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Information technology — Multimedia framework (MPEG-21) —

Part 22:
User Description

Technologies de l'information — Cadre multimédia (MPEG-21) —

Partie 22: Description de l'utilisateur

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

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

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

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

This second edition cancels and replaces the first edition (ISO/IEC 21000-22:2016), which has been technically revised. It also incorporates the Amendment ISO/IEC 21000-22:2016/Amd. 1:2018.

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

— addition of technologies related to loudness control and visual expression.

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

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

Information technology — Multimedia framework (MPEG-21) —

Part 22:
User description

1 Scope

This document standardizes four data formats: User Description (UD), Context Description (CD), Service Description (SD), and Recommendation Description (RD). This document also specifies technologies related to loudness control and visual expression.

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 terminological databases for use in standardization at the following addresses:

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

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

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 programmes on a smart TV.

3.10
manager
<UD/C/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

Chapters 5, 6, 7, 8 and 9 present the specification of the general description, and of the UD, CD, SD and RD, respectively. Annex A provides the schemes for all these descriptions while Annex B provides related classification schemes.

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.
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

These 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"/>
    </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.

Name	Definition
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 W3C Recommendation XML Schema Part 2[13]. When neither endTime nor duration is defined, the startTime denotes a specific time point.

Name	Definition
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.

Name	Definition
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 (W3C Recommendation XML Schema Part 2[13]) 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.

Name	Definition
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:ClassificationSchemeAliasType" 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"/>
```

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```
                    <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:
VisualExpressionPreferenceType"/>
            </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.

Name	Definition
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.
VisualExpressionPreference	A set of data edited by user's intention/emotion or created by recognizing user's situation/condition.

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:Specia
lty>
</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>
</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.
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>
   </complexType>
      </extension>
   </complexContent>
   <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"/>
                      </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	Describes 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>ServiceProvider</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 name="Time" type="ct:TimeType" minOccurs="0"
maxOccurs="unbounded"/>
            </sequence>
         </complexType>
      </element>
   </sequence>
</complexType>
```

5.8.2 Semantics

Name	Definition
eventType	An abstract representation of a generic real event.

Name	Definition
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 MultimediaExperience. 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.

Name	Definition
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 `MultimediaExperience`. 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 `MultimediaExperience`. 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 (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"?>
<UDxmlns="  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:AudioPresentationPreferencesType" minOccurs="0"/>
            <element name="DisplayPresentationPreferences"
type="mpeg21:DisplayPresentationPreferencesType" minOccurs="0"/>
            <element name="GraphicsPresentationPreferences"
type="mpeg21:GraphicsPresentationPreferencesType" minOccurs="0"/>
            <element name="TextPresentationPreferences"
type="ud:TextPresentationPreferencesType" 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.
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 filtering and search preferences, browsing preferences and recording preferences, 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.

Name	Definition
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.
TargetDisplayDeviceCapability	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.

Name	Definition
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.

Name	Definition
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
ServiceGeneralInform ation	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"/>
</complexType>
    <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>
```

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:GeneralAudioPreferenceType" minOccurs="0"/>
                <element name="AudioPresentationEnvironmentPreference"
type="ud:AudioPresentationEnvironmentPreferenceType" minOccurs="0"/>
            </sequence>
        </extension>
    </complexContent>
</complexType>
```

5.20.2 Semantics

Name	Definition
`GeneralAudioPresentationPreference`	Describes the preference for lossless and lossy audio services.
`AudioPresentationEnvironmentPreference`	Describes more precise information for audio services. The element references `AudioPresentationEnvironmentPreferenceType`.

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`.
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`.

Name	Definition
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 aresult, 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 center 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 20Hz to 20kHz.

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 users 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 100W to 200W, the preferred impedance range for "keti001" is from 6Ω to 8Ω.

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="http://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
SpeechStylePreferenc eType	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 not provided.

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"><complexType>
               <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.

Name	Definition
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).
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, "http://www.w3.org/TR/emotion-voc/xml#big6".

```
<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>
```

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.

Name	Definition
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 (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).

Name	Definition
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 (British English, South Korean, etc.).
LanguageAccent	Specifies the specific accent of the given spoken language (Italian, Jej, etc.).

Name	Definition
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.

Name	Definition
	— 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.
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/
CompetenceTestDate="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:LanguageRegionid="ID1" timeBase="."timeUnit="P"
mediaTimeBase="." mediaTimeUnit="P" xml:lang="en-us">
      <Header  xsi:type="mpeg7:ClassificationSchemeAliasType"  id="ID2"
alias="NMTOKEN" href="http://www.altova.com/"/>
      <Name xml:lang="en-us"  phoneticTranscription="API"
phoneticAlphabet="other">API Transcription</Name>
```

```
        <NameTerm href="http://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="http://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">
        <Pointlongitude="-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>
        <PostingIdentifierxml:lang="en-us"
phoneticTranscription="String"
phoneticAlphabet="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:LanguageAccentid="ID3" timeBase="."timeUnit="P"
mediaTimeBase="." mediaTimeUnit="P" xml:lang="en-us">
      <Header  xsi:type="mpeg7:ClassificationSchemeAliasType"  id="ID4"
alias="NMTOKEN" href="http://www.altova.com/"/>
      <Name xml:lang="en-us"  phoneticTranscription="String"
phoneticAlphabet="ipaSymbol">Bermuda</Name>
      <PlaceDescription xml:lang="en-us" phoneticTranscription="String"
phoneticAlphabet="ipaSymbol">String</PlaceDescription>
      <Role href="http://www.altova.com/">
```

```
            <Name xml:lang="en-us" phoneticTranscription="String"
phoneticAlphabet="ipaNumber" preferred="true">String</Name>
            <Definition xml:lang="en-us" phoneticTranscription="String"
phoneticAlphabet="other">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.
VisualImpairment	Describes the visual impairment of the user. The syntax and semantics of VisualImpairmentType are specified in ISO/IEC 21000-7.

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.
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

This complex type describes knowledge that the user wants to share for recommendation purposes.

5.35.1 Syntax

```xml
<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 Mozart. For example, by exploring one of the `dct:subject` statements (namely the one pointing at the resource `http://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="http://dbpedia.org/ontology/"
xmlns:dct="http://purl.org/dc/terms/"
xmlns:owl="http://www.w3.org/2002/07/owl#"
xmlns:dbp="http://dbpedia.org/property/"
xmlns:foaf="http://xmlns.com/foaf/0.1/"
xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:prov="http://www.w3.org/ns/prov#">
<rdf:Description
rdf:about="http://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="http://schema.org/Person"/>
```

```
    <rdf:type
rdf:resource="http://www.ontologydesignpatterns.org/ont/dul/DUL.owl#Natur
alPerson"/>
    <rdf:type rdf:resource="http://dbpedia.org/ontology/Person"/>
    <rdf:type rdf:resource="http://dbpedia.org/ontology/Agent"/>
    <dbo:deathPlace rdf:resource="http://dbpedia.org/resource/Austria"/>
    <dbo:deathPlace rdf:resource="http://dbpedia.org/resource/Vienna"/>
    <dbo:deathDate
rdf:datatype="http://www.w3.org/2001/XMLSchema#date">1791-12-
05</dbo:deathDate>
    <dbo:birthPlace
rdf:resource="http://dbpedia.org/resource/Salzburg"/>
    <dbo:birthPlace rdf:resource="http://dbpedia.org/resource/Austria"/>
    <dbo:birthDate
rdf:datatype="http://www.w3.org/2001/XMLSchema#date">1756-01-
27</dbo:birthDate>
    <dct:subject
rdf:resource="http://dbpedia.org/resource/Category:Knights_of_the_Golden_
Spur"/>
    <dct:subject
rdf:resource="http://dbpedia.org/resource/Category:German_male_classical_
composers"/>
    <dct:subject
rdf:resource="http://dbpedia.org/resource/Category:German_opera_composers
"/>
    <dct:subject
rdf:resource="http://dbpedia.org/resource/Category:Classical-
period_composers"/>

    <dct:subject
rdf:resource="http://dbpedia.org/resource/Category:Austrian_opera_compose
rs"/>
    <dct:subject
rdf:resource="http://dbpedia.org/resource/Category:Child_classical_musici
ans"/>
    <dct:subject
rdf:resource="http://dbpedia.org/resource/Category:Composers_for_pedal_
piano"/>
    <dct:subject
rdf:resource="http://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 the 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.

Name	Definition
`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 `GeneralDescription`.

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:VisualExpressionEnvironmentType"/>
   </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.
ContextDescriptionTy pe	This data type contains static and dynamic information about the user context.
ClassificationScheme Alias	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 GeneralDescription.
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).
DeviceCharacteristic s	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.
OtherEnvironmentalIn fo	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 GeneralDescription.

Name	Definition
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	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 the 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:SensorDeviceCapabilityListType" 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.
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.

Name	Definition
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 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:IlluminationCharacteristicsType" 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"/>s
        </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.

Name	Definition
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 `GeneralDescription`.

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.
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 GeneralDescription.

Name	Definition
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 `GeneralDescription`.

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"/>
   <sequence>
      <element name="ClassificationSchemeAlias"
type="ct:ClassificationSchemeAliasType" minOccurs="0"
maxOccurs="unbounded"/>
      <element name="ServiceID" type="mpeg7:UniqueIDType"/>
      <element name="ServiceGeneralInformation"
type="sd:ServiceGeneralInformationType"/>
      <element name="ServiceTargetInformation"
type="sd:ServiceTargetInformationType"/>
      <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"/>
   </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.

Name	Definition
`ServiceTargetInforma tion`	Describes the 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.
`LoudnessControlServi ceDescription`	`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.
`VisualExpressionServ iceDescription`	A set of base visual objects for expressing human's emotion, intention, situation and condition.

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:ContextDescriptionType" 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.
PreferredContextDescriptionInformation	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.

7.11.1.1 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:UserActionHistoryType" minOccurs="0"/>
                    <element name="NetworkOfUser"
type="cd:NetworkInfoType"/>
                    <element name="AudioPresentationPreferences"
type="ud:AudioPresentationPreferencesType" 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.

Name	Definition
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:preferenceValueType" 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.

Name	Definition
AudioInfo	Describes the information about the audio quality of the media (loudness, samplerate, bitrate, tempered, tempered loudness).

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.

Name	Definition
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.

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="ClassifficationSchemeAlias"
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:compactUsageDescriptionType"/>
                            <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"/>
   </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).

Name	Definition
`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.

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
RecommendationInform ationType	Describes the recommendation information.
RecommendationCatego ry	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.
RecommendedObjectInf ormation	Describes the object information such as id, name and format which are recommended by recommendation engine.
RecommendationPriori ty	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.

Name	Definition
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>This 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 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.

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
costFunctionMinimisa tioClusteringType	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.
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.

Name	Definition
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.

Name	Definition
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.

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 http://standards.iso.org/iso-iec/21000/-22/ed-2/en/.

9.2 Development environment

Item	Contents
Operating system	Windows 7 Professional 64bit
CPU	Intel Core i5-4570
Memory	8 GB
Development tools	Eclipse (Mars.1) JAXB (2.2.11)
Development language	JAVA 1.8

9.3   Structure of reference software
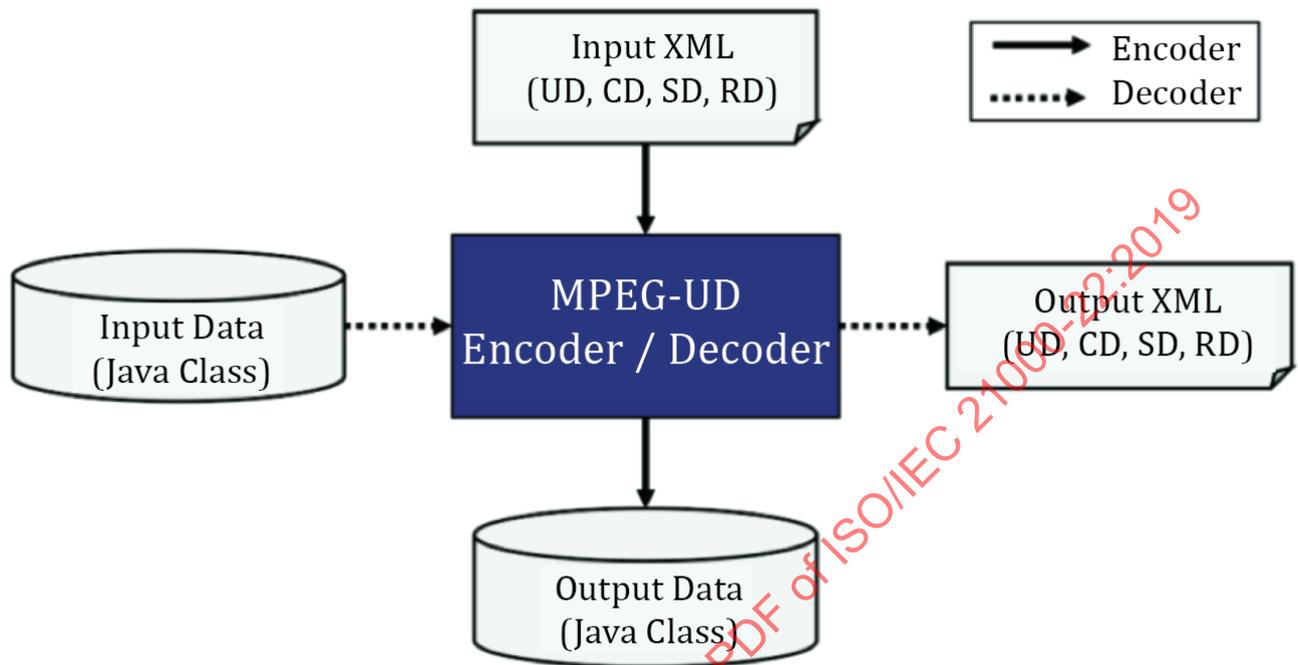
Figure 1 — MPEG-21 UD reference software

9.4   Reference software classes and method

9.4.1   General

Figure 1 provides a flow diagram of the reference software, which is available at http://standards.iso.org/iso-iec/21000/-22/ed-2/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 () ;
```

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```
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 2, provides 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
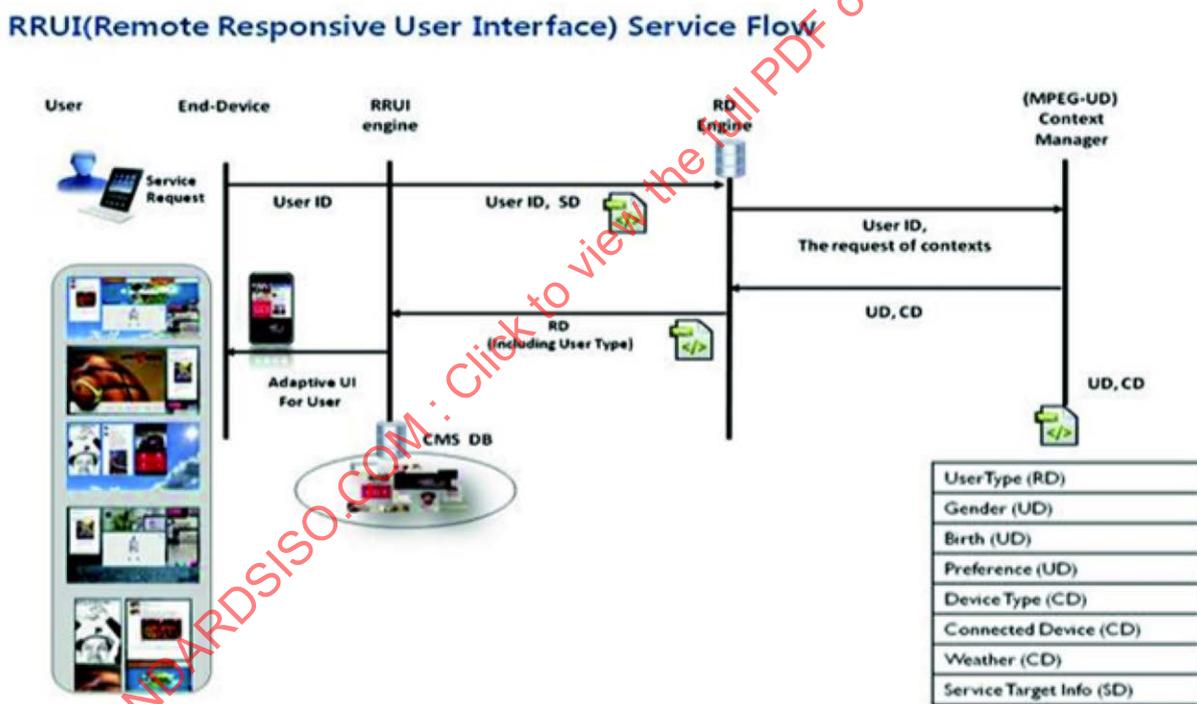
Figure 2 — RRUI service flow

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 3.
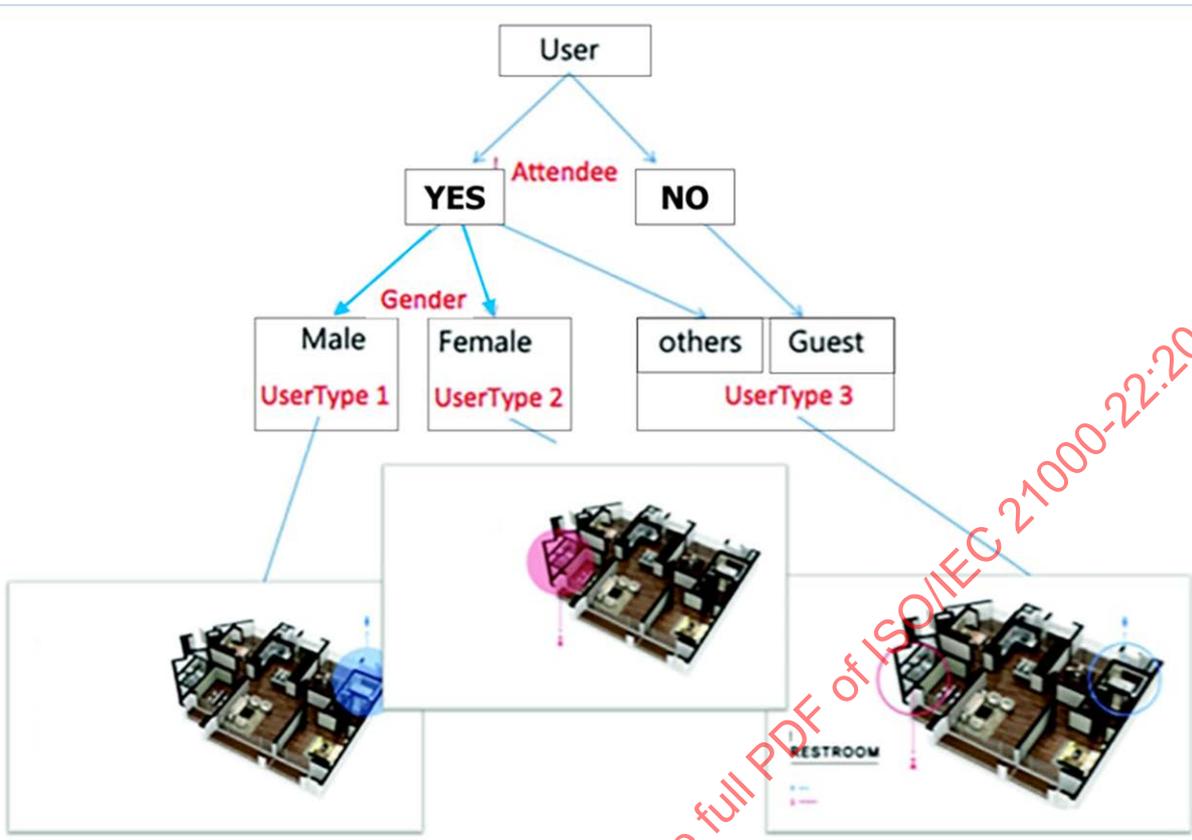
Figure 3 — Example of ServiceUserType

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 3) described in SD of RRUI service. And RRUI application sends a responsive user interface (Figure 4) to the user_001.

Figure 4 — 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 5.

Figure 5 — 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 6 and 7.

Figure 6 — Main page of lossless audio contents service
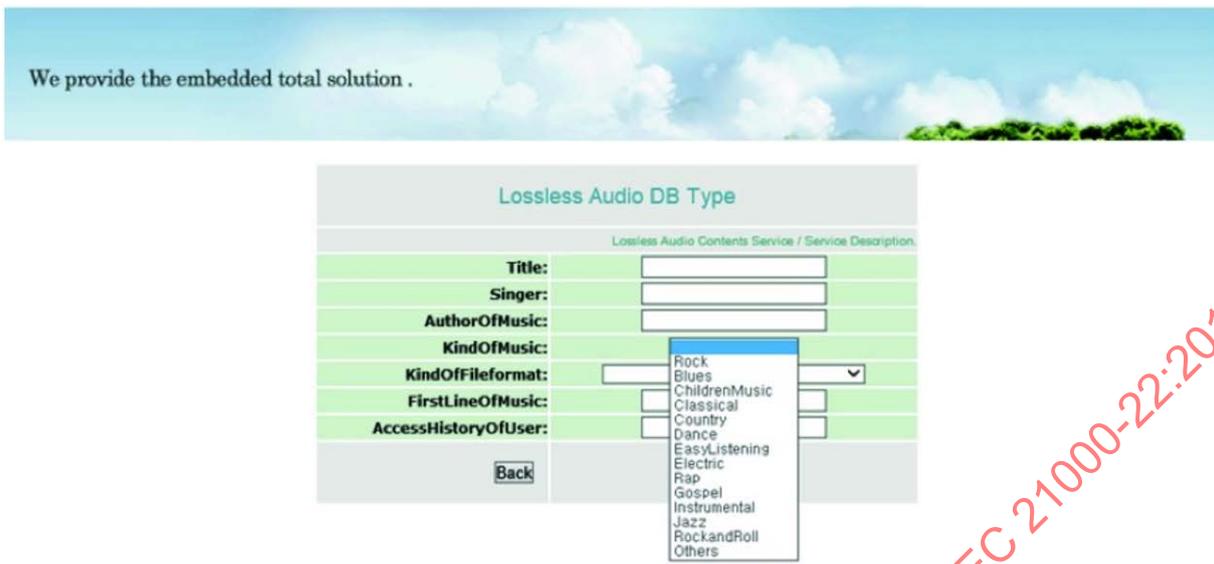
Figure 7 — SD page of lossless audio contents service

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 8).

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.
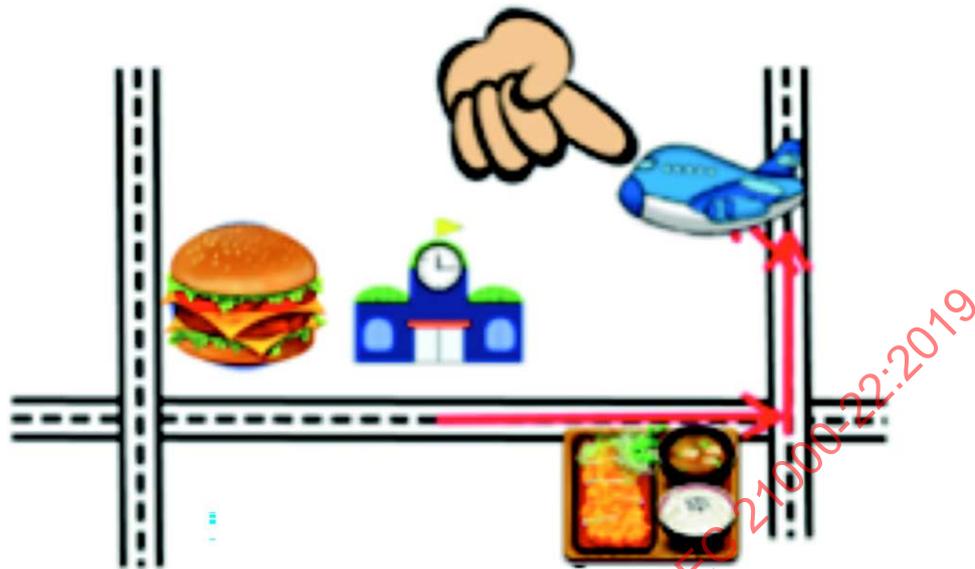
Figure 8 — Conceptual model of visual communications

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 9).

Figure 9 — 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, 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 but can 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 Bluetooth 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 voice 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 Michelle as a Korean tourist addressing a Spanish-speaking person in the following steps (see Figure 10):

Step 1   In Michelle's UD, her preferred source languages are Korean, English and Chinese. The preferred target languages are English, Japanese and Chinese.

Step 2   She turns on the application and tries to connect to the Spanish speaking person for translation service.

Step 3   The man speaks Spanish but no Spanish translation service is available. However, his second preferred source language is English. The app recommends Korean-English translation and chooses the relevant translation engine. (This is the RD part.)

Step 4   The translation service is started and the translated output is in a woman's voice since Michelle set the preferred voice gender as woman.

Step 5   Michelle can find the metro station with the help of the man.

RD recommends
- Korean-English Translation Engine
- Female – Male voice ourput

Michelle's UD
- Source language: Korean, English, French
- Target language: English, Chinese, Japanese
- Voice Gender: female

Man's UD
- Source language: Spanish, English
- Target language: English, Spanish, Russian
- Voice Gender: male
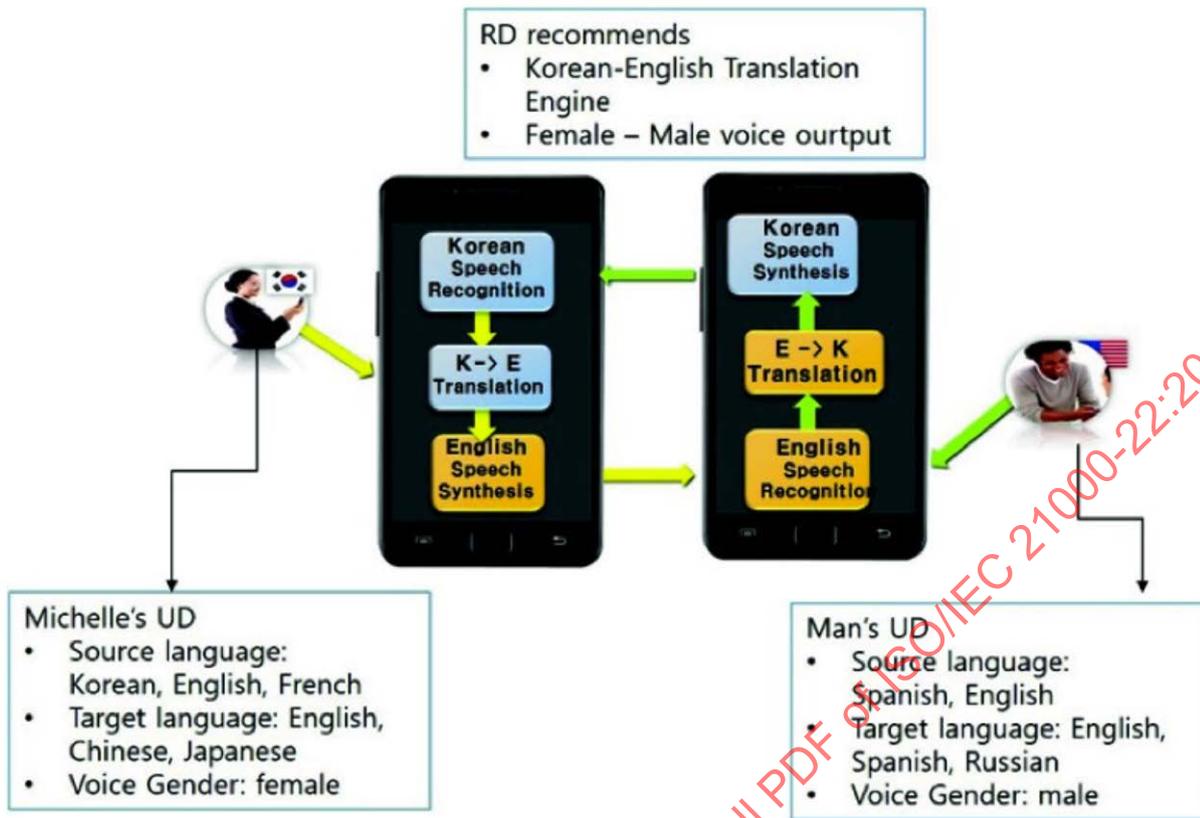
Figure 10 — Using the app where the two users have language preferences

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 11).

Figure 11 — 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 12).
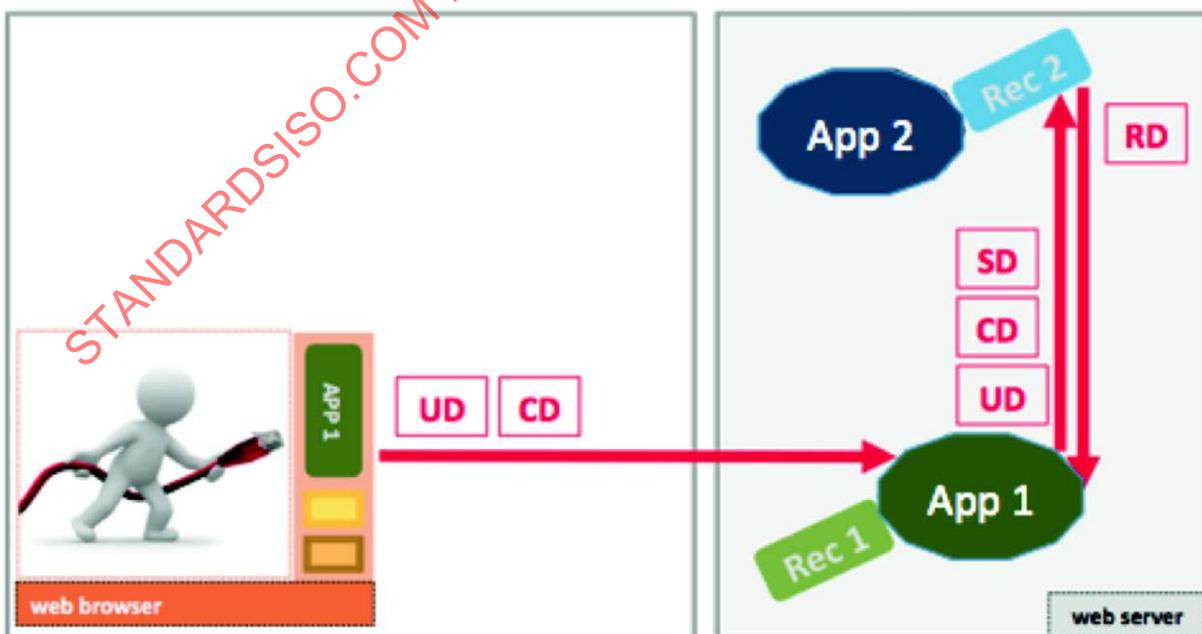

Figure 12 — Conceptual representation of recommending multimedia services

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 13).

Figure 13 — Demonstrator setup

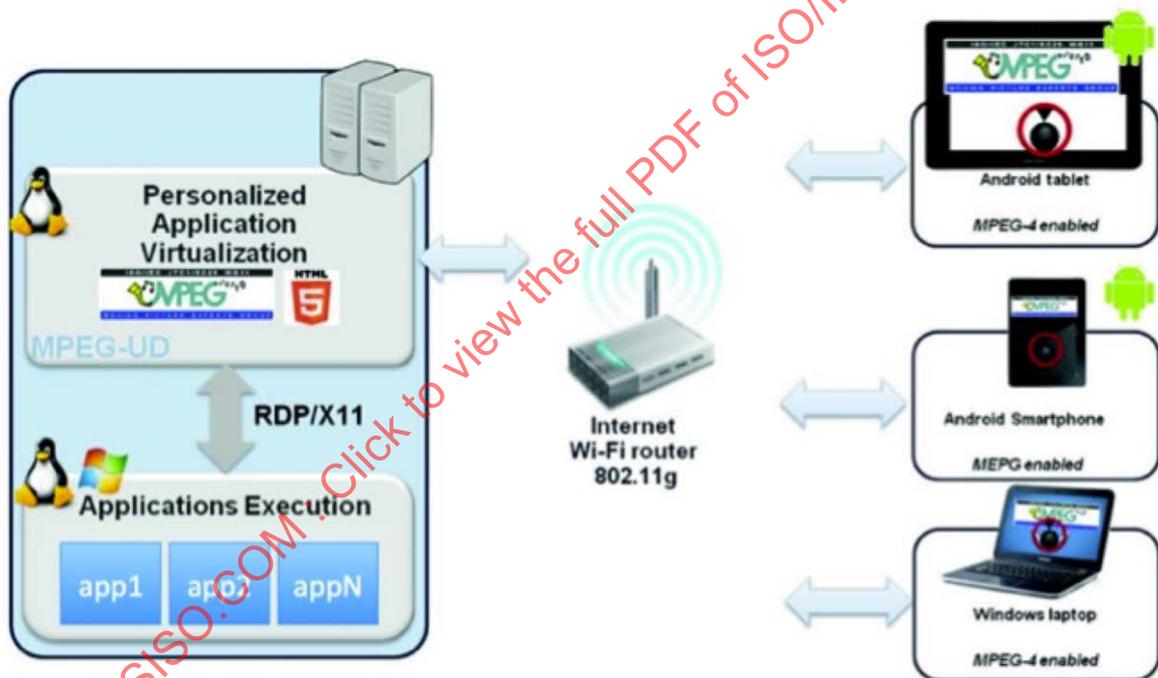### 10.6.3 Validation

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 14).

— User centric collaboration functionalities by customizing the collaborative services according the users' role (as illustrated in Figure 15).
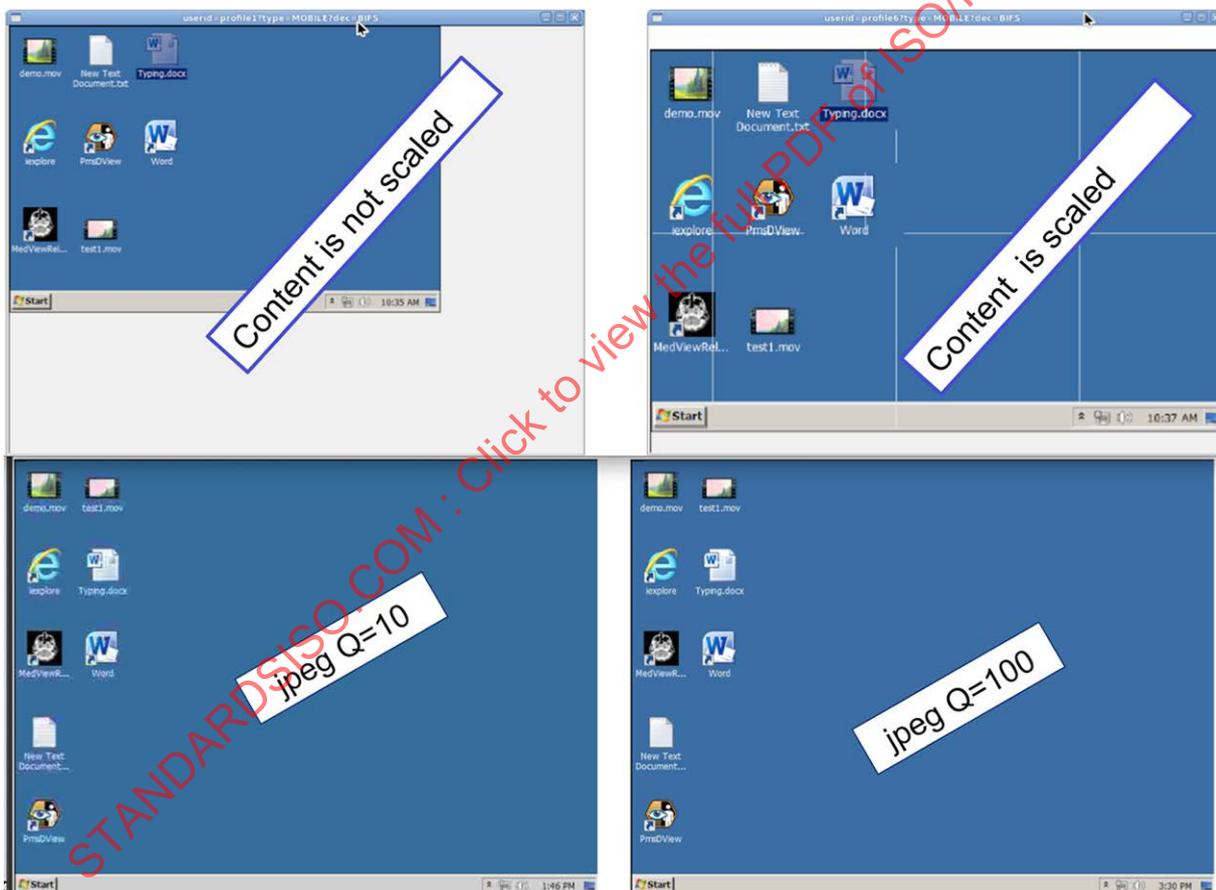
Figure 14 — Adapted content in real-time according the user terminal/network/preferences

Figure 15 — User centric collaboration functionalities enabling/disabling

Annex A
(normative)

UD technologies

The MPEG-21 UD technologies are available at http://standards.iso.org/iso-iec/21000/-22/ed-2/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>
```