud:UserProfile xsi:type="ud:PersonProfileType">
   <ud:Specialty>urn:mpeg:mpeg21:UD:CS:UserSpecialtyCS:2016:01</ud:Specialty>
</ud:UserProfile>
```

5.3 PersonProfileType

The PersonProfileType describes a person entity. The PersonProfileType can be used to describe individual basic properties of a human being.

5.3.1 Syntax

```
<complexType name="PersonProfileType">
   <complexContent>
   <extension base="ud:UserProfileType">
     <sequence>
       <element name="PersonInformation" type="mpeg7:PersonType" minOccurs="0"/>
       <element name="Birthtime" type="dateTime" minOccurs="0" />
       <element name="Language" type="ud:LanguageType" minOccurs="0"
maxOccurs="unbounded"/>
```

```
       <element name="Accessibility" type="ud:AccessibilityType" minOccurs="0"/>
       <element name="RelationshipStatus" minOccurs="0">
         <simpleType>
            <restriction base="string">
               <enumeration value="single"/> <enumeration value="engaged"/> <enumeration
value="married"/> <enumeration value="separated"/> <enumeration value="divorced"/>
<enumeration value="widowed"/> <enumeration value="in_a_relationship"/> <enumeration
value="in_an_open_relationship"/> <enumeration value="it_is_complicated"/> <enumeration
value="other"/>
<enumeration value="unspecified"/>
            </restriction>
          </simpleType>
        </element>
        <element name="Gender" type="ud:GenderType" minOccurs="0"/> <element
name="SocialInformation" type="ud:SocialInformationType"
minOccurs="0" maxOccurs="unbounded"/>
     </sequence>
   </extension>
   </complexContent>
</complexType>
```

5.3.2 Semantics

Name	*Definition*
PersonProfileType	Describes some basic properties of a human being.
PersonInformation	Inherits the structure from the MPEG-7: PersonType.
Birthtime	This element describes the user's birthtime.
Language	Describe properties of one or more specific languages that this user is able to use.
Accessibility	Describe the user's need to access digital resources and the user's detail impairment information in the context of audiovisual condition.
RelationshipStatus	This element describes the relationship status of the user
Gender	This element indicates the gender of the user.
SocialInformation	Describes information on the social communities subscribed by the user, and provided by a given service.

5.3.3 Examples

```
<ud:UserProfile xsi:type="ud:PersonProfileType">
   <ud:Specialty>urn:mpeg:mpeg21:UD:CS:UserSpecialtyCS:2016: 01</ud:Specialty>
   <ud:PersonInformation>
      <mpeg7:Name xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004">
      <mpeg7:GivenName>Jaewon</mpeg7:GivenName> </mpeg7:Name>
      <mpeg7:PersonDescription>Mpeg-UD Member</mpeg7:PersonDescription>
      <mpeg7:Nationality>KR</mpeg7:Nationality>
   </ud:PersonInformation>
   <ud:Gender>female</ud:Gender>
</ud:UserProfile>
```

5.4 OrganizationProfileType

OrganizationProfileType can be used to describe the profile of an organization.

5.4.1 Syntax

```
<complexType name="OrganizationProfileType">
   <complexContent>
     <extension base="ud:UserProfileType">
        <sequence>
            <element name="OrganizationInformation" type="mpeg7:OrganizationType"/>
        </sequence>
     </extension>
   </complexContent>
</complexType>
```

5.4.2 Semantics

Name	*Definition*
`OrganizationProfileType`	Describes the profile of the organization.
`OrganizationInformation`	Describes basic properties of the organization using MPEG- 7:OrganizationType.

5.4.3 Examples

```
<ud:UserProfile xsi:type="ud:OrganizationProfileType">
   <ud:Specialty></ud:Specialty>
   <ud:OrganizationInformation>
      <mpeg7:Name>MPEG-UD Group</mpeg7:Name>
         <mpeg7:Kind>
            <mpeg7:Name>Mpeg- SYSTEM Subgroup</mpeg7:Name>
         </mpeg7:Kind>
   </ud:OrganizationInformation>
</ud:UserProfile>
```

5.5 DeviceProfileType

`DeviceProfileType` can be used to describe the profile of a device acting as user.

5.5.1 Syntax

```
<complexType name="DeviceProfileType">
   <complexContent>
      <extension base="ud:UserProfileType">
         <sequence>
            <element name="Device" type="mpeg21:TerminalCapabilityBaseType"/>
            <element name="DeviceCategory" type="mpeg7:termReferenceListType"
minOccurs="0"/>
         </sequence>
      </extension>
   </complexContent>
</complexType>
```

5.5.2 Semantics

Name	*Definition*
`DeviceProfileType`	Description of the device profile.

Name	*Definition*
`Device`	Description of the device capabilities
`DeviceCategory`	Terms for the `DeviceCategory` are specified by the DeviceCategoryCS (`urn: mpeg: mpeg21: UD: CS: DeviceCategoryCS: 2016`).

5.5.3 Examples

```
<ud:UserProfile xsi:type="ud:DeviceProfileType">
   <ud:Device xsi:type="mpeg21:DisplaysType">
   <mpeg21:Display>
       <mpeg21:DisplayCapability xsi:type="mpeg21:DisplayCapabilityType">
       <mpeg21:ScreenSize horizontal="42" vertical="41"/>
       </mpeg21:DisplayCapability>
       </mpeg21:Display>
   </ud:Device>
   <ud:DeviceCategory>urn:mpeg:mpeg21:UD:CS:DeviceCategoryCS:2016:0001</
ud:DeviceCategory>
</ud:UserProfile>
```

5.6 GroupedProfileType

`GroupedProfileType` can be used to describe basic attributes of a group, intended as a set of users.

5.6.1 Syntax

```
<complexType name="GroupedProfileType">
   <complexContent>
      <extension base="ud:UserProfileType">
         <choice minOccurs="2" maxOccurs="unbounded">
            <element name="User" type="ud:UserProfileType"/> <element name="UserRef"
type="anyURI"/>
         </choice>
      </extension>
   </complexContent>
</complexType>
```

5.6.2 Semantics

Name	*Definition*
`GroupedProfileType`	Describes an individual group's basic profile.
`User`	Describes information about one of the group's members. (e.g. one of User Profile, Device Profile, Organization Profile).
`UserRef`	A reference to a group's member through the specification of its URI.

5.6.3 Examples

```
<ud:UD>
   <ud:UserID>
      <ud:UserID>ID_35243</ud:UserID>
   </ud:UserID>
   <ud:UserProfile xsi:type="ud:GroupedProfileType">
   <ud:User xsi:type="ud:PersonProfileType">
```

```
   <ud:PersonInformation>
   <mpeg7:Name><mpeg7:GivenName>Jim</mpeg7:GivenName></mpeg7:Name>
   </ud:PersonInformation>
   </ud:User>
   <ud:UserRef>ID_3023_Jim</ud:UserRef>
   <ud:UserRef>ID_303_John</ud:UserRef>
 </ud:UserProfile>
</ud:UD>
```

5.7 UsageHistoryType

The `UsageHistoryType` describes the history of interaction and consumption of multimedia..

5.7.1 Syntax

```
<complexType name="UsageHistoryType">
   <complexContent>
      <extension base="ud:BaseUserType">
         <sequence>
            <element name="DetailedUserInteraction" type="ud:DetailedUserInteractionType"
minOccurs="0"/>
<element name="ServiceUsageInformation" type="ud:ServiceUsageInformationType"
minOccurs="0" />
         </sequence>
      </extension>
   </complexContent>
</complexType>
<complexType name="DetailedUserInteractionType">
      <annotation>
         <documentation>The main complex type describing detailed interaction with
multimedia items</documentation>
      </annotation>
      <sequence>
         <element name="MultimediaExperiences">
            <complexType>
               <sequence>
                  <element name="MultimediaExperience" type="ud:MultimediaExperienceType"
maxOccurs=”unbounded”>
                  </element>
               </sequence>
            </complexType>
         </element>
      </sequence>
</complexType>
<complexType name="ServiceUsageInformationType">
      <sequence>
         <element name="ServiceID" type="sd:ServiceDescriptionType"/>
         <element name="UsageTime" type="ct:TimeType"/>
      </sequence>
</complexType>
```

5.7.2 Semantics

Name	*Definition*
UsageHistoryType	Specifies the history of interaction and consumption of multimedia.
MultimediaExperiences	The set of multimedia experiences of the user.
ServiceUsageInformation	Describes information about service usage based on ServiceUsageInformationType. Users use a lot of applications and services for a variety of reasons. When encountering a problem such as storage limitation and program errors, it might be difficult to describe usage history completely. In this case, ServiceUsageInformation element can be used to helps to summarize information about usage history.
DetailedUserInteraction	Structure containing information about the multimedia experiences of the user.
UsageInformationType	Describies a general information related to usage.
SeiviceID	Describes the service used by the user.
UsageTime	Describes time duration for service usage. The syntax and semantics of TimeType are specified in General Description.

5.7.3 Examples

```
<ud:UsageHistory>
   <ud:ServiceUsageInformation>
      <ud:ServiceID xmlns:ct="urn:mpeg:mpeg21:UD:CT:2016" xmlns:sd="urn:mpeg:mpeg21:UD:
SD:2016">
         <sd:ServiceID>13243</sd:ServiceID>
         <sd:ServiceGeneralInformation>
            <sd:ServiceName>Service1</sd:ServiceName>         <sd:ServiceProviderName>Ser
viceProvider</sd:ServiceProviderName>
         </sd:ServiceGeneralInformation>
         <sd:ServiceTargetInformation></sd:ServiceTargetInformation>
            <sd:IsServiceAvailable>true</sd:IsServiceAvailable>
         </ud:ServiceID>
         <ud:UsageTime>
            <startTime xmlns="urn:mpeg:mpeg21:UD:CT:2016">2016-01-03T09:00:00Z</
startTime>
            <endTime xmlns="urn:mpeg:mpeg21:UD:CT:2016">2016-01-03T09:40:00Z</endTime>
         </ud:UsageTime>
      </ud:ServiceUsageInformation>
   </ud:UsageHistory>
```

5.8 EventType

An abstract representation of a generic event.

5.8.1 Syntax

```
<complexType name="EventType" abstract="true">
   <annotation>
      <documentation>An abstract representation of a generic real event</documentation>
   </annotation>
   <sequence minOccurs="1" maxOccurs="unbounded">
      <element name="Coordinates">
         <complexType>
            <sequence>
```

```
                <element name="Location" type="ct:LocationType" minOccurs="0"/>
                </element>
                <element name="Time" type="ct:TimeType" minOccurs="0"
maxOccurs="unbounded"/>
                </element>
             </sequence>
          </complexType>
       </element>
    </sequence>
</complexType>
```

5.8.2 Semantics

Name	*Definition*
eventType	An abstract representation of a generic real event.
Coordinates	Spatial and temporal coordinates of the event. Multiple Coordinates model events occurring in distributed space and time (e.g. listening to a CD track by track when driving from office to home).
Location	The location where the event occurs.
Time	The (sequence of) time interval(s) or time point(s) at which the event occurs.

5.8.3 Examples

"EventType" is an abstract complex type. Examples are provided in sections related to derived types.

```
<ud:Schedule>
      <ud:ScheduleEvent xmlns:ct="urn:mpeg:mpeg-ud:2014:01-CT-NS"
descriptionMethod="byAgent" eventName="103rd Meeting" startTime="2015-09-30T10:00:00Z">
         <ud:RecurrenceInfo>
            <ct:startTime>2015-09-30T10:00:00Z</ct:startTime>
            <ct:duration>P10D</ct:duration>
         </ud:RecurrenceInfo>
      </ud:ScheduleEvent>
</ud:Schedule>
```

5.9 InteractionAtomType

This complex type specifies the common structure of pieces of multimedia consumed or provided by a user.

5.9.1 Syntax

```
<complexType name="InteractionAtomType">
   <annotation>
      <documentation>An abstract representation of observables and artefacts</
documentation>
   </annotation>
   <sequence>
      <element name="Role" type="anyURI">
         <annotation>
            <documentation>A piece of metadata that expresses the functionality of an
interaction atom (e.g. an observable or an artefact) while in a specific state. For
example, if the user adds a text part (artefact) with the intention of annotating an
image (observable), then the role of such text will be "annotation"</documentation>
```

```
         </annotation>
      </element>
      <element name="MultimediaObject">
         <annotation>
            <documentation>Any type of data that can be handled by a device in order to
produce multimedia contents, e.g. in video, audio, text formats. The description of a
multimedia object may include its low-level characteristics (e.g. the "colour histogram"
of a video). A multimedia object can play a role as an observable or as an artefact
during a state of a multimedia experience. Multimedia objects comprise the following
types of objects: Text, Image, Video, AudioVisual, Audio, Application
            </documentation>
         </annotation>
         <complexType>
            <complexContent>
               <extension base="didl:ItemType">
                  <sequence>
                     <element name="SourceService" type="sd:ServiceDescriptionType"
minOccurs="0"/>
                  </sequence>
               </extension>
            </complexContent>
         </complexType>
      </element>
      <sequence minOccurs="0">
         <element name="Composition">
            <complexType>
               <sequence maxOccurs="unbounded">
                  <element name="Artefact" type="ud:ArtefactType"/>
                  <element name="Observable" type="ud:ObservableType"/>
               </sequence>
            </complexType>
         </element>
      </sequence>
   </sequence>
</complexType>
```

5.9.2 Semantics

Name	*Definition*
`InteractionAtomType`	Specifies the common structure of pieces of multimedia consumed or provided by a user.
`Role`	Specifies the functionality of an interaction atom (e.g. an observable or an artefact) while in a state of a `Multimedia Experience`. Values for the content of this element are specified in InteractionAtomRoleCS (`urn:mpeg: mpeg21:UD:CS:InteractionAtomRolesCS:2016`).
`MultimediaObject`	Specifies descriptions of multimedia iteam consumed or provided by a user and its source service.
`Composition`	Any composition of Artefacts or Observables.

5.9.3 Examples

`InteractionAtomType` is an abstract representation of observables and artefacts available for a user in a certain State of a MultimediaExperience. The following example illustrates a case in which in the same State of a MultimediaExperience a user produced on Artefact and observed one Observable.

```
...
   <State>
      <Artefacts>
         <Artefact>
            <Role>...</Role>
            <MultimediaObject>...</MultimediaObject>
         </Artefact>
      </Artefacts>
      <Observables>
         <Observable>
            <Role>...</Role>
            <MultimediaObject>...</MultimediaObject>
            <UsageEvent>...</UsageEvent>
         </Observable>
      </Observables>
   </State>
...
```

5.10 ArtefactType

A specific multimedia object provided by the user while in a specific state of a `Multimedia Experience`. An artefact is any multimedia object actively generated by a user (e.g. tags, annotations, voice recording) or selected by the user during a specific state of his/her multimedia experience.

5.10.1 Syntax

```
<complexType name="ArtefactType">
   <annotation>
         <documentation>A specific multimedia object provided by the user while in a
specific state of a Multimedia Experience. An artefact is any multimedia object actively
generated by a user (e.g. tags, annotations, voice recording) or selected by the user
during a specific state of his/her multimedia experience</documentation>
   </annotation>
   <complexContent>
      <extension base="ud:InteractionAtomType"/>
   </complexContent>
</complexType>
```

5.10.2 Semantics

Name	*Definition*
`artefactType`	A specific multimedia object provided by the user while in a specific state of a `Multimedia Experience`. An artefact is any multimedia object actively generated by a user (e.g. tags, annotations, voice recording) or selected by the user during a specific state of his/her multimedia experience.

5.10.3 Examples

This example illustrates a case in which in a specific state of a MultimediaExperience a user has produced 3 artefacts.

```
<State>
<Artefact>
   <Role>...</Role>
```

```
   <MultimediaObject>...</MultimediaObject>
</Artefact>
<Artefact>
   <Role>...</Role>
   <MultimediaObject>...</MultimediaObject>
</Artefact>
<Artefact>
   <Role>...</Role>
   <MultimediaObject>...</MultimediaObject>
</Artefact>
...
</State>
```

5.11 ObservableType

A specific multimedia object that the user may decide to use, while in a specific state of his/her multimedia experience. An observable is any multimedia object enjoyable by the user in a specific state (e.g. an image displayed on the graphic interface).

5.11.1 Syntax

```
<complexType name="ObservableType">
   <annotation>
      <documentation>A specific multimedia object that the user may decide to use, while
in a specific state of his/her multimedia experience. An observable is any multimedia
object enjoyable by the user in a specific state (e.g. an image displayed on the graphic
interface)</documentation>
   </annotation>
   <complexContent>
      <extension base="ud:InteractionAtomType">
         <sequence minOccurs="0" maxOccurs="unbounded">
            <element name="UsageEvent">
               <annotation>
                  <documentation>A specific event which occurs every time the user
decides to actually use an observable (e.g. when the user is reading a text, watching a
video, ...)</documentation>
               </annotation>
               <complexType>
                  <complexContent>
                  <extension base="ud:EventType">
                     <attribute name="usageType" type="anyURI"/> </extension>
                  </complexContent>
               </complexType>
            </element>
         </sequence>
      </extension>
   </complexContent>
</complexType>
```

5.11.2 Semantics

Name	*Definition*
`UsageEvent`	Structure containing information about when the observable has been actually used by the user. A specific event which occurs every time the user decides to actually use an observable (e.g. when the user is reading a text, watching a video, etc.).

5.11.3 Examples

This example illustrates a case in which a user identified with U100 has observed an observable during a period starting and ending at specific points in time at an unknown location.

```
<?xml version="1.0" encoding="UTF-8"?>
<UD xmlns="urn:mpeg:mpeg21:UD:UD:2016" xmlns:xsi="http://www.w3.org/2001/XMLSchema-
instance" xsi:schemaLocation=" urn:mpeg:mpeg21:UD:UD:2016 1.MPEG-UD-UD.xsd">
<UserID>U100</UserID>
   ...
   <Observables>
      <Observable>
         <Role>...</Role>
         <MultimediaObject>...</MultimediaObject>
         <UsageEvent>
            <Coordinates>
               <Time><ct:StartTime>2001-12-17T09:30:47Z </ct:StartTime></Time>
            </Coordinates>
            </UsageEvent>
         </Observable>
      </Observables>
   ...
```

5.12 MultimediaExperienceType

The complex set of events (states and usage events) representing the fruition by the user, within a given time interval, of a certain number of multimedia contents.

5.12.1 Syntax

```
<complexType name="MultimediaExperienceType">
   <annotation>
      <documentation>The complex set of events (states and usage events) representing the
fruition by the user, within a given time interval, of a certain number of multimedia
contents</documentation>
   </annotation>
   <sequence>
      <element name="States">
         <complexType>
            <sequence maxOccurs="unbounded">
               <element name="State" type="ud:StateType"/> </sequence>
         </complexType>
      </element>
   </sequence>
</complexType>
```

5.12.2 Semantics

Name	*Definition*
States	The states that compose the multimedia experience.
State	A specific event, identified by a set of "variables" or "coordinates" univocally identifying the set of interaction atoms and their respective roles in a given state of the multimedia experience.

5.12.3 Examples

This example shows the structure of a MultimediaExperience as a sequence of different states, each occurring at certain moments in time. In each state, the user may observe observables or produce artefacts. In the first and last state, there is information about the usage event of the observable.

```
<MultimediaExperience>
   <States>
      <State>
      <Coordinates>
         <Time>
            <ct:startTime>2001-12-17T09:30:47Z </ct:startTime>
         </Time>
      </Coordinates>
      <Observables>
         <Observable>
            <Role>...</Role>
            <MultimediaObject>...</MultimediaObject>
            <UsageEvent>
               <Coordinates>
                  <Time>
                     <ct:startTime>2001-12-17T09:30:47Z</ct:startTime>
                  </Time>
               </Coordinates>
            </UsageEvent>
         </Observable>
      </Observables>
      </State>
      <State>
         <Coordinates>
            <Time>
               <ct:startTime>2001-12-17T09:40:47Z</ct:startTime>
         </Time>
         </Coordinates>
      <Artefacts>
         <Artefact>
         <Role>...</Role>
         <MultimediaObject>...</MultimediaObject>
         </Artefact>
      </Artefacts>
   </State>
   <State>
      <Coordinates>
         <Time>
```

```
            <ct:startTime>2001-12-17T09:40:47Z</ct:startTime>
         </Time>
      </Coordinates>
      <Artefacts>
         <Artefact>
            <Role>...</Role>
            <MultimediaObject>...</MultimediaObject>
         </Artefact>
      </Artefacts>
   </State>
   <State>
      <Coordinates>
         <Time>
            <ct:startTime>2001-12-17T09:45:47Z</ct:startTime>
         </Time>
      </Coordinates>
   <Observables>
      <Observable>
         <Role>...</Role>
         <MultimediaObject>...</MultimediaObject>
         <UsageEvent>
            <Coordinates>
               <Time>
                  <ct:startTime>2001-12-17T09:50:47Z </ct:startTime>
               </Time>
            </Coordinates>
            </UsageEvent>
         </Observable>
      </Observables>
      </State>
</States>
</MultimediaExperience>
```

5.13 StateType

A specific event, identified by a set of “variables” or “coordinates”, univocally identifying the set of interaction atoms and their respective roles in a given state of the multimedia experience.

5.13.1 Syntax

```
<complexType name="StateType">
   <annotation>
      <documentation>A specific event, identified by a set of “variables” or
“coordinates” univocally identifying the set of interaction atoms and their respective
roles in a given state of the multimedia experience</documentation>
   </annotation>
   <complexContent>
      <extension base="ud:EventType">
         <sequence>
            <element name="Artefacts" minOccurs="0">
            <complexType>
               <sequence>
```

```
                <element name="Artefact" type="ud:ArtefactType" maxOccurs="unbounded"/>
             </sequence>
          </complexType>
       </element>
          <element name="Observables" minOccurs="0"> <complexType>
             <sequence>
                <element name="Observable" type="ud:ObservableType"
maxOccurs="unbounded"/>
             </sequence>
          </complexType>
       </element>
    <element name="SemanticallyRelatedStates" minOccurs="0"> <complexType>
       <sequence>
          <element name="StatesRef" minOccurs="1" maxOccurs="unbounded">
             <simpleType>
                <list itemType="anyURI"/>
             </simpleType>
          </element>
       </sequence>
          <attribute name="criterion" type="anyURI"/> </complexType>
          </element>
       </sequence>
       <attribute name="order" type="nonNegativeInteger"/> <attribute name="id"
type="anyURI"/>
    </extension>
 </complexContent>
</complexType>
```

5.13.2 Semantics

Name	*Definition*
`Artefacts`	Specifies the artefacts characterizing the state.
`Observables`	Specifies the observables characterizing the state.
`SemanticallyRelatedStates`	Specifies the structure pointing to semantically related states to the current state.
`Criterion`	Specifies the pointer to the specific semantic of the relation. The values for this attribute are specified in StatesSemanticRelationshipCS (`urn:mpeg:mpeg21:UD:CS:StatesSemanticRelationshipsCS:2016`).

5.13.3 Examples

This example shows the structure of a state inside a `MultimediaExperience` of user U100. A state can contain any number of artefacts and observables. It can also contain information about states that are semantically related to each other through the `SemanticallyRelatedStates` structure.

```
<?xml version="1.0" encoding="UTF-8"?>
<UD   xmlns="   urn:mpeg:mpeg21:UD:UD:2016"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="
urn:mpeg:mpeg21:UD:UD:2016 1.MPEG-UD-UD.xsd">
   <UserID>U100</UserID>
      ...
      <States>
         <State>
```

```
            <Artefacts>...<Artefacts>
            <Observables>...</Observables>
            <SemanticallyRelatedStates>
               <StatesRef>...</StatesRef>
            </SemanticallyRelatedStates>
         </State>
      </States>
      ...
```

5.14 PreferenceType

`PreferenceType` describes the preference related to the various services. Preference could be conceived of as an individual's attitude towards a set of objects. Interested topics, preference on presentation style, sensory effects preference, score of satisfaction, service usage preferences, preference on service provider, interested topics and multimedia can be a preference.

5.14.1 Syntax

```
<complexType name="PreferenceType">
   <complexContent>
      <extension base="ud:BaseUserType">


         <sequence>
            <element name="UserPreferences" type="mpeg7:UserPreferencesType"
minOccurs="0"/>
            <element name="AudioPresentationPreferences" type="ud:AudioPresentationPrefe
rencesType" minOccurs="0"/>
            <element name="DisplayPresentationPreferences" type="mpeg21:DisplayPresentati
onPreferencesType" minOccurs="0"/>
            <element name="GraphicsPresentationPreferences" type="mpeg21:GraphicsPresenta
tionPreferencesType" minOccurs="0"/>
            <element name="TextPresentationPreferences" type="ud:TextPresentationPreferen
cesType" minOccurs="0" maxOccurs="unbounded"/>
            <element name="ServicePreference" type="ud:ServicePreferencesType"
minOccurs="0"/>
            <element name="TranslationPreference" type="ud:TranslationPreferenceType"
minOccurs="0"/>
            <element name="WebLinkPreferences" type="ud:WebLinkPreferenceType"
minOccurs="0" maxOccurs="unbounded"/>
         </sequence>
      </extension>
   </complexContent>
</complexType>
```

5.14.2 Semantics

Name	*Definition*
`PreferenceType`	Describes the preference related to the various services. Preference could be conceived of as an individual's attitude towards a set of objects. Interested topics, preference on presentation style, sensory effects preference, score of satisfaction, service usage preferences, preference on service provider, interested topics and media can be a preference.

Name	*Definition*
UserPreferences	Describes the user's preferences pertaining to consumption of multimedia content, in particular, filtering, searching and browsing of multimedia content. The mpeg7:UserPreferencesType contains FilteringAndSearchPreferences, BrowsingPreferences and RecordingPreferences, and contains an attribute indicating whether the user's preferences may be updated automatically.
AudioPresentationPreferences	Describes the preferences of a user regarding the presentation or rendering or audio resources. This element refers AudioPresentationPreferencesType.
DisplayPresentationPreferences	Describes preferences of a User regarding the presentation or rendering of images and videos. This mpeg21:DisplayPresentationPreferencesType includes descriptors of preferences related to the color and the conversion of stereoscopic video. The ColorTemperaturePreference, the BrightnessPreference, the SaturationPreference and the ContrastPreference describe the preferences of a User regarding the color of the displayed visual contents in terms of color temperature, brightness, saturation and contrast, each of which is a usual color attribute of images. StereoscopicVideoConversion describes the preferences of a User related to the conversion of 2D video to 3D stereoscopic video and also the conversion of 3D stereoscopic video to 2D video.
GraphicsPresentationPreferences	Describes presentation preferences related to graphics media. This mpeg21:GraphicsPresentationPreferencesType contains GeometryEmphasis, TextureEmphasis and AnimationEmphasis element.
TextPresentationPreferences	Describes user's presentation preference related to text to be presented in the display device.
ServicePreference	Describes the level of preferences for specific services.
TranslationPreference	Describes the preferences for translation services.
WebLinkPreferences	Describes the preference related to the various weblinks

5.15 TextPresentationPreferencesType

This TextPresentationPreferencesType describes the user's presentation preference related to text to be presented in the display device.

5.15.1 Syntax

```
<complexType name="TextPresentationPreferencesType">
   <sequence>
      <element name="TextPropertyPreference" type="ud:TextPropertyPreferenceType"/>
      <element name="TargetDisplayDeviceCapability" type="mpeg21:DisplayCapabilityType"
minOccurs="0"/>
   </sequence>
</complexType>

<complexType name="TextPropertyPreferenceType">
   <complexContent>
      <extension base="mpeg21:FontType">
         <attribute name="italic" type="boolean" use="optional" default="false"/>
<attribute name="oblique" type="boolean" use="optional" default="false"/>
         <attribute name="bold" type="boolean" use="optional" default="false"/>
<attribute name="smallcap" type="boolean" use="optional" default="false"/>
<attribute name="underline" type="boolean" use="optional" default="false"/>
<attribute name="overline" type="boolean" use="optional" default="false"/>
      </extension>
   </complexContent>
</complexType>
```

5.15.2 Semantics

Name	*Definition*
`TextPropertyPreference`	Describes the user's preference of text properties such as font type, font colour, font size, font style, etc.
`TargetDisplayDevicCapability`	Describes the capabilities of the target display device to which text presentation preferences describing in `TextPropertyPreference` element are applied. The syntax and semantics of `DisplayCapabilityType` are specified in ISO/IEC 21000-7.
`italic`	Specifies whether italic style is used or not. The default value is "false".
`oblique`	Specifies whether oblique style is used or not. The default value is "false". The oblique style is slightly slanted but the letterforms do not change shape.
`bold`	Specifies whether bold style is used or not. The default value is "false".
`smallCap`	Specifies whether small-cap style is used or not. The default value is "false". The small-cap style is that all lowercase letters are converted to uppercase letters.
`underline`	Specifies whether underline style is used or not. The default value is "false".
`overline`	Specifies whether overline style is used or not. The default value is "false".

5.15.3 Example

```
<ud:UD>
   <ud:UserID>keti</ud:UserID>
   <ud:Preference>
      <ud:TextPresentationPreferences>
         <ud:TextPropertyPreference fontColor="black" fontSize="10" fontType="arial"
italic="true" underline="true"/>
            <ud:TargetDisplayDeviceCapability>
            <mpeg21:Mode>
               <mpeg21:Resolution horizontal="720" vertical="480"/>
            </mpeg21:Mode>
            <mpeg21:ScreenSize horizontal="49" vertical="52"/>
         </ud:TargetDisplayDeviceCapability>
      </ud:TextPresentationPreferences>
   </ud:Preference>
</ud:UD>
```

5.16 WebLinkPreferenceType

`WebLinkPreferenceType` type describes the preference related to the various weblinks.

`WebLinkPreferenceType` type is composed of `WebLinkAddress` element, `WebLinkUsageHistoryType` element and `preferenceLevel` attribute for that link.

5.16.1 Syntax

```
<complexType name="WebLinkPreferenceType">
      <sequence>
      <element name="WebLinkAddress" type="anyURI"/>
      <element name="WebLinkUsageHistory" type="ud:WebLinkUsageHistoryType" minOccurs="0"
maxOccurs="unbounded"/>
      </sequence>
      <attribute name="preferenceLevel" type="ct:ZeroToOnehundredRatioType"
use="optional" default="50"/>
```

```
</complexType>
```

5.16.2 Semantics

Name	*Definition*
`WebLinkPreferenceType`	Describes the preference related to the specific weblink.
`WebLinkAddress`	Describes the URI of the preferred weblink.
`WebLinkUsageHistory`	Describes the usage history of a specific weblink
`preferenceLevel`	Describes a ranking of the weblink preference. Value ranges from 0 to 100 and default value is 50.

5.16.3 Example

```
<ud:Preference>
      <ud:WebLinkPreferences>
         <ud:WebLinkAddress></ud:WebLinkAddress>
         <ud:WebLinkUsageHistory feedback="true">
            <ud:Coordinates>
               <ud:Time>
                  <ct:startTime xmlns:ct="urn:mpeg:mpeg21:UD:CT:2016">2015-06-
04T18:13:51.0Z</ct:startTime>
               </ud:Time>
            </ud:Coordinates>
         </ud:WebLinkUsageHistory>
      </ud:WebLinkPreferences>
</ud:Preference>
```

5.17 WebLinkUsageHistoryType

`WebLinkUsageHistoryType` type describes the usage history of a specific weblink.

5.17.1 Syntax

```
<complexType name="WebLinkUsageHistoryType">
      <complexContent>
            <extension base="ud:EventType">
               <attribute name="feedback" type="boolean"/>
            </extension>
      </complexContent>
</complexType>
```

5.17.2 Semantics

Name	*Definition*
`WebLinkUsageHistoryType`	Describes the usage history of a specific weblink.
`feedback`	Describes the user feedback of a specific weblink. It represents one of two values: TRUE or FALSE. (TRUE: positive feedback, False: negative feedback)

5.18 ServicePreferenceType

`ServicePreferencesType` describes the level of preferences for specific services. Every user can have his personal preferences of the various services, respectively. A UD instance can contain preferences about specific services.

5.18.1 Syntax

```
<complexType name="ServicePreferencesType">
   <sequence>
      <element name="ServiceGeneralInformation" type="sd:ServiceGeneralInformationType"/>
   </sequence>
         <attribute name="preferenceLevel" type="ct:ZeroToOnehundredOrdinalType"
use="required"/>
</complexType>
```

5.18.2 Semantics

Name	*Definition*
`ServiceGeneralInformation`	Describes general information of the service. Service name, provider name, generic service information, service URI, service category, etc. can be described by this type.
`Specialty`	Indicate the priority or weight assigned to a particular user preference, relative to other components. The range of the preference values is from 0 to 100.

5.18.3 Examples

```
<ud:Preference>
   <ud:ServicePreference preferenceLevel="95">
      <ud:ServiceGeneralInformation>
         <sd:ServiceName>Service</sd:ServiceName>
         <sd:ServiceProviderName>Company</sd:ServiceProviderName>
      </ud:ServiceGeneralInformation>
   </ud:ServicePreference>
</ud:Preference>
```

5.19 GeneralAudioPreferenceType

This `GeneralAudioPreferencesType` describes the preferences for lossless and lossy audio services.

5.19.1 Syntax

```
<complexType name="GeneralAudioPreferenceType">
   <sequence>
      <element name="CreationInfo" type="cd:AudioEnvironmentType" minOccurs="0"/>
<element name="LosslessAudioFormat" type="ud:LosslessAudioFormatType" minOccurs="0"/>
      <element name="LossyAudioFormat" type="ud:LossyAudioFormatType" minOccurs="0"/>
      <element name="AudioFileSize" type="ud:LosslessAudioFileSizeType" minOccurs="0"/>
      <element name="AudioMusicPreference" type="ud:AudioMusicPreferenceType"
minOccurs="0"/>
   </sequence>
   <attribute name="id" type="ID" use="optional"/>
   <simpleType name="LosslessAudioFormatType">
      <restriction base="NMTOKEN">
         <enumeration value="AppleLossless"/>
         <enumeration value="AdaptiveTransformAcousticCoding"/>
         <enumeration value="aptXLossless"/>
         <enumeration value="AudioLosslessCoding"/>
         <enumeration value="DirectStreamTransfer"/>
         <enumeration value="DolbyTrueHD"/>
```

```
            <enumeration value="DTSHDMasterAudio"/>
            <enumeration value="FreeLosslessAudioCodec"/>
            <enumeration value="MeridianLosslessPacking"/>
            <enumeration value="MonkeyAudio"/>
            <enumeration value="MPEG4SLS"/>
            <enumeration value="OptimFROG"/>
            <enumeration value="OriginalSoundQuality"/>
            <enumeration value="RealAudioLossless"/>
            <enumeration value="Shorten"/>
            <enumeration value="TrueAudioLossless"/>
            <enumeration value="WavPackLossless"/>
            <enumeration value="WindowsMediaAudioLossless"/>
            <enumeration value="Others"/>
        </restriction>
    </simpleType>
    <simpleType name="LossyAudioFormatType">
        <restriction base="NMTOKEN">
            <enumeration value="CELT"/>
            <enumeration value="AAC"/>
            <enumeration value="MP3"/>
            <enumeration value="OGG"/>
            <enumeration value="AMR"/>
            <enumeration value="WMA"/>
            <enumeration value="AC3"/>
            <enumeration value="Speex"/>
            <enumeration value="TwinVQ"/>
            <enumeration value="Others"/>
        </restriction>
    </simpleType>
    <simpleType name="AudioFileSizeType">
        <restriction base="nonNegativeInteger"/>
    </simpleType>
    <simpleType name="AudioMusicPreferenceType"> <restriction base="NMTOKEN">
            <enumeration value="Rock"/>
            <enumeration value="Blues"/>
            <enumeration value="ChildrenMusic"/>
            <enumeration value="Classical"/>
            <enumeration value="Country"/>
            <enumeration value="Dance"/>
            <enumeration value="EasyListening"/>
            <enumeration value="Electric"/>
            <enumeration value="Rap"/>
            <enumeration value="Gospel"/>
            <enumeration value="Instrumental"/>
            <enumeration value="Jazz"/>
            <enumeration value="RockandRoll"/>
            <enumeration value="Others"/>
        </restriction>
    </simpleType>
</complexType>
```

5.19.2 Semantics

Name	*Definition*
`CreationInfo`	Describes user's preference on the creating information for audio.
`LosslessAudioFormat`	Describes user's preference on the format type for lossless audio.
`LossyAudioFormat`	Describes user's preference on the format type for lossy audio
`AudioFileSize`	Describes user's preference on the actual file size for audio.
`AudioMusicPreference`	Describes user's preference on the preference of music for audio.

5.19.3 Examples

```
<ud:CreationInfo>
<cd:RecordingEnvironment>
   <cd:HowlingLevel>3.4</cd:HowlingLevel>
   <cd:NumberOfMic>1</cd:NumberOfMic>
</cd:RecordingEnvironment>
</ud:CreationInfo>
<ud:LosslessAudioFormat>FreeLosslessAudioCodec</ud:LosslessAudioFormat>
<ud:LossyAudioFormat>AAC</ud:LossyAudioFormat>
<ud:LosslessAudioFileSizeType>5000000</ud:LosslessAudioFileSizeType>
<ud:AudioMusicPreference>Dance</ud:AudioMusicPreference>
...
```

5.20 AudioPresentationPreferencesType

5.20.1 Syntax

```
<complexType name="AudioPresentationPreferencesType">
   <complexContent>
      <extension base="mpeg21:AudioPresentationPreferencesType">
         <sequence>
            <element name="GeneralAudioPresentationPreference" type="ud:GeneralAudioPref
erenceType" minOccurs="0"/>
            <element name="AudioPresentationEnvironmentPreference" type="ud:AudioPresenta
tionEnvironmentPreferenceType" minOccurs="0"/>
         </sequence>
      </extension>
   </complexContent>
</complexType>
```

5.20.2 Semantics

Name	*Definition*
`GeneralAudioPresentationPref erence`	Describes the preference for lossless and lossy audio services
`AudioPresentationEnvironment Preference`	Describes more precise information for audio services. The element references `AudioPresentationEnvironmentPreferenceTyp`.

5.21 AudioPresentationEnvironmentPreferenceType

5.21.1 Syntax

```
<complexType name="AudioPresentationEnvironmentPreferenceType">
   <sequence>
      <element name="RootMeanSquareValueRange" minOccurs="0" maxOccurs="unbounded">
         <complexType>
            <sequence>
               <element name="MinRMS" type="float" minOccurs="0"/>
               <element name="MaxRMS" type="float" minOccurs="0"/>
            </sequence>
            <attribute name="unit" type="mpeg7:termReferenceType" use="optional"/>
         </complexType>
      </element>
      <element name="ImpedanceRange" minOccurs="0" maxOccurs="unbounded"> <complexType>
         <sequence>
            <element name="Min" type="float" minOccurs="0"/>
            <element name="Max" type="float" minOccurs="0"/>
         </sequence>
         <attribute name="unit" type="mpeg7:termReferenceType" use="optional"/> </
complexType>
      </element>
      <element name="SpeakerLayoutPreferences" type="SpeakerLayoutType" minOccurs="0"
maxOccurs="unbounded"/>
   </sequence>
</complexType>
<complexType name="SpeakerLayoutType">
   <sequence>
      <element name="Brand" type="string" minOccurs="0"/>
      <element name="Channel" type="string" minOccurs="0"/>
   </sequence>
</complexType>
```

5.21.2 Semantics

Name	*Definition*
RootMeanSquareValueRange	Describes more precise information for audio services. This element references ExtendedAudioPresentationPreferencesType.
MinRMS	Describes the minimum value for RMS. The type of this element is float.
MaxRMS	Describes the maximum value for RMS. The type of this element is float.
unit	Specifies the unit of the sensed value, if a unit other than the default unit is used, as a reference to a classification scheme term that shall be using the mpeg7:termReferenceType defined in ISO/IEC 15938-5:2003, 7.6. The CS that may be used for this purpose is the UnitTypeCS defined in ISO/IEC 23005-6. The binary representation of the UnitTypeCS is also defined in ISO/IEC 23005-6.
ImpedanceRange	Specifies preferred range of impedance value. The range of impedance is represented with Min and Max elements.
Min	Describes the minimum value for impedance. The type of this element is float.
Max	Describes the maximum value for impedance. The type of this element is float.

Name	*Definition*
SpeakerLayoutPreferences	Describes more precise information about speaker layout. This element references SpeakerLayoutType.

Semantics of the SpeakerLayoutType:

Name	*Definition*
SpeakerLayoutType	Describes more precise information about speaker layout. This element references SpeakerLayoutType.
Brand	Describes specific brand name of a particular speaker layout for specifying speaker layout. The value of this element shall follow the pattern of original naming. Ex) 'Dolby' (O), 'dolby' (X), 'DTX' (O), 'dtx' (X).
Channel	Describes channel layout for speakers. The value of this element is constructed with "*channel number.woofer number*" ex) '5.1', '22.2.

5.21.3 Examples

The following description elements represent the audio related preferences of the user whose id is expressed with "keti001". They can be used either by the server or the terminal to adapt the presentation to the preferences of the user.

VolumeControl: In the example below, the user has the preference to hear music very loud. As a result, 0.85 is designated.

FrequencyEqualizer: This information represents the preference of a user to specific frequencies. This information consists of a set of frequency bands and its associated of attenuation values for the 31 ISO centre frequencies. In the example below, the first and the second value of period specify a frequency range, i.e. the start and the end frequency values of a frequency band, and the following frequency, the values represent the associated user equalizer preference values. The user preference value can be controlled in range [-15 dB, 15 dB] period.

AudibleFrequencyRange: This information represents the preferred audible frequency range in Hz. In the example below, the person's preferred an audible frequency range is from 20 Hz to 20 kHz.

Soundfield: The information represents the preference of a user for a specific soundfield. This information consists of the URI and its associated parameters to designate a room impulse response. As an example, the adaptation engine can process its soundfield function convolving input audio resource with impulse response signal in the remote storage on the basis of this information.

SoniferousSpeed: It is usually very difficult for User's with an auditory impairment to listen to fast speech. The SoniferousSpeed is specified as a ratio, where 1 indicates the original speed; values other than 1 indicate multiplicative time-scaling by the given ratio (i.e. 0.5 specifies twice as fast and 2.0 indicates half the original speed). In the example below, the soniferous speed preference is indicated as twice as fast.

ExtendedSoundfieldPreferences: The information represents the preference of RMS value and impedance ranges. In this example, the range of RMS value is from 100*W* to 200*W*, the preferred impedance range for "keti001" is from 6 Ω to 8 Ω.

SpeakerLayoutPreferences: The information specifies the preferred loudspeaker layouts. In this example, the user of "keti001" are usually preferred 'Dolby 5.1' channel sound.

```
<ud:UD>
   <ud:UserID>keti</ud:UserID>
   <ud:Preference>
      <ud:AudioPresentationPreferences>
         <mpeg21:VolumeControl>0.85</mpeg21:VolumeControl>
```

```
         <mpeg21:FrequencyEqualizer>-10 -10 -10 -10 -10 -10 -10 -10 -10 -10 -10 -10 0 0 0
0 10 10 10 10 -10 -10 -10 -10 -10 -10 -10 -10 -10 -10 - 10</mpeg21:FrequencyEqualizer>
         <mpeg21:AudibleFrequencyRange>
            <mpeg21:StartFrequency>20</mpeg21:StartFrequency>
            <mpeg21:EndFrequency>20000</mpeg21:EndFrequency>
         </mpeg21:AudibleFrequencyRange>
         <mpeg21:AudioOutputDevice>Loudspeaker</mpeg21:AudioOutputDevice>
         <mpeg21:Soundfield>
            <mpeg21:ImpulseResponse
href="https://www.sac.or.kr/concertHall/hallImp.wav">
            <mpeg21:SamplingFrequency>44100</mpeg21:SamplingFrequency>
               <mpeg21:BitsPerSample>16</mpeg21:BitsPerSample>
               <mpeg21:NumOfChannels>1</mpeg21:NumOfChannels>
            </mpeg21:ImpulseResponse>
         </mpeg21:Soundfield>
         <mpeg21:SoniferousSpeed>0.5</mpeg21:SoniferousSpeed>
      <ud:AudioPresentationEnvironmentPreference>
         <ud:RootMeanSquareValueRange>
            <ud:MinRMS>100</ud:MinRMS>
            <ud:MaxRMS>200</ud:MaxRMS>
         </ud:RootMeanSquareValueRange>
         <ud:ImpedanceRange>
            <ud:Min>6</ud:Min>
            <ud:Max>8</ud:Max>
         </ud:ImpedanceRange>
         <ud:SpeakerLayoutPreferences>
            <ud:Brand>Dolby</ud:Brand>
            <ud:Channel>5.1</ud:Channel>
         </ud:SpeakerLayoutPreferences>
      </ud:AudioPresentationEnvironmentPreference>
   </ud:AudioPresentationPreferences>
</ud:Preference>
</ud:UD>
```

5.22 TranslationPreferencesType

The `TranslationPreferencesType` describes the preferences for translation services.

5.22.1 Syntax

```
<complexType name="TranslationPreferenceType">
   <sequence>
      <element name="SourceLanguagePreference" type="language" minOccurs="0"/>
      <element name="TargetLanguagePreference" type="language" minOccurs="0"/>
      <element name="SpeechStylePreference" type="ud:SpeechStylePreferenceType"/>
<element name="VoiceGenderPreference" type="ud:GenderType"
default="unspecified" minOccurs="0"/>
   </sequence>
   <attribute name="VoicePitch" type="mpeg7:nonNegativeReal" use="optional"/>
   <attribute name="VoiceSpeed" type="mpeg7:nonNegativeReal" use="optional"/>
   <attribute name="RequestVariants" type="boolean" use="optional" default="false"/>
</complexType>
```

5.22.2 Semantics

Name	*Definition*
SourceLanguagePreference	Describes user's preference on the source language for translation.
TargetLanguagePreference	Describes user's preference on the target language for translation.
SpeechStylePreference	Describes user's preference on the style of the translated output speech.
VoiceGenderPreference	Describes user's preference on the gender of the translated output speech.
VoicePitch	Describes user's preference on the pitch of the translated output speech.
VoiceSpeed	Describes user's preference on the speed of the translated output speech.
RequestVariants	Describes user's preference on multiple translation outputs so that the user can choose one of the possible translations

5.22.3 Examples

```
<ud:Preference>
   <ud:TranslationPreference   VoicePitch="5"   VoiceSpeed="3"
RequestVariants="false">
      <ud:SourceLanguagePreference>en-us</ud:SourceLanguagePreference>
      <ud:TargetLanguagePreference>kr</ud:TargetLanguagePreference>
      <ud:SpeechStylePreference>informal</ud:SpeechStylePreference>
      <ud:VoiceGenderPreference>unspecified</ud:VoiceGenderPreference>
   </ud:TranslationPreference>
<ud:PreferenceDescription>
   <ud:UserID>
      <mpeg7:Name>Jake</mpeg7:Name>
   </ud:UserID>
</ud:PreferenceDescription>
</ud:Preference>
```

5.23 SpeechStylePreferenceType

5.23.1 Syntax

```
<simpleType name="SpeechStylePreferenceType">
   <restriction base="NMTOKEN">
      <enumeration value="formal"/>
      <enumeration value="informal"/>
   </restriction>
</simpleType>
```

5.23.2 Semantics

Name	*Definition*
SpeechStylePreferenceType	Describes user preference on the speech style. The speech style can be formal for official usage of a language or informal used in everyday, personal conversations.

5.24 GenderType

GenderType indicates the gender of the user.

5.24.1 Syntax

```
<simpleType name="GenderType">
   <restriction base="NMTOKEN">
      <enumeration value="female"/>
      <enumeration value="male"/>
      <enumeration value="neuter"/>
      <enumeration value="unspecified"/>
   </restriction>
</simpleType>
```

5.24.2 Semantics

Name	*Definition*
GenderType	Describes the gender of the user in terms of: female, male neuter, unspecified. Neuter refers to neither male neither female and unspecified refers to the gender, which is intentionally notprovided.

5.24.3 Examples

```
<ud:UserProfile xsi:type="ud:PersonProfileType">
   <ud:Gender>female</ud:Gender>
</ud:UserProfile>
```

5.25 EmotionType

The EmotionType can be used to represents user's subjective notion and feeling. The user's emotion can be described including its changes over time. The emotion can be acquired by some direct input of user or inference results from sensor data.

5.25.1 Syntax

```
<complexType name="EmotionType">
   <complexContent>
      <extension base="ud:BaseUserType">
         <sequence>
            <element name="EmotionGroup" minOccurs="0" maxOccurs="unbounded"><complexTy
pe>
               <sequence>
                  <element name="PeriodOfOccurrence" type="ct:TimeType"/>
                  <element name="EmotionDescription" type="ud:EmotionDescriptionType"
maxOccurs="unbounded"/>
               </sequence>
               <attribute name="ref-id" type="anyURI" use="required"/> </complexType>
            </element>
            <element name="DynamicEmotionVocabulary" minOccurs="0" maxOccurs="unbounded">
               <complexType>
                  <sequence>
                     <element name="DynamicEmotion" maxOccurs="unbounded"> <complexType>
                        <attribute name="name" type="string" use="required"/> </
complexType>
                     </element>
                  </sequence>
                  <attribute name="id" type="anyURI" use="required"/> </complexType>
```

```
            </element>
         </sequence>
      </complexType>

      <complexType   name="EmotionDescriptionType">
         <sequence>
            <element   name="emotionName" type="token"/>
            <element   name="value" type="ct:normalizedRatioValueType"/>
         </sequence>
         <attribute   name="triggeredBy" type="anyURI"/>
         <attribute   name="aspect" type="token" use="optional"/>
         <attribute   name="detectedFrom" type="anyURI"/>
         <attribute   name="reliability" type="ct:ZeroToOneRatioType"/>
      </extension>
   </complexContent>
</complexType>
```

5.25.2 Semantics

Name	*Definition*
EmotionType	Describes user's subjective notion and feeling. The user's emotion can be described including its changes over time. The emotion can be acquired by some direct input of user or inference results from sensor data.
EmotionGroup	Describes an emotion with some related information. The emotion is described by several EmotionDescription elements, each being present with different values of reliability.
PeriodOfOccurrence	Describes the starting and ending time of an emotion group using absolute times. This ct:TimeType denotes the absolute time at which an emotion group with some related information happened.
EmotionDescription	Describes a specific emotional state.
ref-id	Provides a reference id which is used for identifying an emotion vocabulary in DynamicEmotionVocabulary or existing classification scheme.
DynamicEmotionVocabulary	Describes an emotion vocabulary defined by the user.
DynamicEmotion	Describes a word specifying a single emotion defined by the user.
Name	Describes the name of an emotion defined by the user.
Id	Provides an id of a DynamicEmotionVocabulary instance to be referenced by the EmotionGroup.
emotionName	Denotes the name of an emotion as the result of measuring a user's emotional state. The value should match one of the name attribute value of the DynamicEmotionVocabulary instance referenced by ref-id attribute or the name of a term of a classification scheme referenced by ref-id attribute.
Value	Describes the level of emotion on the result of measuring a user's emotional state. This value can be described based on normalizedRatioValueType.
triggeredBy	Describes who and what caused this emotion. The emotion can be triggered by various sources such as persons, animals and media. It may reference a user description's identifier for describing this information in the case of triggered by persons or animals, etc. In the case of media, it may reference a resource identifier.
Aspect	Describes the specific occasion of the triggered emotion, e.g. battery duration of the smartphone or speech of the spokesman.
detectedFrom	Describes the modality through which an emotion is detected. Specific user emotion is usually detected through human's action and appearances such as face, gesture, voice, word, posture or EEG (electroencephalography).

Name	*Definition*
`reliability`	Describes the degree of reliability on the result of measuring a user's emotional state. The value of `reliability` shall be a floating point number and cannot be lower than 0 or greater than 1.

5.25.3 Examples

This example describes an emotion detected from "face", and this emotion "happiness" is triggered by watching a media referenced 8.1.1.1 and its reliability is measured in "0.5" degree. This emotion lasts from 2015-06-04T18:13:51.0Z to one minute later. As shown in the example, EmotionGroup references DynamicEmotionVocabulary's id as a reference id, "my6". And there is another triggered emotion, "fear", described by static emotion vocabulary classification scheme[1)].

```
<ud:Emotion>
   <ud:EmotionGroup ref-id="my6">
      <ud:PeriodOfOccurrence>
         <ct:startTime>2015-06-04T18:13:51.0Z</ct:startTime>
         <ct:endTime>2015-06-04T18:14:51.0Z</ct:endTime>
      </ud:PeriodOfOccurrence>
      <ud:EmotionDescription triggeredBy="http://test.com/test.mp4" aspect="battery"
detectedFrom="face" reliability="0.5">
         <ud:emotionName>happiness</ud:emotionName>
         <ud:value>
            <ct:ZeroToOneRatio>0.5</ct:ZeroToOneRatio>
         </ud:value>
      </ud:EmotionDescription>
      </ud:EmotionGroup>
      <ud:DynamicEmotionVocabulary id="my6">
         <ud:DynamicEmotion name="happiness"/>
         <ud:DynamicEmotion name="sadness"/>
         <ud:DynamicEmotion name="neutral"/>
         <ud:DynamicEmotion name="surprise"/>
         <ud:DynamicEmotion name="disgust"/>
         <ud:DynamicEmotion name="anger"/>
      </ud:DynamicEmotionVocabulary>
      <ud:EmotionGroup ref-id="http://www.w3.org/TR/emotion-voc/xml#big6">
<ud:PeriodOfOccurrence>
         <ct:startTime>2015-06-04T18:13:51.0Z</ct:startTime>
         <ct:endTime>2015-06-04T18:14:51.0Z</ct:endTime>
      </ud:PeriodOfOccurrence>
      <ud:EmotionDescription triggeredBy="http://3d.keti.re.kr/cake.mp4" aspect="battery"
detectedFrom="face" reliability="0.5">
         <ud:emotionName>fear</ud:emotionName>
         <ud:value>
            <ct:ZeroToOneRatio>0.5</ct:ZeroToOneRatio>
         </ud:value>
      </ud:EmotionDescription>
   </ud:EmotionGroup>
</ud:Emotion>
```


1) Available at http://www.w3.org/TR/emotion-voc/xml#big6

5.26 ScheduleType

`ScheduleType` can be used for describing scheduled events thus giving to the user the opportunity of properly organize specific plans.

5.26.1 Syntax

```
<complexType name="ScheduleType">
   <complexContent>
      <extension base="ud:BaseUserType">
         <sequence>
            <element name="ScheduleEvent" type="ud:ScheduleEventType"
maxOccurs="unbounded"/>
         </sequence>
      </extension>
   </complexContent>
</complexType>
```

5.26.2 Semantics

Name	*Definition*
`ScheduleType`	`ScheduleType` describes a combination of scheduled events.
`ScheduleEvent`	Describes a specific scheduled event.

5.27 ScheduleEventType

`ScheduleEventType` describes a single schedule. Information about the users shared and the possible recurrence cycles of time is included.

5.27.1 Syntax

```
<complexType name="ScheduleEventType">
   <complexContent>
      <extension base="ud:EventType">
         <sequence>
            <element name="SharedUser" type="mpeg7:UserIdentifierType" minOccurs="0"
maxOccurs="unbounded"/>
            <element name="RecurrenceInfo" type="ct:ExtendedTimeType"/>
            <element name="AlarmTime" type="ct:TimeType" minOccurs="0"/>
            <element name="AlarmFormat" type="ct:ObjectType"/>
         </sequence>
         <attribute name="eventName" type="string"/>
         <attribute name="descriptionMethod" use="optional">
            <simpleType>
               <restriction base="string"> <enumeration value="byHuman"/> <enumeration
value="bySoftwareAgent"/> <enumeration value="byIndustrialProcess"/> <enumeration
value="byDevice"/> <enumeration value="byOthers"/> </restriction>
            </simpleType>
         </attribute>
      </extension>
   </complexContent>
</complexType>
```

5.27.2 Semantics

Name	*Definition*
ScheduleEventType	This data type describes a single schedule.
SharedUser	Describes users which can share the given schedule description.
RecurrenceInfo	Describes recurrence cycle of an event.
AlarmTime	Describes the alarm time for scheduled event. The alarm will deliver to user by the time appointed.
AlarmFormat	Describes format of alarm such as visual object, audio object, video object, text object, image object.
EventName	Describes a name of the event.
DescriptionMethod	Describes how the information related to the schedule is acquired. This information can be explicitly inserted by the user and/or can be inferred by an engine. This means that, in the latter case, schedule descriptions may not really match the user's needs.

5.27.3 Examples

```
<ud:Schedule>
   <ud:ScheduleEvent xmlns:ct="urn:mpeg:mpeg-ud:2014:01-CT-NS"
descriptionMethod="byAgent" eventName="103rd Meeting" startTime="2015-09-30T10:00:00Z">
      <ud:SharedUser>
         <mpeg7:Name xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004">John</mpeg7:Name>
      </ud:SharedUser>
      <ud:RecurrenceInfo>
         <ct:startTime>2015-09-30T10:00:00Z</ct:startTime>
         <ct:duration>P10D</ct:duration>
      </ud:RecurrenceInfo>
      <ud:AlarmTime>
         <ct:startTime>2015-09-30T09:00:00Z</ct:startTime>
      </ud:AlarmTime>
   </ud:ScheduleEvent>
</ud:Schedule>
```

5.28 ActivityType

This subclause describes the structure of ActivityType in which ActivityType is to provide a description of the user's activity. In particular, mobility, destination and physical status of a user are specified. The mobility is to provide a description of user's movement. The destination is to provide a description of the place where a user is going or being sent. The physical status is to provide a description of user's health conditions.

5.28.1 Syntax

```
<complexType name="ActivityType">
   <complexContent>
      <extension base="ud:BaseUserType">
            <sequence>
                <element name="Mobility" type="mpeg21:MobilityCharacteristicsType"
minOccurs="0"/>
                <element name="Destination" type="mpeg21:DestinationType" minOccurs="0"/>
                <element name="PhysicalStatus" type="ud:PhysicalStatusType"
minOccurs="0"/>
            </sequence>
```

```
            <attribute name="activityItem" type="string" use="optional"/>
         </extension>
   </complexContent>
</complexType>

<complexType name="PhysicalStatusType">
   <sequence>
      <element name="HeartRate" minOccurs="0">
         <complexType>
            <simpleContent>
               <extension base="ct:valueByRatio">
                  <attribute name="measureTime" type="dateTime" use="optional"/>
               </extension>
            </simpleContent>
         </complexType>
      </element>
      <element name="RespiratoryRate" minOccurs="0">
         <complexType>
            <simpleContent>
               <extension base="ct:valueByRatio">
                  <attribute name="measureTime" type="dateTime" use="optional"/>
</extension>
            </simpleContent>
         </complexType>
      </element>
      <element name="BloodSugar" minOccurs="0">
         <complexType>
            <simpleContent>
               <extension base="ct:valueByRatio">
                  <attribute name="measureTime" type="dateTime" use="optional"/>
</extension>
            </simpleContent>
         </complexType>
      </element>
      <element name="BodyTemperature" minOccurs="0">
         <complexType>
            <simpleContent>
               <extension base="ct:valueByRatio">
                  <attribute name="measureTime" type="dateTime" use="optional"/>
</extension>
            </simpleContent>
         </complexType>
      </element>
      <element name="BloodPressure" type="ud:BloodPressureType" minOccurs="0" />
   </sequence>
</complexType>

<complexType name="BloodPressureType">
   <sequence>
      <element name="Systolic" type="ct:valueByRatio"/>
      <element name="Diastolic" type="ct:valueByRatio"/>
   </sequence>
```

```
   <attribute name="measureTime" type="dateTime" use="optional"/>
</complexType>
```

5.28.2 Semantics

Name	*Definition*
ActivityType	This data type describes information of user's activity in terms of mobility, destination and physical status.
Mobility	Describes the mobility characteristics of a user. The syntax and semantics of MobilityCharacteristicsType are specified in ISO/IEC 21000-7.
Destination	Describes the destination of a user. The syntax and semantics of DestinationType are specified in ISO/IEC 21000-7.
PhysicalStatus	Describes the health conditions of a user.
activityItem	Describes the specific activity performed by a user (e.g. walking, running, drinking, watching, etc.).

Semantics of the PhysicalStatusType:

Name	*Definition*
PhysicalStatusType	This data type describes information of user's health conditions.
measureTime	Describes the time when the user's physical status is examined.
HeartRate	Describes the heart rate of a user in beats per minute (bpm).
RespiratoryRate	Describes the respiratory rate of a user in breaths per minute (BPM).
BloodSugar	Describes the blood sugar of a user in millimoles per litre (mmol/L).
BloodTemperature	Describes the body temperature of a user in degree Celsius (°C).
BloodPressure	Describes the blood pressure of a user.

Semantics of the BloodPressureType:

Name	*Definition*
BloodPressureType	This data type describes the blood pressure of a user.
Systolic	Describes the systolic pressure of a user in millimeter of mercury (mmHg).
Diastolic	Describes the diastolic pressure of a user in millimeter of mercury (mmHg).
measureTime	Describes the time when the user's physical status is examined.

5.28.3 Examples

```
<ud:Activity activityItem="walking">
   <ud:Mobility xsi:type="mpeg21:MobilityCharacteristicsType">
      <mpeg21:UpdateInterval>
         <mpeg21:LastUpdatePoint latitude="43.3" longitude="101.6"/>
         <mpeg21:LastUpdateBinIndex>4</mpeg21:LastUpdateBinIndex>
         <mpeg21:Lmax>180</mpeg21:Lmax> <mpeg21:Values>
            0.4 0.2 0.1 0.1 0.1 0.1 0.0 0.0
            0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
            0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
            0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
         </mpeg21:Values>
      </mpeg21:UpdateInterval>
      <mpeg21:Directivity>
         <mpeg21:Mean>35</mpeg21:Mean>
         <mpeg21:Variance>27</mpeg21:Variance>
```

```
         <mpeg21:Values>
            0.1 0.2 0.5 0.2 0.0 0.0 0.0 0.0
            0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
         </mpeg21:Values>
      </mpeg21:Directivity>
   </ud:Mobility>
</ud:Activity>
```

5.29 IntentionType

The `IntentionType` describes the intention of the user with a multimedia object.

5.29.1 Syntax

```
<complexType name="IntentionType">
   <sequence>
      <element name="IntentionObject" type="ct:ObjectType" minOccurs="0"/>
      <element name="IntentionAction" type="mpeg7:termReferenceListType" minOccurs="0"/>
   </sequence>
</complexType>
```

5.29.2 Semantics

Name	*Definition*
`IntentionType`	Describes a list of intentions related to specific actions which a given user may perform with a multimedia object.
`IntentionObject`	Describes the object selected by the user for expressing a specific intention.
`IntentionAction`	Terms for the IntentionAction are specified by the `IntentionActionCS` (`urn:mpeg:mpeg21:UD:CS:IntentionActionCS:2016`).

5.29.3 Examples

```
<ud:Intention>
   <ud:IntentionObject ObjectFormat="Visual">
      <ct:ObjectID>ID155</ct:ObjectID>
      <ct:ObjectName>MCDonald</ct:ObjectName>
   </ud:IntentionObject>
   <ud:IntentionAction>Search</ud:IntentionAction>
</ud:Intention>
```

5.30 LanguageType

The `LanguageType` specifies the level of knowledge of a user in a language.

5.30.1 Syntax

Syntax of the `LanguageType`:

```
<complexType name="LanguageType">
   <sequence>
      <element name="Name" type="language"/>
      <element name="CompetenceReference" type="ud:LanguageCompetenceReferenceType"
minOccurs="0"/>
```

```
      <element name="LanguageRegion" type="mpeg7:PlaceType" minOccurs="0"/>
      <element name="LanguageAccent" type="mpeg7:PlaceType" minOccurs="0"/>
   </sequence>
   <attribute name="type">
      <simpleType>
         <restriction base="string">
            <enumeration value="native"/>
            <enumeration value="foreign"/>
         </restriction>
      </simpleType>
   </attribute>
   <attribute name="ReadingLevel" use="optional">
      <simpleType>
         <restriction base="NMTOKEN">
            <enumeration value="advanced"/>
            <enumeration value="intermediate"/>
            <enumeration value="novice"/>
         </restriction>
      </simpleType>
   </attribute>
   <attribute name="WritingLevel" use="optional">
      <simpleType>
         <restriction base="NMTOKEN">
            <enumeration value="advanced"/>
            <enumeration value="intermediate"/>
            <enumeration value="novice"/>
         </restriction>
      </simpleType>
   </attribute>
   <attribute name="SpeakingLevel" use="optional">
      <simpleType>
         <restriction base="NMTOKEN">
            <enumeration value="advanced"/>
            <enumeration value="intermediate"/>
            <enumeration value="novice"/>
         </restriction>
      </simpleType>
   </attribute>
   <attribute name="ListeningLevel" use="optional">
      <simpleType>
         <restriction base="NMTOKEN">
            <enumeration value="advanced"/>
            <enumeration value="intermediate"/>
            <enumeration value="novice"/>
         </restriction>
      </simpleType>
   </attribute>
</complexType>
```

5.30.2 Semantics

Name	*Definition*
`LanguageType`	Describes the level of knowledge of a user in a language.
`Name`	Specifies the name of the specific language used by a given user.
`CompetenceReference`	Describes a competence of a given user.
`LanguageRegion`	Specifies the geographical region referred to the given language (e.g. British English, South Korean, etc.).
`LanguageAccent`	Specifies the specific accent of the given spoken language (e.g. Italian, Jej, etc.).
`Type`	— Specifies whether the specific language corresponds to the language that a given user has grown up speaking from early childhood. If so, the "native" value is adopted. Otherwise, the "foreign" value.
`ReadingLevel`	Describes the reading level of the user for the specific language. — Advanced: The user is able to understand texts from many genres dealing with a wide range of subjects, both familiar and unfamiliar. They are able to understand lengthy texts of a professional, academic, or literary nature. — Intermediate: The user is able understand information conveyed in simple, predictable, loosely connected texts. The user is able to understand messages found in highly familiar, everyday contexts. — Novice: The user can get a limited amount of information from highly predictable texts in which the topic or context is very familiar. The user is best able to understand a text when they are able to anticipate the information in the text.
`WritingLevel`	Describes the writing level of the user for the specific language. — Advanced: The user is able to produce most kinds of formal and informal correspondence, in-depth summaries, reports, and research papers on a variety of social, academic, and professional topics. The user can demonstrate a high degree of control of grammar and syntax, of both general and specialized/professional vocabulary. — Intermediate: The user is able to meet practical writing needs, such as simple messages and letters, requests for information, and notes. They use basic vocabulary and structures to express meaning that is comprehensible to those accustomed to the writing of non-natives. — Novice The user can produce simple sentences with limited vocabulary. The user can provide limited information on simple forms and documents. The user can reproduce practiced material to convey the most simple messages.
`SpeakingLevel`	Describes the speaking level of the user for the specific language. — Advanced: The user is able to communicate with accuracy and fluency on a variety of topics in formal and informal settings. — Intermediate: The user is able to talk about familiar topics related to their daily life with sentence-level language, typically in present time with a limited set of vocabulary. — Novice: The user can communicate short messages on everyday topics that affect them directly through the use of isolated words and phrases.

Name	*Definition*
ListeningLevel	Describes the listening level of the user for the specific language. — Advanced: The user is able to understand speech in a standard dialect on a wide range of familiar and less familiar topics. The user can follow linguistically complex extended conversation such as that found in academic and professional settings, lectures, speeches and reports. — Intermediate: The user can understand information conveyed in simple, sentence-length speech on familiar or everyday topics. The user is generally able to comprehend one utterance at a time while engaged in face-to-face conversations. — Novice: The user can understand words and phrases from simple questions, statements, and high-frequency commands. The user can understand key words, and formulaic expressions that are highly contextualized and predictable, such as those found in introductions and basic statements.

5.30.3 Examples

```
<ud:Language type="native" ReadingLevel="advanced" WritingLevel="novice"
SpeakingLevel="advanced" ListeningLevel="intermediate">
   <ud:Name>en-us</ud:Name>
   <ud:CompetenceReference CompetenceTestURI="http://www.publicLanguageTest.com/" Compete
nceTestDate="2015-08-13">
      <ud:CompetenceTestName>Public language test</ud:CompetenceTestName>
      <ud:CompetenceLevel competenceField="Verbal expression">
         <ud:FieldScore maxScore="10">8</ud:FieldScore>
      </ud:CompetenceLevel>
   </ud:CompetenceReference>
   <ud:LanguageRegion   id="ID1"   timeBase="."   timeUnit="P" mediaTimeBase="."
mediaTimeUnit="P" xml:lang="en-us">
      <Header   xsi:type="mpeg7:ClassificationSchemeAliasType"   id="ID2" alias="NMTOKEN"
href="https://www.altova.com/"/>
      <Name   xml:lang="en-us"   phoneticTranscription="API" phoneticAlphabet="other">API
Transcription</Name>
      <NameTerm href="https://www.aalanguage.com/">
         <Name   xml:lang="en-us"   phoneticTranscription="String"
phoneticAlphabet="other" preferred="true">String</Name>
         <Definition   xml:lang="en-us"   phoneticTranscription="String" phoneticAlphabet
="sampa">String</Definition>
         <Term relation="NT" termID="NMTOKEN">
            <Name   xml:lang="en-us"   phoneticTranscription="String"
phoneticAlphabet="sampa" preferred="true">AdAPI</Name>
            <Definition xml:lang="en-us" phoneticTranscription="String" phoneticAlphabet=
"ipaNumber">HiAPI</Definition>
         </Term>
      </NameTerm>
      <PlaceDescription xml:lang="en-us" phoneticTranscription="String"
phoneticAlphabet="other">North America</PlaceDescription>
      <Role href="https://www.altova.com/">
         <Name   xml:lang="en-us"   phoneticTranscription="String"
phoneticAlphabet="sampa" preferred="true">String</Name>
         <Definition   xml:lang="en-us"   phoneticTranscription="String" phoneticAlphabet
="sampa">String</Definition>
         <Term relation="NT" termID="NMTOKEN">
            <Name   xml:lang="en-us"   phoneticTranscription="String"
phoneticAlphabet="sampa" preferred="true">String</Name>
```

```
            <Definition xml:lang="en-us" phoneticTranscription="String" phoneticAlphabet=
"ipaSymbol">String</Definition>
         </Term>
      </Role>
      <GeographicPosition datum="String">
         <Point   longitude="-180"   latitude="-90" altitude="3.14159265358979"/>
      </GeographicPosition>
      <Region>South Dakota</Region>
      <PostalAddress xml:lang="en-us">
         <AddressLine xml:lang="en-us" phoneticTranscription="String"
phoneticAlphabet="sampa">432 Berendo St. S.Dakota</AddressLine>
         <PostingIdentifier   xml:lang="en-us" phoneticTranscription="String" phoneticAlp
habet="sampa">D65477</PostingIdentifier>
      </PostalAddress>
      <ElectronicAddress>
         <Telephone type="central">860-6677</Telephone>
         <Fax>042-860-4868</Fax>
         <Email>none</Email>
         <Url>http://www.berendo.com/</Url>
      </ElectronicAddress>
   </ud:LanguageRegion>
   <ud:LanguageAccent   id="ID3"   timeBase="."   timeUnit="P" mediaTimeBase="."
mediaTimeUnit="P" xml:lang="en-us">
      <Header   xsi:type="mpeg7:ClassificationSchemeAliasType"   id="ID4" alias="NMTOKEN"
href="https://www.altova.com/"/>
      <Name   xml:lang="en-us"   phoneticTranscription="String" phoneticAlphabet="ipaSymb
ol">Bermuda</Name>
      <PlaceDescription xml:lang="en-us" phoneticTranscription="String" phoneticAlphabet=
"ipaSymbol">String</PlaceDescription>
      <Role href="https://www.altova.com/">
         <Name xml:lang="en-us" phoneticTranscription="String"
phoneticAlphabet="ipaNumber" preferred="true">String</Name>
         <Definition xml:lang="en-us" phoneticTranscription="String" phoneticAlphabet="ot
her">String</Definition>
         <Term relation="NT" termID="NMTOKEN">
            <Name xml:lang="en-us" phoneticTranscription="String"
phoneticAlphabet="ipaSymbol" preferred="true">String</Name>
         </Term>
      </Role>
   <Region>North Carolina</Region>
   </ud:LanguageAccent>
</ud:Language>
```


5.31 LanguageCompetenceReferenceType

Describes the user's competence in a specific language verified by standardized tests.

5.31.1 Syntax

```
<complexType name="LanguageCompetenceReferenceType">
   <sequence>
      <element name="CompetenceTestName" type="string"/>
      <element name="CompetenceLevel" type="ud:CompetenceLevelType"
maxOccurs="unbounded"/>
   </sequence>
```

```
   <attribute name="CompetenceTestURI" type="anyURI" use="optional"/> <attribute
name="CompetenceTestDate" type="date" use="optional"/>
</complexType>
```

5.31.2 Semantics

Name	*Definition*
LanguageCompetenceReferenceType	Describes the user's competence in a specific language, verified by standardized tests.
CompetenceTestName	Specifies the name of a given standardized test (e.g. TOEFL, IELTS, DALF).
CompetenceLevel	Specifies the score or the level provided by a given competence test.
CompetenceTestURI	Provides the URI of the competence test. (e.g. http://www.ets.org/toefl).
CompetenceTestDate	Provides the date of the competence test taken by the user.

5.32 CompetenceLevelType

5.32.1 Syntax

```
<complexType name="CompetenceLevelType">
   <sequence>
      <choice>
         <element name="FieldScore">
            <complexType>
               <simpleContent>
                  <extension base="integer">
                     <attribute name="maxScore" type="integer" use="optional"/> </
extension>
                  </simpleContent>
               </complexType>
            </element>
         <element name="FieldLevel" type="string"/> </choice>
      </sequence>
   <attribute name="competenceField" type="string" use="optional"/>
</complexType>
```

5.32.2 Semantics

Name	*Definition*
CompetenceLevelType	Provides the score or level of the competency test.
FieldScore	Specifies, for a given field, the numeric score provided by the competence test.
MaxScore	Specifies, for a given field, the maximum value attributed by the competence test.
FieldLevel	Specifies, for a given field, the numeric score or the level provided by the competence test.
CompetenceField	Specifies the field evaluated by the competence test.

5.33 AccessibilityType

The AccessibilityType describes specific disabilities of a given user.

5.33.1 Syntax

```
<complexType name="AccessibilityType">
   <sequence>
      <element name="AccessMode">
         <simpleType>
            <restriction base="string">
               <enumeration value="auditory"/>
               <enumeration value="textual"/>
               <enumeration value="visual"/>
            </restriction>
         </simpleType>
      </element>
      <element name="SensoryImpairments" type="ud:SensoryImpairmentType" minOccurs="0"/>
   </sequence>
</complexType>

<complexType name="SensoryImpairmentType">
   <sequence>
      <element name="AuditoryImpairment" type="mpeg21:AuditoryImpairmentType"
minOccurs="0"/>
      <element name="VisualImpairment" type="mpeg21:VisualImpairmentType" minOccurs="0"/>
   </sequence>
</complexType>
```

5.33.2 Semantics

Name	*Definition*
`AccessibilityType`	Describes the user's need to access digital resources, and the user's detail impairment information in the context of audiovisual condition.
`AccessMods`	Describes the user's need to access digital resources in the form of audio or video or text.
`SensoryImpairments`	Describes the user's sensory impairment in detail.
`AuditoryImpairment`	Describes the auditory impairment of the user. The syntax and semantics of `AuditoryImpairmentType` are specified in ISO/IEC 21000-7:2007.
`VisualImpairment`	Describes the visual impairment of the user. The syntax and semantics of `VisualImpairmentType` are specified in ISO/IEC 21000-7:2007.

5.33.3 Examples

This example describes an accessibility information of the user. The user needs "textural" access mode because of his/her auditory impairment. This auditory impairment is described in `AuditoryImpairment` element using the audiogram representation which is describing the values of the hearing threshold shift to frequencies measured by hearing level in dB.

```
<ud:Accessibility>
<ud:AccessMode>texual</ud:AccessMode>
   <ud:Impairments>
      <ud:AuditoryImpairment>
         <mpeg21:RightEar>
            <mpeg21:Freq250Hz>60</mpeg21:Freq250Hz>
            <mpeg21:Freq500Hz>50</mpeg21:Freq500Hz>
            <mpeg21:Freq1000Hz>70</mpeg21:Freq1000Hz>
```

```
            <mpeg21:Freq2000Hz>60</mpeg21:Freq2000Hz>
            <mpeg21:Freq4000Hz>70</mpeg21:Freq4000Hz>
            <mpeg21:Freq8000Hz>50</mpeg21:Freq8000Hz>
         </mpeg21:RightEar>
         <mpeg21:LeftEar>
            <mpeg21:Freq250Hz>60</mpeg21:Freq250Hz>
            <mpeg21:Freq500Hz>50</mpeg21:Freq500Hz>
            <mpeg21:Freq1000Hz>70</mpeg21:Freq1000Hz>
            <mpeg21:Freq2000Hz>60</mpeg21:Freq2000Hz>
            <mpeg21:Freq4000Hz>70</mpeg21:Freq4000Hz>
            <mpeg21:Freq8000Hz>50</mpeg21:Freq8000Hz>
         </mpeg21:LeftEar>
      </ud:AuditoryImpairment>
   </ud:Impairments>
</ud:Accessibility>
```

5.34 SocialInformationType

5.34.1 Syntax

```
<complexType name="SocialInformationType">
   <sequence>
      <element name="ServiceID" type="sd:ServiceDescriptionType" minOccurs="0"/>
      <element name="LoginID" type="ud:UserDescriptionType"/>
      <element name="LoginPassword" >
         <simpleType>
            <restriction base="string">
               <minLength value="8"/>
               <maxLength value="512"/>
            </restriction>
         </simpleType>
      </element>
      <element name="Nickname" type="Name" minOccurs="0"/>
      <element name="GroupID" type="mpeg7:UserIdentifierType" minOccurs="0"/>
      <element name="FriendUserID" type="mpeg7:UserIdentifierType" minOccurs="0"
maxOccurs="unbounded"/>
      <element name="PrivateInformationAccessID" type="mpeg7:UserIdentifierType"
minOccurs="0" maxOccurs="unbounded"/>
   </sequence>
</complexType>
```

5.34.2 Semantics

Name	*Definition*
socialinformationType	Describes a specific information of a given user, provided to a specific service, mainly referred to a social community.
ServiceID	Describes the service used by the user.
LoginID	Describes the login id of the user.
LoginPassword	Describes the password.
Nickname	Describes the nickname of the user if any.
GroupID	Describes the group which the user belongs to.

Name	*Definition*
FriendUserID	Describes the list of friends.
PrivateInformationAccessID	Describes the list of other users who can access private information of a given user.

5.35 KnowledgeType

We propose to add the following complex type: This complex type describes knowledge that the user wants to share for recommendation purposes.

5.35.1 Syntax

```
<complexType name="KnowledgeType">
   <choice maxOccurs="unbounded">
      <element name="KnowledgeGraph">
         <complexType>
            <sequence>
               <any namespace="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
processContents="skip"/>
            </sequence>
            <attribute name="IRI" type="anyURI"/>
         </complexType>
      </element>
      <element name="KnowledgeGrpahRef">
         <complexType>
            <attribute name="url" type="anyURI"/>
         </complexType>
      </element>
   </choice>
</complexType>
```

5.35.2 Semantics

Name	*Definition*
KnowledgeGraph	The knowledge graph shared by the user.
IRI	Attribute specifying the IRI of the shared knowledge graph
KnowledgeGraphRef	Reference to the knowledge graph shared by the user.
URL	The URL from which the knowledge graph can be downloaded

5.35.2.1 Examples

The following example illustrates a case in which a user shares the knowledge about Wolfgang Amadeus Mozart. A Recommendation Engine can exploit this knowledge by e.g. exploring other entities in DBPedia of one or more of the categories stated in the knowledge graph about W.A. Mozart. For example, by exploring one of the `dct:subject` statements (namely the one pointing at the resource `https://dbpedia.org/resource/Category:Austrian_classical_composers`) the engine will discover that Joseph Haydn is also an Austrian classical composer, and thus can decide to recommend Haydn's compositions to the user.

```
<UD xmlns="urn:mpeg:mpeg21:UD:UD:2016" xmlns:xsi="http://www.w3.org/2001/XMLSchema-
instance" xsi:schemaLocation="urn:mpeg:mpeg21:UD:UD:2016 1.MPEG_21_UD_UD.xsd"
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#">
   <UserID>U100</UserID>
```

```
   <UserProfile>
      [...]
   </UserProfile>
   [...]
   <Knowledge>
      <KnowledgeGraph>
         <rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#" xmlns:dbo="https://dbpedia.org/
ontology/" xmlns:dct="https://purl.org/dc/terms/" xmlns:owl="http://www.w3.org/2002/07/
owl#" xmlns:dbp="https://dbpedia.org/property/" xmlns:foaf="http://xmlns.com/foaf/0.1/"
xmlns:dc="https://purl.org/dc/elements/1.1/" xmlns:prov="http://www.w3.org/ns/prov#">
   <rdf:Description rdf:about="https://dbpedia.org/resource/Wolfgang_Amadeus_Mozart">
      <rdf:type rdf:resource="http://www.ontologydesignpatterns.org/ont/dul/DUL.
owl#Agent"/>
      <rdf:type rdf:resource="http://xmlns.com/foaf/0.1/Person"/>
      <rdf:type rdf:resource="https://schema.org/Person"/>
      <rdf:type rdf:resource="http://www.ontologydesignpatterns.org/ont/dul/DUL.
owl#NaturalPerson"/>
      <rdf:type rdf:resource="https://dbpedia.org/ontology/Person"/>
      <rdf:type rdf:resource="https://dbpedia.org/ontology/Agent"/>
      <dbo:deathPlace rdf:resource="https://dbpedia.org/resource/Austria"/>
      <dbo:deathPlace rdf:resource="https://dbpedia.org/resource/Vienna"/>
      <dbo:deathDate rdf:datatype="http://www.w3.org/2001/XMLSchema#date">1791-12-05</
dbo:deathDate>
      <dbo:birthPlace rdf:resource="https://dbpedia.org/resource/Salzburg"/>
      <dbo:birthPlace rdf:resource="https://dbpedia.org/resource/Austria"/>
      <dbo:birthDate rdf:datatype="http://www.w3.org/2001/XMLSchema#date">1756-01-27</
dbo:birthDate>
      <dct:subject rdf:resource="https://dbpedia.org/resource/Category:Knights_of_the_
Golden_Spur"/>
      <dct:subject rdf:resource="https://dbpedia.org/resource/Category:German_male_
classical_composers"/>
      <dct:subject rdf:resource="https://dbpedia.org/resource/Category:German_opera_
composers"/>
      <dct:subject rdf:resource="https://dbpedia.org/resource/Category:Classical-period_
composers"/>

      <dct:subject rdf:resource="https://dbpedia.org/resource/Category:Austrian_opera_
composers"/>
      <dct:subject rdf:resource="https://dbpedia.org/resource/Category:Child_classical_
musicians"/>
      <dct:subject rdf:resource="https://dbpedia.org/resource/Category:Composers_for_
pedal_piano"/>
      <dct:subject rdf:resource="https://dbpedia.org/resource/Category:Austrian_
classical_composers"/>
   </rdf:Description>
</rdf:RDF>
</KnowledgeGraph>
</Knowledge>
[...]
</UD>
```

5.36 ObjectSharingType

5.36.1 Syntax

```
<complexType name="ObjectSharingType">
   <complexContent>
      <extension base="ud:BaseUserType">
   <sequence>
      <element name="ShareUserID" type="mpeg7:UserIdentifierType" minOccurs="0"
maxOccurs="unbounded"/>
      <element name="ObjectID" type="sd:ServiceObjectType" minOccurs="0"/> <element
name="Ownership" type="boolean" minOccurs="0"/>
      <element name="ObjectAccessibility" type="ud:ObjectAccessibilityType"
minOccurs="0"/>
   </sequence>
      </extension>
   </complexContent>
</complexType>
```

5.36.2 Semantics

Name	*Definition*
ObjectSharingType	Describes the object to be shared.
SharingUserID	Describes the users sharing the object.
ObjectID	Describes the ID of the object.
Ownership	Describes the ownership of the object.
ObjectAccessibility	Describes the way object is accessible.

5.36.3 Examples

This example indicates use of ObjectSharingType.

```
<ud:ObjectSharing>
   <ud:ShareUserID>
      <Name>User01</Name>
   </ud:ShareUserID>
   <ud:ObjectID>
      <sd:ServiceObjectInformation ObjectFormat="Visual">
         <ct:ObjectID>ID204</ct:ObjectID>
      </sd:ServiceObjectInformation>
   </ud:ObjectID>
   <ud:Ownership>true</ud:Ownership>
   <ud:ObjectAccessibility>Private</ud:ObjectAccessibility>
</ud:ObjectSharing>
```

5.37 ObjectAccessibilityType

5.37.1 Syntax

```
<simpleType name="ObjectAccessibilityType">
   <restriction base="string">
      <enumeration value="Private"/>
      <enumeration value="Protected"/>
```

```
      <enumeration value="Public"/>
   </restriction>
</simpleType>
```

5.37.2 Semantics

Name	*Definition*
ObjectAccessibilityType	Describes the accessibility of object to be shared.

5.37.3 Examples

This example indicates use of ObjectAccessibilityType.

```
<ud:ObjectAccessibility>Private</ud:ObjectAccessibility>
```

5.38 UsagePatternType

The UsagePatternType describes various usages patterns of user.

5.38.1 Syntax

```
<complexType name="UsagePatternType">
   <sequence>
      <element name="WebUsage">
        <complexType>
         <sequence>
<element name="AverageTimeOfUsage" type="duration" minOccurs="0"/>
   <element name="AverageNumberOfUsage" type="integer" minOccurs="0"/>
         </sequence>
        </complexType>
      </element>
<!--<element name="ApplicationUsage" type="ud:ApplicatoinUsageType"/> TBC -->
   </sequence>
</complexType>
```

5.38.2 Semantics

Name	*Definition*
UsagePatternType	Specifies various patterns about usage pattern of user.
WebUsage	Specifies web usage pattern of user.
AverageTimeOfUsage	Describes a period of using web per day on average.
AverageNumberOfUsage	Describes a number of using web per day on average.

5.38.3 Examples

```
<ud:UsagePattern>
   <ud:WebUsage>
      <ud:AverageTimeOfUsage>P50M</ud:AverageTimeOfUsage>
      <ud:AverageNumberOfUsage>3</ud:AverageNumberOfUsage>
   </ud:WebUsage>
</ud:UsagePattern>
```

5.39 LoudnessPreferencesType

5.39.1 Syntax

```
<complexType name="LoudnessPreferencesType">
   <sequence>
      <element name="CapabilityOfHearing" type="UD:CapabilityOfHearing"/>
      <element name="PreferredVolume" type="UD:PreferredVolume"/>
      <element name="PreferredGenre" type="UD:PreferredGenre"/>
      <element name="PreferredEqualizer" type="UD:PreferredEqualizerType"/>
      <element name="ToleranceRangeOfLoudness" type="UD:ToleranceRangeOfLoudness"/>
      <element name="CurrentFeeling" type="UD:CurrentFeeling"/>
      <element name="BodyCondition" type="UD:BodyCondition"/>
   </sequence>
</complexType>

   <complexType name="CapabilityOfHearing">
      <sequence>
         <element name="MinFrequency" type="integer" minOccurs="0" maxOccurs="1"/>
         <element name="MaxFrequency" type="integer" minOccurs="0" maxOccurs="1"/>
         <element name="HearingAid" type="boolean"/>
      </sequence>
   </complexType>

   <complexType name="PreferredVolume">
      <sequence>
            <element name="LoudnessLevel" type="float" minOccurs="0"
maxOccurs="Unbounded"/>
      </sequence>
   </complexType>

   <complexType name="PreferredGenre">
      <sequence>
            <element name="Alternative" type="boolean" minOccurs="0"/>
            <element name="Blues" type="boolean" minOccurs="0"/>
            <element name="Classical" type="boolean" minOccurs="0"/>
            <element name="Country" type="boolean" minOccurs="0"/>
            <element name="Dance" type="boolean" minOccurs="0"/>
            <element name="Electronic" type="boolean" minOccurs="0"/>
            <element name="European" type="boolean" minOccurs="0"/>
            <element name="Rap" type="boolean" minOccurs="0"/>
            <element name="Indie" type="boolean" minOccurs="0"/>
            <element name="Inspirational" type="boolean" minOccurs="0"/>
            <element name="Asian" type="boolean" minOccurs="0"/>
            <element name="Jazz" type="boolean" minOccurs="0"/>
            <element name="Latin" type="boolean" minOccurs="0"/>
            <element name="NewAge" type="boolean" minOccurs="0"/>
            <element name="Opera" type="boolean" minOccurs="0"/>
            <element name="Reggae" type="boolean" minOccurs="0"/>
            <element name="Rock" type="boolean" minOccurs="0"/>
            <element name="World" type="boolean" minOccurs="0"/>
```

```
    </sequence>
</complexType>

<complexType name="PreferredEqualizerType">
    <sequence>
        <element name="Normal" type="boolean" minOccurs="0"/>
        <element name="Classic" type="boolean" minOccurs="0"/>
        <element name="Dance" type="boolean" minOccurs="0"/>
        <element name="Flat" type="boolean" minOccurs="0"/>
        <element name="Folk" type="boolean" minOccurs="0"/>
        <element name="HeavyMetal" type="boolean" minOccurs="0"/>
        <element name="HipHop" type="boolean" minOccurs="0"/>
        <element name="Jazz" type="boolean" minOccurs="0"/>
        <element name="Pop" type="boolean" minOccurs="0"/>
        <element name="Rock" type="boolean" minOccurs="0"/>
        <element name="Latin" type="boolean" minOccurs="0"/>
        <element name="Custom" type="boolean" minOccurs="0"/>
    </sequence>
</complexType>

<complexType name="ToleranceRangeOfLoudness">
    <sequence>
          <element name="minLoudness" type="float" minOccurs="0" maxOccurs="1"/>
        <element name="maxLoudness" type="float" minOccurs="0" maxOccurs="1"/>
    </sequence>
</complexType>

<complexType name="CurrentFeeling">
    <sequence>
        <element name="Happy" type="boolean" minOccurs="0"/>
        <element name="Sad" type="boolean" minOccurs="0"/>
        <element name="Good" type="boolean" minOccurs="0"/>
        <element name="Bad" type="boolean" minOccurs="0"/>
        <element name="Angry" type="boolean" minOccurs="0"/>
        <element name="Delighted" type="boolean" minOccurs="0"/>
        <element name="Depressed" type="boolean" minOccurs="0"/>
        <element name="Moody" type="boolean" minOccurs="0"/>
        <element name="Agitated" type="boolean" minOccurs="0"/>
        <element name="Frustrated" type="boolean" minOccurs="0"/>
        <element name="Blessed" type="boolean" minOccurs="0"/>
    </sequence>
</complexType>

<complexType name="BodyCondition">
    <sequence>
        <element name="Healthy" type="boolean" minOccurs="0"/>
        <element name="Fever" type="boolean" minOccurs="0"/>
        <element name="Nauseated" type="boolean" minOccurs="0"/>
        <element name="Exhausted" type="boolean" minOccurs="0"/>
      <element name="Sleepy" type="boolean" minOccurs="0"/>
```

```
        <element name="Hungry" type="boolean" minOccurs="0"/>
        <element name="Thirsty" type="boolean" minOccurs="0"/>
        <element name="Sick" type="boolean" minOccurs="0"/>
        <element name="Dizzy" type="boolean" minOccurs="0"/>

     </sequence>
  </complexType>
```

5.39.2 Semantics

Name	*Definition*
CapabilityOfHearing	Describes the user's capability of hearing
PreferredVolume	Describes the user's preferred volume level, where the level is an integer varing from 0 to 100
PreferredGenre	Describes the user's preferred musical genre
PreferredEqualizer	Describes the user's preferred equalizer
ToleranceRangeOfLoudness	Describes the tolerance range of loudness that the user endures or prefers, where the tolerance indicates two values (minimum loudness level and maximum loudness level, in dB)
CurrentFeeling	Describes the user's mood at current time
BodyCondition	Describes the user's body condition

5.40 VisualExpressionType

5.40.1 Syntax

```
<complexType name="UD:VisualExpressionType">
      <sequence>
         <element name="TargetObject" type="UD:TargetObject" minOccurs="0"/>
         <element name="EditableMethod" type="UD:EditableMethod" minOccurs="0"/>
         <element name="ExpressionDevice" type="UD:ExpressionDevice"/>
         <element name="EditingInfo" type="UD:EditingInfo"/>
         <element name="EditingHistory" type="UD:EditingHistory" minOccurs="0"/>
</sequence>
</complexType>

<complexType name="TargetObject">
   <sequence>
      <element name="Face" type="Face" minOcuurs="0" maxOccurs="unbounded"/>
      <element name="Clock" type="Clock" minOcuurs="0" maxOccurs="unbounded"/>
      <element name="Animal" type="Animal" minOcuurs="0" maxOccurs="unbounded"/>
      <element name="Fruit" type="Fruit" minOcuurs="0" maxOccurs="unbounded"/>
      <element name="Weather" type="Weather" minOcuurs="0" maxOccurs="unbounded"/>
      <element name="Food" type="Food" minOcuurs="0" maxOccurs="unbounded"/>
      <element name="Vehicle" type="Vehicle" minOcuurs="0" maxOccurs="unbounded"/>
      <element name="Plant" type="Plant" minOcuurs="0" maxOccurs="unbounded"/>
      <element name="Flag" type="Flag" minOcuurs="0" maxOccurs="unbounded"/>
    <element name="Building" type="Building" minOcuurs="0" maxOccurs="unbounded"/>
   </sequence>
</complexType>
```

```
<complexType name="EditableMethod">
   <sequence>
      <element name="Voice" type="boolean"/>
      <element name="Text" type="boolean"/>
      <element name="Touch" type="boolean"/>
   </sequence>
</complexType>

<complexType name="ExpressionDevice">
   <sequence>
      <element name="SmartphoneName" type="string" minOccurs="0"/>
      <element name="SmartpadName" type="string" minOccurs="0"/>
      <element name="SmartWatchName" type="string" minOccurs="0"/>
      <element name="LaptopName" type="string" minOccurs="0"/>
      <element name="PCName" type="string" minOccurs="0"/>
   </sequence>
</complexType>

<complexType name="EditingInfo">
   <sequence>
      <element name="Name" type="string" maxOccurs="unbounded"/>
<element name="PlacementX" type="integer" maxOccurs="unbounded"/>
      <element name="PlacementY" type="integer" maxOccurs="unbounded"/>
      <element name="Size" type="integer" maxOccurs="unbounded"/>
      <element name="Color" type="string" maxOccurs="unbounded"/>
    <element name="Rotation" type="integer" maxOccurs="unbounded"/>
      </sequence>
</complexType>

<complexType name="EditingHistory">
   <sequence>
      <element name="EditUser" type="string" />
      <element name="EditDate" type="date" />
      <element name="EditedVOType" type="SD:VOType" />
      <element name="EditedVOName" type="string" />
   </sequence>
</complexType>
```


5.40.2 Semantics

Name	*Definition*
TargetObject	Specifies the target visual object to be edited by the user.
EditingMethod	Specifies the method through which the target visual object is edited by the user.
ExpressionDevice	Specifies the device to be used for editing by the user.
EditingInfo	Specifies the information about the editing actions done by the user.
EditingHistory	Specifies the history of the editing actions by the user.

5.41 BaseUserType

5.41.1 Syntax

This Syntax is `BaseUserType` type.

```
<complexType name="BaseUserType" abstract="true">
   <sequence>
      <element name="InformationAccessID" type="mpeg7:UserIdentifierType" minOccurs="0"
maxOccurs="unbounded"/>
      <element name="InformationAccessGroupURI" type="anyURI" minOccurs="0"
maxOccurs="unbounded"/>
   </sequence>
</complexType>
```

5.41.2 Semantics

Name	*Definition*
`BaseUserType`	`BaseUserType` is an abstract type providing a base for description of each element.
`InformationAccessID`	Specifies the list of user's ID of other users who can access private information.
`InformationAccessGroupURI`	References to groups of users who can access private information through the specification of its URI. Refer to the `GroupID` of `InformationAccessUserGroup` in `General Description`.

5.42 ConsecutiveVibrationPreferenceType

The ConsecutiveVibrationPreferenceType describes user's preferred settings of consecutive vibration.

5.42.1 Syntax

```
<complexType name="ConsecutiveVibrationPreference">
   <complexContent>
      <extension base="ud:BaseUserType">
         <sequence>
            <element name="CVDuration" minOccurs="0" maxOccurs="unbounded"/>
            <element name="CVInterval" minOccurs="0" maxOccurs="unbounded"/>
            <element name="CVPeriod" minOccurs="0" maxOccurs="unbounded"/>
            <element name="CVAmplitude" minOccurs="0" maxOccurs="unbounded"/>
            <element name=" CVFrequency" minOccurs="0" maxOccurs="unbounded"/>
         </sequence>
      </extension>
   </complexContent>
</complexType>
```

5.42.2 Semantics

Name	*Definition*
`CVDuration`	Describes vibration time in second for individual vibrators
`CVInterval`	Describes vibration interval time in second between ending time of a vibration and starting of the next vibration in a pattern
`CVPeriod`	Describes iteration time in second for a single vibration pattern

Name	*Definition*
CVAmplitude	Describes intensity of vibration for individual vibrators
CVFrequency	Describes frequency in Hertz of a single vibration for individual vibrators

6 Context description

This clause specifies Context Description (CD) which contains root elements at the basis of individual use cases and describes a structure of ContextDescriptionType data type. ContextDescriptionType contains several elements, such as ValidTimeDuration, season, DeviceCharacteristics, NetworkInfo, Location, Weather and OtherEnvironmentalInfo each of which is used for describing user's environmental information.

6.1 ContextDescriptionType

6.1.1 Syntax

```
<complexType name="CD" abstract="true">
   <attribute name="InfoSource" type="anyURI"/>
</complexType>

<complexType name="ContextDescriptionType">
   <sequence>
      <element   name="ClassificationSchemeAlias" type="ct:ClassificationSchemeAliasType"
minOccurs="0" maxOccurs="unbounded"/>
      <element name="ContextIdentification" type="cd:ContextIdentificationType"
minOccurs="0"/>
      <element   name="ValidTimeDuration"   type="ct:TimeType" minOccurs="0"/>
      <element   name="Season"   type="mpeg7:termReferenceType" minOccurs="0"/>
      <element   name="DeviceCharacteristics" type="cd:DeviceCharacteristicsType"
minOccurs="0" maxOccurs="unbounded"/>
      <element name="NetworkInfo" type="cd:NetworkInfoType" minOccurs="0"
maxOccurs="unbounded"/>
      <element name="Location" type="ct:LocationType" minOccurs="0"/>
      <element name="Weather" type="cd:WeatherType" minOccurs="0"/>
      <element name="OtherEnvironmentalInfo" type="cd:OtherEnvironmentalInfoType"
minOccurs="0"/>
      <element name="OtherContextInfo" type="anyType" minOccurs="0"
maxOccurs="unbounded"/>
      <element name=" LoudnessEnvironment" type="cd:LoudnessEnvironmentType"/>
      <element name="VisualExpressionEnvironment" type="cd:VisualExpressionEnvironmentTy
pe"/>
      <element name="ConsecutiveVibrationEnvironment" type="cd: ConsecutiveVibrationEnvir
onmentType"/>
   </sequence>
   <attributeGroup ref="ct:commonAttributes"/>
   <attribute name="Priority" type="ct:ZeroToOnehundredOrdinalType" use="optional"/>
</complexType>
```

6.1.2 Semantics

Name	*Definition*
CD	This data element is the root element of the Context Description.
ContextDescriptionType	This data type contains static and dynamic information about the user context.

Name	*Definition*
ClassificationSchemeAlias	Specifies an alias for a ClassificationScheme to be referenced within the UserDescriptionType by a simplified URI.
ValidTimeDuration	Describes valid time duration for context description. The syntax and semantics of PeriodOfTimeType are specified in General Description.
Season	Describes current season information according to the region. Terms for the Season are specified by the CS Season (urn:mpeg: mpeg21:UD:CS:SeasonCS: 2016).
DeviceCharacteristics	Describes general characteristics of the terminal.
NetworkInfo	Describes network related information.
Location	Describes current location when a service is requested. The syntax and semantics of PlaceType are specified in ISO/IEC 15938-5.
Weather	Describes current weather when a service is requested.
OtherEnvironmentalInfo	Describes environmental information of noise or illumination characteristics around user.
commonAttributes	Describes a group of attributes for the CommonAttributes. The syntax and semantics of commonAttributes are specified in General Description.
Priority	Describes the level of priority of the context description by using the ct:ZeroToOnehundredOrdinalType.
OtherContextInfo	A placeholder for other context – related information outside the standard namespace.
LoudnessControlContextDescription	Loudness Control Context Description describes the existing audio environment (e.g. natural noise, music from other audio sources, audio device's locations) which may be useful in recommending volume level and audio output devices in a heterogeneous audio environment.
VisualExpressionContextDescription	A set of data acquired from sensors or sensory devices about User's environment or body condition
ConsecutiveVibrationEnvironment	A set of data acquired from external devices (e.g. IoMT) about User's environment or body condition

6.1.3 Examples

This example shows ContextDescriptionType data type.

```
<CD userID="ID_2013710471" Priority ="1"> <cd:ValidTimeDuration>
<ct:startTime>2014-01-03T09:00:00Z</ct:startTime> <ct:endTime>2014-01-03T10:00:00Z</
ct:endTime>
</cd:ValidTimeDuration>
<cd:Season>urn:mpeg:mpeg21:UD:CS:SeasonCS:2016:1.1</cd:Season>
<cd:DeviceCharacteristics deviceID="Phone" inUse="true" availablity="true">
<cd:DeviceCapability xsi:type="mpeg21:DisplaysType"> <mpeg21:Display>
<mpeg21:DisplayCapability
xsi:type="mpeg21:DisplayCapabilityType">
<mpeg21:Mode>
<mpeg21:Resolution horizontal="720" vertical="480"/> </mpeg21:Mode>
</mpeg21:DisplayCapability>
</mpeg21:Display>
</cd:DeviceCapability>
<cd:NetworkInterfaceUnit id="ID_2" minGuaranteed="32000" maxCapacity="384000"/>
</cd:DeviceCharacteristics>
<cd:Weather>
<cd:Precipitation value="10.0" duration="1" formation="Snowflakes"/> </cd:Weather>
</CD>
```

6.2 ContextIdentificationType

This subclause describes a structure of `ContextIdentificationType` by specifying/identifying the ID of the context and the session.

6.2.1 Syntax

```
<complexType name="ContextIdentificationType">
   <sequence>
      <element name="InstanceIdentifier" type="mpeg7:UniqueIDType"/>
      <element name="sessionID" type="ID"/>
   </sequence>
</complexType>
```

6.2.2 Semantics

Name	*Definition*
`ContextIdentification`	Complex type describing the context ID and its session
`InstanceIdentifier`	An element describing the ID of the context.
`sessionID`	An element describing the session ID used by the context.

6.2.3 Examples

This example shows `ContextIdentificationType` data type.

```
<cd:ContextIdentification>
<cd:InstanceIdentifier>http://example.com/user/john.doe</cd:InstanceIden tifier>
   <cd:sessionID>ID_1</cd:sessionID>
</cd:ContextIdentification>
```

6.3 DeviceCharacteristicsType

This subclause describes the structure of `DeviceCharacteristicsType`. `DeviceCharacteristicsType` is used to describe the static and dynamic information of the device. The static information includes the device type, the device maker, the network service provider, etc. The dynamic information includes the battery level, the available memory size, the CPU utilization level, the available device's network unit, and the device location.

6.3.1 Syntax

```
<complexType name="DeviceCharacteristicsType">
   <complexContent>
      <extension base="cd:BaseContextType">
         <sequence>
            <element name="DeviceCapability" type="mpeg21:TerminalCapabilityBaseType"
minOccurs="0" maxOccurs="unbounded"/>
            <element name="SensorDeviceCapabilityList" type="mpegVcidl:SensorDeviceCapabi
lityListType" minOccurs="0" maxOccurs="unbounded"/>
            <element name="NetworkInterfaceUnit" type="mpeg21:NetworkCapabilityType"
minOccurs="0" maxOccurs="unbounded"/>
            <element name="DeviceLocation" type="ct:LocationType" minOccurs="0"/>
</sequence>
         <attribute name="deviceID" type="ID" use="required"/>
         <attribute name="availablity" type="boolean" default="true"/>
         <attribute name="inUse" type="boolean" default="false"/>
```

```
         <attribute name="operatingSystem" type="string"/>
         <attribute name="version" type="string"/>
      </extension>
   </complexContent>
</complexType>
```

6.3.2 Semantics

Name	*Definition*
DeviceCharacteristicsType	This data type describes general characteristics of the terminal.
DeviceCapability	Describes the capabilities of the terminal in terms of input-output capabilities and device properties. The syntax and semantics of TerminalCapabilityBaseType are specified in ISO/IEC 21000-7.
SensorDeviceCapabilityLi st	Describes the sensor capability of built-in device.
NetworkInterfaceUnit	Describes device's network unit. The syntax and semantics of NetworkCapabilityType are specified in ISO/IEC 21000-7.
DeviceLocation	Describes the location of the device.
deviceID	Specifies the unique device identifier.
Availability	Specifies availability of device.
inUse	Specifies whether device is currently in use.
operatingSystem	Describes the operating system used by the device.
Version	Describes the version of the operating system/device.

6.3.3 Examples

This example describes terminal's display resolution that 720 × 480 using mpeg-21:DisplaysType. Also, this description indicates that the maximum capacity of 384 kbps and a minimum guaranteed bandwidth of 32 kbps.

```
<cd:DeviceCharacteristics deviceID="dd">
   <cd:DeviceCapability xsi:type="mpeg21:DisplaysType">
      <mpeg21:Display>
         <mpeg21:DisplayCapability xsi:type="mpeg21:DisplayCapabilityType">
            <mpeg21:Mode>
               <mpeg21:Resolution horizontal="720" vertical="480"/>
            </mpeg21:Mode>
         </mpeg21:DisplayCapability>
      </mpeg21:Display>
   </cd:DeviceCapability>
<cd:SensorDeviceCapabilityList>
   <mpegVcidl:SensorDeviceCapability xsi:type="scdv:HumiditySensorCapabilityType">
      . . .
   </mpegVcidl:SensorDeviceCapability>
   . . .
</cd:SensorDeviceCapabilityList>

   <cd:NetworkInterfaceUnit   id="ID_5"   minGuaranteed="32000" maxCapacity="384000"/>
   <cd:DeviceLocation>
      <cd:GeographicLocation>
         <mpeg7:GeographicPosition datum="itrf">
            <mpeg7:Point latitude="37.3" longitude="126.58" altitude="100"/>
</mpeg7:GeographicPosition>
```

```
      </cd:GeographicLocation>
   </cd:DeviceLocation>
</cd:DeviceCharacteristics>
```

6.4 NetworkInfoType

This subclause describes structure of `NetworkInfo` element. `NetworkInfoType` describes the static and dynamic information of the available network around user.

6.4.1 Syntax

```
<complexType name="NetworkInfoType">
   <complexContent>
      <extension base="cd:BaseContextType">
         <sequence>
            <element name="NetworkCapability" type="mpeg21:NetworkCapabilityType"/>
            <element name="NetworkCondition" type="mpeg21:NetworkConditionType"/>
         </sequence>
         <attribute name="networkID" type="ID"/>
         <attribute name="InUse" type="boolean"/>
      </extension>
   </complexContent>
</complexType>
```

6.4.2 Semantics

Name	*Definition*
`NetworkInfoType`	This data type describes static and dynamic information of network around user. The syntax and semantics of `NetworkCapabilityType` are specified in ISO/IEC 21000-7.
`NetworkCapability`	Describes static information of network around user. The syntax and semantics of `NetworkCapabilityType` are specified in ISO/IEC 21000-7.
`NetworkCondition`	Describes dynamic information for network around user. The syntax and semantics of `NetworkConditionType` are specified in ISO/IEC 21000-7.
`networkID`	Specifies the unique network identifier.
`InUse`	Specifies whether device is currently in use.

6.4.3 Examples

This example describes a network that is characterized by a maximum capacity of 384 kbps and a minimum guaranteed bandwidth of 32 kbps. This description indicates that the maximum bandwidth achieved was 256 kbps and the average over that time was 80 kbps.

```
<cd:NetworkInfo networkID="wifi_1" InUse="true">
   <cd:NetworkCapability xsi:type="mpeg21:NetworkCapabilityType" minGuaranteed="32000"
maxCapacity="384000"/>
   <cd:NetworkCondition xsi:type="mpeg21:NetworkConditionType" duration="PT330N1000F">
      <mpeg21:AvailableBandwidth average="80000" maximum="256000"/>
      <mpeg21:Delay packetTwoWay="330" delayVariation="66"/>
      <mpeg21:Error packetLossRate="0.05"/>
   </cd:NetworkCondition>
</cd:NetworkInfo>
```

6.5 WeatherType

This subclause describes a structure of weather element. `WeatherType` include `Temperature`, `Precipitation`, `wind` and `Humidity` elements.

6.5.1 Syntax

```
<complexType name="WeatherType">
<complexContent>
<extension base="cd:BaseContextType">
<sequence>
<element name="Temperature" type="mpegVsiv:TemperatureSensorType" minOccurs="0"/>
<element name="Precipitation" minOccurs="0"> <complexType>
<attribute name="value" type="float"/>
<attribute name="valueUnit" type="mpegVct:unitType"/>
<attribute name="duration" type="integer"/>
<attribute name="durationUnit" type="mpegVct:unitType"/>
<attribute name="formation">
<simpleType>
<restriction base="string">
<enumeration value="Raindrops"/>
<enumeration value="Ice pellets"/>
<enumeration value="Hail"/>
<enumeration value="Snowflakes"/>
</restriction>
</simpleType>
</attribute>
</complexType>
</element>
<element name="Wind" minOccurs="0">
<complexType>
<complexContent>
<extension base="mpegVsiv:VelocitySensorType">
<attribute name="direction" type="mpeg7:termReferenceType"/>
</extension>
</complexContent>
</complexType>
</element>
<element name="Humidity" type="mpegVsiv:HumiditySensorType" minOccurs="0"/>
</sequence>
</extension>
</complexContent>
</complexType>
```


6.5.2 Semantics

Name	*Definition*
`WeatherType`	This data type represents weather state.
`Temperature`	Describes the temperature. The syntax and semantics of `TemperatureSensorType` are specified in ISO/IEC 23005-5.

Name	*Definition*
Precipitation	Describes the precipitation during the specified period of time as defined by the duration attribute in the default unit of millimeter or in the unit specified by the valueUnit attribute.
Value	Specifies the precipitation in the default unit of millimeter or in the unit specified by the valueUnit attribute.
valueUnit	Specifies the unit of the precipitation value, if a unit other than the default unit is used, as a reference to a classification scheme term provided by UnitTypeCS defined in ISO/IEC 23005-6 using the mpeg7:termReferenceType defined in ISO/IEC 15938-5:2003,7.6.
Duration	Specifies the time period up to the time of measuring the precipitation in the default unit of hour or in the unit specified by durationUnit attribute.
durationUnit	Specifies the unit of the duration, if a unit other than the default unit is used, as a reference to a classification scheme term provided by UnitTypeCS defined in ISO/IEC 23005-6 using the mpeg7:termReferenceType defined in ISO/IEC 15938-5:2003, 7.6.
Formation	Specifies the formation of the precipitation.
Wind	Describes the strength and the direction of the wind. The syntax and semantics of VelocitySensorType are specified in ISO/IEC 23005-5.
Direction	Specifies the direction of the wind coming from, as a reference to a classification scheme term provided by WindDirectionTypeCS defined in B.8 using the mpeg7:termReferenceType defined in ISO/IEC 15938-5:2003, 7.6.
Humidity	Describes the humidity. The syntax and semantics of HumiditySensorType are specified in ISO/IEC 23005-5.

6.5.3 Examples

This example indicates a snow falling 10 centimeters per hour.

```
<cd:Weather>
   <cd:Precipitation value="10.0" valueUnit="centimeter" duration="1"
formation="Snowflakes"/>
</cd:Weather>
```

6.6 OtherEnvironmentalInfoType

This subclause describes structure of OtherEnvironmentalInfo element. OtherEnvironmentalInfoType includes AudioEnvironment and IlluminationCharacteristicsics elements.

6.6.1 Syntax

```
<complexType name="OtherEnvironmentalInfoType">
   <complexContent>
      <extension base="cd:BaseContextType">
         <sequence>
            <element name="AudioEnvironment" type="cd:AudioEnvironmentType"
minOccurs="0"/>
            <element name="IlluminationCharacteristics" type="mpeg21:IlluminationCharacte
risticsType" minOccurs="0"/>
         </sequence>
      </extension>
   </complexContent>
</complexType>
```

6.6.2 Semantics

Name	*Definition*
`OtherEnvironmentalInfoType`	Describes environmental characteristics that affect the consumption of audio-visual contents.
`AudioEnvironment`	Describes the user's audio environment. The `AudioEnvironment` contains `RecordingEnvironment` and `ListeningEnvironment` element.
`IlluminationCharacteristics`	Describes the overall illumination characteristics of the natural environment. The syntax and semantics of `IlluminationCharacteristicsType` are specified in ISO/IEC 21000-7.

6.7 AudioEnvironmentType

This subclause describes structure of `AudioEnvironment` element. `AudioEnvironmentType` includes `RecordingEnvironment` and `ListeningEnvironment` elements.

6.7.1 Syntax

```
<complexType name="AudioEnvironmentType">
   <sequence>
      <element name="RecordingEnvironment" type="cd:RecordingEnvironmentType"
minOccurs="0"/>
      <element name="ListeningEnvironment" type="mpeg21:AudioEnvironmentType"
minOccurs="0"/>
   </sequence>
</complexType>
```

6.7.2 Semantics

Name	*Definition*
`RecordingEnvironment`	Describes the recording audio environment of a particular user. The `RecordingEnvironment` contains `HowlingLevel` and `NumberOfMic` element.
`ListeningEnvironment`	Describes the listening audio environment of a particular user. The syntax and semantics of `AudioEnvironmentType` are specified in ISO/IEC 21000-7.

6.8 RecordingEnvironmentType

This subclause describes structure of `RecordingEnvironment` element. `RecordingEnvironment` includes `HowlingLevel` and `NumberOfMic` elements.

6.8.1 Syntax

```
<complexType name="RecordingEnvironmentType">
   <sequence>
      <element name="HowlingLevel" type="float" minOccurs="0"/>
      <element name="NumberOfMic" type="nonNegativeInteger" minOccurs="0"/>
   </sequence>
</complexType>
```

6.8.2 Semantics

Name	*Definition*
HowlingLevel	The howling level should be measured as SPL in dB. If no accurate measurement is possible this howling level can be estimated, e.g. with a microphone of the terminal.
NumberOfMic	The integer parameter indicates the number of the microphone.

6.8.3 Examples

This example indicates an environment with one microphone and howling (3.4).

```
<cd:RecordingEnvironment>
   <cd:HowlingLevel>3.4</cd:HowlingLevel>
   <cd:NumberOfMic>1</cd:NumberOfMic>
</cd:RecordingEnvironment>
```

6.9 LoudnessEnvironmentType

6.9.1 Syntax

```
<complexType name="LoudnessEnvironmentType">
   <sequence>
      <element name="CurrentPlace" type="CD:CurrentPlace"/>
      <element name="LevelOfNoise" type="CD:LevelOfNoise"/>
      <element name="WeatherInfo" type="CD:WeatherInfo"/>
      <element name="NeighborInfo" type="CD:NeighborInfo"/>
      <element name="ListeningDevice" type="CD:ListeningDevice"/>
      <element name="Situation" type="CD:Situation"/>
   </sequence>
</complexType>

<complexType name="CurrentPlace">
   <sequence>
      <element name="Street" type="boolean"/>
      <element name="Car" type="boolean"/>
      <element name="Train" type="boolean"/>
      <element name="Subway" type="boolean"/>
      <element name="Airplane" type="boolean"/>
      <element name="School" type="boolean"/>
      <element name="Home" type="boolean"/>
      <element name="Work" type="boolean"/>
   </sequence>
</complexType>

<complexType name="LevelOfNoise">
   <sequence>
      <element name="minNoiseLevel" type="float" minOccurs="0"/>
      <element name="maxNoiseLevel" type="float" minOccurs="0"/>
   </sequence>
</complexType>
```

```
<complexType name="WeatherInfo">
   <sequence>
      <element name="Temperature" type="float" minOccurs="0"/>
      <element name="Humidity" type="float" minOccurs="0"/>
      <element name="Precipitation" type="float" minOccurs="0"/>
      <element name="AirPressure" type="float" minOccurs="0"/>
      <element name="WindSpeed" type="float" minOccurs="0"/>
      <element name="Snow" type="boolean"/>
      <element name="Rain" type="boolean"/>
   </sequence>
</complexType>

<complexType name="NeighborInfo">
   <sequence>
      <element name="NameOfPeople" type="string" minOccurs="0" maxOccurs="unbounded"/>
      <element name="NumberOfPeople" type="integer" minOccurs="0"/>
   </sequence>
</complexType>

<complexType name="ListeningDeviceType">
   <sequence>
      <element name="Earphone" type="boolean"/>
      <element name="Headphone" type="boolean"/>
      <element name="ExternalSpeaker" type="boolean"/>
      <element name="minFrequencyResponse" type="integer" minOccurs="0"/>
      <element name="maxFrequencyResponse" type="integer" minOccurs="0"/>
      <element name="Impedance" type="integer" minOccurs="0"/>
      <element name="Wireless" type="boolean"/>
   </sequence>
</complexType>

<complexType name="Situation">
   <sequence>
      <element name="Inside" type="Boolean" minOccurs="0"/>
      <element name="Outside" type="Boolean" minOccurs="0"/>
      <element name="Moving" type="Boolean" minOccurs="0"/>
      <element name="Still" type="Boolean" minOccurs="0"/>
      <element name="Studying" type="Boolean" minOccurs="0"/>
      <element name="Exercising" type="Boolean" minOccurs="0"/>
      <element name="Meditating" type="Boolean" minOccurs="0"/>
      <element name="Sleeping" type="Boolean" minOccurs="0"/>
      <element name="Talking" type="Boolean" minOccurs="0"/>
      <element name="Busy" type="Boolean" minOccurs="0"/>
   </sequence>
</complexType>

<complexType name="VisualExpression">
   <sequence>
      <element name="AppointedEvent" type="CD:AppointedEvent" minOccurs="0"/>
      <element name="EnvironmentalInfo" type="CD:EnvironmentalInfo" minOccurs="0"/>
```

```
      <element name="BodyConditionInfo" type="CD:BodyConditionInfo" minOccurs="0"/>
      <element name="Situation" type="CD:Situation" minOccurs="0"/>
      <element name="SensorInfo" type="CD:SensorInfo" minOccurs="0"/>
   </sequence>
</complexType>

<complexType name="AppointedEvent">
   <sequence>
      <element name="EventName" type="string" minOccurs="0"/>
      <element name="EventDate" type="date" minOccurs="0"/>
      <element name="EventTime" type="time" minOccurs="0"/>
   </sequence>
</complexType>

<complexType name="EnvironmentalInfo">
   <sequence>
      <element name="Temperature" type="float" minOccurs="0"/>
      <element name="Brigthness" type="integer" minOccurs="0"/>
      <element name="GPSCoordinates" type="float" minOccurs="0"/>
      <element name="AngularMeasurements" type="float" minOccurs="0"/>
      <element name="Time" type="string" minOccurs="0"/>
      <element name="NoiseLevel" type="float" minOccurs="0"/>
   </sequence>
</complexType>

<complexType name="BodyConditionInfo">
   <sequence>
      <element name="BodyTemperature" type="float" minOccurs="0"/>
      <element name="HeartRate" type="string" minOccurs="0"/>
      <element name="BodyWeight" type="float" minOccurs="0"/>
   </sequence>
</complexType>

<complexType name="Situation">
   <sequence>
      <element name="Inside" type="Boolean" minOccurs="0"/>
      <element name="Outside" type="Boolean" minOccurs="0"/>
      <element name="Moving" type="Boolean" minOccurs="0"/>
      <element name="Still" type="Boolean" minOccurs="0"/>
      <element name="Studying" type="Boolean" minOccurs="0"/>
      <element name="Exercising" type="Boolean" minOccurs="0"/>
      <element name="Meditating" type="Boolean" minOccurs="0"/>
      <element name="Sleeping" type="Boolean" minOccurs="0"/>
      <element name="Communicating" type="Boolean" minOccurs="0"/>
   </sequence>
</complexType>
```

6.9.2 Semantics

Name	*Definition*
`CurrentPlace`	Describes the user's location (Street, Car, Subway, Airplane, School, Home, Work).
`LevelOfNoise`	Describes the noise level around the user, where the noise level indicates two values (minimum noise level and maximum noise level, in dB).
`WeatherInfo`	Describes the weather information around the user.
`NeighborInfo`	Describes the neighboring people (names and/or number) around the user.
`ListeningDevice`	Describes the listening device.
`Situation`	Describes the situation the user is in.

6.10 VisualExpressionType

6.10.1 Syntax

```
<complexType name="CD:VisualExpression">
   <sequence>
      <element name="AppointedEvent" type="AppointedEvent" minOccurs="0"/>
      <element name="EnvironmentalInfo" type="EnvironmentalInfo" minOccurs="0"/>
      <element name="BodyConditionInfo" type="BodyConditionInfo" minOccurs="0"/>
      <element name="Situation" type="Situation" minOccurs="0"/>
      <element name="SensorInfo" type="SensorInfo" minOccurs="0"/>
   </sequence>
</complexType>

<complexType name="AppointedEvent">
   <sequence>
      <element name="EventName" type="string" minOccurs="0"/>
      <element name="EventDate" type="date" minOccurs="0"/>
      <element name="EventTime" type="time" minOccurs="0"/>
   </sequence>
</complexType>

<complexType name="EnvironmentalInfo">
   <sequence>
      <element name="Temperature" type="float" minOccurs="0"/>
      <element name="Brigthness" type="integer" minOccurs="0"/>
      <element name="GPSCoordinates" type="float" minOccurs="0"/>
      <element name="AngularMeasurements" type="float" minOccurs="0"/>
      <element name="Time" type="string" minOccurs="0"/>
      <element name="NoiseLevel" type="float" minOccurs="0"/>
   </sequence>
</complexType>

<complexType name="BodyConditionInfo">
   <sequence>
      <element name="BodyTemperature" type="float" minOccurs="0"/>
      <element name="HeartRate" type="string" minOccurs="0"/>
      <element name="BodyWeight" type="float" minOccurs="0"/>
   </sequence>
```

```
</complexType>

<complexType name="Situation">
   <sequence>
      <element name="Inside" type="Boolean" minOccurs="0"/>
      <element name="Outside" type="Boolean" minOccurs="0"/>
      <element name="Moving" type="Boolean" minOccurs="0"/>
      <element name="Still" type="Boolean" minOccurs="0"/>
      <element name="Studying" type="Boolean" minOccurs="0"/>
      <element name="Exercising" type="Boolean" minOccurs="0"/>
      <element name="Meditating" type="Boolean" minOccurs="0"/>
      <element name="Sleeping" type="Boolean" minOccurs="0"/>
      <element name="Communicating" type="Boolean" minOccurs="0"/>
   </sequence>
</complexType>

<complexType name="SensorInfo">
   <sequence>
      <element name="SensorName" type="string"/>
      <element name="SensorInput" type="string" minOccurs="0"/>
      <element name="SensorOutput" type="string" minOccurs="0"/>
   </sequence>
</complexType>
```

6.10.2 Semantics

Name	*Definition*
`AppointedEvent`	Describes the user's appointed event listed in a scheduler or a personnel note.
`EnvironmentalInfo`	Describes the user's environmental information acquired from sensors such as camera, microphone, GPS and gyroscope.
`BodyConditionInfo`	Describes the user's body condition information acquired from sensors.
`SituationInfo`	Describes the user's current situation inferred from sensors' information.
`SensorInfo`	Describes the information about the sensor used to collect contextual data.

6.11 BaseContextType

6.11.1 Syntax

This Syntax is `BaseContextType` type.

```
<complexType name="BaseContextType" abstract="true">
   <sequence>
      <element name="InformationAccessID" type="mpeg7:UserIdentifierType" minOccurs="0"
maxOccurs="unbounded"/>
      <element name="InformationAccessGroupURI" type="anyURI" minOccurs="0"
maxOccurs="unbounded"/>
   </sequence>
   <attribute name="InfoSource" type="anyURI"/>
</complexType>
```

6.11.2 Semantics

Name	*Definition*
BaseContextType	BaseContextType is an abstract type providing a base for description of each element.
InformationAccessID	Specifies the list of user's ID of other users who can access private information.
InformationAccessGroupURI	References to groups of users who can access private information through the specification of its URI. Refer to the GroupID of InformationAccessUserGroup in General Description.

6.12 ContextDescriptionType

InformationAccessID has been added into ContextDescriptionType. InformationAccessID. The InformationAccessID specifies a list of users who can access the privacy information.

6.12.1 Syntax

This Syntax is BaseContextType type.

```
<element name="CD" type="cd:ContextDescriptionType"/>
   <complexType name="BaseContextType" abstract="true">
      <attribute name="InfoSource" type="anyURI"/>
   </complexType>
   <complexType name="ContextDescriptionType">
      <sequence>
         <element name="InformationAccessGroup" type="ct:InformationAccessUserGroup"
minOccurs="0" maxOccurs="unbounded"/>
      <element name="ClassificationSchemeAlias" type="ct:ClassificationSchemeAliasType"
minOccurs="0" maxOccurs="unbounded"/>
         <element name="ContextIdentification" type="cd:ContextIdentificationType"
minOccurs="0"/>
         <element name="ValidTimeDuration" type="ct:TimeType" minOccurs="0"/>
         <element name="Season" type="mpeg7:termReferenceType" minOccurs="0"/>
         <element name="DeviceCharacteristics" type="cd:DeviceCharacteristicsType"
minOccurs="0" maxOccurs="unbounded"/>
         <element name="NetworkInfo" type="cd:NetworkInfoType" minOccurs="0"
maxOccurs="unbounded"/>
         <element name="Location" type="ct:LocationType" minOccurs="0"/>
         <element name="Weather" type="cd:WeatherType" minOccurs="0"/>
         <element name="OtherEnvironmentalInfo" type="cd:OtherEnvironmentalInfoType"
minOccurs="0"/>
         <element name="OtherContextInfo" type="anyType" minOccurs="0"
maxOccurs="unbounded"/>
      </sequence>
      <attributeGroup ref="ct:commonAttributes"/>
       <attribute name="Priority" type="ct:ZeroToOnehundredOrdinalType" use="optional"/>
</complexType>
```

6.12.2 Semantics

Name	*Definition*
CD	This data element is the root element of the Context Description.
ContextDescriptionType	This data type contains static and dynamic information about the user context.
InformationAccessGroup	Describes the group of other users who can access private information.

Name	*Definition*
ClassificationSchemeAlias	Specifies an alias for a ClassificationScheme to be referenced within the UserDescriptionType by a simplified URI.
ValidTimeDuration	Describes valid time duration for context description. The syntax and semantics of PeriodOfTimeType are specified in General Description.
Season	Describes current season information according to the region. Terms for the season are specified by the CS Season (urn:mpeg: mpeg21:UD:CS:SeasonCS:2016).
DeviceCharacteristics	Describes general characteristics of the terminal.
NetworkInfo	Describes network related information.
Location	Describes current location when a service is requested. The syntax and semantics of PlaceType are specified in ISO/IEC 15938-5.
Weather	Describes current weather when a service is requested.
OtherEnvironmentalInfo	Describes environmental information of noise or illumination characteristics around user.
commonAttributes	Describes a group of attributes for the CommonAttributes. The syntax and semantics of commonAttributes are specified in General Description.
Priority	Describes the level of priority of the context description by using the ZeroToOnehundredOrdinalType.
OtherContextInfo	A placeholder for other context – related information outside the standard namespace

7 Sevice description

7.1 BaseServiceType

7.1.1 Syntax

```
<complexType name="BaseServiceType" abstract="true">
   <sequence>
      <element name="InformationAccessID" type="mpeg7:UserIdentifierType" minOccurs="0"
maxOccurs="unbounded"/>
      <element name="InformationAccessGroupURI" type="anyURI" minOccurs="0"
maxOccurs="unbounded"/>
   </sequence>
</complexType>
```

7.1.2 Semantics

Name	*Definition*
BaseServiceType	BaseServiceType is an abstract type providing a base for description of each element.
InformationAccessID	Specifies the list of user's ID of other users who can access private information.
InformationAccessGroupURI	References to groups of users who can access private information through the specification of its URI. Refer to the GroupID of InformationAccessUserGroup in General Description.

7.2 ServiceDescriptionType

This subclause describes a structure of ServiceDescriptionType data type. The ServiceDescriptionType contains several elements, such as ServiceGeneralInformation, ServiceTargetInformation, ServiceInterfaces, InternalServices, Priority, IsServiceAvailable and ServiceObjectsInformation each of which is used for describing service's information.

7.2.1 Syntax

```
<complexType name="SD">
   <complexContent>
      <extension base="sd:BaseServiceType">
         <sequence>
            <element name="InformationAccessGroup" type="ct:InformationAccessUserGroup"
minOccurs="0" maxOccurs="unbounded"/>
            <element name="ClassificationSchemeAlias" type="ct:ClassificationSchemeAliasT
ype" minOccurs="0" maxOccurs="unbounded"/>
            <element name="ServiceID" type="mpeg7:UniqueIDType"/>
            <element name="ServiceGeneralInformation" type="sd:ServiceGeneralInformationT
ype"/>
            <element name="ServiceTargetInformation" type="sd:ServiceTargetInformationTy
pe"/>
            <element name="ServiceInterfaces" type="sd:ServiceInterfacesType"
minOccurs="0"/>
            <element name="InternalServices" type="sd:InternalServicesType"
minOccurs="0"/>
            <element name="Priority" type="ct:ZeroToOnehundredOrdinalType"
minOccurs="0"/>
            <element name="IsServiceAvailable" type="boolean"/>
            <element name="ServiceObjectsInformation" type="sd:ServiceObjectType"
minOccurs="0"/>
            <element name="LoudnessControlServiceDescription" type="LoudnessInfoType"/>
            <element name="VisualExpressionServiceDescription"
type="SD:VisualExpression"/>
            <element name="ConsecutiveVibrationServiceDescription" type="SD:
ConsecutiveVibration"/>
         </sequence>
      </extension>
   </complexContent>
</complexType>
```

7.2.2 Semantics

Name	*Definition*
SD	Specifies the root element of the Service Description.
InformationAccessGroup	Describes the group of other users who can access private information.
ClassificationSchemeAlias	The classification scheme alias information.
ServiceID	Describes the unique ID of the service.
ServiceGeneralInformation	Describes general information about a given service.
ServiceTargetInformation	Describes user's preferred service.
ServiceInterfaces	Describes interfaces used for exchanging information among the services and/or recommendation engine and/or application.
InternalServices	Describes an internal service.
Priority	Specifies the priority level associated to a given service.
IsServiceAvailable	Specifies availability of the service.
LoudnessControlServiceDescription	LoudnessControlServiceDescription shall describe set of supported audio services (e.g. audio output formats, volume levels, list of accessible copyright protected materials) available to the user in order to ensure continuous and smooth audio services while adhering to copyright protection and applicable laws.

Name	*Definition*
VisualExpressionServiceDescription	A set of base visual objects for expressing human's emotion, intention, situation and condition.
ConsecutiveVibrationService	Describes a set of consecutive vibration patterns according to the user preferences

7.3 ServiceGeneralInformationType

This subclause specifies general information of the service.

7.3.1 Syntax

```
<complexType name="ServiceGeneralInformationType">
   <complexContent>
      <extension base="sd:BaseServiceType">
   <sequence>
      <element name="ServiceName" type="Name"/>
      <element name="ServiceProviderName" type="Name"/>
      <element name="Description" type="string" minOccurs="0"/>
      <element name="ServiceURI" type="anyURI" minOccurs="0"/>
      <element name="ServiceCategory" type="mpeg7:termReferenceListType" minOccurs="0"/>
      <element name="SupportedFormat" type="mpeg7:MediaInformationType" minOccurs="0"/>
   </sequence>
      </extension>
   </complexContent>
</complexType>
```

7.3.2 Semantics

Name	*Definition*
SeviceGeneralInformation	Specifies a general information about a given service.
ServiceName	Specifies the name of the provided service.
ServiceProviderName	Specifies the name of the service provider.
Description	Specifies a generic description of the given provided service.
ServiceURI	Specifies the URI by which the given service can be accessed.
ServiceCategory	Terms for the ServiceCategory are specified by the ServiceCategoryCS (urn:mpeg: mpeg21:UD:CS:ServiceCategoryCS:2016).
SupportedFormat	Specifies specific media formats available in a service.

7.4 ServiceTargetInformationType

This subclause specifies service target information type of the service. Service target information consists of 3 components: PreferredUserDescriptionInformation, PreferredContextDescriptionInformation and ServiceTargetModel. Each element describes the policy and strategy for a specific service.

7.4.1 Syntax

```
<complexType name="ServiceTargetInformationType">
   <complexContent>
      <extension base="sd:BaseServiceType">


   <choice maxOccurs="unbounded">
```

```
      <element name="PreferredUserDescriptionInformation" type="ud:UserDescriptionType"
minOccurs="0" maxOccurs="unbounded"/>
      <element name="PreferredContextDescriptionInformation" type="cd:ContextDescriptionT
ype" minOccurs="0" maxOccurs="unbounded"/>
      <element name="ServiceTargetModel" type="sd:ServiceTargetModelType" minOccurs="0"
maxOccurs="unbounded"/>
   </choice>
      </extension>
   </complexContent>
</complexType>
```

7.4.2 Semantics

Name	*Definition*
`ServiceTargetInformationType`	Specifies information about preferred user and context for a service.
`PreferredUserDescription Information`	Specifies the description of preferred user for the service.
`PreferredContextDescriptio nInformation`	Specifies the description of preferred context of usage for the service.
`ServiceTargetModel`	Specifies the informational role of user segmentation.

7.5 ServiceTargetModelType

This subclause describes a specific decision-model to specify types about targeted user groups by a service provider and sepecifies vocabularies for describing specific sets of a service type.

7.5.1 Syntax

```
<complexType name="ServiceTargetModelType">
   <sequence>
      <element name="ServiceTargetTree" minOccurs="0" maxOccurs="unbounded">
         <complexType>
            <sequence>
               <element name="Node" type="sd:NodeType" minOccurs="0"/>
            </sequence>
         </complexType>
      </element>
      <element name="ServiceTargetSet" type="sd:VocabularySetType">
         <unique name="userType-vocabulary">
            <selector xpath="sd:vocabulary"/>
            <field xpath="@name"/>
         </unique>
      </element>
   </sequence>
</complexType>
<complexType name="NodeType">
   <sequence>
      <element name="Question" type="string" minOccurs="0"/>
      <element name="ChildNode" type="sd:NodeType" minOccurs="0"
maxOccurs="unbounded"/>
   </sequence>
   <attribute name="nodeID" type="ID" use="optional"/>
   <attribute name="answer" type="string" use="optional"/>
```

```
   <attribute name="serviceTargetType" type="token" use="optional"/>
</complexType>
```

7.5.2 Semantics

Name	*Definition*
ServiceTargetModelType	Describes decision-model for user type about target user groups and specifies vocabulary set for user types.
ServiceTargetTree	Specifies a decision tree model associated to a specific target user group.
Node	Describes root node in decision tree that includes one question and associated child nodes.
ServiceTargetSet	Specifies a set of user type vocabularies which describes the target user groups segmented by a service provider.
NodeType	Describes each node in a decision tree. The NodeType contains Question, ChildNode elements and nodeID, answer, and serviceTargetType attributes.
Question	Describes question for child node selection.
ChildNode	Describes a child node of this node with NodeType to generate a decision tree.
nodeID	Specifies the unique node identifier.
answer	Specifies an answer, quantifying the condition for this node to be selected, to the question of parent node.
serviceTargetType	Specifies the targeted user group of a service, when this node is selected as a result of decision tree navigation, by referencing a vocabulary of user type (target user group) in ServiceTargetSet.

7.6 VocabularySetType

This subclause specifies a vocabulary set for describing target user groups.

7.6.1 Syntax

```
<complexType name="VocabularySetType">
   <sequence>
      <element name="vocabulary" maxOccurs="unbounded">
         <complexType>
            <attribute name="name" type="NMTOKEN" use="required"/>
         </complexType>
      </element>
   </sequence>
   <attribute name="id" type="ID" use="required"/>
</complexType>
```

7.6.2 Semantics

Name	*Definition*
VocabularySetType	Type for a set of vocabulary to describe target user groups.
Vocabulary	Specifies each vocabulary which belongs to the given vocabulary set.
name	Specifies the name of a given vocabulary.
id	Specifies the unique identifier of a given vocabulary set.

7.7 ServiceInterfacesType

7.7.1 Syntax

```
<complexType name="ServiceInterfacesType">
   <complexContent>
      <extension base="sd:BaseServiceType">

<sequence>
      <element name="ServiceInterface" type="sd:ServiceInterfaceType"
maxOccurs="unbounded"/>
   </sequence>
      </extension>
   </complexContent>
</complexType>
```

7.7.2 Semantics

Name	*Definition*
ServiceInterfacesType	Type for the service interfaces supported by the service.
ServiceInterface	Describes each service interface.

7.8 ServiceInterfaceType

7.8.1 Syntax

```
<complexType name="ServiceInterfaceType">
   <sequence>
      <element name="ServiceInterfaceInformationURI" type="anyURI"/>
      <element name="Description" type="string" minOccurs="0"/>
      <element name="RequiredInputData" type="sd:RequiredInputDataType" minOccurs="0"/>
   </sequence>
</complexType>
```

7.8.2 Semantics

Name	*Definition*
ServiceInterfaceType	Describes a given service interface from service provider such as ServiceInterfaceInformationURI, generic description of service and extra input data.
Description	Specifies a generic description about a service interface.
RequiredInputData	Specifies the input data requested for the access/utilization of a service.

7.9 RequiredInputDataType

It specifies input data needed for accessing and using a service.

7.9.1 Syntax

```
<complexType name="RequiredInputDataType">
   <choice maxOccurs="unbounded">
      <element name="RequiredUDInfo" type="sd:xPathType" minOccurs="0"
maxOccurs="unbounded"/>
```

```
      <element name="RequiredCDInfo" type="sd:xPathType" minOccurs="0"
maxOccurs="unbounded"/>
   </choice>
</complexType>
<simpleType name="xPathType">
   <restriction base="token"/>
</simpleType>
```

7.9.2 Semantics

Name	*Definition*
RequiredInputDataType	Type for required input data for service utilization, including CompactUD, CompactCD and AdditionalInputData.
RequiredUDInfo	Optional XPath expression which specifies the node of the metadata fragment related to required user description by the service being addressed.
RequiredCDInfo	Optional XPath expression which specifies the node of the metadata fragment related to required context description by the service being addressed.

7.10 InternalServicesType

It specifies a list of internal services provided by the service.

7.10.1 Syntax

```
<complexType name="InternalServicesType">
   <complexContent>
      <extension base="sd:BaseServiceType">
   <sequence>
      <element name="InternalService" type="sd:InternalServiceType"
maxOccurs="unbounded"/>
   </sequence>
      </extension>
   </complexContent>
</complexType>
```

7.10.2 Semantics

Name	*Definition*
InternalServicesType	Specifies a list of internal services provided by the service.
InternalService	Specifies an internal service provided by the service.

7.11 InternalServicesType

It specifies a lists of internal services provided by the service.

7.11.1 Syntax

```
<complexType name="InternalServiceType">
   <choice>
      <element name="Service" type="sd:ServiceDescriptionType"/>
      <element name="ServiceRef">
         <complexType>
            <attribute name="referenceServiceID" type="anyURI"/>
```

```
        </complexType>
      </element>
   </choice>
   <attribute name="servicePriority" type="ct:ZeroToOnehundredOrdinalType" use="optional"
default="50"/>
</complexType>
```

7.11.2 Semantics

Name	*Definition*
InternalServiceType	Specifies an internal service provided by the service.
ServiceRef	Specifies a reference to the internal service already specified.
referenceServiceID	Specifies the unique identifier of a service.
servicePriority	Specifies the priority of an internal service. Value ranges from 0 to 100 (default value is 50).

7.12 AudioDBType

It specifies some audio related metadata.

7.12.1 Syntax

```
  <complexType name="AudioDBType" mixed="true">
   <complexContent>
      <restriction base="didl:StatementType">
         <sequence>
            <element name="AudioDB">
               <complexType>
                  <sequence>
                     <element name="Title" type="mpeg7:NameComponentType"
minOccurs="0"/>
                     <element name="Singer" type="mpeg7:PersonType" minOccurs="0"/>
                     <element name="AuthorOfMusic" type="mpeg7:PersonType"
minOccurs="0"/>
                     <element name="KindOfMusic" type="ud:AudioMusicPreferenceType"
minOccurs="0"/>
                     <element name="KindOfFileformat" minOccurs="0">
                        <simpleType>
                           <union memberTypes="ud:LosslessAudioFormatType
ud:LossyAudioFormatType"/>
                        </simpleType>
                     </element>
                     <element name="FirstLineOfMusic" type="mpeg7:NameComponentType"
minOccurs="0"/>
                     <element name="AccessHistoryOfUser" type="mpeg7:UserActionHistoryTy
pe" minOccurs="0"/>
                     <element name="NetworkOfUser" type="cd:NetworkInfoType"/>
                     <element name="AudioPresentationPreferences" type="ud:AudioPresentat
ionPreferencesType" minOccurs="0"/>
                  </sequence>
               </complexType>
            </element>
         </sequence>
```

```
      </restriction>
   </complexContent>
</complexType>
```

7.12.2 Semantics

Name	*Definition*
`Title`	Specifies the title of a given audio track stored on a generic database.
`Singer`	Specifies the singer of a given audio track stored on a generic database.
`AuthorOfMusic`	Specifies the music author of a given audio track stored on a generic database.
`KindOfMusic`	Specifies the music genre of a given audio track stored on a generic database.
`FirstLineOfMusic`	Specifies the first paragraph of lyrics for lossless audio on the database.
`AccessHistoryOfUser`	Describes the access history of user access on the database.
`NetworkOfUser`	Describes the network environment of user on the database.
`AudioPresentationPreferences`	Describes the audio presentation preferences information.

7.13 AudioDBDescriptorType

An MPEG-21 DIDL Descriptor carrying metadata related to audio items.

7.13.1 Syntax

```
<complexType name="AudioDBDescriptorType">
   <complexContent>
      <extension base="didl:DescriptorType"/>
   </complexContent>
</complexType>
```

7.13.2 Semantics

Name	*Definition*
`AudioDBDescriptorType`	A complex type derived from MPEG-21 DIDL Descriptor carrying information about lossless audio items.

7.14 VideoDBType

This subclause describes structure of `VideoDBType`. `VideoDBType` includes `TypeOfMovie`, `RatingOfVideo`, `FileformatOfVideo`, `FirstReleasedYear` and `OriginalLanguage` elements and inherits by restriction from `didl:StatementType`.

7.14.1 Syntax

```
<complexType name="VideoDBType" mixed="true">
   <complexContent>
      <restriction base="didl:StatementType">
         <sequence>
            <element name="VideoDB">
               <complexType>
                  <sequence>
                     <element name="TypeOfMovie" minOccurs="0">
                        <complexType>
                           <complexContent>
```

```
                              <extension base="mpeg7:TermUseType">
                                 <attribute name="preferenceValue" type="mpeg7:preference
ValueType" use="optional" default="10"/>
                              </extension>
                           </complexContent>
                        </complexType>
                     </element>
                     <element name="RatingOfVideo" type="nonNegativeInteger"
minOccurs="0"/>
                     <element name="XSizeOfVideo" type="nonNegativeInteger"
minOccurs="0"/>
                     <element name="YSizeOfVideo" type="nonNegativeInteger"
minOccurs="0"/>
                     <element name="FirstReleaseYear" type="nonNegativeInteger"
minOccurs="0"/>
                     <element name="OriginLanguage" type="ud:LanguageType"
minOccurs="0"/>
                  </sequence>
               </complexType>
            </element>
         </sequence>
      </restriction>
   </complexContent>
</complexType>
```

7.14.2 Semantics

Name	*Definition*
TypeOfMovie	Describes the type of video on the database.
RatingOfVideo	Describes the rating of video on the database.
XSizeOfVideo	Describes the X-axis size of video on the database.
YSizeOfVideo	Describes the Y-axis size of video on the database.
FirstReleasedYear	Describes the first released year of video on the database.
OriginalLanguage	Describes the original language of video on the database.

7.15 VideoDBDescriptorType

An MPEG-21 DIDL Descriptor carrying VideoDBStatement(s).

7.15.1 Syntax

```
<complexType name="VideoDBDescriptorType">
   <complexContent>
      <extension base="didl:DescriptorType"/>
   </complexContent>
</complexType>
```

7.15.2 Semantics

Name	*Definition*
VideoDBDescriptorType	A complex type derived from MPEG-21 DIDL Descriptor carrying information about video items.

7.16 ServiceObjectType

ServiceObjectType describes the objects offered to the user by the service provider (e.g., service object, database of multimedia).

7.16.1 Syntax

```
<complexType name="ServiceObjectType">
   <complexContent>
      <extension base="sd:BaseServiceType">
   <choice maxOccurs="unbounded">
      <element name="ServiceObjectInformation" type="ct:ObjectType">
         <annotation>
            <documentation>Other items provided by the service</documentation>
         </annotation>
      </element>
      <element name="DatabaseOfMultimedia">
         <annotation>
            <documentation>Digital Items provided by service</documentation>
         </annotation>
         <complexType>
            <complexContent>
               <extension base="didl:ItemType">
                  <sequence>
                     <element name="CreationInformation" type="mpeg7:CreationType"
minOccurs="0">
                        <annotation>
                           <documentation>Information about creation metadata of the
recommended digital item</documentation>
                        </annotation>
                     </element>
                     <element name="AVSegment" minOccurs="0">
                        <complexType>
                           <choice>
                              <element name="MovingRegion"
type="mpeg7:MovingRegionType"/>
                              <element name="Segment"
type="mpeg7:AudioVisualSegmentType"/>
                           </choice>
                        </complexType>
                     </element>
                  </sequence>
               </extension>
            </complexContent>
         </complexType>
      </element>
   </choice>
      </extension>
   </complexContent>
</complexType>
```

7.16.2 Semantics

Name	*Definition*
ServiceObjectType	This data type describes the objects offered to the user by the service provider.
ServiceObjectInformation	Describes the information of the objects provided by the service, in case they are not digital items.
DatabaseOfMultimedia	Describes the digital items provided by service.
CreationInformation	Information about creation metadata of the recommended digital item, expressed using MPEG-7 CreationType.
AVSegment	A moving region or an audiovisual segment of the recommended digital item. To be used in case the recommended digital item is an audiovisual object.

7.17 LoudnessInfoType

7.17.1 Syntax

```
<complexType name="LoudnessInfoType">
   <sequence>
      <element name="ServiceMediaType" type="ServiceMediaType"/>
      <element name="MediaInfoType" type="MediaInfoType"/>
   </sequence>
</complexType>

<complexType name="ServiceMediaType">
   <choice>
      <element name="Video" type="boolean" minOccurs="0"/>
      <element name="Audio" type="boolean" minOccurs="0"/>
      <element name="Image" type="boolean" minOccurs="0"/>
      <element name="Text" type="string" minOccurs="0"/>
   </choice>
</complexType>

<complexType name="MediaInfoType">
   <sequence>
      <element name="Genre" type="string" minOccurs="0"/>
      <element name="PlayTime" type="float" minOccurs="0"/>
      <element name="Resolution" type="string" minOccurs="0"/>
      <element name="Bitrate" type="integer" minOccurs="0"/>
      <element name="Framerate" type="integer" minOccurs="0"/>
      <element name="MediaFormat" type="string" minOccurs="0"/>
      <element name="Advertisement" type="AdvertisementInfo" minOccurs="0"/>
      <element name="Sound" type="AudioInfo" minOccurs="0" maxOccurs="unbounded"/>
   </sequence>
</complexType>

<complexType name="AdvertisementInfo">
   <sequence>
      <element name="Advertisement" type="boolean" minOccurs="0"/>
      <element name="PlayTime" type="float" minOccurs="0"/>
      <element name="Resolution" type="string" minOccurs="0"/>
      <element name="Bitrate" type="integer" minOccurs="0"/>
```

```
      <element name="Framerate" type="integer" minOccurs="0"/>
      <element name="Sound" type="AudioInfo" minOccurs="0"/>
   </sequence>
</complexType>

<complexType name="AudioInfo">
   <sequence>
      <element name="Loudness" type="float" minOccurs="0"/>
      <element name="SampleRate" type="float" minOccurs="0"/>
      <element name="BitRate" type="integer" minOccurs="0"/>
      <element name="Tempered" type="boolean" minOccurs="0"/>
      <element name="TemperedLoudness" type="float" minOccurs="0"/>
   </sequence>
</complexType>
```

7.17.2 Semantics

Name	*Definition*
ServiceMedia	Describes the media type (Video, Audio, Image, Text).
MediaInfo	Describes the information about the media (Genre, PlayTime, Resolution, BitRate, Framerate, MediaFormat, Advertisement).
AdvertisementInfo	Describes the information about the advertisement included in the media.
AudioInfo	Describes the information about the audio quality of the media (Loudness, SampleRate, BitRate, Tempered, TemperedLoudness).

7.18 VisualExpressionInfoType

7.18.1 Syntax

```
<complexType name="SD:VisualExpression">
   <sequence>
      <element name="VisualObject" type="VOType"/>
   </sequence>
</complexType>

<complexType name="VOType">
   <choice minOccurs="0" maxOccurs="unbounded">
      <element name="Face" type="Face"/>
      <element name="Clock" type="Clock"/>
      <element name="Animal" type="Animal"/>
      <element name="Fruit" type="Fruit"/>
      <element name="Weather" type="Weather"/>
      <element name="Food" type="Food"/>
      <element name="Vehicle" type="Vehicle"/>
      <element name="Plant" type="Plant"/>
      <element name="Building" type="Building"/>
   </choice>
</complexType>

<complexType name="Face">
   <sequence>
```

```
      <element name="FaceOutline" type="VOComponentInfo" minOccurs="0"
maxOccurs="unbounded"/>
      <element name="Eye" type="VOComponentInfo" maxOccurs="unbounded"/>
      <element name="Nose" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Mouth" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Hair" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Ear" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="FacialHair" type="VOComponentInfo" minOccurs="0"
maxOccurs="unbounded"/>
      <element name="Eyebrows" type="VOComponentInfo" minOccurs="0"
maxOccurs="unbounded"/>
   </sequence>
</complexType>

<complexType name="Clock">
   <sequence>
      <element name="Frame" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="HourNeedle" type="VOComponentInfo" minOccurs="0"
maxOccurs="unbounded"/>
      <element name="MinuteNeedle" type="VOComponentInfo" minOccurs="0"
maxOccurs="unbounded"/>
   </sequence>
</complexType>

<complexType name="Animal">
   <extension base="Face">
      <sequence>
         <element name="Head" type="VOComponentInfo" minOccurs="0"
maxOccurs="unbounded"/>
         <element name="Body" type="VOComponentInfo" minOccurs="0"
maxOccurs="unbounded"/>
         <element name="Leg" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
         <element name="Tail" type="VOComponentInfo" minOccurs="0"
maxOccurs="unbounded"/>
         <element name="Clothing" type="VOComponentInfo" minOccurs="0"
maxOccurs="unbounded"/>
         <element name="Horn" type="VOComponentInfo" minOccurs="0"
maxOccurs="unbounded"/>
   <element name="Wings" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      </sequence>
   </extension>
</complexType>

<complexType name="Fruit">
   <sequence>
      <element name="Body" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Leaf" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Stem" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
   </sequence>
</complexType>

<complexType name="Weather">
   <sequence>
```

```
   <element name="Sun" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Cloud" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Fog" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Rain" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Snow" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Wind" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
   </sequence>
</complexType>

<complexType name="Food">
   <sequence>
   <element name="Rice" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Bread" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Hamburger" type="VOComponentInfo" minOccurs="0"
maxOccurs="unbounded"/>
      <element name="Sandwich" type="VOComponentInfo" minOccurs="0"
maxOccurs="unbounded"/>
      <element name="Steak" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Hotdog" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Fish" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Soup" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Curry" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Noodle" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Cake" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Fries" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Beer" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Wine" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Plate" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Cutlery" type="VOComponentInfo" minOccurs="0"
maxOccurs="unbounded"/>
   </sequence>
</complexType>

<complexType name="Vehicle">
   <sequence>
      <element name="Body" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Wheel" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Wing" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Sail" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Door" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
   </sequence>
</complexType>

<complexType name="Plant">
   <sequence>
      <element name="Body" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Leaf" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Stem" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Fruit" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Root" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
   </sequence>
```

```
</complexType>

<complexType name="Building">
   <sequence>
      <element name="Structure" type="VOComponentInfo" minOccurs="0"
maxOccurs="unbounded"/>
      <element name="Window" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Door" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
      <element name="Roof" type="VOComponentInfo" minOccurs="0" maxOccurs="unbounded"/>
   </sequence>
</complexType>

<complexType name ="VOComponentInfo"/>
   <sequence>
      <element name ="PlacementX" type="integer" maxOccurs="1"/>
      <element name ="PlacementY" type="integer" maxOccurs="1"/>
      <element name ="Size" type="integer" maxOccurs="1"/>
      <element name ="Color" type="string" maxOccurs="1"/>
      <element name ="Rotation" type="integer" maxOccurs="1"/>
      <element name ="PlacementOrder" type="integer" maxOccurs="1"/>
   </sequence>
</complexType>
```

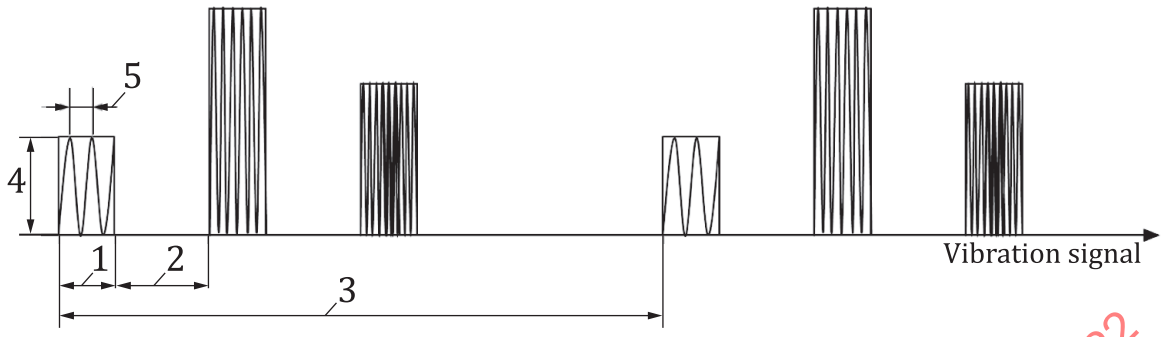
7.18.2 Semantics

Name	*Definition*
VOType	Describes the type of the visual object (VO) .
VOComponentInfo	Describes the editable components of a visual object.
PlacementX	Describes the X coordinate (relative or absolute) of a visual object.
PlacementY	Describes the Y coordinate (relative or absolute) of a visual object.
Size	Describes the size (scalable number or percentage) of a visual object.
Color	Describes the color of the component.
Rotation	Describes the angle of rotation for the component (in degrees).
PlacementOrder	Describes the placement order of the component where the highest number represents the closest placement and the lowest number represents the furthest placement.

7.19 ConsecutiveVibrationServiceType

7.19.1 General

This subclause describes consecutive vibration information. Figure 2 shows the process to deliver the vibration signals via a consecutive way, where the vibration information could be generated by controlling the duration, interval, period, amplitude, and frequency.



Key

1 duration
2 interval
3 period
4 amplitude
5 frequency

Figure 2 — ConsecutiveVibrationServiceType Diagram

7.19.2 Syntax

```
<complexType name="ConsecutiveVibrationServiceType">
   <sequence>
      <element name="CVService" type="CVServiceType" minOccurs="0"/>
      <element name=" CVSetting" type="CVSettingType" minOccurs="0"/>
   <sequence>
</complexType>
<complexType name="CVService">
   <sequence>
      <element name="LoadGuidance" type=" LoadGuidance" minOcuurs="0"
maxOccurs="unbounded"/>
      <element name="ScheduleAlarm" type="ScheduleAlarm" minOcuurs="0"
maxOccurs="unbounded"/>
      <element name="EventAlarm" type="EventAlarm" minOcuurs="0" maxOccurs="unbounded"/>
      <element name="Appointment" type="Appointment" minOcuurs="0"
maxOccurs="unbounded"/>
      <element name="Emergency" type="Emergency" minOcuurs="0" maxOccurs="unbounded"/>
   </sequence>
</complexType>
```

7.19.3 Semantics

Name	*Definition*
`CVService`	Specifies a list of Services to be provided by the consecutive vibration technology
`CVDelivery`	Terms for the `CVDelivery` are specified by the `IntentionActionCS` (`urn:mpeg:mpeg21:UD:CS:CVSettingCS:2022`

8 Recommendation description

8.1 RecommendationDescriptionType

This clause describes the complex type of a recommendation description.

8.1.1 Syntax

```
<complexType name="RD">
   <sequence>
      <element name="ClassificationSchemeAlias" type="ct:ClassificationSchemeAliasType"
minOccurs="0" maxOccurs="unbounded"/>
      <element name="RecommendationID" type="mpeg7:UniqueIDType"/>
      <element name="compactUsageDescription" type="rd:compactUsageDescriptionType"
minOccurs="0" maxOccurs="unbounded"/>
      <element name="QueryDescription" type="rd:queryDescriptionType" minOccurs="0"
maxOccurs="unbounded"/>
      <element name="ServiceUserType" type="string" minOccurs="0" maxOccurs="unbounded"/>
      <element name="ProcessChain" type="rd:ProcessChainType" minOccurs="0"/>
      <element name="RecommendationHistory" minOccurs="0"/>
      <complexType>
         <sequence>
            <element name="RecommendationResult" maxOccurs="unbounded">
               <complexType>
                  <sequence>
                     <element name="Recommendation" type="rd:compactUsageDescriptionTy
pe"/>
                     <element name="Result" type="anyType">
                        <annotation>
                           <documentation>Any tangible result of the recommendation:
satisfaction, feedback </documentation>
                        </annotation>
                     </element>
                  </sequence>
               </complexType>
            </element>
         </sequence>
      </complexType>
      <element name="RecommendationInformation" type="rd:RecommendationInformationType"
minOccurs="0" maxOccurs="unbounded"/>
      <element name="LoudnessControlRecommendationDescription"
type="LoudnessControlType"/>
      <element name="VisualExpressionRecommendationDescription"
type="RD:VisualExpression"/>
      <element name="ConsecutiveVibrationRecommendationDescription" type="RD:
ConsecutiveVibration"/>
   </sequence>
   <attributeGroup ref="ct:commonAttributes"/>
   <attribute name="provider" type="anyURI" use="optional"/>
</complexType>
```

8.1.2 Semantics

Name	*Definition*
RD	The root element of Recommendation Description.
ClassificationSchemeAlias	Specifies an alias for a ClassificationScheme to be referenced within the UserDescriptionType by a simplified URI.
RecommendationID	The unique ID of the recommendation.
compactUsageDescription	A structure containing information about the recommended items.
QueryDescription	A structure containing information about a recommended query.
ServiceUserType	Indicates user type for a specific service. Only vocabulary name defined in SD can be used for representations of the userType. ServiceUserType can use only vocabularies defined in ServiceTargetSet element in SD.
ProcessChain	Process description that can be executed at the client side, generated by the recommendation engine.
RecommendationHistory	A structure containing information about past recommendations.
RecommendationResult	A structure containing the recommendation result.
Recommendation	A structure containing the past recommendations.
Result	Any tangible result of the recommendation: satisfaction, feedback.
RecommendationInformation	A structure containing information about the recommendation (metadata of the recommendation).
CommonAttributes	Common attributes of all top-level MPEG-UD descriptors.
Provider	Information about the recommendation provider (e.g. which recommendation engine).
LoudnessControlRecommendationDescription	Description of safety protocols for controlling the volume and a list of recommended audio services based on user/context/service descriptions
VisualExpressionRecommendationDescription	A set of statistical data edited/created from base visual objects.
ConsecutiveVibrationRecommendationDescription	Describes a set of consecutive vibration patterns according to user preferences

8.2 compactUsageDescriptionType

compactUsageDescriptionType specifies compact usage description representation, which is composed of a sequence of clusters, lists, labelled sets or equivalence sets. These representations are used to organize and enhance the recommendation engine output for the receiving application.

8.2.1 Syntax

```
<complexType name="compactUsageDescriptionType">
<annotation>
<documentation>Main complex type for compact usage description
representation. It may be composed of an infinite sequence of clusterings, lists,
labelled sets or equivalence sets.</documentation>
</annotation>
<sequence>
      <element name="Clustering" type="rd:clusteringType" minOccurs="0"
maxOccurs="unbounded"/>
      <element name="List" type="rd:orderedSetType" minOccurs="0"
maxOccurs="unbounded"/>
      <element name="LabelledSet" type="rd:labelledSetType" minOccurs="0"
maxOccurs="unbounded"/>
      <element name="EquivalenceSet" type="rd:equivalenceSetType" minOccurs="0"
```

```
maxOccurs="unbounded"/>
      <element name="SimpleResource" type="rd:RecommendableResourceType" minOccurs="0"
maxOccurs="unbounded"/>
      <element name="GenericSet" type="rd:genericSetType" minOccurs="0"
maxOccurs="unbounded"/>
</sequence>
</complexType>
```

8.2.2 Semantics

Name	*Definition*
compactUsageDescriptionType	Main complex type for compact usage description representation. It may be composed of an infinite sequence of clusterings, lists, labelled sets or equivalent sets.
`Clustering`	A structure describing a result of a clustering.
`List`	A structure describing a ranked list, e.g. a result of an information retrieval operation providing scores for each returned result.
`LabelledSet`	A structure describing a labeled set (e.g. a result of a classification).
`EquivalenceSet`	A structure describing an equivalence set, i.e. a set in which elements are equivalent under a specified criterion.
`SimpleResource`	A simple resource with no structure.
`GenericSet`	A structure describing a generic set of recommended resources.

8.2.3 Example

This example illustrates the structure of a compactUsageDescription element in a case of a recommendation engine which recommends to a user other users to be asked for friendship. In this case, it is a List of elements to be provided. Each element is wrapped in an OrderedMember structure which contains also the rank information. Higher rank means higher recommendation. Both users (u2 and u1) are recommended as good users to be asked for friendship (e.g. through a social network) but u2 is ranked higher than u1 by the recommender engine.

```
<compactUsageDescription>
 <List>
  <OrderedMember>
    <SetElement resourceID="res2">
     <Resource>
      <UserDescriptionFragment>
       <ud:UserID>u2</ud:UserID>
      </UserDescriptionFragment>
     </Resource>
     <Role roleType="Ask_Friendship"/>
    </SetElement>
   <Rank>0.9</Rank>
  </OrderedMember>
  <OrderedMember>
    <SetElement resourceID="res1">
     <Resource>
      <UserDescriptionFragment>
       <ud:UserID>u1</ud:UserID>
      </UserDescriptionFragment>
     </Resource>
     <Role roleType="Ask_Friendship"/>
```

```
    </SetElement>
   <Rank>0.5</Rank>
  </OrderedMember>
 </List>
</compactUsageDescription>
```

8.3 QueryDescriptionType

Element containing information about queries recommended to be invoked on specific services.

8.3.1 Syntax

```
<complexType name="queryDescriptionType">
   <annotation>
      <documentation>Main complex type for query description. It include as a service
reference which is used to identify the service on which the query is to be invoked.
  </documentation>
   </annotation>
   <sequence>
      <element name="SearchServiceReference" type="sd:ServiceDescriptionType"/>
      <element name="Query" type="rd:queryClauseType"/>
   </sequence>
</complexType>
```

8.3.2 Semantics

Name	*Definition*
queryDescriptionType	Main complex type for query description. It includes a service reference which is used to identify the service on which the query is to be invoked.
SearchServiceReference	A description of the service to be invoked.
Query	This element contains a structured description of the query to be perfomed on the service defined in SearchServiceReference.

8.4 ProcessChainType

PricessChainType is a process description that can be executed at the client side, generated by the recommendation engine. The processes can for example be an emergency call or sending an emergency SMS.

8.4.1 Syntax

```
<complexType name="ProcessChainType">
   <annotation>
      <documentation>Process description that can be executed at the client side,
generated by the recommendation engine. The processes can be an emergency call or
sending an emergency sms</documentation>
   </annotation>
   <sequence>
      <element name="ProcessChainCommand" maxOccurs="unbounded">
         <complexType>
            <sequence>
               <element name="ActionType" type="mpeg7:termReferenceType" />
               <element name="ActionTo" type="anyURI" />
```

```
                <element name="ActionFrom" type="anyURI" />
                <element name="ActionMessage" type="mpeg7:TextualType" />
                <element name="ActionObject" type="ud:ArtefactType" maxOccurs="unbounded"
/>
            </sequence>
        </complexType>
    </element>
  </sequence>
</complexType>
```

8.4.2 Semantics

Name	*Definition*
ProcessChainType	Specifies a process that can be executed, e.g. an emergency call or sending an emergency SMS.
ProcessChainCommand	Specifies the command to be executed.
ActionType	Specifies the type of the action to be processed.
ActionTo	Specifies to whom the action is meant to.
ActionFrom	Specifies from whom the action is being requested.
ActionMessage	Specifies a message describing the action.
ActionObject	Specifies an object/representation of the action.

8.5 RecommendationInformationType

Basic metadata about the recommendation itself.

8.5.1 Syntax

```
<complexType name="RecommendationInformationType">
  <sequence>
    <element name="RecommendationCategory" type=" mpeg7:ControlledTermUseType"
minOccurs="0"/>
    <element name="RecommendedObjectInformation" type="ct:ObjectType"
minOccurs="0"/>
    <element name="RecommendationPriority" type="ct:ZeroToOnehundredRatioType"
minOccurs="0"/>
  </sequence>
</complexType>
```

8.5.2 Semantics

Name	*Definition*
RecommendationInformationType	Describes the recommendation information.
RecommendationCategory	Describes the category of recommendation. Each of representative service's name can be used as a category of recommendation. Terms for the RecommendationCategory are specified by the serviceCategoryCS.
RecommendedObjectInformation	Describes the object information such as id, name and format which are recommended by recommendation engine.
RecommendationPriority	Describes the priority of object in the recommendation object list which are ordered by recommendation engine.

8.6 RecommendableResourceType

This complex type specifies the core structure of a recommended resource. This can be a fragment of UD, CD or SD accompanied by the specification of a role that the fragment has in the context of the recommendation.

8.6.1 Syntax

```
<complexType name="RecommendableResourceType">
   <annotation>
      <documentation>This complex type models the recommendable object. This can
be a fragment of UD, CD or SD</documentation>
   </annotation>
   <choice>
      <element name="UserDescriptionFragment" type="ud:UserDescriptionType">
         <annotation>
            <documentation>A fragment of User Description useful in the context of
this Recommendation</documentation>
         </annotation>
         <complexType>
            <complexContent>
               <extension base="ud:UserDescriptionType">
                  <sequence minOccurs="0">
                     <element ref="rd:Role"/>
                  </sequence>
               </extension>
            </complexContent>
         </complexType>
      </element>
      <element name="ContextDescriptionFragment" type="cd:ContextDescriptionType">
         <annotation>
            <documentation>A fragment of Context Description useful in the context of
this Recommendation</documentation>
         </annotation>
         <complexType>
            <complexContent>
               <extension base="cd:ContextDescriptionType">
                  <sequence minOccurs="0">
                     <element ref="rd:Role"/>
                  </sequence>
               </extension>
            </complexContent>
         </complexType>
      </element>
      <element name="ServiceDescriptionFragment" type="sd:ServiceDescriptionType">
         <annotation>
            <documentation>A fragment of Service Description useful in the context
of this Recommendation</documentation>
         </annotation>
         <complexType>
            <complexContent>
               <extension base="sd:ServiceDescriptionType">
```

```
                  <sequence minOccurs="0">
                     <element ref="rd:Role"/>
                  </sequence>
               </extension>
            </complexContent>
         </complexType>
      </element>
   </choice>
</complexType>
```

8.6.2 Semantics

Name	*Definition*
RecommendableResourceType	This complex type models the recommendable object. This can be a fragment of UD, CD or SD.
UserDescriptionFragment	A fragment of User Description useful in the context of this recommendation.
Role	The role of this fragment in the context of this recommendation.
ContextDescriptionFragment	A fragment of Context Description useful in the context of this recommendation.
ServiceDescriptionFragment	A fragment of Service Description useful in the context of this recommendation.

8.7 Resource

This is the generic recommendable resource. This can be a UD, SD or CD fragment.

8.7.1 Syntax

```
<element name="Resource" type="rd:RecommendableResourceType">
   <annotation>
      <documentation>This is the generic recommendable resource. This can be a
UD, SD or CD fragment.</documentation>
   </annotation>
</element>
```

8.7.2 Semantics

Name	*Definition*
Resource	Specifies a fragment of UD or CD or SD.

8.8 resourceUsageType

This complex type models the usage of a generic resource as a combination of a resource description and of information about other usages of the same resource by other users.

8.8.1 Syntax

```
<complexType name="resourceUsageType">
   <annotation>
      <documentation>This complex type models the usage of a generic resource as a
combination of a Resource description and of information about other usages of
the same resource by other users.</documentation>
   </annotation>
   <sequence>
```

```
      <element ref="rd:Resource"/>
      <element name="UsageInformation" type="ud:UserDescriptionType" minOccurs="0"
maxOccurs="unbounded"/>
      <element ref="rd:Role" minOccurs="0"/>
   </sequence>
   <attribute name="resourceID" type="anyURI" use="required"/>
</complexType>
<element name="Role">
   <complexType mixed="true">
      <attribute name="roleType" type="anyURI" use="required"/>
   </complexType>
</element>
```

8.8.2 Semantics

Name	*Definition*
`resourceUsageType`	This complex type models the usage of a generic resource as a combination of a resource description and of information about other usages of the same resource by other users.
`UsageInformation`	Information about which user used the recommended resource.
`Role`	The role of the resource in the usage.
`resourceID`	The ID of the resource.
`roleType`	An URI specifying a role.

8.9 clusteringType

A recommendation engine can provide results in clusters, i.e. in groups of mutually affine resources. This abstract complex type specifies the structure of all clustering results used in a recommendation description by a recommendation engine.

8.9.1 Syntax

```
<complexType name="clusteringType" abstract="true">
   <annotation>
      <documentation>This is the abstract type for all clustering
structures.</documentation>
   </annotation>
   <sequence>
      <element name="ClusterStructure" type="rd:clusterStructureType"/>
      <element name="ClusteringParameters" type="anyType">
         <annotation>
            <documentation>Thisl element carries information specific to each
particular clustering technique.</documentation>
         </annotation>
      </element>
   </sequence>
   <attribute name="clusteringLabel" type="anyURI" use="required">
      <annotation>
         <documentation>This label identifies the clustering algorithm that produced
this clustering.</documentation>
      </annotation>
```

```
   </attribute>
   <attribute name="proximityFunction" type="anyURI" use="optional">
      <annotation>
         <documentation>This attribute identifies the proximity function adopted
inside the clustering algorithm when this can be parametrised. For example if the
clustering algorithm is "K-means", then an euclidean distance can be used or a
generalised Minkowski distance of some order.</documentation>
      </annotation>
   </attribute>
   <attribute name="features" type="NMTOKENS" use="optional">
      <annotation>
         <documentation>This attribute specifies which features of the multimedia
item have been used to cluster. This is in form of a list of elements identifier,
complex types identifier or other kind of resource identifiers that univoquely
identify a certain feature and its extraction mechanism.</documentation>
      </annotation>
   </attribute>
</complexType>
```

8.9.2 Semantics

Name	*Definition*
clusteringType	Describes the recommended equalizer
ClusterStructure	Describes the recommended level of loudness, where the level is an integer value ranging from 0 to 100
ClusteringParameters	Describes the types of warnings that can be recommended to the user
clusteringLabel	Describes the statistical information that can be used for recommending
proximityFunction	Describes the recommendation information given to the user
features	This attribute specifies which features of the multimedia item havebeen used to cluster. This is in form of a list of elements identifier, complex types identifier or other kind of resource identifiers that univoquely identify a certain feature and its extraction mechanism.

8.10 genericClusteringType

This is the root type for all concrete clustering results of a recommendation engine. This complex type should be used when further information about the type of clustering algorithm is not available.

8.10.1 Syntax

```
<complexType name="genericClusteringType">
   <annotation>
      <documentation>This is the root type for all clustering structures. This
complex type should be used when further information about the type of clustering
algorithm is not available.</documentation>
   </annotation>
   <complexContent>
      <extension base="rd:clusteringType"/>
   </complexContent>
</complexType>
```

8.10.2 Semantics

Name	*Definition*
genericClusteringType	This is the root type for all clustering structures. This complex type should be used when further information about the type of clustering algorithm is not available.

8.11 hierarchicalClusteringType

This is the root type for all hierarchical clustering types. This complex type should be used in XML instances to indicate that the clustering algorithm is hierarchical. The hierarchicalClusteringType attribute identifies the two main families of hierarchical clusterings (bottom up and top down).

8.11.1 Syntax

```
<complexType name="hierarchicalClusteringType">
   <annotation>
      <documentation>This is the root type for all hierarchical clustering types.
This complex type should be used in XML instances to indicate that the clustering
algorithm is hierarchical. The hierarchicalClusteringType attribute identifies
the two main families of hierarchical clusterings (bottom up and top
down)
</documentation>
   </annotation>
   <complexContent>
      <extension base="rd:clusteringType">
         <attribute name="hierarchicalClusteringType">
            <annotation>
               <documentation> This attribute specifies the type of hierarchical
clustering.</documentation>
            </annotation>
            <simpleType>
               <restriction base="string">
                  <enumeration value="bottomUp"/>
                  <enumeration value="topDown"/>
               </restriction>
            </simpleType>
         </attribute>
      </extension>
   </complexContent>
</complexType>
```

8.11.2 Semantics

Name	*Definition*
hierarchicalClusteringType	This is the root type for all hierarchical clustering types. This complex type should be used in XML instances to indicate that the clustering algorithm is hierarchical. The hierarchicalClusteringType attribute identifies the two main families of hierarchical clusterings (bottom up and top down).
hierarchicalClusteringType	This attribute specifies the type of hierarchical clustering.

8.12 SequentialClusteringType

This is the root type for all sequential clustering types. This complex type should be used in XML instances to indicate that the clustering algorithm used for clustering is of sequential type (e.g. BSAS).

8.12.1 Syntax

```
<complexType name="sequentialClusteringType">
   <annotation>
      <documentation>This is the root type for all sequential clustering types.
This complex type should be used in XML instances to indicate that the clustering
algorithm used for clustering is of sequential type (e.g. BSAS). </documentation>
   </annotation>
   <complexContent>
      <extension base="rd:clusteringType"/>
   </complexContent>
</complexType>
```

8.12.2 Semantics

Name	*Definition*
sequentialClusteringType	This is the root type for all sequential clustering types. This complex type should be used in XML instances to indicate that the clustering algorithm used for clustering is of sequential type (e.g. BSAS).

8.13 costFunctionMinimisationClusteringType

This is the root type for all cost function minimisation clustering types. This complex type should be used in XML instances to indicate that the clustering algorithm used for clustering is of this kind (e.g., Kmeans).

8.13.1 Syntax

```
<complexType name="costFunctionMinimisationClusteringType">
   <annotation>
      <documentation>This is the root type for all cost function minimisation
clustering types. This complex type should be used in XML instances to indicate
that the clustering algorithm used for clustering is of this kind (e.g., Kmeans).
</documentation>
   </annotation>
   <complexContent>
      <extension base="rd:clusteringType"/>
   </complexContent>
</complexType>
```

8.13.2 Semantics

Name	*Definition*
costFunctionMinimisatioClusteringType	This is the root type for all cost function minimisation clustering types.This complex type should be used in XML instances to indicate that the clustering algorithm used for clustering is of this kind (e.g. Kmeans).

8.14 clusterStructureType

This complex type represents the core structure of a clustering. It can contain other clusteringstructures, to allow hierarchical clustering representation, or cluster members directly.

8.14.1 Syntax

```
<complexType name="clusterStructureType">
   <annotation>
      <documentation>This complex type represents the core structure of a
clustering. It can contain other structures, to allow hierarchical clustering
representation, or cluster members directly.</documentation>
   </annotation>
   <sequence>
      <element name="Cluster" type="rd:clusterStructureType" minOccurs="0"
maxOccurs="unbounded">
         <annotation>
            <documentation>This element has the function of allowing recursive
structures for clusterings. Especially useful for representing results of
hierarchical clustering.</documentation>
         </annotation>
      </element>
      <element name="ClusterMember" type="rd:setMemberType" minOccurs="0"
maxOccurs="unbounded"/>
      <element name="QualityInformation" minOccurs="0" maxOccurs="unbounded">
         <annotation>
            <documentation>This group of optional elements carry information about
quality metrics of found clusters. Metrics are identified through URIs (e.g.
Davies-Bouldin index)</documentation>
         </annotation>
         <complexType>
            <attribute name="metricID" type="anyURI">
               <annotation>
                  <documentation>An URI identifying a cluster quality
metric.</documentation>
               </annotation>
            </attribute>
            <attribute name="value" type="anySimpleType"/>
         </complexType>
      </element>
   </sequence>
</complexType>
```


8.14.2 Semantics

Name	*Definition*
`clusterStructureType`	This complex type represents the core structure of a clustering. It can contain other structures to allow hierarchical clustering representation or cluster members directly.
`Cluster`	This element has the function of allowing recursive structures for clusterings. Especially useful for representing results of hierarchical clustering.
`ClusterMember`	Represent the member of hierarchical clustering.

Name	*Definition*
`QualityInformation`	This group of optional elements carry information about quality metrics of found clusters. Metrics are identified through URIs (e.g.Davies-Bouldin index).
`metricID`	An URI identifying a cluster quality metric.
`value`	The value of the cluster quality metric.

8.15 genericAggregateType

Recommendation engines can provide their results in aggregates, i.e. several recommended resources can be placed together meaning that they are recommended as a whole set of resources. This abstract complex type is the root abstract type for all aggregations.

8.15.1 Syntax

```
<complexType name="genericAggregateType" abstract="true">
   <annotation>
      <documentation>This is the root abstract type for all
aggregations.</documentation>
   </annotation>
   <attribute name="resourceID" type="ID" use="optional"/>
</complexType>
```

8.15.2 Semantics

Name	*Definition*
`genericAggregateType`	This is the root abstract type for all aggregations.

8.16 setMemberType

This complex type represents a generic element of a set, where a set can be a clusering structure or an aggregate. The element of any set in RD is a combination of a recommendable resource, optional information about users having used the resource, and the role of the resource in the recommendation. This is represented by the complex type `resourceUsageType`.

8.16.1 Syntax

```
<complexType name="setMemberType">
   <annotation>
      <documentation>This complex type represents a generic element of a set.
</documentation>
   </annotation>
   <sequence>
      <element name="SetElement" type="rd:resourceUsageType">
         <annotation>
            <documentation> This element is the actual set member. A set member is
a combination of a declaration of a recommendable resource, of information aboutits
usage by one or more users, and of the role of the resource in the recommendation.</
documentation>
         </annotation>
      </element>
      <element name="MembershipDegree" type="float" minOccurs="0">
         <annotation>
            <documentation>Any element of the set may have a membership degree to
```

```
the set. This is meant to encompass fuzzy set approaches. By default when membership
degree value is not present, it is assumed sharp assignment to the set, which is also
equivalent to a membership degree value set to 1.</documentation>
         </annotation>
      </element>
   </sequence>
</complexType>
```

8.16.2 Semantics

Name	*Definition*
setMemberType	This complex type represents a generic element of a set.
SetElement	This element is the actual set member. A set member is a combination of a declaration of a recommendable resource, of information about its usage by one or more users, and of the role of the resource in the recommendation.
MembershipDegree	Any element of the set may have a membership degree to the set. This is meant to encompass fuzzy set approaches. By default, when membership degree value is not present, it is assumed sharp assignment to the set, which is also equivalent to a membership degree value set to 1.

8.17 orderedSetMemberType

This complex type represents members of ordered sets.

8.17.1 Syntax

```
<complexType name="orderedSetMemberType">
   <annotation>
      <documentation>This complex type represents ordered sets.</documentation>
   </annotation>
   <complexContent>
      <extension base="rd:setMemberType">
         <sequence>
            <element name="Rank">
               <annotation>
                  <documentation>This element represents the rank of the set element in
the ordered set. Order of members in the set is given by order of the members'ranks.</
documentation>
               </annotation>
               <complexType>
                  <simpleContent>
                     <extension base="float">
                        <attribute name="type">
                           <simpleType>
                              <restriction base="string">
                                 <enumeration value="numeric_order"/>
                                 <enumeration value="relevance_score"/>
                              </restriction>
                           </simpleType>
                        </attribute>
                     </extension>
                  </simpleContent>
               </complexType>
            </element>
```

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

8.17.2 Semantics

Name	*Definition*
orderedSetMemberType	This complex type represents ordered sets.
Rank	This element represents the rank of the set element in the ordered set. Order of members in the set is given by order of the members' ranks.
type	Rank information can be of two types indicated by the attribute type: numeric order or relevance score. In the first case the member ranked lower is considered of higher relevance, while in the latter case the member ranked higher is considered of higher importance. In absence of this attribute, default is relevance score.

8.18 genericSetType

This complex type specifies the structure of a generic set of resources as an extension of a generic aggregate.

8.18.1 Syntax

```
<complexType name="genericSetType">
   <annotation>
      <documentation> This complex type specifies the structure of a generic set
of resources as an extension of a generic aggregate.</documentation>
   </annotation>
   <complexContent>
      <extension base="rd:genericAggregateType">
         <sequence>
            <element ref="rd:Member" maxOccurs="unbounded"/>
         </sequence>
         <attribute name="name" type="Name" use="optional"/>
      </extension>
   </complexContent>
</complexType>
```

8.18.2 Semantics

Name	*Definition*
genericSetType	The complex type specifies the structure of a generic set of resources as an extension of a generic aggregate.
name	The name of the set.

8.19 labelledSetType

This complex type represents information about labelled sets. A labelled set is a set with one or more associated labels. A labelled set can be used to represent the output of a classifier in a recommendation.

8.19.1 Syntax

```
<complexType name="labelledSetType">
   <annotation>
      <documentation>This complex type represents information about labelled
sets. A labelled set is a set with one or more associated labels. A labelled set
can be used to represent the output of a classifier in a recommednation.
      </documentation>
   </annotation>
   <complexContent>
      <extension base="rd:genericSetType">
         <sequence>
            <element name="LabellingInfo">
               <annotation>
                  <documentation>An element grouping together all labels of this set.</
documentation>
               </annotation>
               <complexType>
                  <sequence maxOccurs="unbounded">
                     <element name="Label">
                        <complexType>
                           <simpleContent>
                              <extension base="anyURI">
                                 <attribute name="labelName" type="string"/>
                                 <attribute name="labelID" type="anyURI"/>
                                 <attribute name="confidence">
                                    <simpleType>
                                       <restriction base="float">
                                          <minInclusive value="0.0"/>
                                          <maxInclusive value="1.0"/>
                                       </restriction>
                                    </simpleType>
                                 </attribute>
                              </extension>
                           </simpleContent>
                        </complexType>
                     </element>
                  </sequence>
                  <attribute name="labellingScheme" type="anyURI">
                     <annotation>
                        <documentation>Identifies the labelling scheme from which the
Label value is taken</documentation>
                     </annotation>
                  </attribute>
               </complexType>
            </element>
         </sequence>
      </extension>
   </complexContent>
</complexType>
```

8.19.2 Semantics

Name	*Definition*
`labelledSetType`	This complex type represents information about labelled sets. A labelled set is a set with one or more associated labels. A labelled set can be used to represent the output of a classifier.
`LabellingInfo`	An element grouping together all labels of this set.
`Label`	The label element.
`labelName`	The name of the label.
`labelID`	The ID of the label in the labeling scheme.
`confidence`	The confidence level of the assigned label.
`labellingScheme`	Identifies the labelling scheme from which the label value is taken.

8.20 orderedSetType

This complex type represents ordered sets.

8.20.1 Syntax

```
<complexType name="orderedSetType">
   <annotation>
      <documentation>This complex type represents ordered sets. </documentation>
   </annotation>
   <complexContent>
      <restriction base="rd:genericSetType">
         <choice maxOccurs="unbounded">
            <element ref="rd:OrderedMember"/>
         </choice>
         <attribute name="resourceID" type="ID" use="optional"/>
         <attribute name="name" type="Name" use="optional"/>
      </restriction>
   </complexContent>
</complexType>
```

8.20.2 Semantics

Name	*Definition*
`orderedSetType`	This complex type represents ordered sets.
`OrderedMember`	The actual ordered memberof the set.

8.21 equivalenceSetType

Recommendation engines can provide results organized in equivalence sets, i.e. in sets of resources considered equivalent under some recommendation criterion. This complex type represents equivalence sets. The equivalence criterion is expressed by the attribute `equivalenceCriterion`.

8.21.1 Syntax

```
<complexType name="equivalenceSetType">
   <annotation>
      <documentation>This complex type represents equivalence sets. An
equivalence set is a set in which all contained members are equivalent under a
```

```
certain user-defined criterion. The criterion is expressed by the attribute
equivalenceCriterion</documentation>
   </annotation>
   <complexContent>
      <extension base="rd:genericSetType">
         <attribute name="equivalenceCriterion" type="anyURI" use="required">
            <annotation>
               <documentation>This attribute is used to specify the criterion under
which the members of this set are equivalent.</documentation>
            </annotation>
         </attribute>
      </extension>
   </complexContent>
</complexType>
```

8.21.2 Semantics

Name	*Definition*
`equivalenceSetType`	This complex type represents equivalence sets. An equivalence set is a set in which all contained members are equivalent under a certain user-defined criterion. The criterion is expressed by the attribute `equivalenceCriterion`.
`equivalenceCriterion`	This attribute is used to specify the criterion under which the members of this set are equivalent.

8.22 linkageSetType

This particular type of ordered set is used to represent linkage between a source item and a set of target items as an n-ary relation.

8.22.1 Syntax

```
<complexType name="linkageSetType">
   <annotation>
      <documentation>This particular type of ordered set is used to represent
linkage between a source item and a set of target items as an n-ary
relation.</documentation>
   </annotation>
   <complexContent>
      <extension base="rd:orderedSetType">
         <sequence>
            <element name="SourceItem" type="rd:RecommendableResourceType">
               <annotation>
                  <documentation>This represents the source item of the n-ary relation.</
documentation>
               </annotation>
            </element>
         </sequence>
      </extension>
   </complexContent>
</complexType>
```

8.22.2 Semantics

Name	*Definition*
`linkageSetType`	This particular type of ordered set is used to represent linkage between a source item and a set of target items as an n-ary relation.
`SourceItem`	This represents the source item of the n-ary relation.

8.23 Member

Utility element for generic set members.

8.23.1 Syntax

```
<element name="Member" type="rd:setMemberType">
   <annotation>
      <documentation>Utility element for generic set members</documentation>
   </annotation>
</element>
```

8.23.2 Semantics

Name	*Definition*
`Member`	Utility element for generic set members.

8.24 OrderedMember

Utility element for ordered set members.

8.24.1 Syntax

```
<element name="OrderedMember" type="rd:orderedSetMemberType"
substitutionGroup="rd:Member">
   <annotation>
      <documentation>Utility element for ordered set members</documentation>
   </annotation>
</element>
```

8.24.2 Semantics

Name	*Definition*
`OrderedMember`	Utility element for ordered set members.

8.25 queryClauseType

This abstract complex type represents a generic query clause.

8.25.1 Syntax

```
<complexType name="queryClauseType" abstract="true">
   <annotation>
      <documentation>This abstract complex type represents a generic query clause.
 </documentation>
   </annotation>
```

```
   <choice maxOccurs="unbounded">
      <choice>
         <element name="QueryByMedia" maxOccurs="unbounded">
            <complexType>
               <sequence>
                  <element name="ReferenceItem" type="didl:ItemType"/>
                  <element name="QuerySpecification" type="mpqf:QueryType"/>
               </sequence>
            </complexType>
         </element>
         <element name="QueryByAggregate">
            <annotation>
               <documentation>This element is useful to refer to an aggregate as a
query. If for example an equivalence set is referred, the search engine can use
any of the members as the query.
 </documentation>
            </annotation>
            <complexType>
               <choice>
                  <element name="Aggregate" type="rd:genericAggregateType"/>
                  <element name="AggregateRef">
                     <complexType>
                        <attribute name="resourceRef" type="IDREF"/>
                     </complexType>
                  </element>
               </choice>
            </complexType>
         </element>
      </choice>
      <sequence>
         <element name="QueryClause" type="rd:queryClauseType">
            <annotation>
               <documentation>To allow recursive definition of nested
clauses</documentation>
            </annotation>
         </element>
      </sequence>
   </choice>
   <attribute name="logicalValue" type="boolean" use="optional" default="true">
      <annotation>
         <documentation>This attribute specifies if the clause has to be negated
in the query (value=false) or not.</documentation>
      </annotation>
   </attribute>
   <attribute name="queryMetric" use="optional" default="findSimilar">
      <annotation>
         <documentation>This attribute specifies whether the search has to be
executed finding maximally similar or maximally dissimilar items w.r.t. the
query.</documentation>
      </annotation>
      <simpleType>
```

```
         <restriction base="string">
            <enumeration value="findSimilar"/>
            <enumeration value="findDissimilar"/>
         </restriction>
      </simpleType>
   </attribute>
</complexType>
```

8.25.2 Semantics

Name	*Definition*
queryClauseType	This abstract complex type represents a generic query clause.
QueryByMedia	A structure specifying a query by media.
ReferenceItem	The reference media item used for querying by media.
QueryByAggregate	This element is useful to refer to an aggregate as a query. If, for example, an equivalence set is referred, the search engine can use any of the members as the query.
Aggregate	An aggregate used as a reference for the query.
AggregateRef	A pointer to an aggregate used as a reference for the query.
resourceRef	A pointer to the aggregate resource.
QueryClause	To allow recursive definition of nested clauses.
logicalValue	This attribute specifies if the clause has to be negated in the query (value=-false) or not.
queryMetric	The metric used for the query. It can be either “findSimilar” or “findDissimilar”.

8.25.3 Example

This is an abstract complex type. Examples of derived complex types are provided in the appropriate clauses.

8.26 ORqueryClauseType

8.26.1 Syntax

```
<complexType name="ORqueryClauseType">
   <annotation>
      <documentation>This complex type represent an OR query clause. In an OR query
clause all terms of the query are to be taken in OR combination.</documentation>
   </annotation>
   <complexContent>
      <extension base="rd:queryClauseType"/>
   </complexContent>
</complexType>
```

8.26.2 Semantics

Name	*Definition*
ORqueryClauseType	This complex type represents an OR query clause. In an OR query

8.27 ANDqueryClauseType

8.27.1 Syntax

```
<complexType name="ANDqueryClauseType">
   <annotation>
      <documentation>This complex type represent an AND query clause. In an OR query
clause all terms of the query are to be taken in AND combination.</documentation>
   </annotation>
   <complexContent>
      <extension base="rd:queryClauseType"/>
   </complexContent>
</complexType>
```

8.27.2 Semantics

Name	*Definition*
ANDqueryClauseType	This complex type represents an AND query clause. In an OR query clause, all terms of the query are to be taken in AND combination.

8.28 LoudnessControlType

8.28.1 Syntax

```
<complexType name="LoudnessControlType">
   <sequence>
      <element name="RecommendedEqualizer" type="RecommendedEqualizerType"/>
      <element name="RecommendedLevelOfLoudness" type="RecommendedLevelOfLoudness"/>
      <element name=" RecommendedWarning" type="RecommendedWarning"/>
   </sequence>
</complexType>
<complexType name="RecommendedEqualizerType">
   <sequence>
      <element name="Normal" type="boolean" minOccurs="0"/>
      <element name="Classic" type="boolean" minOccurs="0"/>
      <element name="Dance" type="boolean" minOccurs="0"/>
      <element name="Flat" type="boolean" minOccurs="0"/>
      <element name="Folk" type="boolean" minOccurs="0"/>
      <element name="HeavyMetal" type="boolean" minOccurs="0"/>
      <element name="HipHop" type="boolean" minOccurs="0"/>
      <element name="Jazz" type="boolean" minOccurs="0"/>
      <element name="Pop" type="boolean" minOccurs="0"/>
      <element name="Rock" type="boolean" minOccurs="0"/>
      <element name="Latin" type="boolean" minOccurs="0"/>
      <element name="Custom" type="boolean" minOccurs="0"/>
   </sequence>
</complexType>
<complexType name="RecommendedLevelOfLoudness">
   <sequence>
      <element name="Volume" type="integer" minOccurs="0"/>
   </sequence>
</complexType>
```

```
<complexType name="RecommendedWarning">
   <sequence>
      <element name="Text" type="boolean" minOccurs="0"/>
      <element name="Sound" type="boolean" minOccurs="0"/>
      <element name="Vibration" type="boolean" minOccurs="0"/>
      <element name="ForceShutdown" type="boolean" minOccurs="0"/>
   </sequence>
</complexType>
```

8.28.2 Semantics

Name	*Definition*
RecommendedEqualizer	Describes the recommended equalizer
RecommendedLevelOfLoudness	Describes the recommended level of loudness, where the level is an integer value ranging from 0 to 100
RecommendedWarning	Describes the types of warnings that can be recommended to the user (Text, Sound, Vibration, ForceShutdown)

8.29 VisualExpressionType

8.29.1 Syntax

```
<complexType name="RD:VisualExpression">
   <sequence>
      <element name="Statistics" type="Statistics"/>
      <element name="RecommendationInfo" type="RecommendationInfo"/>
   </sequence>
</complexType>
<complexType name ="Statistics">
   <sequence>
      <element name ="UsedFrequency" type="integer" minOccurs="0"/>
      <element name ="RecommendedFrequency" type="integer" minOccurs="0"/>
      <element name ="UserFrequency" type="integer" minOccurs="0"/>
      <element name ="TotalFrequency" type="integer" minOccurs="0"/>
   </sequence>
</complexType>
<complexType name="RecommendationInfo">
   <sequence>
      <element name ="VOType" type="SD:VOType" minOccurs="0"/>
      <element name ="RealtedVOTypes" type="SD:VOType" minOccurs="0"
maxOccurs="Unbounded"/>
      <element name ="Vocabulary" type="string" minOccurs="0"/>
      <element name ="Editation" type="string" minOccurs="0"/>
   </sequence>
</complexType>
```

8.29.2 Semantics

Name	*Definition*
Statistics	Describes the statistical information that can be used for recommendation
RecomendationInfo	Describes the recommendation information given to the user

9 Reference software

9.1 General

This clause provides a specific implementation including MPEG-21 UD encoder, decoder and validator that behaves in a conformant manner. The source code is available at https://standards.iso.org/iso-iec/21000/-22/ed-3/en/.

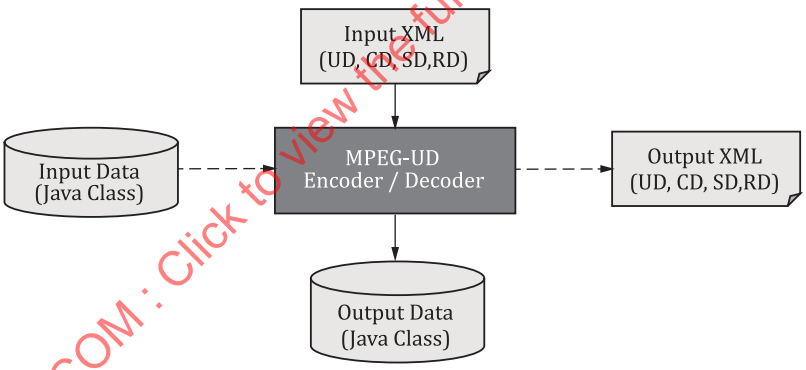
9.2 Development environment

Item	Contents
Memory	8 GB
Development tools	Eclipse® (Mars.1) JAXB (2.2.11)
Development language	Java™ 1.8

Eclipse® is the trademark of a product supplied by the Eclipse® Foundation. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO or IEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

Java™ is the trademark of a product supplied by Oracle®. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO or IEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

9.3 Structure of reference software



Key

encoder

decoder

Figure 3 — MPEG-21 UD reference software

9.4 Reference software classes and method

9.4.1 General

Figure 3 provides a flow diagram of the reference software, which is available at https://standards.iso.org/iso-iec/21000/-22/ed-3/en/.

9.4.2 Encoder

The main functionality of the encoder is to generate a standard MPEG-21 UD XML data to an output stream or a file. The encoder is divided into two types of functions *New* and *Make*.

The *New* function does not need any input parameters and it creates a java instance of requested description type. The return value can be UD, CD, SD and RD class by a new function.

The *Make* function has two input parameters; the first is a type of description instance and the second can be a type of OutputStream and/or File.

— **newUD()** – Create UserDescriptionType JAVA Instance

— **newCD()** – Create ContextDescriptionType JAVA Instance

— **newSD()** – Create ServiceDescriptionType JAVA Instance

— **newRD()** – Create RecommendationDescriptionType JAVA Instance

— **MakeXML(T c, OutputStream/File o)**

  — Parameters

    — c: The c parameter can be one of the following T types:

      UserDescriptionType;

      ContextDescriptionType;

      ServiceDescriptionType;

      RecommendationDescriptionType;

    — o: The o parameter is of the OutputStream type specifying the output stream for the XML data or file type specifying the location where the XML data is to be stored depending on the specified parameter type (OutputStream or File).

9.4.3 Decoder

The main functionality of the decoder is to extract the XML information (e.g., UD, CD, SD and RD). The decoder supports two different parsing methods, one is a URL and the other is a web address.

The first method is to decode UD, CD, SD and RD automatically by a given XML URL. The second method is to decode UD, CD, SD and RD using its own function.

- Decode(String pathToFile)
  - Parameters
    - pathToFile: The pathToFile is of String type and its specifies the location of the XML file to read XML data
  - Return Value: Mpeg-21 UD Class (included UD, CD, SD and RD Instance)
- DecodeUD(String pathToFile)
  - Parameters
    - pathToFile: The pathToFile is of String type and its specifies the location of the XML file to read XML data
  - Return Value: UserDescriptionType Class
- DecodeCD(String pathToFile)
  - Parameters
    - pathToFile: The pathToFile is of String type and its specifies the location of the XML file to read XML data
  - Return Value: ContextDescriptionType Class
- DecodeSD(String pathToFile)
  - Parameters
    - pathToFile: The pathToFile is of String type and its specifies the location of the XML file to read XML data
  - Return Value: ServiceDescriptionType Class
- DecodeRD(String pathToFile)
  - Parameters
    - pathToFile: The pathToFile is of String type and its specifies the location of the XML file to read XML data
  - Return Value: RecommendationDescriptionType Class

9.4.4 Validator

The validator is developed to check the validation of an input document. The validator only has one function: *ValidationCheck*. If the input document is invalid, the validator shows an error message on the display device.

- ValidationCheck(String pathToFile)
  - Parameters
    - pathToFile: The pathToFile is of String type and its specifies the location of the XML file to read XML data
  - Return Value: false(0) if the XML file is valid; otherwise, true(1)

9.5 Example using the encoder

The following example shows how to use the encoder. First, it creates instances like UniqueIDType, DeviceProfileType, DisplayType, UserDescriptionType etc. Second, it sets a value in the generated instances and then it sets UserId and UserProfile. Finally, it creates an XML as OutputStream or File.

```
// TODO: add construction code here,
// Create Instance
UniqueIDType udid = new UniqueIDType();
DeviceProfileType dpt = new DeviceProfileType() ;
DisplaysType displaysType = new DisplaysType() ;
DisplayType displayType = new DisplayType() ;
DisplayCapabilityType dcType = new DisplayCapabilityType () ;
ScreenSize sc = new ScreenSize() ;

// Make MPEG-21 UD Class Instance
UserDescriptionType ud = Encoder.newUD() ;

// Set Values
udid.setValue("udID_001");
sc.setHorizontal(1024);
sc.setVertical(768);
dcType.setScreenSize(sc);
displayType.getDisplayCapability().add(dcType);
displaysType.getDisplay().add(displayType);
dpt.setDevice(displaysType);

//setting the UserID and UserProfile
ud.setUserID(udid);
ud.setUserProfile(dpt);

// Make XML Data
// Case 1 : Output Stream
OutputStream os = System.out;
Encoder.MakeXML(ud, os);

// Case 2 : File
Encoder.MakeXML(ud, new File("testXML.xml"));
```

9.6 Example using the decoder

The following example shows how to use the decoder. The decoder supports two different parsing methods. The first method is to decode automatically a given URL in XML format by using the decode

function. The second method is to decode using a specific decode function corresponding to a specific description type like DecodeUD for UD, DecodeCD for CD, DecodeSD for SD and DecodeRD for RD.

```
MpegUD mud = null ;
// Parsing Xml into Java Class data
// Case 1
mud = Decoder.Decode("sample_rd.xml");

// Case 2
UserDescriptionType ud = Decoder.DecodeUD("sample_ud.xml");
ContextDescriptionType cd = Decoder.DecodeCD("sample_cd.xml");
ServiceDescriptionType sd = Decoder.DecodeSD("sample_sd.xml");
RecommendationDescriptionType rd = Decoder.DecodeRD("sample_rd.xml");

// TODO: add construction code here,
if (mud.ud != null) {
    System.out.println("<UserID>");
    System.out.println("Value : " + mud.ud.getUserID().getValue());
    System.out.println("----------------------------");
}
```

9.7 Example of the validator for reference software

The following example shows how to use the validator for the description. If the return value is false(0), the description, XML document (like UD, CD, SD and RD), is valid. Otherwise, it is invalid.

```
URL url = new URL("sample_rd.xml");

boolean retVal = false;
retVal = Validator.ValidationCheck (url) ;

if (!retVal) {
    System.out.println("Document Valid!!");
}
```


10 Implementation guidelines

This clause contains six example applications to help with the implementation of this document.

10.1 Application 1: Remote Responsive User Interface

10.1.1 General

The Remote Responsive User Interface (RRUI), see Figure 4, is to provide suitable UI according to the user information. When the user connects to this service, the RRUI service engine requests information about the user to the RD engine (recommendation engine), which is located both in and out of the

application. The RD engine collects the information and produces RD to help make the best UI with the context manager. This information can consist of UD, CD, and SD. The UD can include a variety of the user's information, such as a basic profile information (birth, gender, etc.) and preference. The CD can include user environment contexts, such as a connected device information and weather. The SD can include marketing and service strategy from a service provider point. The RD engine creates the RD using collected UD, CD and SD. The RD can include the user type/pattern information that help make a more suitable user interface, UD and CD. And then, it sends RD to the RRUI engine. This RRUI engine can create a suitable UI based on RD and send it to the user.

Various user contexts for each user can be aggregated from many context providers, such as agents of device (GPS sensor, illumination sensor) and many service providers (such as Social Network Services provider, portal service provider). However most context providers produce user information based on their individual format. For this reason, it is difficult to aggregate and reuse information directly for a specific application.

To provide a more intelligent service considering both the user environment and the intention of the service provider, user information and service information from many sources should be used easily by an application. For this reason, the contexts for the user and service provider requires standardization to be used commonly by most applications which can't get information directly.

10.1.2 Workflow

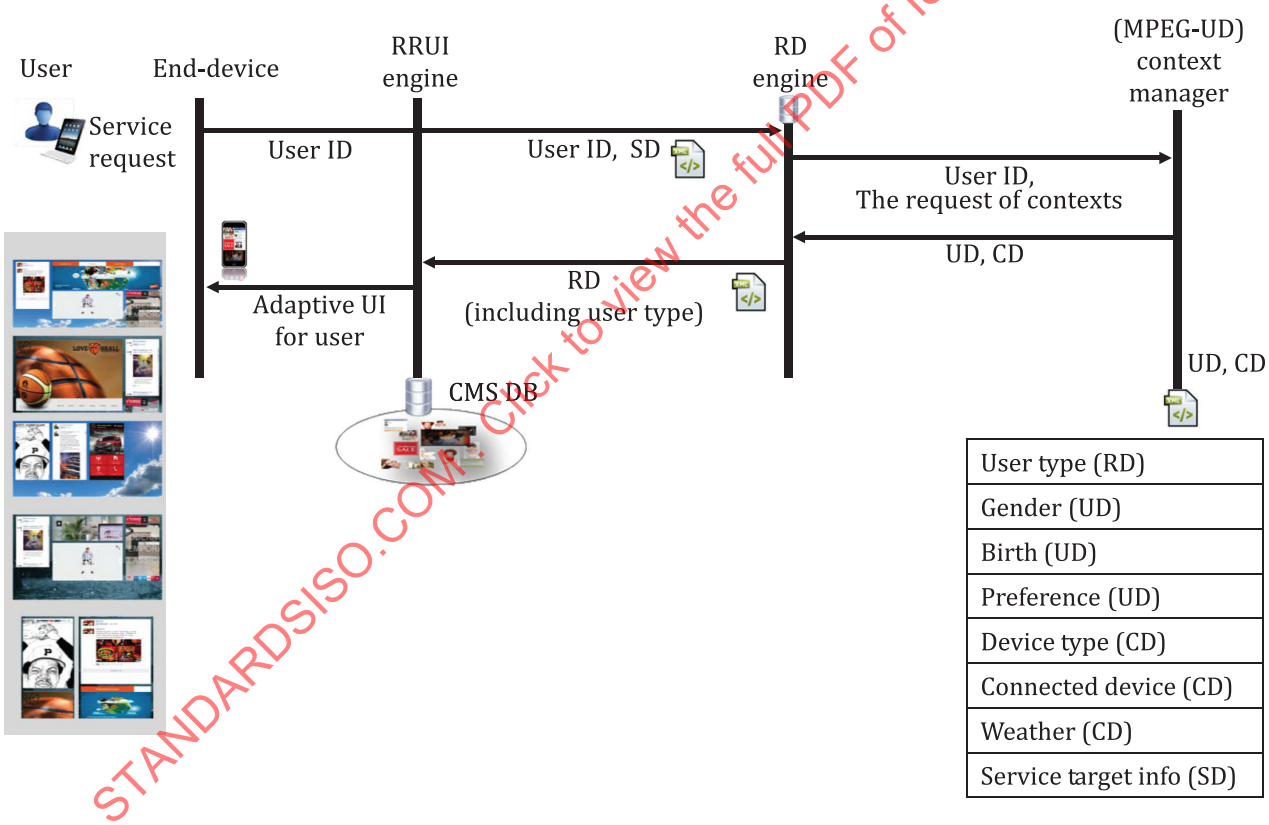


Figure 4 — RRUI service flow

Step 1 The user connects the RRUI application through his/her client device.

Step 2 RRUI Engine sends user ID and SD to the RD Engine.

Step 3 The RD Engine collects the information (UD/CD from context manager, SD from RRUI engine) to produce RD.

Step 4 The RD Engine creates RD using UD/CD/SD and sends them to the RRUI Engine.

Step 5 The RRUI engine creates a suitable UI instance based on the RD in real time with using CMS, and sends it to the application.

Step 6 The user receives a suitable UI from the RRUI engine.

10.1.3 Validation

10.1.3.1 MPEG-21-UD elements

— Used UD elements: UserID, UserProfile, Preference;

— Used CD elements: UserID, DeviceCharacteristics, Weather;

— Used SD elements: ServiceTargetInformation;

— Used RD elements: ServiceUserType.

10.1.3.2 Experimental results

Suppose some people are attending a conference and one of them tries to find a restroom in the venue. In this case, the place where the person needs to go depends on gender. Showing place suggestions to user after examining his/her gender is easier to comprehend rather than showing all restrooms in the building. For this reason, the RRUI system provides a customized service for different users with a different interface.

First, the RRUI system checks contexts from a specific agent providing UD. UD includes information about the user. For this scenario, SD has information about “ServiceTargetModel”, and there are two factors deciding it. The first one is whether user is an attendee or not, and the second one is the gender of user. The RD engine can figure out “ServiceUserType” using information in UD and analysing the rule in SD (ServiceTargetModel). The RRUI service can finally make a responsive user interface based on “ServiceUserType” in RD. The application scenario is as in Figure 5.

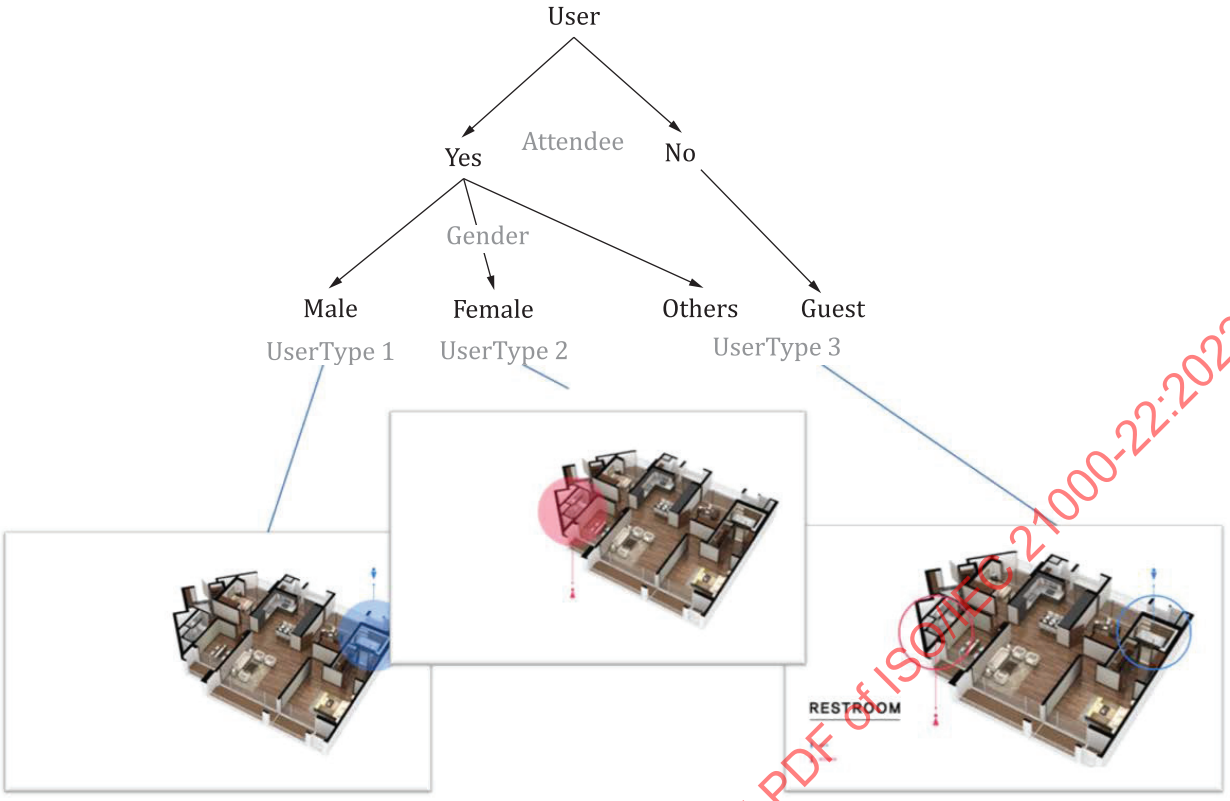


Figure 5 — Example of ServiceUserType

If a user(ID: user_001) who is an attendee and a female that wants to know information about restroom, RD engine decides the ServiceUserType (UserType2) of the user according to the rule (Figure 5) described in SD of RRUI service. And RRUI application sends a responsive user interface (Figure 6) to the user_001.

Figure 6 — Final user interface for User_001

This example application can consider another use case, such as various user interfaces for an application launcher, as shown in Figure 7.

Key

1 PAD
2 PC
3 smart tv launcher
a User A.
b User B.

Figure 7 — Various user interfaces for launcher (another use case)

10.2 Application 2: Lossless audio service

10.2.1 General

The specific method to describe the lossless audio of users should be considered.

— The contents provider requests the accessibility profile of the user who is in need of lossless audio service to the mobile audio player or smartphone or Web.

— The database system of lossless audio is very important in terms of how to classify that audio information, such as author, title, and genre.

— Most smartphone manufacturers launch new handsets capable of surfing the Internet using Wi-Fi wireless and 4G technology. If a user does not use a classified database system, when a user needs to find a favourite audio file, the user will waste time searching through unnecessary files.

— The personal contents provider makes lossless audios, using the user description and various authoring tools.

10.2.2 Workflow

A simple service of lossless audio contents with some of UD, CD and SD of lossless audio and elements enabled is presented.

10.2.3 Validation

10.2.3.1 MPEG-21-UD elements

— **Used UD elements:** UserID, UserProfile,UsageHistory, Preference, Emotion, Schedule, Activity, Intension, Preference, AudioPresentationPreferences LosslessAudioPresentationPreference, GeneralAudioPreferencesType, CreationInfo, LosslessAudioFormat, LossyAudioFormat, AudioFileSize, AudioMusicPreference;

— **Used CD elements:** ContextIdentification, ValidTimeDuration, Season, DeviceCharacteristics, NetworkInfo, Weather, OtherEnvironmentalInfo, Priority, LosslessAudioEnvironment, AuthorOfCreating, AuthoringTool, AuthoringAlgorithm;

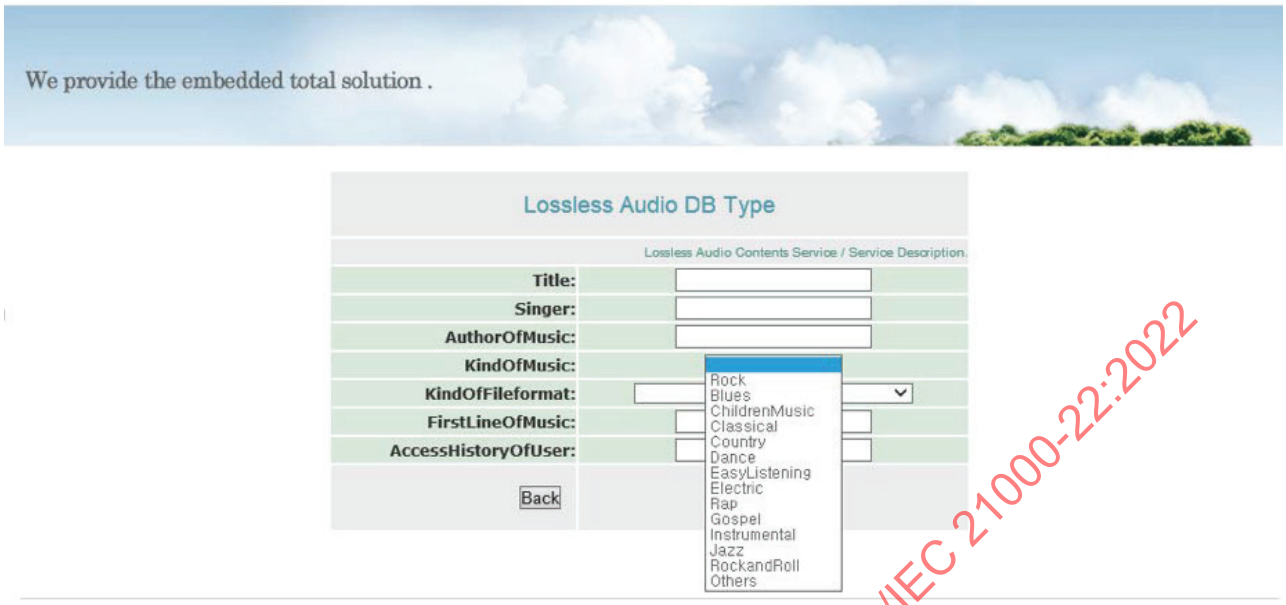
— **Used SD elements:** ServiceID, ServiceGeneralInformation, ServiceTargetInformation, ServiceInterfaces, InternalServices, Priority, IsServiceAvailable, ServiceObjectInfomation, DatabaseOfMultimedia, LosslessAudioDBType, LossyAudioDBType, VideoDBType, Title, Singer, AuthorOfMusic, KindOfMusic, KindOfFileformat, FirstLineOfMusic, AccessHistoryOfUser, NetworkOfUser.

10.2.3.2 Experimental results

The user's descriptions of lossless audio contents are present in a webpage. Each elements of UD, CD and SD are classified as subpages. The database system of UD, CD and SD for lossless audio is composed of gathering information by portal site, as shown in Figures 8 and 9.

NOTE This illustration corresponds to a software implementation with only an English interface.

Figure 8 — Main page of lossless audio contents service



NOTE This illustration corresponds to a software implementation with only an English interface.

Figure 9 — SD page of lossless audio contents service

10.3 Application 3: Visual communication system

10.3.1 General

Visual objects can be used not only for visual communication messenger, but also in various Social Network Services (SNS). Since these are used in mobile environments, the importance of UI to be more accessible to the visual objects increases. In this context, a recommendation service for visual objects that may be used plays an important role. There are many different recommendation services developed for different purposes, and these recommendation services can be used in different services such as SNS, messenger, etc. With MPEG-21 UD, these recommendation services can serve the user for their different needs (see Figure 10).

A simple scenario demonstrating a program of recommending visual objects (VOs) with respect to a given VO specified by the user in UD is presented in 10.3.

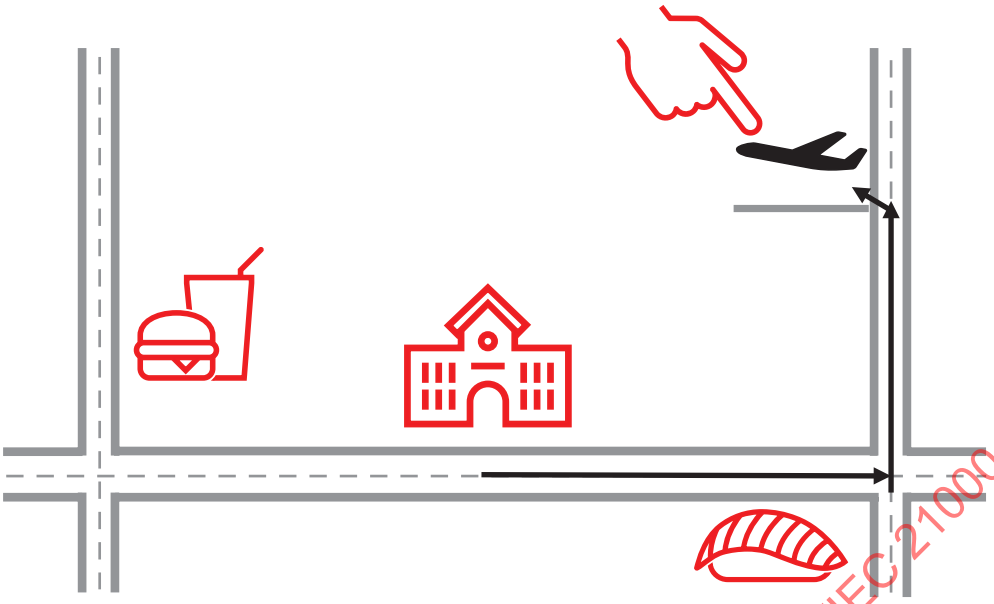


Figure 10 — Conceptual model of visual communications

10.3.2 Workflow

Step 1 A user requests for visual objects associated to restaurants in the visual communication (VC) application. A restaurant is also given in the form of visual objects. This request is described in UD through the VC application.

Step 2 As a list of visual objects associated to restaurants, the VC service provider transfers visual objects related to the user's intention to the recommendation engine.

Visual objects can include information about activity and URI to generate suitable recommendation services in the recommendation engine.

Step 3 From UD, the recommendation engine takes the user service preference information.

Step 4 From CD, the recommendation engine takes the geographic location information specified by the user.

Step 5 Among the visual objects associated to restaurants given by the VC service provider, the recommendation engine selects those that are in the neighbourhood of the user-specified geographic location in CD with user's preference in UD. The selected ones are described in RD, the output of the recommendation engine.

Step 6 The VC application shows the list of recommendations in RD to the user.

- The user can access the URI of recommended visual objects to get more detailed information of a recommended service.
- Visual object can be displayed on the screen of a device according to activity type of visual objects to help users understand.

10.3.3 Validation

10.3.3.1 MPEG-21-UD elements

The elements of UD, CD, SD and RD of ISO/IEC 21000-22 used in the demonstration are as follows.

— UD : UserID, UserProfile, Intention, Preference;

— CD : UserID, DeviceCharacteristics, Location, NetworkInfor;

— SD : ServiceGeneralInformation, ServiceObjectsInformation, ServiceObject, Object;

— RD : RecommendationID, ObjectInformation, RecommendationInformation.

10.3.3.2 Experimental results

Figure 9 shows an implemented VC demonstration program on Eclipse®. When a user's location is changed on the street map, the RD engine recommends restaurants considering the location and service category of the object. The number of restaurants recommended by the RD engine is limited by criteria (see Figure 11).

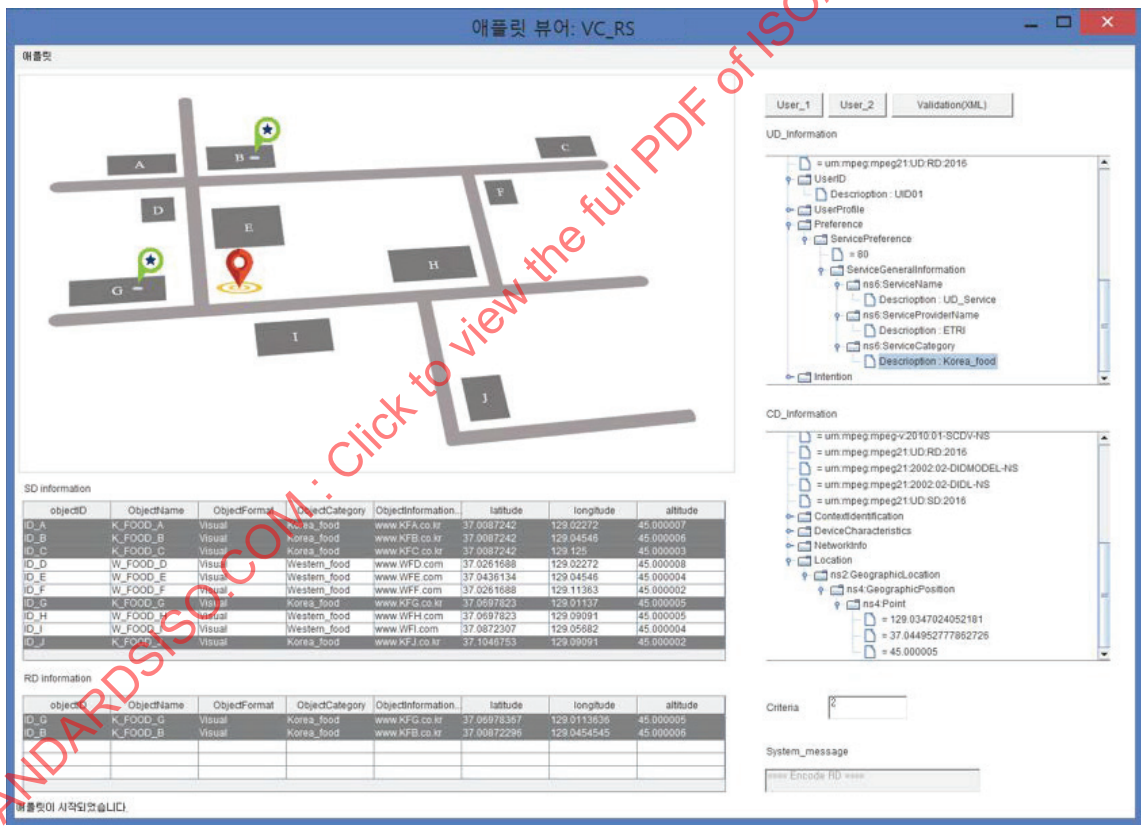


Figure 11 — Visual communication demonstration program

As displayed UD information, the user likes "Korea_food". On the street map, the user stands between "G" and "I". The RD engine of VC demonstration program makes a recommendation considering such a situation.

In the SD information, rows shaded in a grey colour indicate that a record belongs to a category that has the value "Korea_food". The others indicate records corresponding to "Western_food".

In the RD information, records recommended by the RD engine of the VC demonstration program are listed.

Information of UD and CD are mapped to an XML tree. The XML tree for UD displays information of UD1.xml or UD2.xml.

10.4 Application 4: Translation preferences

10.4.1 General

In a language translation system, interoperability between different translation engines is a crucial factor to cover as many languages as possible. UD can be used to facilitate the interoperability in that source languages and target languages described in UD provide information to find a best match automatically among possible translation engines.

In this document, we present a demonstration of the use of the translation preferences, in a multilingual translation application. The translation preference elements describe the user's preferences for translation services, such as voice gender and source/target languages.

Consider a translation application: a free, speech-based multilingual translation for a smart phone. It is initially aimed at dealing with translation in the travel domain and can also be used for general purposes. Currently English, Korean, Chinese and Japanese are the available languages but more languages such as Spanish, German and French are being developed. It is developed for face-to-face translation with short-range wireless technology communication between two users. In this new platform, UD was applied for using translation preferences. The user's preferred source and target languages can be represented in the UD to be referenced as the source/target languages when providing the translation service. In addition, the preference for the gender of the translated voice output can be also represented as one of the translation preference attributes.

10.4.2 Workflow

The workflow of the demo considers a Korean-speaking tourist addressing a Spanish-speaking tourist in the following steps (see Figure 12):

Step 1 In the Korean-speaking tourist's UD, the preferred source languages are Korean, English and Chinese. The preferred target languages are English, Japanese and Chinese.

Step 2 The Korean-speaking tourist turns on the application and tries to connect to the Spanish-speaking tourist for the translation service.

Step 3 No Spanish translation service is available. However, Spanish-speaking tourist's second preferred source language is English. The application recommends Korean-English translation and chooses the relevant translation engine. (This is the RD part.)

Step 4 The translation service starts and the translated output is in a woman's voice since the Korean-speaking tourist set the preferred voice gender as female.

Step 5 The Korean-speaking tourist can find the metro station with the help of the Spanish-speaking tourist.

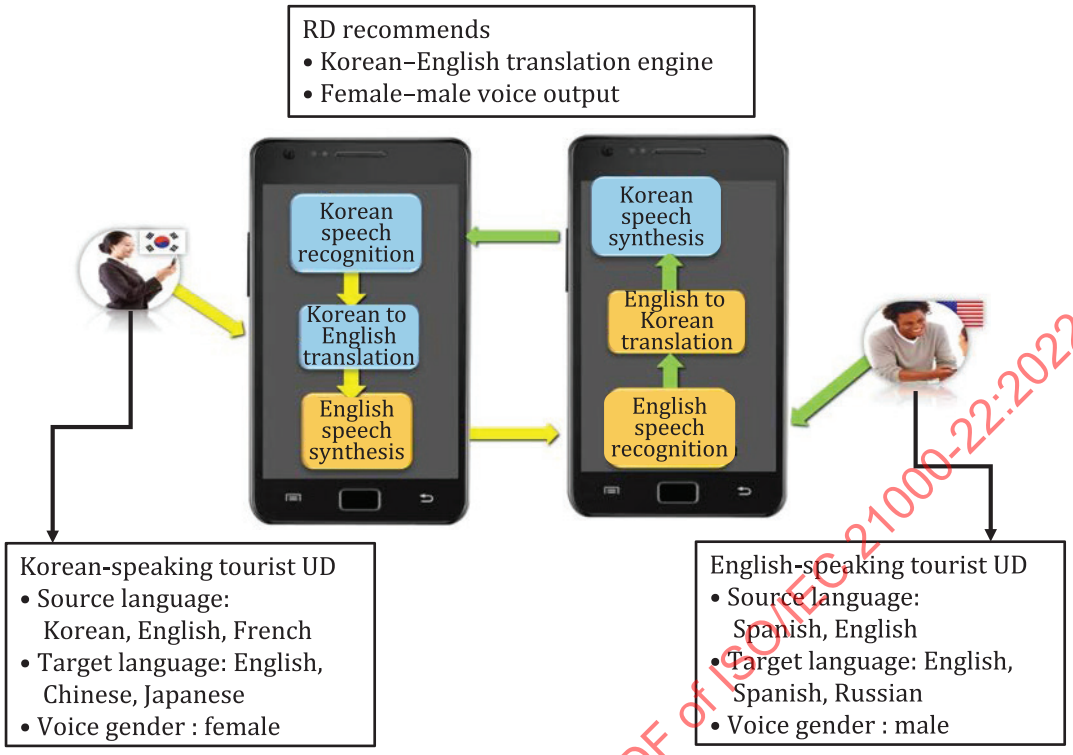


Figure 12 — Using the app where the two users have language preferences

10.4.3 Validation

10.4.3.1 MPEG-21-UD elements

The elements of UD and RD of ISO/IEC 21000-22 used in the demonstration are as follows.

— UD: TranslationPreference, SourceLanguagePreference, TargetLanguagePreference, VoiceGenderPreference;

— RD: RecommendationInformation.

10.4.3.2 Experimental results

Using the translation preference elements of UD, the service provider selects the best match for a source language and target languages and the corresponding translation engine is used with a preferred output voice gender, which is in this case is a female voice for Michelle and a male voice for the Spanish man (see Figure 13).

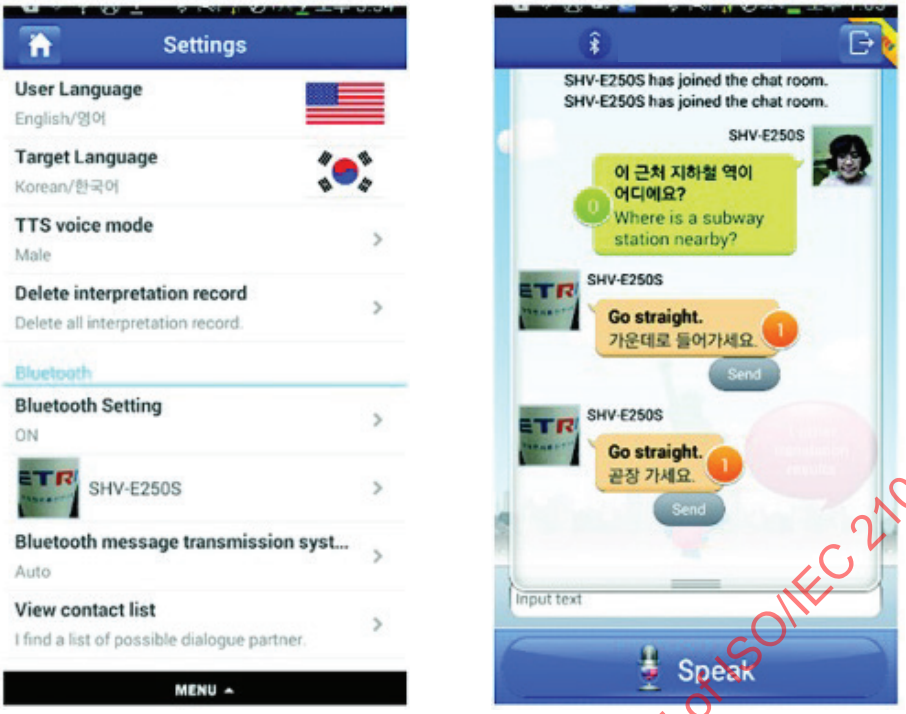


Figure 13 — Example

10.5 Application 5: Recommending multimedia services

10.5.1 General

Considering state-of-the-art technology, providing a huge amount of services and an 'application' of everything is considered a realistic and imminent scenario. Consequently, the problem of a web applications 'jam' can be identified as a consequence. In this scenario, recommending users with contents and services they are actually looking for (thus matching) their needs represents a crucial point. In this situation, MPEG-21 UD plays a strategic role in ensuring interoperability between different applications and services.

This demonstration aims to show how two sample apps, e.g. *App 1* and *2*, could mutually exchange standard descriptions which can be exploited for recommendation actions.

10.5.2 Workflow

A very simple use case has been conceptualized in order to demonstrate the usage of MPEG-21-UD XML schemas: a user, by interacting with the web application *App 2*, receives recommendations from *App 1* about related video contents. The main steps are summarized.

Initially "Some User", whose UD is empty, runs the web application *App 2*. Afterwards he/she enjoys a "multimedia experience" by reading a book about an Italian chronicle and by commenting it.

At this point, according to user policies, *App 1* sends UD information to the App 2 recommendation engine which returns standard recommendation descriptions to the service provider. Such recommendations, described by an "Equivalence Set", contain three "equivalent" members which are recommended to the user.

The user then decides to "watch" one of them ("ID = 100") thus enabling the updating of UD.

According to the policies of the user (who actively and explicitly set them on the UD manager) and of the application (which internally adopt them) additional scenarios are possible. For example, no UD

information is sent to the engine (because of a *null* sharing or a specific *App 1* policy). In this case, a default recommendation RD can still be returned. Such a recommendation provides additional information that the application can use as a filter for a maximized recommendation.

Alternatively, a different engine (not App 1) can recommend to the application a specific query on a known "Service X", described by its SD.

10.5.3 Validation

10.5.3.1 MPEG-21-UD elements used in the demo

— **Used UD elements:** ud:UserID, mpeg7:Name, ud:UsageHistory, ud:DetailedUserInteraction, ud:MultimediaExperiences, ud:MultimediaExperience, ud:States, ud:State, ud:Artefacts, ud:Artefact, ud:Observables, ud:Observable, ud:Role, ud:MultimediaObject, didl:Descriptor, didl:Statement, dii:Identifier;

— **RD elements:** rd:compactUsageDescription, rd:EquivalenceSet, rd:Member, rd:SetElement, rd:Resource, rd:DigitalItem, didl:Descriptor, didl:Statement, dii:Identifier, didl:Component, didl:Resource, rd:List, rd:OrderedMember, rd:Rank, rd:QueryDescription, rd:SearchServiceReference, rd:Query, rd:QueryByAggregate, rd:Aggregate.

10.5.3.2 Experimental results

A conceptual representation of a realistic use case is provided: according to MPEG-21-UD XML schemas, *App 1* and *App 2* applications are made interoperable (see Figure 14).

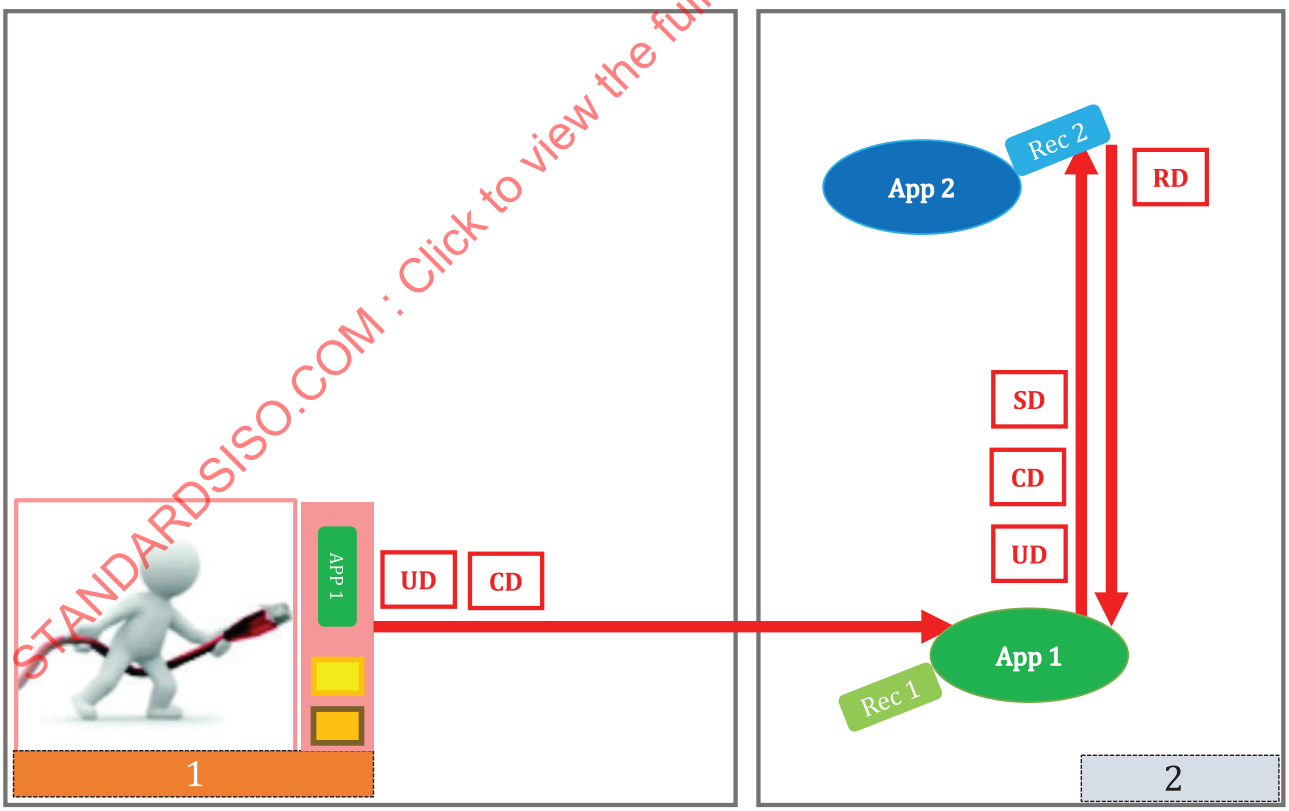


Figure 14 — Conceptual representation of recommending multimedia services

10.6 Application 6: User-centric application personalization in a Cloud

10.6.1 General

This demonstration shows how MPEG-21-UD ensures interoperability between heterogeneous hardware/software configurations involved in legacy applications portability in a Cloud. In this respect, three client terminals (laptop, tablet and smartphone), and three operating systems are considered.

10.6.2 Workflow

The demonstrator is based on two MPEG technologies, namely MPEG-4 BiFS and MPEG-21-UD. In this respect, MPEG-4 BiFS is used for enabling the application virtualization into the cloud, and the MPEG-21-UD schemas are used for describing the users/contexts/services and recommendations when a user accesses the applications. Thus, the user receives a personalized environment according to his/her descriptions (see Figure 15).

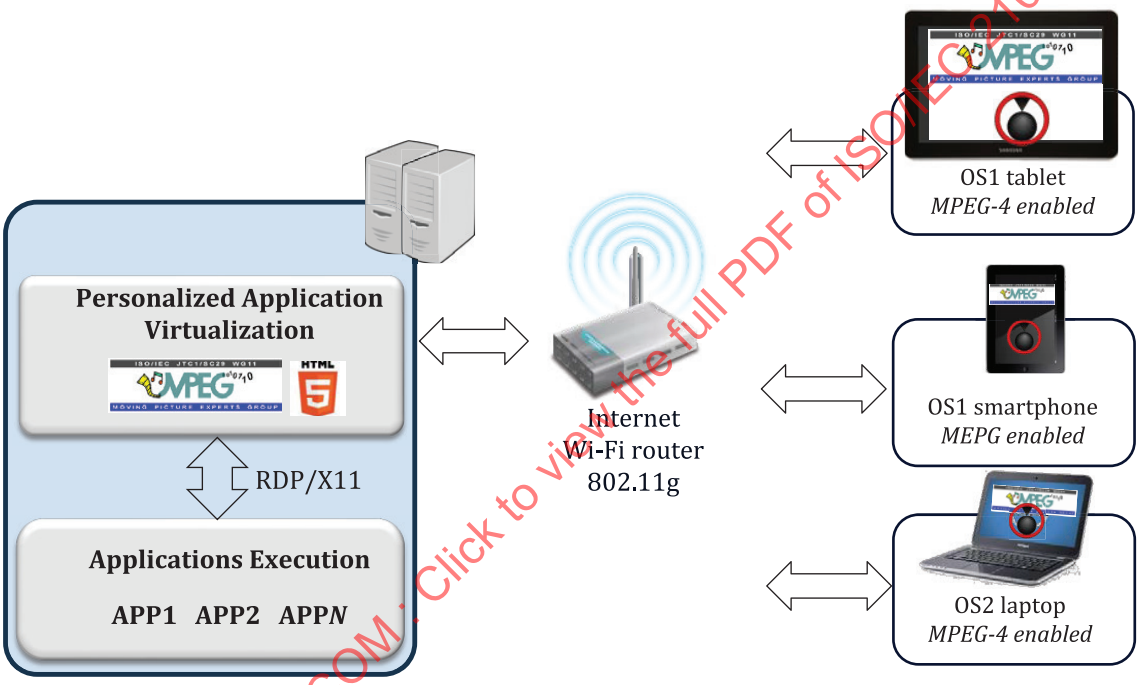


Figure 15 — Demonstrator setup

10.6.3 Validation

10.6.3.1 MPEG-21-UD elements

— **UD elements:** PersonProfileType; GroupedProfileType; AccessibilityType; UsageHistoryType; interactionAtomType; multimediaExperienceType; PreferenceType; ServicePreferencesType; ActivityType; IntentionType;

— **CD elements:** ContextDescriptionType; ContextIdentificationType; DeviceCharacteristicsType; NetworkInfoType; LocationType ;

— **SD elements:** ServiceDescriptionType; ServiceGeneralInformationType; FormatType; ServiceTargetInformationType; ServiceTargetModelType; ServiceInterfacesType; RequiredInputDataTypeType; InternalServicesType;

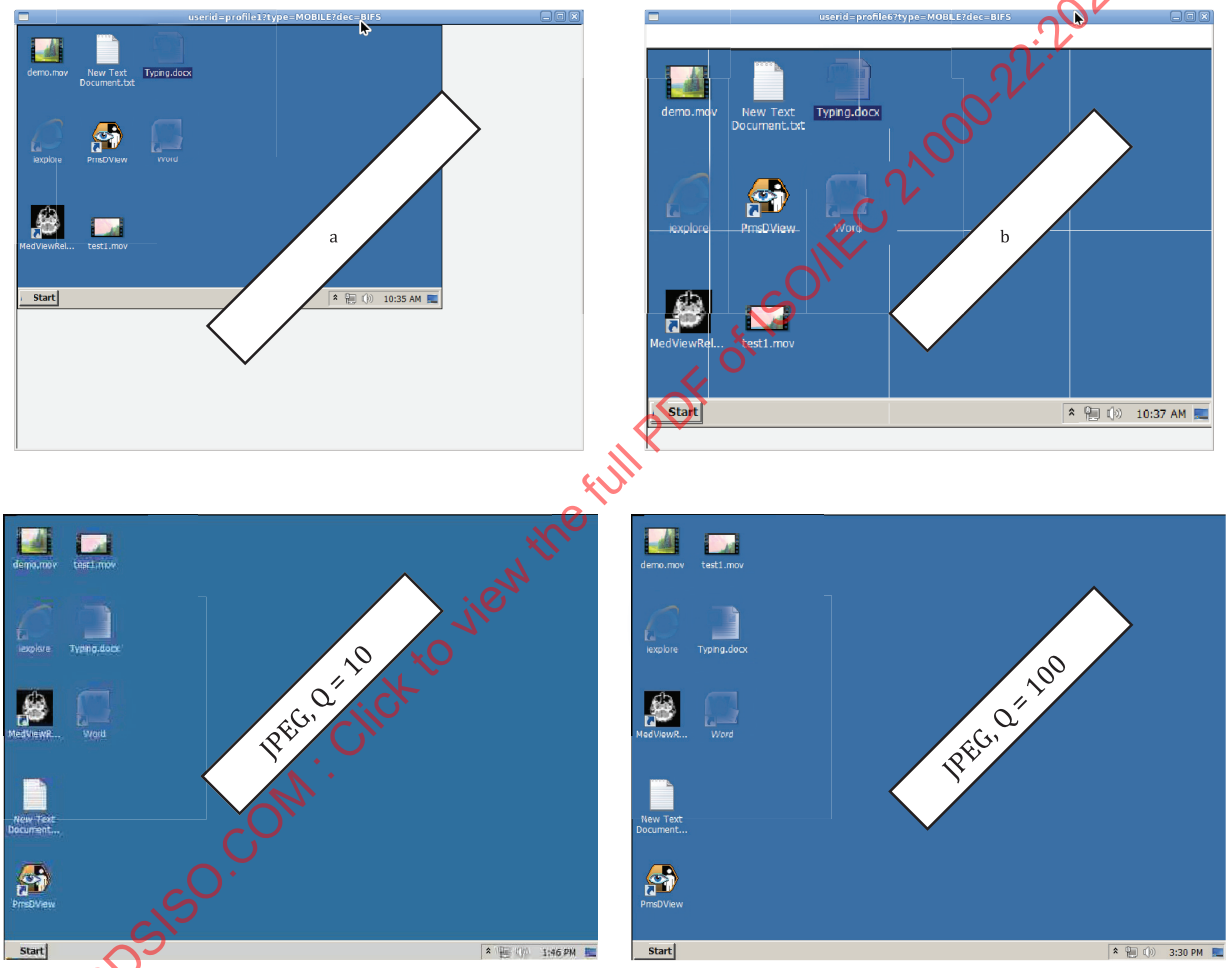
— **RD elements:** recommendationDescriptionType; RecommendationInformationType; RecommendableResourceType ; resourceUsageType ; genericAggregateType ; equivalenceSetType.

10.6.3.2 Experimental results

The main benefits are:

— Increased and enriched user experience, by adapting in real-time the content generated in the cloud, according the user terminal/network/preferences (as illustrated in Figure 16).

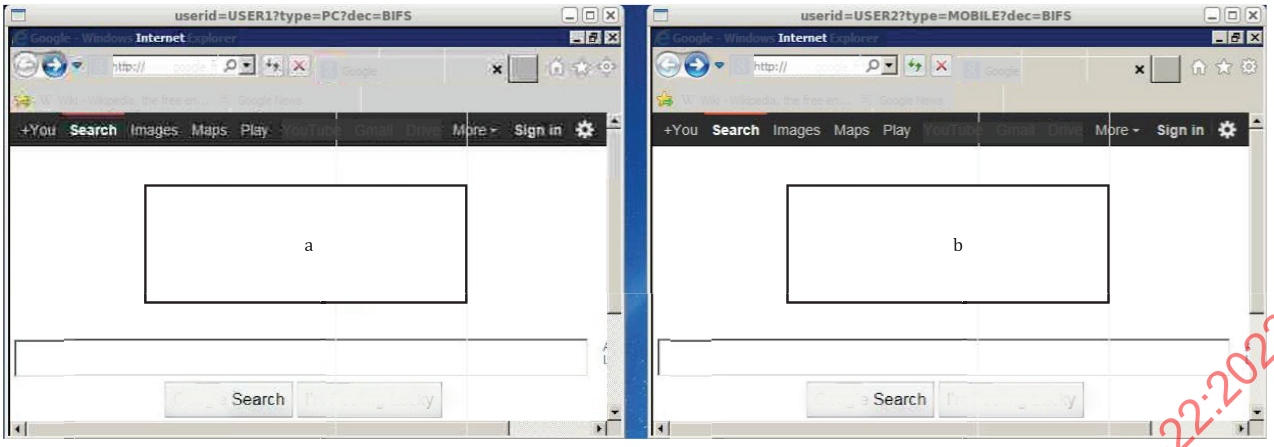
— User centric collaboration functionalities by customizing the collaborative services according the users' role (as illustrated in Figure 17).



a Content is not scaled.

b Content is scaled.

Figure 16 — Adapted content in real-time according the user terminal/network/preferences



a Interaction is disabled by region.

b Full interaction is enabled.

Figure 17 — User centric collaboration functionalities enabling/disabling

Annex A
(Normative)

The MPEG-21 UD technologies are available at https://standards.iso.org/iso-iec/21000/-22/ed-3/en. This attachment includes 5 schemes with the following file names:

— 0.MPEG_21_UD_CT.xsd (General Description)

— 1.MPEG_21_UD_UD.xsd (User Description)

— 2.MPEG_21_UD_CD.xsd (Context Description)

— 3.MPEG_21_UD_SD.xsd (Service Description)

— 4.MPEG_21_UD_RD.xsd (Recommendation Description)

All the schemes are referenced, and for their use, it should be placed in a single folder.

Annex B
(Normative)

Classification Schemes

B.1 General

All of the classification schemes defined in this clause are uniquely identified by a URN starting with the "urn:mpeg:mpeg21:UD:CS:" namespace identifier, followed by the name of the classification scheme and the year of its appearance. The URN " urn:mpeg:mpeg21:UD:CS:UserSpecialtyCS:2016" identifies the classification scheme provided for the user's specialties.

B.2 User specialty CS

XML schema description of the User Specialty is as follows:

```
<ClassificationScheme uri="urn:mpeg:mpeg21:UD:CS:UserSpecialtyCS:2016">
    <Term termID="A">
      <Definition xml:lang="en">Real estate activities</Definition>
      <Term termID="01">
         <Definition xml:lang="en">Crop and animal production, hunting and related
service activities</Definition>
         <Term termID="011"> <Definition xml:lang="en">Growing of non-perennial crops </
Definition></Term>
         <Term termID="0111"> <Definition xml:lang="en"> Growing of cereals (except
rice), leguminous crops and oil seeds</Definition></Term>
         <Term termID="0112"> <Definition xml:lang="en"> Growing of rice</Definition></
Term>
         <Term termID="0113"> <Definition xml:lang="en"> Growing of vegetables and
melons, roots and tubers</Definition></Term>
         <Term termID="0114"> <Definition xml:lang="en"> Growing of sugar cane</
Definition></Term>
         <Term termID="0115"> <Definition xml:lang="en"> Growing of tobacco</
Definition></Term>
         <Term termID="0116"> <Definition xml:lang="en"> Growing of fibre crops </
Definition></Term>
         <Term termID="0119"> <Definition xml:lang="en"> Growing of other non-perennial
crops</Definition></Term>
         <Term termID="012"> <Definition xml:lang="en"> Growing of perennial crops</
Definition></Term>
         <Term termID="0121"> <Definition xml:lang="en"> Growing of grapes</Definition></
Term>
         <Term termID="0122"> <Definition xml:lang="en"> Growing of tropical and
subtropical fruits</Definition></Term>
         <Term termID="0123"> <Definition xml:lang="en"> Growing of citrus fruits</
Definition></Term>
         <Term termID="0124"> <Definition xml:lang="en"> Growing of pome fruits and stone
fruits</Definition></Term>
         <Term termID="0125"> <Definition xml:lang="en"> Growing of other tree and bush
fruits and nuts</Definition></Term>
         <Term termID="0126"> <Definition xml:lang="en"> Growing of oleaginous fruits</
Definition></Term>
```

```
         <Term termID="0127"> <Definition xml:lang="en"> Growing of beverage crops</
Definition></Term>
         <Term termID="0128"> <Definition xml:lang="en"> Growing of spices, aromatic,
drug and pharmaceutical crops</Definition></Term>
         <Term termID="0129"> <Definition xml:lang="en"> Growing of other perennial
crops</Definition></Term>
         <Term termID="013"> <Definition xml:lang="en"> Plant propagation</Definition></
Term>
         <Term termID="014"> <Definition xml:lang="en"> Animal production</Definition></
Term>
         <Term termID="0141"> <Definition xml:lang="en"> Raising of cattle and
buffaloes</Definition></Term>
         <Term termID="0142"> <Definition xml:lang="en"> Raising of horses and other
equines </Definition></Term>
         <Term termID="0143"> <Definition xml:lang="en"> Raising of camels and camelids</
Definition></Term>
         <Term termID="0144"> <Definition xml:lang="en"> Raising of sheep and goats</
Definition></Term>
         <Term termID="0145"> <Definition xml:lang="en"> Raising of swine/pigs</
Definition></Term>
         <Term termID="0146"> <Definition xml:lang="en"> Raising of poultry</
Definition></Term>
         <Term termID="0149"> <Definition xml:lang="en"> Raising of other animals </
Definition></Term>
         <Term termID="015"> <Definition xml:lang="en"> Mixed farming</Definition></Term>
         <Term termID="016"> <Definition xml:lang="en"> Support activities to agriculture
and post-harvest crop activities </Definition></Term>
         <Term termID="0161"> <Definition xml:lang="en"> Support activities for crop
production</Definition></Term>
         <Term termID="0162"> <Definition xml:lang="en"> Support activities for animal
production</Definition></Term>
         <Term termID="0163"> <Definition xml:lang="en"> Post-harvest crop activities</
Definition></Term>
         <Term termID="0164"> <Definition xml:lang="en"> Seed processing for
propagation</Definition></Term>
         <Term termID="017"> <Definition xml:lang="en">Hunting trapping and related
service activities </Definition></Term>
      </Term>
      <Term termID="02"> <Definition xml:lang="en">Forestry and logging</Definition>
         <Term termID="021"> <Definition xml:lang="en">210 Silviculture and other
forestry activities </Definition></Term>
         <Term termID="022"> <Definition xml:lang="en">220 Logging</Definition></Term>
         <Term termID="023"> <Definition xml:lang="en">230 Gathering of non-wood forest
products</Definition></Term>
         <Term termID="024"> <Definition xml:lang="en">240 Support services to forestry
</Definition></Term>
      </Term>
      <Term termID="03"> <Definition xml:lang="en">Fishing and aquaculture</Definition>
         <Term termID="031"> <Definition xml:lang="en">Fishing </Definition></Term>
         <Term termID="0311"> <Definition xml:lang="en">Marine fishing</Definition></
Term>
         <Term termID="0312"> <Definition xml:lang="en">Freshwater fishing</Definition></
Term>
         <Term termID="032"> <Definition xml:lang="en">Aquaculture </Definition></Term>
         <Term termID="0321"> <Definition xml:lang="en">Marine aquaculture</Definition></
Term>
         <Term termID="0322"> <Definition xml:lang="en">Freshwater aquaculture</
Definition></Term>
```

```
      </Term>
   </Term>
    <Term termID="B">
      <Definition xml:lang="en">Mining and quarrying</Definition>
      <Term termID="05"> <Definition xml:lang="en">  Mining of coal and lignite</
Definition>
         <Term termID="051"> <Definition xml:lang="en">510 Mining of hard coal </
Definition></Term>
         <Term termID="052"> <Definition xml:lang="en">520 Mining of lignite</
Definition></Term>
      </Term>
      <Term termID="06"> <Definition xml:lang="en"> Extraction of crude petroleum and
natural gas</Definition>
         <Term termID="061"> <Definition xml:lang="en">610 Extraction of crude petroleum
</Definition></Term>
         <Term termID="062"> <Definition xml:lang="en">620 Extraction of natural gas </
Definition></Term>
      </Term>
      <Term termID="07"> <Definition xml:lang="en"> Mining of metal ores</Definition>
         <Term termID="071"> <Definition xml:lang="en">710 Mining of iron ores </
Definition></Term>
         <Term termID="072"> <Definition xml:lang="en">Mining of non-ferrous metal ores
</Definition></Term>
         <Term termID="0721"> <Definition xml:lang="en">Mining of uranium and thorium
ores</Definition></Term>
         <Term termID="0729"> <Definition xml:lang="en">Mining of other non-ferrous metal
ores</Definition></Term>
      </Term>
      <Term termID="08"> <Definition xml:lang="en"> Other mining and quarrying</
Definition>
         <Term termID="081"> <Definition xml:lang="en">810 Quarrying of stone, sand and
clay </Definition></Term>
         <Term termID="089"> <Definition xml:lang="en">Mining and quarrying n.e.c.</
Definition></Term>
         <Term termID="0891"> <Definition xml:lang="en">Mining of chemical and fertilizer
minerals</Definition></Term>
         <Term termID="0892"> <Definition xml:lang="en">Extraction of peat </
Definition></Term>
         <Term termID="0893"> <Definition xml:lang="en">Extraction of salt </
Definition></Term>
         <Term termID="0899"> <Definition xml:lang="en">Other mining and quarrying n.e.c.
</Definition></Term>
      </Term>
      <Term termID="09"> <Definition xml:lang="en"> Mining support service activities</
Definition>
         <Term termID="091"> <Definition xml:lang="en">910 Support activities for
petroleum and natural gas extraction </Definition></Term>
         <Term termID="099"> <Definition xml:lang="en">990 Support activities for other
mining and quarrying</Definition></Term>
      </Term>
   </Term>
    <Term termID="C">
      <Definition xml:lang="en">Manufacturing</Definition>
      <Term termID="10"> <Definition xml:lang="en"> Manufacture of food products</
Definition>
         <Term termID="101"> <Definition xml:lang="en">1010 Processing and preserving of
meat</Definition></Term>
```

```
         <Term termID="102"> <Definition xml:lang="en">1020 Processing and preserving of
fish, crustaceans and molluscs
         </Definition></Term>
         <Term termID="103"> <Definition xml:lang="en">1030 Processing and preserving of
fruit and vegetables</Definition></Term>
         <Term termID="104"> <Definition xml:lang="en">1040 Manufacture of vegetable and
animal oils and fats </Definition></Term>
         <Term termID="105"> <Definition xml:lang="en">1050 Manufacture of dairy products
</Definition></Term>
         <Term termID="106"> <Definition xml:lang="en">Manufacture of grain mill
products, starches and starch products
         </Definition></Term>
         <Term termID="1061"> <Definition xml:lang="en">Manufacture of grain mill
products </Definition></Term>
         <Term termID="1062"> <Definition xml:lang="en">Manufacture of starches and
starch products</Definition></Term>
         <Term termID="107"> <Definition xml:lang="en">Manufacture of other food products
</Definition></Term>
         <Term termID="1071"> <Definition xml:lang="en">Manufacture of bakery products</
Definition></Term>
         <Term termID="1072"> <Definition xml:lang="en">Manufacture of sugar </
Definition></Term>
         <Term termID="1073"> <Definition xml:lang="en">Manufacture of cocoa, chocolate
and sugar confectionery
         </Definition></Term>
         <Term termID="1074"> <Definition xml:lang="en">Manufacture of macaroni, noodles,
couscous and similar farinaceous products
         </Definition></Term>
         <Term termID="1075"> <Definition xml:lang="en">Manufacture of prepared meals and
dishes</Definition></Term>
         <Term termID="1079"> <Definition xml:lang="en">Manufacture of other food
products n.e.c.</Definition></Term>
         <Term termID="108"> <Definition xml:lang="en">1080 Manufacture of prepared
animal feeds</Definition></Term>
      </Term>
      <Term termID="11"> <Definition xml:lang="en"> Manufacture of beverages</Definition>
         <Term termID="1101"> <Definition xml:lang="en">Distilling, rectifying and
blending of spirits
         </Definition></Term>
         <Term termID="1102"> <Definition xml:lang="en">Manufacture of wines</
Definition></Term>
         <Term termID="1103"> <Definition xml:lang="en">Manufacture of malt liquors and
malt</Definition></Term>
         <Term termID="1104"> <Definition xml:lang="en">Manufacture of soft drinks;
production of mineral waters and other bottled waters
         </Definition></Term>
      </Term>
      <Term termID="12"> <Definition xml:lang="en"> Manufacture of tobacco products</
Definition>
         <Term termID="120"> <Definition xml:lang="en">1200 Manufacture of tobacco
products </Definition></Term>
      </Term>
      <Term termID="13"> <Definition xml:lang="en"> Manufacture of textiles</Definition>
         <Term termID="131"> <Definition xml:lang="en">Spinning, weaving and finishing of
textiles</Definition></Term>
         <Term termID="1311"> <Definition xml:lang="en">Preparation and spinning of
textile fibres</Definition></Term>
```

```
         <Term termID="1312"> <Definition xml:lang="en">Weaving of textiles </
Definition></Term>
         <Term termID="1313"> <Definition xml:lang="en">Finishing of textiles </
Definition></Term>
         <Term termID="139"> <Definition xml:lang="en">Manufacture of other textiles</
Definition></Term>
         <Term termID="1391"> <Definition xml:lang="en">Manufacture of knitted and
crocheted fabrics</Definition></Term>
         <Term termID="1392"> <Definition xml:lang="en">Manufacture of made-up textile
articles, except apparel </Definition></Term>
         <Term termID="1393"> <Definition xml:lang="en">Manufacture of carpets and rugs
</Definition></Term>
         <Term termID="1394"> <Definition xml:lang="en">Manufacture of cordage, rope,
twine and netting </Definition></Term>
         <Term termID="1399"> <Definition xml:lang="en">Manufacture of other textiles
n.e.c. </Definition></Term>
      </Term>
      <Term termID="14"> <Definition xml:lang="en"> Manufacture of wearing apparel </
Definition>
         <Term termID="141"> <Definition xml:lang="en">1410 Manufacture of wearing
apparel, except fur apparel</Definition></Term>
         <Term termID="142"> <Definition xml:lang="en">1420 Manufacture of articles of
fur</Definition></Term>
         <Term termID="143"> <Definition xml:lang="en">1430 Manufacture of knitted and
crocheted apparel </Definition></Term>
      </Term>
      <Term termID="15"> <Definition xml:lang="en"> Manufacture of leather and related
products </Definition>
         <Term termID="151"> <Definition xml:lang="en">Tanning and dressing of leather;
manufacture of luggage, handbags, saddlery and harness; dressing
      and dyeing of fur </Definition></Term>
         <Term termID="1511"> <Definition xml:lang="en">Tanning and dressing of leather;
dressing and dyeing of fur</Definition></Term>
         <Term termID="1512"> <Definition xml:lang="en">Manufacture of luggage, handbags
and the like, saddlery and harness
         </Definition></Term>
         <Term termID="152"> <Definition xml:lang="en">1520 Manufacture of footwear</
Definition></Term>
      </Term>
      <Term termID="16"> <Definition xml:lang="en"> Manufacture of wood and of products
of wood and cork, except furniture;
      </Definition>
         <Term termID="161"> <Definition xml:lang="en">1610 Sawmilling and planing of
wood</Definition></Term>
         <Term termID="162"> <Definition xml:lang="en">Manufacture of products of wood,
cork, straw and plaiting materials
         </Definition></Term>
         <Term termID="1621"> <Definition xml:lang="en">Manufacture of veneer sheets and
wood-based panels </Definition></Term>
         <Term termID="1622"> <Definition xml:lang="en">Manufacture of builders¡¯
carpentry and joinery</Definition></Term>
         <Term termID="1623"> <Definition xml:lang="en">Manufacture of wooden
containers</Definition></Term>
         <Term termID="1629"> <Definition xml:lang="en">Manufacture of other products of
wood; manufacture of articles of cork, straw and plaiting materials
         </Definition></Term>
      </Term>
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      <Term termID="17"> <Definition xml:lang="en"> Manufacture of paper and paper
products </Definition>
         <Term termID="1701"> <Definition xml:lang="en">Manufacture of pulp, paper and
paperboard</Definition></Term>
         <Term termID="1702"> <Definition xml:lang="en">Manufacture of corrugated paper
and paperboard and of containers of paper and paperboard
         </Definition></Term>
         <Term termID="1709"> <Definition xml:lang="en">Manufacture of other articles of
paper and paperboard</Definition></Term>
      </Term>
      <Term termID="18"> <Definition xml:lang="en"> Printing and reproduction of recorded
media </Definition>
         <Term termID="181"> <Definition xml:lang="en">Printing and service activities
related to printing
         </Definition></Term>
         <Term termID="1811"> <Definition xml:lang="en">Printing </Definition></Term>
         <Term termID="1812"> <Definition xml:lang="en">Service activities related to
printing </Definition></Term>
         <Term termID="182"> <Definition xml:lang="en">1820 Reproduction of recorded
media </Definition></Term>
      </Term>
      <Term termID="19"> <Definition xml:lang="en"> Manufacture of coke and refined
petroleum products</Definition>
         <Term termID="191"> <Definition xml:lang="en">1910 Manufacture of coke oven
products</Definition></Term>
         <Term termID="192"> <Definition xml:lang="en">1920 Manufacture of refined
petroleum products</Definition></Term>
      </Term>
      <Term termID="20"> <Definition xml:lang="en"> Manufacture of chemicals and chemical
products </Definition>
         <Term termID="201"> <Definition xml:lang="en">Manufacture of basic chemicals,
fertilizers and nitrogen compounds, plastics and synthetic rubber in primary
      forms</Definition></Term>
         <Term termID="2011"> <Definition xml:lang="en">Manufacture of basic chemicals</
Definition></Term>
         <Term termID="2012"> <Definition xml:lang="en">Manufacture of fertilizers and
nitrogen compounds</Definition></Term>
         <Term termID="2013"> <Definition xml:lang="en">Manufacture of plastics and
synthetic rubber in primary forms
         </Definition></Term>
         <Term termID="202"> <Definition xml:lang="en">Manufacture of other chemical
products </Definition></Term>
         <Term termID="2021"> <Definition xml:lang="en">Manufacture of pesticides and
other agrochemical products
         </Definition></Term>
         <Term termID="2022"> <Definition xml:lang="en">Manufacture of paints, varnishes
and similar coatings, printing ink and mastics
         </Definition></Term>
         <Term termID="2023"> <Definition xml:lang="en">Manufacture of soap and
detergents, cleaning and polishing preparations, perfumes and toilet preparations
         </Definition></Term>
         <Term termID="2029"> <Definition xml:lang="en">Manufacture of other chemical
products n.e.c.</Definition></Term>
         <Term termID="203"> <Definition xml:lang="en">2030 Manufacture of man-made
fibres </Definition></Term>
      </Term>
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