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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

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

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The committee responsible for this document is ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

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

Introduction

The use of multimedia is pervading more and more our daily life and services are becoming more and more customized to user needs. Although MPEG has already developed other standards such as MPEG-7, MPEG-21, and MPEG-M that address User Description, the level of specification in those standards cannot cope with the needs of current and upcoming services such as augmented reality and social networks.

In a context of a large number of competing service providers, a user typically relies on a Recommendation Service that suggests choices to Users. Conceivably, the use of more than one Recommendation Service in combination could provide better choices to users. However, comparing different recommendations can be difficult if the users seeking recommendations, the contexts in which they operate and the services they are using are described in incompatible fashions.

The aim of the MPEG-21 User Description standard, referred to as MPEG-21 UD, is to enable Recommendation Services that provide standard, i.e. compatible, recommendations. To achieve this goal, standards for the following input and output formats of a Recommendation Engine are needed:

a)   the input format that includes

1)   Description of User (UD) seeking recommendation,

2)   Description of Context (CD) in which User operates, and

3)   Description of Service (SD) offering content sought by User;

b)   the output format, called Recommendation Description (RD), that includes

1)   subsets of UD/CD/SD,

2)   additional logical relations,

3)   metadata related to the subsets, and

4)   recommendation.

The scope of MPEG-21 UD can be exemplified by the following use scenario. A Smart TV manufacturer has included a new type of recommendation functionalities in the TV set to help customers select programmes. The TV set supports standard User Description (UD), Context Description (CD) and Service Description (SD). With these data, User can access different Recommendation Services each of which provides a standard Recommendation Description (RD). The TV set has an application which mashes up the different recommendations and provides customized recommendations to User.

The Description Managers of Figure 1 are in charge of

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

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

Recommendation Engines process UD, CD and SD and provide Recommendations in the form of Recommendation Description (RD) typically to an Application.
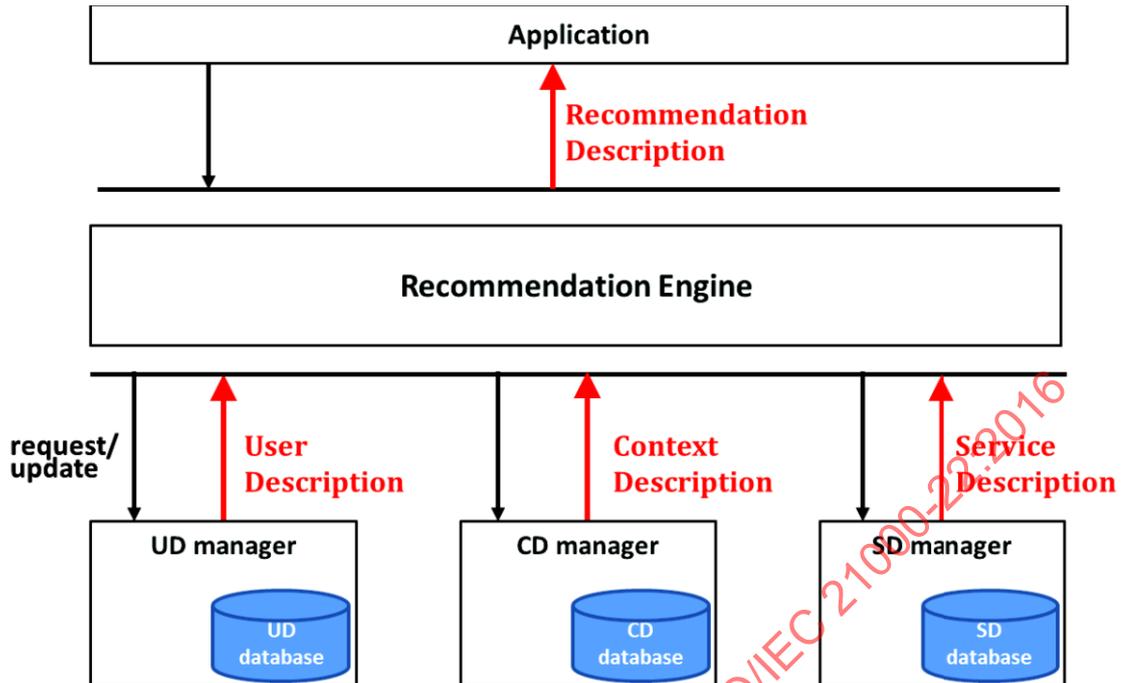
Figure 1 — Conceptual model of MPEG-21 User Description (red elements UD/CD/SD/RD indicate the formats specified by MPEG-21 User Description)

Information technology — Multimedia framework (MPEG-21) — Part 22: User Description

1 Scope

This document standardizes the four data formats: User Description (UD), Context Description (CD), Service Description (SD), and Recommendation Description (RD).

— User Description (UD): a set of descriptions which may contain static and dynamic information about the user, including some other data like the history of the user's interactions, preferences, security settings regarding these information, etc.

— Context Description (CD): a set of descriptions of the environmental situation in which the user operates, e.g., user's device in use, physical position, environmental variables (temperature, humidity, sound level, etc.), security settings regarding these inform ation, etc.

— Service Description (SD): a set of descriptions containing information (including security settings) about the service (or a set of sub-services), that is offered to the end-user application, e.g. video on demand, maps, etc.

— Recommendation Description (RD): a set of descriptions containing information about recommended items, provided when a customer requests a service in a certain context and in a certain environment. RD may include 1) the recommended content, 2) information extracted from UD, CD, SD, 3) additional logical relations among UD/CD/SD (or their subsets) and 4) metadata from UD/CD/SD.

This document specifies User Description, Context Description, Service Description and Recommendation Description. Description Managers, Recommendation Engine and Application are outside of the scope of this document.

2 Normative references

There are no normative references cited 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, e.g. identity, interactions, preferences, security settings regarding these information, etc.

3.3
context description
CD
set of data that describes the context and environmental situation in which the user is located, e.g. device in use, physical position, environmental variables (temperature, humidity, etc.), traffic conditions, security settings regarding these information, etc.

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/CD/SD and additional logical relations and metadata related to the subsets

Note 1 to entry: The application may subsequently process the RD to build final recommendation for the user.

3.6
user
human or a software agent, an industrial process or a 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, e.g. device in use, physical location, etc.

3.9
application
an entity in charge of responding to the user's requests (e.g. an interface allowing users to choose their preferred programs on a Smart TV)

3.10
UD/CD/SD managers
entities that provide functionalities of filtering, accessing, storing, editing, updating and securing UD/CD/SD

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

4   General description

This clause specifies Common Types (CT). This technology is available as presented in Annex A and the classification schemes are detailed in Annex B.

4.1 General description tools

4.1.1 commonAttributes

This `commonAttributes` can be used to describe properties of each sub element for UD, CD, SD and RD.

4.1.1.1 Syntax

```
<attributeGroup name="commonAttributes">
   <attribute name="generatedTime" type="dateTime"/>
</attributeGroup>
```

4.1.1.2 Semantics

Name	Definition
commonAttributes	Describes properties of each sub element for UD, CD, SD and RD.
generatedTime	Specifies generated time of description.

4.1.1.3 Examples

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

4.1.2 Value types

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.

4.1.2.1 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"/>
      <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>
```

4.1.2.2 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 intermal name or naming convention.
valueByOrdinal	Describes a natural ordering value such as ranking of priorities, the order of people's place 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 difference 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

Name	Definition
	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 a 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 a integer number and cannot be lower than 0 or greater than 100.
normalizedRatioValueType	Describes the normalized ratio value. Based on this type, only one of ZeroToOneRatio or ZeroToOnehundredRatio element shall be instantiated.
normalizedOrdinalValueType	Describes the normalized ordinal value. Based on this type, only one of ZeroToTenOrdinal or ZeroToOnehundredOrdinal element shall be instantiated.

4.1.2.3 Examples

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

4.1.3 TimeType

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

4.1.3.1 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>
```

4.1.3.2 Semantics

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

4.1.3.3 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>
```

4.1.4 Extended TimeType

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.

4.1.4.1 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>
```

4.1.4.2 Semantics

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

4.1.4.3 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>
```

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4.1.5 LocationType

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

4.1.5.1 Syntax

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

4.1.5.2 Semantics

Semantics of the `LocationType`:

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

4.1.5.3 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>
```

4.1.6 ClassificationSchemeAliasType

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

4.1.6.1 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>
```

4.1.6.2 Semantics

Name	Definition
ClassificationSchemeAliasType	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.

4.1.6.3 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 -->
```

4.1.7 ObjectType

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

4.1.7.1 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>
```

4.1.7.2 Semantics

Name	Definition
ObjectType	This data type describes the objects offered by the service. All kind of items that are provided by a service provider can be an object.
ObjectID	Describes an object ID used for identifying an object in ObjectType.
ObjectName	Describes the name of the object.
ObjectActivity	Describes the activity of the object intended by the user. In case of visual object, value for this element can be vibrating, flickering, appearing and disappearing.
ObjectCategory	Describes the category of the object, such as similar object's representative name. Terms for the ObjectCatrgory 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)

4.1.7.3 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>
```

5   User description

This clause specifies User Description (UD). This technology is available as presented in Annex A and the classification schemes are detailed in Annex B.

5.1 User description tools

5.1.1 UserDescriptionType

`UserDescriptionType` specifies the structure of the root element UD.

5.1.1.1 Syntax

```
<element name="UD" type="ud:UserDescriptionType"/>
<complexType name="UserDescriptionType">
  <sequence>
      <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"/>
    <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="ObjectSharing" type="ud:ObjectSharingType"
minOccurs="0"/>
  </sequence>
  <attributeGroup ref="ct:commonAttributes"/>
</complexType>
```

5.1.1.2 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.
ClassificationSchemeAlias	Specifies an alias for a ClassificationScheme to be referenced within the UserDescriptionType by a simplified URI.
UserID	Describes the unique identifier of a user.
UserProfile	Describes user profile based on UserProfileType
UsageHistory	Describes usage history based on UsageHistoryType. This element can represent user's history for a given service, such as searching or movie recommendations.
Preference	Describes Preference based on PreferenceType.
Emotion	Describes Emotion based on EmotionType. This type represents user's emotion, including its changes over time.
Schedule	Describes schedule based on ScheduleType.
Activity	Describes user activity based on ActivityType.
Representation	Describes the representation such as user character and image used by

Name	Definition
	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.
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.
commonAttributes	Describes a group of attributes for the CommonAttributes. The syntax and semantics of commonAttributes are specified in Common Type

5.1.2 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).

5.1.2.1 Syntax

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

5.1.2.2 Semantics

Semantics of the UserProfileType:

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

5.1.2.3 Examples

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

5.1.3 PersonProfileType

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

5.1.3.1 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>
```

5.1.3.2 Semantics

Semantics of the `PersonProfileType`:

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.

5.1.3.3 Examples

```
<ud:UserProfile xsi:type="ud:PersonProfileType">
    <ud:Specialty>urn:mpeg:mpeg21:UD:CS:UserSpecialtyCS:2016: 01</ud:Specialty>
 <ud:PersonInformation>
     <mpeg7:Name xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004">
```

```
          <mpeg7:GivenName>Jaewon</mpeg7:GivenName>
      </mpeg7:Name>
      <mpeg7:PersonDescription>Mpeg-UD Member</mpeg7:PersonDescription>
      <mpeg7:Nationality>KR</mpeg7:Nationality>
   </ud:PersonInformation>
   <ud:Gender>female</ud:Gender>
</ud:UserProfile>
```

5.1.4 OrganizationProfileType

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

5.1.4.1 Syntax

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

5.1.4.2 Semantics

Semantics of the `OrganizationProfileType`:

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

5.1.4.3 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>
```

5.1.5 DeviceProfileType

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

5.1.5.1 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>
```

5.1.5.2 Semantics

Semantics of the `DeviceProfileType`:

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`).

5.1.5.3 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:DeviceCat
egory>

  </ud:UserProfile>
```

5.1.6 GroupedProfileType

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

5.1.6.1 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>
```

5.1.6.2 Semantics

Semantics of the `GroupedProfileType`:

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.

5.1.6.3 Example

```
<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>
```

5.1.7 UsageHistoryType

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

5.1.7.1 Syntax

```
<complexType name="UsageHistoryType">
      <sequence>
        <element name="DetailedUserInteraction"
type="ud:DetailedUserInteractionType"/>
      </sequence>
  </complexType>
  <complexType name="DetailedUserInteractionType">
    <annotation>
      <documentation>The main complex type describing detailed interaction with
multimedia items</documentation>
    </annotation>
      <sequence>
        <element name="MultimediaExperiences">
            <complexType>
                <sequence>
```

```
                    <element name="MultimediaExperience"
type="ud:MultimediaExperienceType" maxOccurs="unbounded"/>
                </sequence>
            </complexType>
        </element>
    </sequence>
</complexType>
```

5.1.7.2 Semantics

Semantics of the `UsageHistoryType`:

Name	Definition
UsageHistoryType	Specifies the history of interaction and consumption of multimedia.
MultimediaExperiences	The set of multimedia experiences of the user.
DetailedUserInteraction	Structure containing information about the multimedia experiences of the user.

5.1.7.3 Example

The following example illustrates a case in which a user identified with u100 has a record of two Multimedia Experiences in her DetailedUserInteraction section of UD.

```
<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">

    <UserID>u100</UserID>

    <UsageHistory>

        <DetailedUserInteraction>

            <MultimediaExperiences>

                <MultimediaExperience>

                    <States>

                        <State>

                            <Coordinates>...</Coordinates>

                        </State>

                        ...

                    </States>

                </MultimediaExperience>

                <MultimediaExperience>

                    <States>

                        <State>

                            <Coordinates>...</Coordinates>

                        </State>

                        ...

                    </States>
```

```
                    </MultimediaExperience>
                </MultimediaExperiences>
            </DetailedUserInteraction>
        </UsageHistory>
</UD>
```

5.1.8 EventType

An abstract representation of a generic event.

5.1.8.1 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>
```

5.1.8.2 Semantics

Semantics of the `EventType`:

Name	Definition
eventType	An abstract representation of a generic real event.
Coordinates	Spatial and temporal coordinates of the event. Multiple Coordinates model events occurring in distributed space and time (e.g. listening 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.

5.1.8.3 Example

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

5.1.9 InteractionAtomType

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

5.1.9.1 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>
```

5.1.9.2 Semantics

Semantics of the `InteractionAtomType`:

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

5.1.9.3 Example

`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>
...
```

5.1.10 artefactType

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

5.1.10.1 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>
```

5.1.10.2 Semantics

Semantics of the `artefactType`:

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

5.1.10.3 Example

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>
```

5.1.11 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).

5.1.11.1 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>
```

5.1.11.2 Semantics

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

5.1.11.3 Example

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>

     ...
```

5.1.12 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.

5.1.12.1 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>
```

5.1.12.2 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.

5.1.12.3 Example

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>
```

5.1.13 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.

5.1.13.1 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>
```

5.1.13.2 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:2 016.

5.1.13.3 Example

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

```
<?xml version="1.0" encoding="UTF-8"?>

<UD                    xmlns="                    urn:mpeg:mpeg21:UD:UD:2016"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation=" urn:mpeg:mpeg21:UD:UD:2016 1.MPEG-UD-UD.xsd">

  <UserID>U100</UserID>

    ...

    <States>

      <State>

       <Artefacts>...<Artefacts>

       <Observables>...</Observables>

       <SemanticallyRelatedStates>

          <StatesRef>...</StatesRef>

       </SemanticallyRelatedStates>

      </State>

    </States>

    ...
```

5.1.14 PreferenceType

The 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.

5.1.14.1 Syntax

```
<complexType name="PreferenceType">
  <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="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>
  </complexType>
```

5.1.14.2 Semantics

Semantics of the `PreferenceType`:

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 FilteringAndSearchPreferences, BrowsingPreferences and RecordingPreferences, and contains an attribute indicating whether the user's preferences may be updated automatically.
AudioPresentationPreferences	Describes the preferences of a user regarding the presentation or rendering or audio resources. This element refers `AudioPresentationPreferencesType`.
DisplayPresentationPreferences	Describes preferences of a User regarding the presentation or rendering of images and videos. This mpeg21:DisplayPresentationPreferencesType includes descriptors of preferences related to the color and the conversion of stereoscopic video. The ColorTemperaturePreference, the BrightnessPreference,the SaturationPreference and the ContrastPreference describe the preferences of a User regarding the color of the displayed visual contents in terms of color temperature, brightness, saturation and contrast, each of which is a usual color attribute of images. StereoscopicVideoConversion describes the preferences of a User related to the conversion of 2D video to 3D stereoscopic video and also the conversion of 3D stereoscopic video to 2D video.
GraphicsPresentationPreferences	Describes presentation preferences related to graphics media. This mpeg21:GraphicsPresentationPreferencesType contains GeometryEmphasis, TextureEmphasis and AnimationEmphasis element.
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 |

5.1.15 WebLinkPreferenceType

WebLinkPreferenceType type describes the preference related to the various weblinks.

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

5.1.15.1 Syntax

```
<complexType name="WebLinkPreferenceType">
     <sequence>
        <element name="WebLinkAddress" type="anyURI"/>
     </sequence>
    <attribute name="preferenceLevel" type="ct:ZeroToOnehundredRatioType"
use="optional" default="50"/>
</complexType>
```

5.1.15.2 Semantics

Semantics of the WebLinkPreferenceType type:

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

5.1.15.3 Example

```
<ud:Preference>
    <ud:WebLinkPreferences preferenceLevel="32">
      <ud:WebLinkAddress>http://www.abcd.com</ud:WebLinkAddress>
    </ud:WebLinkPreferences>
</ud:Preference>
```

5.1.16 ServicePreferencesType

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.

5.1.16.1 Syntax

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

5.1.16.2 Semantics

Semantics of the `ServicePreferencesType`:

Name	Definition
ServiceGeneralInformatio n	Describes general information of the service. Service name, Provider Name, generic service information, service URI, service category, etc. can be described by this type.
PreferenceLevel	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.

5.1.16.3 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>
```

5.1.17 GeneralAudioPreferencesType

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

5.1.17.1 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"/>
```

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

5.1.17.2 Semantics

Semantics of the `GeneralAudioPreferenceType`:

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.

5.1.17.3 Example

```
<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>
...
```

5.1.18 AudioPresentationPreferencesType

5.1.18.1 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>
```

5.1.18.2 Semantics

Semantics of the `AudioPresentationPreferencesType`:

Name	Definition
`GeneralAudioPresentationP reference`	Describes the preferences for lossless and lossy audio services.
`AudioPresentationEnvironm entPreference`	Describes more precise information for audio services. This element references `AudioPresentationEnvironmentPreferenceType`.

5.1.19 AudioPresentationEnvironmentPreferenceType

5.1.19.1 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>
```

5.1.19.2 Semantics

Semantics of the `AudioPresentationPreferencesType`:

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 23005-6:2016, A.2.1. The binary representation of the `UnitTypeCS` is also defined in ISO/IEC 23005-6:2016, A.2.1.
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`.
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 23005-6:2016, A.2.1. The binary representation of the `UnitTypeCS` is also defined in ISO/IEC 23005-6:2016, A.2.1.
SpeakerLayoutPreferences	Describes more precise information about speaker layout. This element references `SpeakerLayoutType`.

Semantics of the `SpeakerLayoutType`:

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

5.1.19.3 Example

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

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

`FrequencyEqualizer`: This information represents the preference of a User to specific frequencies. This information consists of a set of frequency bands and its associated of attenuation values for the 31 ISO 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 User's with an auditory impairment to listen to fast speech. The SoniferousSpeed is specified as a ratio, where 1 indicates the original speed; values other than 1 indicate multiplicative time-scaling by the given ratio (i.e. 0.5 specifies twice as fast and 2.0 indicates half the original speed). In the example below, the soniferous speed preference is indicated as twice as fast.

`ExtendedSoundfieldPreferences`: The information represents the preference of RMS value and impedance ranges. In this example, the range of RMS value is from $100W$ 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>
```

5.1.20 TranslationPreferencesType

The `TranslationPreferencesType` describes the preferences for translation services.

5.1.20.1 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>
```

5.1.20.2 Semantics

Semantics of the `TranslationPreferencesType`:

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

5.1.20.3 Example

```
<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>
```

5.1.21 SpeechStylePreferenceType

5.1.21.1 Syntax

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

5.1.21.2 Semantics

Semantics of the `SpeechStylePreferenceType`:

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

5.1.22 GenderType

`GenderType` indicates the gender of the user.

5.1.22.1 Syntax

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

5.1.22.2 Semantics

Semantics of the `GenderType`:

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.

5.1.22.3 Example

```
<ud:UserProfile xsi:type="ud:PersonProfileType">

    <ud:Gender>female</ud:Gender>

</ud:UserProfile>
```

5.1.23 EmotionType

The `EmotionType` can be used to represents user's subjective notion and feeling. 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.

5.1.23.1 Syntax

```
<complexType name="EmotionType">
    <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"/>
</complexType>
```

5.1.23.2 Semantics

Semantics of the `EmotionType`:

Name	Definition
EmotionType	Describes user's subjective notion and feeling. 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

Name	Definition
	referenced by the `EmotionGroup`.
emotionName	Denotes the name of an emotion as the result of measuring a user's emotional state. The value should match one of the `name` attribute value of the `DynamicEmotionVocabulary` instance referenced by `ref-id` attribute or the name of a term of a classification scheme referenced by `ref-id` attribute.
Value	Describes the level of emotion on the result of measuring a user's emotional state. This value can be described based on `normalizedRatioValueType`.
triggeredBy	Describes who and what caused this emotion. The emotion can be triggered by various sources such as persons, animals and media. It may reference a user description's identifier for describing this information in the case of triggered by persons or animals, etc. In the case of media, it may reference a resource identifier.
aspect	Describes the specific occasion of the triggered emotion, e.g. battery duration of the Smartphone or speech of the spokesman.
detectedFrom	Describes the modality through which an emotion is detected. Specific user emotion is usually detected through human's action and appearances such as face, gesture, voice, word, posture or EEG (electroencephalography).
reliability	Describes the degree of reliability on the result of measuring a user's emotional state. The value of "reliability" must be a floating point number and cannot be lower than 0 or greater than 1.

5.1.23.3 Example

This example describes an emotion detected from "face", and this emotion "happiness" is triggered by watching a media referenced at "http://3d.keti.re.kr/cake.mp4", 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://3d.keti.re.kr/cake.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>
```

5.1.24 ScheduleType

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

5.1.24.1 Syntax

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

5.1.24.2 Semantics

Semantics of the `ScheduleType`:

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

5.1.25 ScheduleEventType

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

5.1.25.1 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>
```

5.1.25.2 Semantics

Semantics of the `ScheduleEventType`:

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 user's needs.

5.1.25.3 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>
```

5.1.26 ActivityType

This subclause describes the structure of `ActivityType` in which `ActivityType` is to provide a description of 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.

5.1.26.1 Syntax

```
<complexType name="ActivityType">
    <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"/>
  </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>
```

5.1.26.2 Semantics

Semantics of the `ActivityType`:

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

Semantics of the `PhysicalStatusType`:

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

Semantics of the `BloodPressureType`:

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

5.1.26.3 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>
```

5.1.27 IntentionType

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

5.1.27.1 Syntax

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

5.1.27.2 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).

5.1.27.3 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>
```

5.1.28 LanguageType

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

5.1.28.1 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>
```

5.1.28.2 Semantics

Name	Definition
LanguageType	Describes the level of knowledge of a user in a language.
Name	Specifies the name of the specific language used by a given user.
CompetenceReference	Describes a competence of a given user.
LanguageRegion	Specifies the geographical region referred to the given language (e.g. British English, South Korean, etc.).
LanguageAccent	Specifies the specific accent of the given spoken language (e.g. italian, Jej, etc.).
Type	— Specifies whether the specific language corresponds to the language that a given user has grown up speaking from early childhood. If so, the "native" value is adopted. Otherwise, the "foreign" value.
ReadingLevel	Describes the reading level of the user for the specific language. — Advanced: The user is able to understand texts from many genres dealing with a wide range of subjects, both familiar and unfamiliar. They are able to understand lengthy texts of a professional, academic, or literary nature. — Intermediate: The user is able understand information conveyed in simple, predictable, loosely connected texts. The user is able to understand messages found in highly familiar, everyday contexts.

Name	Definition
	— 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. He uses basic vocabulary and structures to express meaning that is comprehensible to those accustomed to the writing of non-natives.
	— Novice
	The user can produce simple sentences with limited vocabulary. The user can provide limited information on simple forms and documents. The user can reproduce practiced material to convey the most simple messages.
SpeakingLevel	Describes the speaking level of the user for the specific language.
	— Advanced:
	The user is able to communicate with accuracy and fluency on a variety of topics in formal and informal settings.
	— Intermediate:
	The user is able to talk about familiar topics related to their daily life with sentence-level language, typically in present time with a limited set of vocabulary.
	— Novice:
	The user can communicate short messages on everyday topics that affect them directly through the use of isolated words and phrases.
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.

5.1.28.3 Examples

```xml
<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:LanguageRegion    id="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">
          <Point              longitude="-180"              latitude="-90"
altitude="3.14159265358979"/>
        </GeographicPosition>
        <Region>South Dakota</Region>
        <PostalAddress xml:lang="en-us">
          <AddressLine   xml:lang="en-us"   phoneticTranscription="String"
phoneticAlphabet="sampa">432 Berendo St. S.Dakota</AddressLine>
          <PostingIdentifier                          xml:lang="en-us"
phoneticTranscription="String"
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:LanguageAccent   id="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>
```

5.1.29 LanguageCompetenceReferenceType

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

5.1.29.1 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>
```

5.1.29.2 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.

5.1.30 CompetenceLevelType

5.1.30.1 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>
```

5.1.30.2 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.

5.1.31 AccessibilityType

The `AccessibilityType` describes specific disabilities of a given user.

5.1.31.1 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>
```

5.1.31.2 Semantics

Semantics of the `AccessibilityType`:

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.
AccessMode	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.

Name	Definition
AuditoryImpairment	Describes the auditory impairment of the user. The syntax and semantics of `AuditoryImpairmentType` are specified in ISO/IEC 21000-7:2007.
VisualImpairment	Describes the visual impairment of the user. The syntax and semantics of `VisualImpairmentType` are specified in ISO/IEC 21000-7:2007.

5.1.31.3 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>
```

5.1.32 SocialInformationType

5.1.32.1 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="PrivetInformationAccessID"
type="mpeg7:UserIdentifierType" minOccurs="0" maxOccurs="unbounded"/>
    </sequence>
  </complexType>
```

5.1.32.2 Semantics

Semantics of the `SocialType`:

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.
PrivetInformationAccessID	Describes the list of other users who can access private information of a given user.

5.1.33 ObjectSharingType

5.1.33.1 Syntax

```
  <complexType name="ObjectSharingType">
    <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>
  </complexType>
```

5.1.33.2 Semantics

Semantics of the `ObjectSharingType`:

Name	Definition
ObjectSharingType	Describes the object to be shared.
ShareUserID	Describes the users that shares the object.
ObjectID	Describes the ID of the object.
Ownership	Describes the ownership of the object.
ObjectAccessibility	Describes the way object is accessible.

5.1.33.3 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>
```

5.1.34 ObjectAccessibilityType

5.1.34.1 Syntax

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

5.1.34.2 Semantics

Semantics of the `ObjectAccessibilityType`:

Name	Definition
ObjectAccessibilityType	Describes the Accessibility of object to be shared.

5.1.34.3 Examples

This example indicates use of `ObjectAccessibilityType`.

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

6 Context description

This clause specifies Context Description (CD). This technology is available as presented in Annex A and the classification schemes are detailed in Annex B.

6.1 Context description tools

6.1.1 ContextDescriptionType data type

This subclause describes a structure of `ContextDescriptionType` data type. The `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.

6.1.1.1 Syntax

```
<element name="CD" type="cd:ContextDescriptionType"/>
<complexType name="BaseContextType" 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"/>

    </sequence>

    <attributeGroup ref="ct:commonAttributes"/>

    <attribute    name="Priority"    type="ct:ZeroToOnehundredOrdinalType"
use="optional"/>   </complexType>
```

6.1.1.2 Semantics

Semantics of the `ContextDescriptionType`:

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.
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 Common Type (4.0 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 Common Type.
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.

6.1.1.3 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>
```

6.1.2 ContextIdentificationType

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

6.1.2.1 Syntax

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

6.1.2.2 Semantics

Semantics of the `ContextIdentificationType`:

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.

6.1.2.3 Examples

This example shows `ContextIdentificationType` data type.

```
<cd:ContextIdentification>

<cd:InstanceIdentifier>>http://example.com/user/john.doe</cd:InstanceIdentifier>

  <cd:sessionID>ID_1</cd:sessionID>

</cd:ContextIdentification>
```

6.1.3 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.

6.1.3.1 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>
```

6.1.3.2 Semantics

Semantics of the `DeviceCharacteristicsType`:

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.
SensorDeviceCapabilityList	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.

6.1.3.3 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>
```

6.1.4 NetworkInfoType

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

6.1.4.1 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>
```

6.1.4.2 Semantics

Semantics of the `NetworkInfoType`:

Name	*Definition*
NetworkInfoType	This data type describes static and dynamic information of network around user.
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.

6.1.4.3 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>
```

6.1.5 WeatherType

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

6.1.5.1 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>
```

6.1.5.2 Semantics

Semantics of the `WeatherType`:

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.
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 23005-6:2016, A.2.1 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 23005-6:2016, A.2.1 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.

6.1.5.3 Examples

This example indicates a snowing 10 centimeters per hour.

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

6.1.6 OtherEnvironmentalInfo

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

6.1.6.1 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>
```

6.1.6.2 Semantics

Semantics of the OtherEnvironmentalInfoType:

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.

6.1.7 AudioEnvironmentType

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

6.1.7.1 Syntax

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

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

6.1.7.2 Semantics

Semantics of the `AudioEnvironmentType`:

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.

6.1.8 RecordingEnvironmentType

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

6.1.8.1 Syntax

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

6.1.8.2 Semantics

Semantics of the `RecordingEnvironmentType`:

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.

6.1.8.3 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>
```

7 Service Description

This clause specifies the syntax and semantics of Service Description (SD) tools. This technology is available as presented in Annex A and the classification schemes are detailed in Annex B.

7.1 Service description tools

7.1.1 ServiceDescriptionType

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

7.1.1.1 Syntax

```
<element name="SD" type="sd:ServiceDescriptionType"/>
  <complexType name="ServiceDescriptionType">
    <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="IntermalServices" type="sd:IntermalServicesType"
minOccurs="0"/>
      <element name="Priority" type="ct:ZeroToOnehundredOrdinalType"
minOccurs="0"/>
      <element name="IsServiceAvailable" type="boolean"/>
      <element name="ServiceObjectsInformation" type="sd:ServiceObjectType"
minOccurs="0"/>
    </sequence>
  </complexType>
```

7.1.1.2 Semantics

Name	Definition
SD	Specifies the root element of the Service Description.
ServiceDescriptionType	Specifies the syntax of the root element containing information about a specific service.
ClassificationSchemeAlias	The Classification scheme alias information.
ServiceID	Describes the unique ID of the service.
ServiceGeneralInformation	Describes general information about a given service.

Name	Definition
ServiceTargetInformation	Describes a user's preferred service.
ServiceInterfaces	Describes interfaces used for exchanging information among the services and/or recommendation engine and/or application.
InternalServices	Describes a specific internal service.
Priority	Specifies the priority level associated to a given service.
IsServiceAvailable	Specifies availability of the service.
ServiceObjectsInformation	Describes the information of objects provided by a service.

7.1.2 ServiceGeneralInformationType

This subclause specifies general information of the service.

7.1.2.1 Syntax

```
<complexType name="ServiceGeneralInformationType">
  <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>
</complexType>
```

7.1.2.2 Semantics

Semantics of the ServiceGeneralInformationType:

Name	Definition
ServiceGeneralInformationType	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.

7.1.2.3 Example

```
<sd:ServiceGeneralInformation>
  <sd:ServiceName>MyService</sd:ServiceName>
  <sd:ServiceProviderName>MyServiceCompany</sd:ServiceProviderName>
  <sd:Description>This Service is ...</sd:Description>
  <sd:ServiceURI>http://example.myservice.com</sd:ServiceURI>
  <sd:ServiceCategory>urn:mpeg:
mpeg21:UD:CS:ServiceCategoryCS:2016:0101</sd:ServiceCategory>
  <sd:SupportedFormat>
    <mpeg7:MediaProfile>
      <mpeg7:MediaFormat>
        <mpeg7:Content href="MPEG7ContentCS">
          <mpeg7:Name>audiovisual</mpeg7:Name>
        </mpeg7:Content>
        <mpeg7:FileFormat href="urn:mpeg:mpeg7:cs:FileFormatCS:2001:3">
          <mpeg7:Name>mpeg</mpeg7:Name>
        </mpeg7:FileFormat>
      </mpeg7:MediaFormat>
    </mpeg7:MediaProfile>
  </sd:SupportedFormat>
</sd:ServiceGeneralInformation>
```

7.1.3 ServiceTargetInformationType

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

7.1.3.1 Syntax

```
  <complexType name="ServiceTargetInformationType">
    <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>
  </complexType>
```

7.1.3.2 Semantics

Semantics of the `ServiceTargetInformationType`:

Name	Definition
ServiceTargetInformation Type	Specifies information about preferred user and context for a service.
PreferredUserDescription Information	Specifies the description of preferred user for the service.
PreferredContextDescript ionInformation	Specifies the description of preferred context of usage for the service.
ServiceTargetModel	Specifies the informational role of user segmentation.

7.1.3.3 Example

```
< sd:ServiceTargetInformation>
<sd:PreferedUserDescriptionInformation xsi:type="ud:UserDescriptionType">

     ...

</sd:PreferedUserDescriptionInformation>
<sd:PreferedContextDescriptionInformation
xsi:type="cd:ContextDescriptionType">

     ...

</sd:PreferedContextDescriptionInformation>


</sd:ServiceTargetInformation>
```

7.1.4 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.

7.1.4.1 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>
```

7.1.4.2 Semantics

Semantics of the `ServiceTargetModelType`:

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`.

7.1.4.3 Example

```
<sd:ServiceTargetInformation>
    <sd:ServiceTargetModel>
      <sd:ServiceTargetTree>
        <sd:Node nodeID="ID_UserTypeSet1Node">
          <sd:Question>What is your gender?</sd:Question>
          <sd:ChildNode       nodeID="ID_22"       answer="female"
serviceTargetType="UserType_3"/>
          <sd:ChildNode nodeID="ID_43" answer="male">
```

```
            <sd:Question>Do you have a car?</sd:Question>
            <sd:ChildNode           nodeID="ID_27"              answer="Yes"
serviceTargetType="UserType_1"/>
            <sd:ChildNode            nodeID="ID_23"             answer="No"
serviceTargetType="UserType_2"/>
        </sd:ChildNode>
        <sd:ChildNode         nodeID="ID_57"         answer="female"
serviceTargetType="UserType_3"/>
      </sd:Node>
    </sd:ServiceTargetTree>
    <sd:ServiceTargetSet id="ID_UserTypeSet1Voca">
      <sd:vocabulary name="UserType_1"/>
      <sd:vocabulary name="UserType_2"/>
      <sd:vocabulary name="UserType_3"/>
      <sd:vocabulary name="UserType_4"/>
    </sd:ServiceTargetSet>
  </sd:ServiceTargetModel>
 </sd:ServiceTargetInformation>
```

7.1.5 VocabularySetType

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

7.1.5.1 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>
```

7.1.5.2 Semantics

Semantics of the VocabularySetType:

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.

7.1.6 ServiceInterfacesType

It specifies the service interfaces.

7.1.6.1 Syntax

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

7.1.6.2 Semantics

Semantics of the `ServiceInterfaceType`:

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

7.1.7 ServiceInterfaceType

It specifies general information about a service interface.

7.1.7.1 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>
```

7.1.7.2 Semantics

Semantics of the `ServiceInterfaceType`:

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

7.1.7.3 Example

```
<sd:ServiceInterface>
  <sd:ServiceInterface                                          href="urn:mpeg:
mpeg21:UD:CS:serviceInterfaceTypeCS:2016:301">
    <mpeg7:Name>Test Service Interface</mpeg7:Name>
  </sd:ServiceInterface>
```

```
<sd:ServiceInterfaceInformationURI>http://example.myservice.com/TestServi
ceInfo</sd:ServiceInterfaceInformationURI>

  <sd:RequiredInputData>

    <sd:RequiredUDInfo>/UD/UserID</sd:RequiredUDInfo>

    <sd:RequiredUDInfo>/UD/PersonProfile/BirthTime</sd:RequiredUDInfo>

<sd:RequiredCDInfo>/CD/DeviceCharacteristics/DeviceLocation</sd:RequiredC
DInfo>

  </sd:RequiredInputData>

</sd:ServiceInterface>
```

7.1.8 RequiredInputDataType

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

7.1.8.1 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>
```

7.1.8.2 Semantics

Semantics of the `RequiredInputDataType`:

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.

7.1.8.3 Example

```
<sd:RequiredInputData>

  <sd:RequiredUDInfo>/UD/UserID</sd:RequiredUDInfo>

  <sd:RequiredUDInfo>/UD/PersonProfile/BirthTime</sd:RequiredUDInfo>


<sd:RequiredCDInfo>/CD/DeviceCharacteristics/DeviceLocation</sd:RequiredC
DInfo>

</sd:RequiredInputData>
```

7.1.9 IntermalServicesType

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

7.1.9.1 Syntax

```
<complexType name="IntermalServicesType">
  <sequence>
    <element name="IntermalService" type="sd:IntermalServiceType"
maxOccurs="unbounded"/>
  </sequence>
</complexType>
```

7.1.9.2 Semantics

Semantics of the `IntermalServicesType`:

Name	Definition
IntermalServicesType	Specifies a lists of internal services provided by the service.
IntermalService	Specifies an internal service provided by the service.

7.1.9.3 Example

```
<sd:IntermalServices>
<sd:IntermalServices>
  <sd:IntermalService servicePriority="60">
    <sd:Service>
      <sd:ServiceID>Service_ID_001-01</sd:ServiceID>
      <sd:ServiceGeneralInformation>

        <sd:ServiceName>MyInternalService_1</sd:ServiceName>

<sd:ServiceProviderName>MyInternalServiceProvider</sd:ServiceProviderName
>

      </sd:ServiceGeneralInformation>

      <sd:ServiceTargetInformation>

        <sd:PreferredUserDescriptionInformation>

          <ud:UserID>UserDescription_ID_001</ud:UserID>
```

```
          </sd:PreferredUserDescriptionInformation>
        </sd:ServiceTargetInformation>
        <sd:IsServiceAvailable>true</sd:IsServiceAvailable>
      </sd:Service>
    </sd:InternalService>
    <sd:InternalService servicePriority="40">
      <sd:ServiceRef referenceServiceID="Service_ID_001-02"/>
    </sd:InternalService>
</sd:InternalServices>
```

7.1.10 InternalServiceType

It specifies an internal service provided by the service.

7.1.10.1 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>
```

7.1.10.2 Semantics

Semantics of the `InternalServiceType`:

Name	Definition
InternalServiceType	Specifies an internal service provided by a the service.
Service	Specifies the internal services using `ServiceDescriptionType`.
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).

7.1.10.3 Example

```
<sd:InternalService servicePriority="50">
<sd:ServiceRef referenceServiceID="ServiceID_111"/>
</sd:InternalService>
<sd:InternalService servicePriority="60">
```

```
  <sd:Service>
    <sd:ServiceID>Service_ID_001-01</sd:ServiceID>
    <sd:ServiceGeneralInformation>
      <sd:ServiceName>MyInternalService_1</sd:ServiceName>

<sd:ServiceProviderName>MyInternalServiceProvider</sd:ServiceProviderName
>
    </sd:ServiceGeneralInformation>
    <sd:ServiceTargetInformation>
     <sd:PreferredUserDescriptionInformation>
        <ud:UserID>UserDescription_ID_001</ud:UserID>
     </sd:PreferredUserDescriptionInformation>
    </sd:ServiceTargetInformation>
    <sd:IsServiceAvailable>true</sd:IsServiceAvailable>
  </sd:Service>
</sd:InternalService>
```

7.1.11 AudioDBType

It specifies some audio related metadata.

7.1.11.1 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"
minOccurs="0"/>
```

```
                <element name="AudioPresentationPreferences"
type="ud:AudioPresentationPreferencesType" minOccurs="0"/>
            </sequence>
          </complexType>
        </element>
      </sequence>
    </restriction>
  </complexContent>
</complexType>
```

7.1.11.2 Semantics

Name	Definition
Title	Specifies the title of a given audio track stored on a generic database.
Singer	Specifies the singer of a given audio track stored on a generic database.
AuthorOfMusic	Specifies the music author of a given audio track stored on a generic database.
KindOfMusic	Specifies the music genre of a given audio track stored on a generic database.
KindOfFileformat	Specifies the file format of a given lossy or lossless 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.

7.1.11.3 Example

An example of metadata related to an audio clip represented using `AudioDBType`.

```
<didl:Statement xsi:type="AudioDBType">

    <AudioDB>

      <Title>My favourite song</Title>

      <Singer xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004">

        <mpeg7:Name>

          <mpeg7:GivenName>My favourite singer</mpeg7:GivenName>

        </mpeg7:Name>

      </Singer>

      <KindOfMusic>Jazz</KindOfMusic>

      <AudioPresentationPreferences>

          <ud:GeneralAudioPresentationPreference>

            <ud:LosslessAudioFormat>DolbyTrueHD</ud:LosslessAudioFormat>

          </ud:GeneralAudioPresentationPreference>

      </AudioPresentationPreferences>
```

```
        </AudioDB>
</didl:Statement>
```

7.1.12 AudioDBDescriptorType

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

7.1.12.1 Syntax

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

7.1.12.2 Semantics

Name	Definition
AudioDBDescriptorType	A complex type derived from MPEG-21 DIDL Descriptor carrying information about Lossless Audio items.

7.1.12.3 Example

An example of usage of `AudioDBDescriptorType`.

```
<DatabaseOfMultimedia>
  <didl:Descriptor xsi:type="AudioDBDescriptorType">
    <didl:Statement xsi:type="AudioDBType">
      <AudioDB>
        <Title>My favourite song</Title>
       <Singer xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004">
          <mpeg7:Name>
            <mpeg7:GivenName>My favourite singer</mpeg7:GivenName>
         </mpeg7:Name>
        </Singer>
       <KindOfMusic>Jazz</KindOfMusic>
       <AudioPresentationPreferences>
          <ud:GeneralAudioPresentationPreference>
             <ud:LosslessAudioFormat>DolbyTrueHD</ud:LosslessAudioFormat>
          </ud:GeneralAudioPresentationPreference>
       </AudioPresentationPreferences>
      </AudioDB>
    </didl:Statement>
</didl:Descriptor>
</DatabaseOfMultimedia>
```

7.1.13 VideoDBType

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

7.1.13.1 Syntax

```xml
<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>
```

7.1.13.2 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.

7.1.13.3 Example

An example of metadata represented using `VideoDBType`.

```
<didl:Statement xsi:type="VideoDBType" mimeType="text/xml">
  <VideoDB>
    <TypeOfMovie>Action</TypeOfMovie>
    <XSizeOfVideo>1920</XSizeOfVideo>
    <YSizeOfVideo>1080</YSizeOfVideo>
    <FirstReleaseYear>2011</FirstReleaseYear>
    <OriginLanguage>
      <ud:Name>Italian</ud:Name>
    </OriginLanguage>
  </VideoDB>
</didl:Statement>
```

7.1.14 VideoDBDescriptorType

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

7.1.14.1 Syntax

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

7.1.14.2 Semantics

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

7.1.14.3 Example

An example of usage of `VideoDBDescriptorType`.

```
<didl:Descriptor xsi:type="VideoDBDescriptorType">
  <didl:Statement xsi:type="VideoDBType" mimeType="text/xml">
    <VideoDB>
      <TypeOfMovie>Action</TypeOfMovie>
      <XSizeOfVideo>1920</XSizeOfVideo>
      <YSizeOfVideo>1080</YSizeOfVideo>
      <FirstReleaseYear>2011</FirstReleaseYear>
      <OriginLanguage>
        <ud:Name>Italian</ud:Name>
```

```
        </OriginLanguage>
      </VideoDB>
    </didl:Statement>
</didl:Descriptor>
```

7.1.15 ServiceObjectType

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

7.1.15.1 Syntax

```
<complexType name="ServiceObjectType">
    <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>
  </complexType>
```

7.1.15.2 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.

7.1.15.3 Example

An example of usage of ServiceObjectInformationType. The element ServiceObjectsInformation includes, in this case, descriptions of a multimedia database composed of two items, one audio item and one video item.

```
<ServiceObjectsInformation>
  <DatabaseOfMultimedia>
    <didl:Item>
      <didl:Descriptor xsi:type="AudioDBDescriptorType">
       <didl:Statement xsi:type="AudioDBType">
        <AudioDB>
         <Title>My favourite song</Title>
         <Singer xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004">
           <mpeg7:Name>
            <mpeg7:GivenName>My favourite singer</mpeg7:GivenName>
           </mpeg7:Name>
         </Singer>
         <KindOfMusic>Jazz</KindOfMusic>
         <AudioPresentationPreferences>
           <ud:GeneralAudioPresentationPreference>
  <ud:LosslessAudioFormat>DolbyTrueHD</ud:LosslessAudioFormat>
           </ud:GeneralAudioPresentationPreference>
         </AudioPresentationPreferences>
        </AudioDB>
       </didl:Statement>
      </didl:Descriptor>
    </didl:Item>
    <didl:Item>
     <didl:Descriptor xsi:type="VideoDBDescriptorType">
      <didl:Statement xsi:type="VideoDBType" mimeType="">
```

```
      <VideoDB>
        <TypeOfMovie>Action</TypeOfMovie>
        <XSizeOfVideo>1920</XSizeOfVideo>
        <YSizeOfVideo>1080</YSizeOfVideo>
        <FirstReleaseYear>2011</FirstReleaseYear>
        <OriginLanguage>
         <ud:Name>Italian</ud:Name>
        </OriginLanguage>
       </VideoDB>
      </didl:Statement>
    </didl:Descriptor>
   </didl:Item>
  </DatabaseOfMultimedia>
</ServiceObjectsInformation>
```

The second example is for the ServiceObjectInformation using the choice.

```
<sd:ServiceObjectsInformation>
     <sd:ServiceObjectInformation ObjectFormat="Visual">
       <ct:ObjectID>ID192</ct:ObjectID>
       <ct:ObjectName>MC_donald</ct:ObjectName>
                       <ct:ObjectCategory                 href="urn:mpeg:
mpeg21:UD:CS:ObjectCategory:2016:0203"><Name>fast_food</Name></ct:ObjectC
ategory>
        <ct:ObjectInformationURI>http://www.ud.com/</ct:ObjectInformatio
nURI>
       <ct:ObjectLocation>
         <ct:GeographicLocation>
            <GeographicPosition datum="itrf">
             <Point longitude="-180" latitude="-90" altitude="60"/>
            </GeographicPosition>
         </ct:GeographicLocation>
       </ct:ObjectLocation>
    </sd:ServiceObjectInformation>


    <sd:ServiceObjectInformation ObjectFormat="Visual">
       <ct:ObjectID>ID196</ct:ObjectID>
       <ct:ObjectName>Lotteria</ct:ObjectName>
                       <ct:ObjectCategory                 href="urn:mpeg:
mpeg21:UD:CS:ObjectCategory:2016:0203"><Name>fast_food</Name></ct:ObjectC
ategory>
```

```
                                    <ct:ObjectInformationURI>http://www.mpeg-
ud.com/</ct:ObjectInformationURI>
        <ct:ObjectLocation>
          <ct:GeographicLocation>
            <GeographicPosition datum="itrf">
              <Point longitude="-130" latitude="80" altitude="60"/>
            </GeographicPosition>
          </ct:GeographicLocation>
        </ct:ObjectLocation>
      </sd:ServiceObjectInformation>
```

8   Recommendation description

This clause specifies the syntax and semantics of Recommendation Description (RD) tools. This technology is available as presented in Annex A and the classification schemes are detailed in Annex B.

8.1 Recommendation description tools

8.1.1 recommendationDescriptionType

This subclause describes the root element and its corresponding complex type of an MPEG-21 UD Recommendation Description.

8.1.1.1 Syntax

```
  <element name="RD" type="rd:recommendationDescriptionType"/>
  <complexType name="recommendationDescriptionType">
    <sequence>
      <element name="ClassificationSchemeAlias"
type="ct:ClassificationSchemeAliasType" minOccurs="0" maxOccurs="unbounded"/>
      <element name="RecommendationID" type="mpeg7:UniqueIDType"/>
      <element name="CompactUsageDescription"
type="rd:compactUsageDescriptionType" minOccurs="0" maxOccurs="unbounded"/>
      <element name="QueryDescription" type="rd:queryDescriptionType"
minOccurs="0" maxOccurs="unbounded"/>
      <element name="ServiceUserType" type="string" minOccurs="0"
maxOccurs="unbounded"/>
      <element name="ProcessChain" type="rd:ProcessChainType" minOccurs="0"/>
      <element name="RecommendationHistory" minOccurs="0">
        <complexType>
          <sequence>
           <element name="RecommendationResult" maxOccurs="unbounded">
            <complexType>
             <sequence>
              <element name="Recommendation"
type="rd: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>
      <element name="RecommendationInformation"
type="rd:RecommendationInformationType" minOccurs="0" maxOccurs="unbounded"/>
    </sequence>
    <attributeGroup ref="ct:commonAttributes"/>
    <attribute name="provider" type="anyURI" use="optional"/>
  </complexType>
```

8.1.1.2 Semantics

Semantics of the `recommendationDescriptionType`:

Name	Definition
RD	The root element of Recommendation Description.
recommendationDescriptionType	The complex type of 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 userType for a specific service. Only vocabulary name defined in SD can be used for representations of the userType (see 7.1.4). ServiceUserType can use only vocabularies defined in ServiceTargetSet element in SD.
ProcessChain	Process description that can be executed at the client side, generated by the recommendation engine.
RecommendationHistory	A structure containing information about past recommendations.
RecommendationResult	A structure containing the recommendation result.
Recommendation	A structure containing the past recommendations.
Result	Any tangible result of the recommendation: satisfaction, feedback.
RecommendationInformation	A structure containing information about the recommendation (metadata of the recommendation).
commonAttributes	Common attributes of all top-level MPEG-UD descriptors.
Provider	Information about the recommendation provider (e.g. which recommendation engine).

8.1.2 compactUsageDescriptionType

It specifies compact usage description representation composed of a sequence of clusterings, lists, labelled sets or equivalence sets. These sets are used to organize the output of a recommendation engine for enhanced usage by the receiving application.

8.1.2.1 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>
```

8.1.2.2 Semantics

Semantics of the `compactUsageDescriptionType`:

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 equivalence 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.

8.1.2.3 Example

This example illustrates the structure of a CompactUsageDescription element in a case of a recommendation engine which recommends 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>
```

8.1.3 QueryDescriptionType

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

8.1.3.1 Syntax

```
<complexType name="queryDescriptionType">
   <annotation>
     <documentation>Main complex type for query description. It include 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>
```

8.1.3.2 Semantics

Semantics of the `queryDescriptionType`:

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`.

8.1.4 ProcessChainType

The `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.

8.1.4.1 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>
```

8.1.4.2 Semantics

Semantics of the `ProcessChainType`:

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.

8.1.5 RecommendationInformationType

Basic metadata about the recommendation itself.

8.1.5.1 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>
```

8.1.5.2 Semantics

Semantics of the `recommendationInformationType`:

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

8.1.5.3 Examples

```
<rd:RecommendationInformation>
  <rd:RecommendedObjectInformation>
    <ct:ObjectID>ID192</ct:ObjectID>
    <ct:ObjectName>MC_donald</ct:ObjectName>
    <ct:ObjectCategory
href="urn:mpeg:mpeg21:UD:CS:ObjectCategory:2016:0203">
     <Name>fast_food</Name>
    </ct:ObjectCategory>
    <ct:ObjectInformationURI>http://www.ud.com/</ct:ObjectInformationURI>
    <ct:ObjectLocation>
      <ct:GeographicLocation>
       <GeographicPosition datum="itrf">
          <Point longitude="-180" latitude="-90" altitude="60"/>
       </GeographicPosition>
      </ct:GeographicLocation>
    </ct:ObjectLocation>
  </rd:RecommendedObjectInformation>
  <rd:RecommendationPriority>1</rd:RecommendationPriority>
</rd:RecommendationInformation>
<rd:RecommendationInformation>
  <rd:RecommendedObjectInformation>
    <ct:ObjectID>ID193</ct:ObjectID>
    <ct:ObjectName>KFC</ct:ObjectName>
    <ct:ObjectCategory
href="urn:mpeg:mpeg21:UD:CS:ObjectCategory:2016:0203">
     <Name>fast_food</Name>
    </ct:ObjectCategory>
    <ct:ObjectInformationURI>http://www.mpeg-
ud.com/</ct:ObjectInformationURI>
    <ct:ObjectLocation>
      <ct:GeographicLocation>
       <GeographicPosition datum="itrf">
          <Point longitude="-180" latitude="-70" altitude="10"/>
       </GeographicPosition>
      </ct:GeographicLocation>
    </ct:ObjectLocation>
  </rd:RecommendedObjectInformation>
```

```
  <rd:RecommendationPriority>2</rd:RecommendationPriority>
</rd:RecommendationInformation>
```

8.1.6 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.

8.1.6.1 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>
```

8.1.6.2 Semantics

Semantics of the `recommendationDescriptionType`:

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.
Role	The role of this fragment in the context of this recommendation.
ServiceDescriptionFragment	A fragment of Service Description useful in the context of this Recommendation.
Role	The role of this fragment in the context of this recommendation.

8.1.6.3 Examples

The following example illustrates the result of a "friendship recommender engine". The engine provides the UserID oft wo users. The first one is recommended for a friendship request, while the second is not recommended.

```
<?xml version="1.0" encoding="UTF-8"?>

<rd:RD   xsi:schemaLocation="urn:mpeg:mpeg-rd:2014:01-RD-NS 4.MPEG-UD-RD-
ver4.0.xsd"        xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:rd="urn:mpeg:mpeg-rd:2014:01-RD-NS">

  <rd:RecommendationID>String</rd:RecommendationID>

  <rd:CompactUsageDescription>

    <rd:SimpleResource>

     <rd:UserDescriptionFragment    xmlns:ud="urn:mpeg:mpeg-ud:2014:01-UD-
NS">

        <ud:UserID>U100</ud:UserID>

        <rd:Role roleType="Good user to ask friendship"/>

     </rd:UserDescriptionFragment>
```

```
    </rd:SimpleResource>
    <rd:SimpleResource>
      <rd:UserDescriptionFragment   xmlns:ud="urn:mpeg:mpeg-ud:2014:01-UD-
NS">
        <ud:UserID>U100</ud:UserID>
        <rd:Role roleType="Never ask this user friendhip"/>
     </rd:UserDescriptionFragment>
    </rd:SimpleResource>
  </rd:CompactUsageDescription>
</rd:RD>
```

8.1.7 Resource

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

8.1.7.1 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>
```

8.1.7.2 Semantics

Semantics of Resource:

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

8.1.7.3 Example

This examples illustrates the case in which a recommended resource is a fragment of UD.

```
<Resource>
  <UserDescriptionFragment>
    <ud:UserID>u2</ud:UserID>
  </UserDescriptionFragment>
</Resource>
```

8.1.8 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.

8.1.8.1 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>
```

8.1.8.2 Semantics

Semantics of the `resourceUsageType`:

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.

8.1.8.3 Example

This example illustrates a case in which a certain Resource (in this case a fragment of UD) has been used by a number of other users identified by the list of UsageInformation elements.

```
...
<Resource>
  <UserDescriptionFragment>
    <ud:UserID>u2</ud:UserID>
  </UserDescriptionFragment>
</Resource>
<UsageInformation>
  <ud:UserID>u100</ud:UserID>
</UsageInformation>
<UsageInformation>
```

```
  <ud:UserID>u200</ud:UserID>

</UsageInformation>

<UsageInformation>

  <ud:UserID>u301</ud:UserID>

</UsageInformation>

<UsageInformation>

  <ud:UserID>u1000</ud:UserID>

</UsageInformation>

...
```

8.1.9 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.

8.1.9.1 Syntax

```
<complexType name="clusteringType" abstract="true">
    <annotation>
     <documentation>This is the abstract type for all clustering
structures.</documentation>
    </annotation>
    <sequence>
      <element name="ClusterStructure" type="rd:clusterStructureType"/>
      <element name="ClusteringParameters" type="anyType">
        <annotation>
         <documentation>Thisl element carries information specific to each
particular clustering technique.</documentation>
        </annotation>
      </element>
    </sequence>
    <attribute name="clusteringLabel" type="anyURI" use="required">
     <annotation>
      <documentation>This label identifies the clustering algorithm that produced
this clustering.</documentation>
     </annotation>
    </attribute>
    <attribute name="proximityFunction" type="anyURI" use="optional">
      <annotation>
       <documentation>This attribute identifies the proximity function adopted
inside the clustering algorithm when this can be parametrised. For example if the
clustering algorithm is "K-means", then an euclidean distance can be used or a
generalised Minkowski distance of some order.</documentation>
      </annotation>
    </attribute>
    <attribute name="features" type="NMTOKENS" use="optional">
      <annotation>
       <documentation>This attribute specifies which features of the multimedia
item have been used to cluster. This is in form of a list of elements identifier,
complex types identifier or other kind of resource identifiers that univoquely
identify a certain feature and its extraction mechanism.</documentation>
```

```
        </annotation>
      </attribute>
    </complexType>
```

8.1.9.2 Semantics

Semantics of the `clusteringType`:

Name	Definition
clusteringType	This is the abstract type for all clustering structures.
ClusterStructure	Represents the core structure of a clustering. It can contain other structures, to allow hierarchical clustering representation, or cluster members directly.
ClusteringParameters	This element carries information about parameters used to perform a particular clustering technique used by the recommendation engine to recommend clusters.
clusteringLabel	This label identifies the clustering algorithm that produced this clustering.
proximityFunction	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.
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.

8.1.9.3 Example

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

8.1.10 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.

8.1.10.1 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>
```

8.1.10.2 Semantics

Semantics of the `genericClusteringType`:

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.

8.1.10.3 Examples

The following example illustrates the result of a "friendship recommender engine". The engine provides a cluster of user descriptions. However, the information that each user in the cluster is recommended for a friendship request is provided for each user description fragment.

```xml
<?xml version="1.0" encoding="UTF-8"?>

<rd:RD    xsi:schemaLocation="urn:mpeg:mpeg-rd:2014:01-RD-NS 4.MPEG-UD-RD-
ver4.0.xsd"         xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:rd="urn:mpeg:mpeg-rd:2014:01-RD-NS"           xmlns:ud="urn:mpeg:mpeg-
ud:2014:01-UD-NS ">

  <rd:RecommendationID>String</rd:RecommendationID>

  <rd:CompactUsageDescription>

    <rd:Clustering                       xsi:type="rd:genericClusteringType"
clusteringLabel="K-means">

     <rd:ClusterStructure>

       <rd:ClusterMember>

         <rd:SetElement resourceID="">

           <rd:Resource>

             <rd:UserDescriptionFragment>

               <ud:UserID>U100</ud:UserID>

               <rd:Role roleType="Good user to ask friendship"/>

             </rd:UserDescriptionFragment>

            </rd:Resource>

         </rd:SetElement>

       </rd:ClusterMember>

       <rd:ClusterMember>

         <rd:SetElement resourceID="">

           <rd:Resource>

             <rd:UserDescriptionFragment>

               <ud:UserID>U200</ud:UserID>

               <rd:Role roleType="Good user to ask friendship"/>

             </rd:UserDescriptionFragment>

           </rd:Resource>

         </rd:SetElement>
```

```
              </rd:ClusterMember>
              <rd:ClusterMember>
                <rd:SetElement resourceID="">
                  <rd:Resource>
                    <rd:UserDescriptionFragment>
                      <ud:UserID>U300</ud:UserID>
                      <rd:Role roleType="Good user to ask friendship"/>
                    </rd:UserDescriptionFragment>
                  </rd:Resource>
                </rd:SetElement>
              </rd:ClusterMember>
            </rd:ClusterStructure>
            <rd:ClusteringParameters/>
          </rd:Clustering>
        </rd:CompactUsageDescription>
</rd:RD>
```

8.1.11 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).

8.1.11.1 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>
```

8.1.11.2 Semantics

Semantics of the `hierarchicalClusteringType`:

Name	Definition
`hierarchicalClusteringTy pe`	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)
`hierarchicalClusteringTy pe`	This attribute specifies the type of hierarchical clustering.

8.1.11.3 Example

This example illustrates the case in which the output of a recommendation engine is the result of a clustering algorithm of type hierarchical clustering named "Very Efficient Hierarchical Clustering". The actual structure of the resulting clustering is composed of a root cluster which contains a number of sub-clusters.

```
<rd:CompactUsageDescription>

    <rd:Clustering                   xsi:type="rd:hierarchicalClusteringType"
clusteringLabel="VEHC"      hierarchicalClusteringType="Very      Efficient
Hierarchical Clustering">

      <ClusterStructure>

       <rd:Cluster> <!-- The root cluster -->

         <rd:Cluster>

           <rd:Cluster>

            <rd:Cluster>

           </rd:Cluster>

           <rd:Cluster>...</rd:Cluster>

           <rd:Cluster>...</rd:Cluster>

         </rd:Cluster>

      </ClusterStructure>

      <rd:ClusteringParameters>...</rd:ClusteringParameters>

    </rd:Clustering>

</rd:CompactUsageDescription>
```

8.1.12 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).

8.1.12.1 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>
```

8.1.12.2 Semantics

Semantics of the sequentialClusteringType:

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).

8.1.13 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 used for clustering is of this kind (e.g., K-means).

8.1.13.1 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., K-
means). </documentation>
  </annotation>
  <complexContent>
    <extension base="rd:clusteringType"/>
  </complexContent>
</complexType>
```

8.1.13.2 Semantics

Semantics of the costFunctionMinimisationClusteringType:

Name	Definition
costFunctionMinimisation ClusteringType	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. K-means).

8.1.13.3 Example

This example illustrates the case in which the output of a recommendation engine is the result of a clustering algorithm of type cost function minimisation named "K-MEANS". The actual structure of the resulting clustering is composed of 2 clusters. Each cluster contains 2 elements.

```
<rd:Clustering        xsi:type="rd:costFunctionMinimisationClusteringType"
clusteringLabel="K-MEANS">

  <rd:ClusterStructure>

    <rd:Cluster>

     <rd:ClusterMember>

     ...

     </rd:ClusterMember>

     <rd:ClusterMember>

     ...

     </rd:ClusterMember>

    </rd:Cluster>

      <rd:Cluster>

      <rd:ClusterMember>

      ...

      </rd:ClusterMember>

      <rd:ClusterMember>

      ...

      </rd:ClusterMember>

       </rd:Cluster>

    <rd:ClusterStructure>

</rd:Clustering>
```

8.1.14 clusterStructureType

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

8.1.14.1 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>
```

8.1.14.2 Semantics

Semantics of the `clusterStructureType`:

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.

8.1.14.3 Example

This example illustrates the general structure of ClusterStructure element. This element is composed by two Clusters and an element carrying information about the quality of the clustering in terms of average entropy of the resulting clustering. Each Cluster contains a number of ClusterMembers. Each ClusterMember contains the SetElement which in turns contain the actual recommended Resource. In this example, all recommended resources are fragments of UD documents.

```
<rd:ClusterStructure>
<rd:Cluster>
  <rd:ClusterMember>
    <rd:SetElement resourceID="r1">
      <rd:Resource>
        <rd:UserDescriptionFragment>
          <ud:UserID>...</ud:UserID>
```

```
            </rd:UserDescriptionFragment>
          </rd:Resource>
        </rd:SetElement>
      </rd:ClusterMember>
      <rd:ClusterMember>
        <rd:SetElement resourceID="r10">
          <rd:Resource>
            <rd:UserDescriptionFragment>
              <ud:UserID>...</ud:UserID>
            </rd:UserDescriptionFragment>
          </rd:Resource>
        </rd:SetElement>
      </rd:ClusterMember>
      <rd:ClusterMember>
        <rd:SetElement resourceID="r100">
          <rd:Resource>
           <rd:UserDescriptionFragment>
              <ud:UserID>...</ud:UserID>
            </rd:UserDescriptionFragment>
          </rd:Resource>
        </rd:SetElement>
      </rd:ClusterMember>
      <rd:ClusterMember>
        <rd:SetElement resourceID="r1000">
          < rd:Resource>
            <rd:UserDescriptionFragment>
              <ud:UserID>...</ud:UserID>
            </rd:UserDescriptionFragment>
          </rd:Resource>
        </rd:SetElement>
      </rd:ClusterMember>
      <rd:ClusterMember>
        <rd:SetElement resourceID="r10000">
          <rd:Resource>
            <rd:UserDescriptionFragment>
              <ud:UserID>...</ud:UserID>
            </rd:UserDescriptionFragment>
```

```
        </rd:Resource>

      </rd:SetElement>

    </rd:ClusterMember>

  </rd:Cluster>

<rd:Cluster>...<rd:Cluster>

<rd:QualityInformation metricID="entropy" value="1.001"/>

</ClusterStructure>
```

8.1.15 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.

8.1.15.1 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>
```

8.1.15.2 Semantics

Semantics of the `genericAggregateType`:

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

8.1.15.3 Example

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

8.1.16 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.

8.1.16.1 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 about
```

```
its 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>
```

8.1.16.2 Semantics

Semantics of the `setMemberType`:

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

8.1.16.3 Example

This example illustrates the generic structure of a Member of a set. A Member is composed by the actual element of the set and information about its usages by other users and about the membership degree of the element to the current enclosing set.

```
<Member>
  <SetElement resourceID="res2">
    <Resource>
      <UserDescriptionFragment>
        <ud:UserID>u2</ud:UserID>
      </UserDescriptionFragment>
    </Resource>
    <UsageInformation>
      <ud:UserID>u100</ud:UserID>
    </UsageInformation>
    <UsageInformation>
      <ud:UserID>u200</ud:UserID>
```

```
    </UsageInformation>
    <UsageInformation>
      <ud:UserID>u301</ud:UserID>
    </UsageInformation>
    <UsageInformation>
      <ud:UserID>u1000</ud:UserID>
    </UsageInformation>
    <Role roleType="Ask_Friendship"/>
  </SetElement>
  <MembershipDegree>0.87</MembershipDegree>
</Member>
```

8.1.17 orderedSetMemberType

This complex type represents members of ordered sets.

8.1.17.1 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>
```

8.1.17.2 Semantics

Semantics of the `orderedSetMemberType`:

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.

8.1.17.3 Example

This example illustrates the generic structure of a OrderedMemer of an ordered set. An OrderedMember is composed by the actual element of the set and information about its usages by other users, about the membership degree of the element to the current enclosing ordered set, and about the order in the enclosing ordered set. This latter information is represented by the Rank element.

```
<OrderedMember>
  <SetElement resourceID="res2">
    <Resource>
      <UserDescriptionFragment>
       <ud:UserID>u2</ud:UserID>
      </UserDescriptionFragment>
    </Resource>
    <Role roleType="Ask_Friendship"/>
  </SetElement>
  <Rank>0.93</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>
```

8.1.18 genericSetType

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

8.1.18.1 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>
```

8.1.18.2 Semantics

Semantics of the `genericSetType`:

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.

8.1.18.3 Example

An example of Generic Set containing a number of Members.

```
<GenericSet      xmlns="some.uri"      xmlns:rd="urn:mpeg:mpeg21:UD:RD:2016"
xsi:type="rd:genericSetType">

<rd:Member>...</rd:Member>

<rd:Member>...</rd:Member>

<rd:Member>...</rd:Member>

...

</GenericSet>
```

8.1.19 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.

8.1.19.1 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>
```

8.1.19.2 Semantics

Semantics of the `labelledSetType`:

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.

Name	Definition
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.

8.1.19.3 Examples

The following example illustrates the result of a "friendship recommender engine". The engine provides a labelled set containing three user descriptions. The information that each user in the set is recommended for a friendship request is provided globally as a label information.

```
<?xml version="1.0" encoding="UTF-8"?>

<rd:RD   xsi:schemaLocation="urn:mpeg:mpeg-rd:2014:01-RD-NS 4.MPEG-UD-RD-
ver4.0.xsd"         xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:rd="urn:mpeg:mpeg-rd:2014:01-RD-NS">

  <rd:RecommendationID>String</rd:RecommendationID>

  <rd:CompactUsageDescription>

    <rd:LabelledSet>

      <rd:Member>

        <rd:SetElement       resourceID="r1"        xmlns:ud="urn:mpeg:mpeg-
ud:2014:01-UD-NS">

          <rd:Resource>

            <rd:UserDescriptionFragment>

              <ud:UserID>U100</ud:UserID>

            </rd:UserDescriptionFragment>

          </rd:Resource>

        </rd:SetElement>

        </rd:Member><rd:Member>

        <rd:SetElement       resourceID="r2"        xmlns:ud="urn:mpeg:mpeg-
ud:2014:01-UD-NS">

          <rd:Resource>

            <rd:UserDescriptionFragment>

              <ud:UserID>U200</ud:UserID>

            </rd:UserDescriptionFragment>

          </rd:Resource>

        </rd:SetElement>

        </rd:Member><rd:Member>

        <rd:SetElement       resourceID="r3"        xmlns:ud="urn:mpeg:mpeg-
ud:2014:01-UD-NS">

          <rd:Resource>

            <rd:UserDescriptionFragment>
```

```
                    <ud:UserID>U300</ud:UserID>
                  </rd:UserDescriptionFragment>
                </rd:Resource>
              </rd:SetElement>
        </rd:Member>
        <rd:LabellingInfo>
  <rd:Label>Good Users to ask friendship</rd:Label>
</rd:LabellingInfo>
      </rd:LabelledSet>
  </rd:CompactUsageDescription>
</rd:RD>
```

8.1.20 orderedSetType

This complex type represents ordered sets.

8.1.20.1 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>
```

8.1.20.2 Semantics

Semantics of the orderedSetType:

Name	Definition
orderedSetType	This complex type represents ordered sets.
OrderedMember	The actual ordered member of the set.

8.1.20.3 Example

An example of Ordered Set containing a number of OrderedMembers. Each ordered member has its own Rank information.

```
<OrderedSet      xmlns="some.uri"      xmlns:rd="urn:mpeg:mpeg21:UD:RD:2016"
xsi:type="rd:orderedSetType">

<rd:OrderedMember>...<rd:Rank>1</rd:Rank></rd:OrderedMember>

<rd:OrderedMember>...<rd:Rank>2</rd:Rank></rd:OrderedMember>

<rd:OrderedMember>...<rd:Rank>3</rd:Rank></rd:OrderedMember>

...

</OrderedSet>
```

8.1.21 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.

8.1.21.1 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>
```

8.1.21.2 Semantics

Semantics of the equivalenceSetType:

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.

8.1.21.3 Example

An example of Equivalence Set containing a number of Members. The equivalence criterion set to the value "duration" expresses the fact that the members are equivalent under that property from the perspective of the recommendation engine.

```
<EquivSet        xmlns="some.uri"        xmlns:rd="urn:mpeg:mpeg21:UD:RD:2016"
xsi:type="rd:equivalenceSetType" rd:equivalenceCriterion="duration">

<rd:Member>...</rd:Member>

<rd:Member>...</rd:Member>

<rd:Member>...</rd:Member>

...

</EquivSet>
```

8.1.22 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.

8.1.22.1 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>
```

8.1.22.2 Semantics

Semantics of the linkageSetType:

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.

8.1.22.3 Example

This example illustrates the usage of linkageSetType. In this case, a Resource described by the SourceItem element (a fragment of SD carrying metadata about a web article) is related to a number of

other Resources (each of which wrapped inside the OrderedMember structure) with a relation strength defined by the Rank information.

```
<LinkageSet    xmlns="some.uri"    xmlns:rd="urn:mpeg:mpeg21:UD:RD:2016"
xsi:type="rd:linkageSetType">

<rd:OrderedMember>...<rd:Rank>1</rd:Rank></rd:OrderedMember>

<rd:OrderedMember>...<rd:Rank>2</rd:Rank></rd:OrderedMember>

<rd:OrderedMember>...<rd:Rank>3</rd:Rank></rd:OrderedMember>

...

<rd:SourceItem>

<rd:ServiceDescriptionFragment>

<sd:ServiceID>HMN</sd:ServiceID>

<sd:ServiceGeneralInformation>

<sd:ServiceName>HyperMediaNews</sd:ServiceName>

<sd:ServiceProviderName>RAIRadiotelevisioneItaliana</sd:ServiceProviderName>

</sd:ServiceGeneralInformation>

<sd:ServiceTargetInformation/>

<sd:IsServiceAvailable>true</sd:IsServiceAvailable>

<sd:ServiceObjectsInformation>

<sd:DatabaseOfMultimedia>

<didl:Item>

<didl:Descriptor>

<didl:Statement mimeType="String">

<![CDATA[

"Si lavora con discrezione per arrivare a un'intesa che apra le porte"
Cardinal Parolin: il Papa andrebbe subito in Cina Condividi 11 ottobre
2015"Il Papa vuole andare in Cina, e credo che se si aprissero le porte
partirebbe oggi stesso". Lo ha detto il segretario di Stato vaticano,
card. Pietro ...

]]>

</didl:Statement>

</didl:Descriptor>

<didl:Component>

<didl:Resource                                        mimeType="text/html"
ref="http://www.rainews.it/dl/rainews/articoli/Papa-Cina-Parolin-
Vaticano-a541ac73-883e-49fa-8570-3f1839dcdc3a.html"/>

</didl:Component>

</didl:Item>

<sd:CreationInformation>

<mpeg7:Title>
```

```
<![CDATA[
<media:title type="plain">Cardinal Parolin: il Papa andrebbe subito in
Cina</media:title>
]]>
</mpeg7:Title>
<mpeg7:Creator>
<mpeg7:Role href="Publisher"/>
<mpeg7:Agent xsi:type="mpeg7:OrganizationType">
<mpeg7:Name>
<![CDATA[ RAI.it ]]>
</mpeg7:Name>
</mpeg7:Agent>
</mpeg7:Creator>
<mpeg7:CreationCoordinates>
<mpeg7:Date>
<mpeg7:TimePoint>2015-10-11T16:33:00</mpeg7:TimePoint>
</mpeg7:Date>
</mpeg7:CreationCoordinates>
</sd:CreationInformation>
</sd:DatabaseOfMultimedia>
</sd:ServiceObjectsInformation>
</rd:ServiceDescriptionFragment>
</rd:SourceItem>
</LinkageSet>
```

8.1.23 Member

Utility element for generic set members.

8.1.23.1 Syntax

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

8.1.23.2 Semantics

Semantics of the Member:

Name	Definition
Member	Utility element for generic set members.

8.1.23.3 Example

An example of Member element.

```
<Member>
  <SetElement resourceID="res1">
    <Resource>
      <UserDescriptionFragment>
        <ud:UserID>u1</ud:UserID>
      </UserDescriptionFragment>
    </Resource>
    <Role roleType="Ask_Friendship"/>
  </SetElement>
</Member>
```

8.1.24 OrderedMember

Utility element for ordered set members.

8.1.24.1 Syntax

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

8.1.24.2 Semantics

Semantics of the OrderedMember:

Name	Definition
OrderedMember	Utility element for ordered set members.

8.1.24.3 Example

An example of OrderedMember element.

```
<OrderedMember>
  <SetElement resourceID="res1">
    <Resource>
      <UserDescriptionFragment>
        <ud:UserID>u1</ud:UserID>
      </UserDescriptionFragment>
    </Resource>
    <Role roleType="Ask_Friendship"/>
  </SetElement>
  <Rank>0.5</Rank>
```

```
</OrderedMember>
```

8.1.25 queryClauseType

This abstract complex type represents a generic query clause.

8.1.25.1 Syntax

```xml
<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>
```

8.1.25.2 Semantics

Semantics of the `queryClauseType`:

Name	Definition
queryClauseType	This abstract complex type represents a generic query clause.
QueryByMedia	A structure specifying a query by media.
ReferenceItem	The reference media item used for querying by media.
QuerySpecification	A structure specifying the query.
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".

8.1.25.3 Example

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

8.1.26 ORqueryClauseType

8.1.26.1 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>
```

8.1.26.2 Semantics

Semantics of the `ORqueryClauseType`:

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

8.1.26.3 Example

This example illustrates a case of a query containing two subclauses to be combined in logical AND mode inside a recommended query. The resulting clause combination is defined to be considered as logically true in the AND combination (i.e. overall it is NOT a negated complex clause). This means that the query processor is asked to find items whose distance from the first reference item is higher than 0.4 OR items that follow temporally the second reference item.

```
<AndQueryClause  xmlns="some.uri"  xmlns:rd="  urn:mpeg:mpeg21:UD:RD:2016"
xsi:type="rd:ANDqueryClauseType" logicalValue="true">

<QueryByMedia>

  <ReferenceItem>...</ReferenceItem>

  <QuerySpecification xsi:type="mpqf:QueryByFeatureRange">

    <mpqf:Distance                    Center="ID1"                    Radius="0.4"
DistanceFunction="euclidean"/>

  </QuerySpecification>

</QueryByMedia>

<QueryByMedia>

  <ReferenceItem>...</ReferenceItem>

  <QuerySpecification xsi:type="mpqf:TemporalQuery">

    <mpqf:TemporalRelation relationType="precedes" sourceResource="ID1"/>

  </QuerySpecification>

</QueryByMedia>

</AndQueryClause>
```

8.1.27 ANDqueryClauseType

8.1.27.1 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>
```

8.1.27.2 Semantics

Semantics of the `ANDqueryClauseType`:

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.

8.1.27.3 Example

This example illustrates a case of a query containing two subclauses to be combined in logical OR mode inside a recommended query. The resulting clause combination is defined to be considered as logically false in the OR combination (i.e. overall it is negated complex clause). This means that the query processor is asked to find items whose distance from the first reference item is higher than 0.4 AND that follow temporally the second reference item.

```
<OrQueryClause  xmlns="some.uri"  xmlns:rd="  urn:mpeg:mpeg21:UD:RD:2016"
xsi:type="rd:ORqueryClauseType" logicalValue="false">

<QueryByMedia>

  <ReferenceItem>...</ReferenceItem>

  <QuerySpecification xsi:type="mpqf:QueryByFeatureRange">

    <mpqf:Distance              Center="ID1"              Radius="0.4"
DistanceFunction="euclidean"/>

  </QuerySpecification>

</QueryByMedia>

<QueryByMedia>

  <ReferenceItem>...</ReferenceItem>

  <QuerySpecification xsi:type="mpqf:TemporalQuery">

    <mpqf:TemporalRelation relationType="precedes" sourceResource="ID1"/>

  </QuerySpecification>

</QueryByMedia>

</OrQueryClause>
```

Annex A
(normative)

MPEG-21 UD technologies

The MPEG-21 UD technologies are attached within this document. This attachment includes five schemes with the following file names:

- **0.MPEG_21_UD_CT.xsd (Common Type)**

- **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 annex 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

The 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>
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n.e.c.</Definition></Term>
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