BS ISO 19149:2011

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Geographic information — Rights expression language for geographic information — GeoREL

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National foreword

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A list of organizations represented on this committee can be obtained on request to its secretary.

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INTERNATIONAL STANDARD

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Geographic information — Rights expression language for geographic information — GeoREL

Information géographique — Langue sur l'expression des droits pour l'utilisation de l'information géographique — GeoREL

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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

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

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 19149 was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics.* A base document was supplied by the Open Geospatial Consortium, Inc.

Introduction

The use of ubiquitous computing in geographic information is often obstructed by legal concerns about the rights of the holders and owners of data and other intellectual property resources. It can be the case that once data or other resource is released into any unconstrained and unprotected environment, the value of the holding is decreased because the underlying data theoretically becomes available from other sources. The multimedia industry has taken the lead in solving this problem by creating a general model for digital rights protection, in which a language was developed in order that instances of those rights might be documented, a rights expression language, specifically in ISO/IEC 21000-5, the ISO REL. This language, used in conjunction with Digital Rights Management (DRM) systems, can protect the value of data and still allow it to be distributed subject to a system of licensing, trust and enforcement.

This International Standard extends the ISO REL to encompass the concerns of holders of geographic data and service resources to equally ensure their protection. This allows the geographic information market to operate with minimal constraints derived from the need for the protection of intellectual property.

There are two major sources for foundational material for this work.

— The first source is ISO/IEC 21000, a multiple part standard that defines digital rights management in general. There is no need to extend this basic foundation for expressing and enforcing rights for resources except in those cases where the special requirements of geographic information and services make it necessary.

— The second source is ISO 19153 (originally an Open Geospatial Abstract Specification volume), which enumerates these special cases for geographic information as well as providing an overall reference model using common geographic information terms that ties the work of the ISO/IEC 21000 work into this spatial standard.

Given these two foundations, the purpose of this International Standard is to extend the ISO REL, consistent with the requirements for such extensions given in ISO/IEC 21000-5, to cover the special cases enumerated in ISO 19153.

INTERNATIONAL STANDARD ISO 19149:2011(E)

Geographic information — Rights expression language for geographic information — GeoREL

1 Scope

This International Standard defines an XML-based vocabulary or language to express rights for geographic information in order that digital licenses can be created for such information and related services. This language, GeoREL, is an extension of the rights expression language in ISO/IEC 21000-5 and is to be used to compose digital licenses. Each digital license will unambiguously express those particular rights that the owners (or their agent) of a digital geographic resource extend to the holders of that license. The digital rights management system in which these licenses are used can then offer *ex ante* (before the fact) protection for all such resources.

NOTE The proper use of a GeoREL includes the preservation of rights access by formula expressed in usage licenses. Thus, data in the public or private domain, when protected, remain in their respective domains if the usage rights granted so state.

These “rights” are not always covered by copyright law, and are often the result of contracts between individuals that specify the proper and allowed uses of resources, as opposed to the threat of copyright litigations which is an *ex post facto* (after the fact) remediation measure, not an *ex ante* protection measure. This International Standard is not a reflection of, or extension of, copyright law.

Mechanisms for the enforcement and preservation of those contract rights are specified in ISO/IEC 21000, and it is not the intention of this International Standard to replace nor redefine those mechanisms, but to use them as previously standardized.

2 Conformance

The license language vocabulary is expressed as an XML schema extending the ISO/IEC 21000-5 REL. A conformant license expression is a well-formed and complete XML document (or its equivalent) that expresses the semantics described in the standard and that is properly protected from modification by the mechanisms described and specified in ISO/IEC 21000.

A license compliant to this International Standard will be consistent with the XML schema for ISO/IEC 21000-5 and the XML schema associated with this International Standard (see requirements in Clause 6).

A software system compliant to this International Standard shall interpret any compliant license in a manner consistent with the semantics expressed in ISO/IEC 21000 and the abstract test suite given in Annex A.

3 Normative references

The following referenced standards are indispensable for the application of this International Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced standard (including any amendments) applies.

ISO 19153[1)], *Geospatial Digital Rights Management Reference Model (GeoDRM RM)*

ISO/IEC 21000 (all parts), *Information technology — Multimedia framework (MPEG-21)*

4 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 21000 apply[2)].

The terms “constraint” and “condition” are used interchangeably, and no distinction is meant in terms of the license based on which term is used. This differs from other cases where constraints are expressed as the contrapositive of conditions.

Following the precedent set in ISO/IEC 21000, the alternative English (Oxford English Dictionary) spelling of the word license has been used in all instances, except when used in proper names. This is in contradiction to the ISO 19153, and the preferred English usage, where the word “license” is usually a verb and the word “licence” is a noun. Both US and UK English dictionaries accept the “s” spellings for the noun, and so this is not in variance with any current dictionary in either dialect. The basic reason for this is to not confuse the spelling of the XML elements (which use the ISO/IEC 21000 spellings) with the spellings in the text. No semantic difference is meant by this typographic convention.

5 Symbols and abbreviated terms

5.1 Abbreviated terms

The following symbols and abbreviated terms are used in this document.

DRM Digital Rights Management

GeoREL Rights Expression Language for Geographic Information (including the ISO REL and the extension defined in this International Standard)

GeoDRM Digital Rights Management for Geographic Information

ISO REL Rights Expression Language from ISO/IEC 21000-5 (see Annex C for notes on ISO REL)

LBS Location Based Service

REL Rights Expression Language

UDDI Universal Description, Discovery and Integration

URI Uniform Resource Identifier

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1) To be published.

2) This International Standard does not include an abstract model. It depends on the models in ISO/IEC 21000 and ISO 19153.

WFS Web Feature Service (ISO 19142)

WSDL Web Services Definition Language

XML Extensible Markup Language

5.2 Symbols used for common XML namespaces

The following namespace prefixes are used in the in-text XML and XML Schema fragments:

`grm` Namespace prefix for the geoRel.xsd license extensions

`xsd` Namespace prefix for the XML Schema basic types, used in defining schema elements

`r` Namespace prefix for rel-r.xsd in ISO/IEC 21000, representing the namespace urn:mpeg:mpeg21:2003:01-REL-R-NS

`sx` Namespace prefix for rel-sx.xsd in ISO/IEC 21000, representing the namespace urn:mpeg:mpeg21:2003:01-REL-SX-NS

`mx` Namespace prefix for rel-mx.xsd in ISO/IEC 21000, representing the namespace urn:mpeg:mpeg21:2003:01-REL-MX-NS

Examples in this International Standard are given as informative illustrations of ideas, and are not valid licenses, since they lack the appropriate signature values that would allow them to be recognized by a qualified security system as well-formed. Other than the absence of signature keys, the fragments are valid, in the sense that within a properly signed license document, they would be valid and correctly parsed and interpreted if correctly placed in the larger context of a license. They do conform to the XML schemas using the above namespace prefixes, unless abbreviated elements are used, and in those cases, the abbreviations are noted in the text, or in the use of ellipsis marks (…) between opening and closing element tags.

To make the requirements expressed in this International Standard easier to find, normative statements specifying either requirements or recommendations have been presented in a **bold font**.

6 Digital rights management systems

This International Standard is written within the model defined in ISO 19153 and within the model defined in ISO/IEC 21000, including all of its parts. The license structure is defined in ISO/IEC 21000-5 and this International Standard only addresses the extension of that license format for the purpose of creating a licensing vocabulary for geographic resources, both data and services, using as much of the existing ISO/IEC 21000-defined framework as possible. An informative description of the entire MPEG-21 systems as defined in ISO/IEC 21000 is given in *The MPEG-21 Book* [6] cited in the Bibliography.

For this purpose, this International Standard defines extensions only to license parts appearing in grants as defined by ISO/IEC 21000-5 and whose semantics are described in ISO 19153. All security, principal identity, and generic resource descriptions and identity descriptions remain as defined in ISO/IEC 21000.

In all cases, licenses valid under this International Standard shall be consistent with the schema given in Annex B and those schemas imported by it, and shall carry a valid digital signature of the resource owner or of one of the owner's recognized agents.

A software system compliant to this International Standard shall interpret any compliant license in a manner consistent with the semantics expressed in ISO/IEC 21000 and this International Standard.

These dependencies on ISO/IEC 21000 and ISO 19153 provide the context for this International Standard. ISO/IEC 21000 provides a general system description for digital rights management, license construction and interpretation, and covers the security techniques that make such systems feasible. ISO 19153 provides a

reference model including those items in the realm of geographic information that require the protection of a licensing system. The extension to the ISO REL as presented in this International Standard is where these two dependencies interact. ISO/IEC 21000 gives requirements for the mechanism for extending the ISO REL and ISO 19153 provides the semantics for those same extensions.

7 Requirements for the expression of digital licenses for geographic resources

A license in a rights expression language has as its major component a sequence of grants which specifies which individuals (represented by principals) may commit which acts (represented by rights) against which items (represented as resources) under which circumstances (represented by conditions). Within an ISO REL grant (XML element r:grant; see Figure 1), these four types of items are specified in the following order, including:

1) Principal – the parties to whom the licensed right is granted, the licensee;
2) Rights – the act or actions covered by the rights licensed by this grant;
3) Resources – the items to be licensed, and hence to which rights are granted;
4) Conditions – conditions on any parts specific to this grant.

Descriptive terms associated with resources, rights and principals because of their geographic nature are needed in the license extension defined by this International Standard. These terms are given in geoCondition elements, using references to the described Principal, Right or Resource using standard ISO/IEC 21000-5 mechanisms. The most obvious requirements deal with geographic constraints within a database resource. Less obvious, but just as important, is the description of geographic processing resources or services that may be associated in particular or in kind to other resources.

These descriptions can link across multiple licenses to create behaviours of the licensing system as required.

EXAMPLE

— A license can be given to each emergency management professional for a given area as proof of his status.
— A license can be associated with each data or service resource that gives emergency management professionals access to use the resource but triggers a side effect that records that access.
— In an emergency, the emergency management professional can use his “proof of status” license to gain access to the resources in the group above.

This is a simple implementation strategy for a “break the glass” use of normally restricted data by authorized personnel.

Since the actions against these types of resources cannot be defined completely within the purview of multimedia, the rights associated with geographic data and processing resources require further description within a geo-license than they would in a baseline ISO/IEC 21000 license.

With new actions (rights) and geographic resources, the conditions placed on grants require more description to fully meet the need of the geographic information and processing communities. Conditions describe how the license part is constrained, using the property or Boolean expression that needs to be matched by that part.

The other parts of a license, including the security specifications and identification, are not affected by the association of geographic properties to the licensed resources, rights, conditions and principals involved in the community. In many cases, useful licenses for geographic resources may confine themselves to the dialect of an ISO/IEC 21000-5 compliant license. These other parts include the identity of the license issuer, also a principal, who shall be an agent (through a “chain of agency”, see ISO 19153) of the owner of the resource. The additional information associated with the issuer is verification information that “digitally signs” the license as an XML document, which proves the identity of the issuer as the signatory, and the license document's “unmodified” state from the time of the signature. The mechanism is defined in ISO/IEC 21000-5 and uses “Digital Signatures” for XML documents.

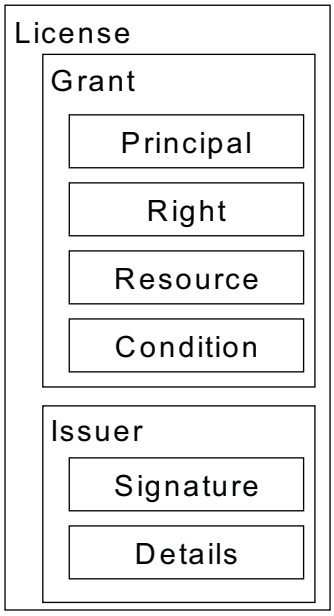

Figure 1 — Structure of a license from ISO/IEC 21000-5

8 Geographic rights expression language extensions — GeoREL

8.1 Technical approach

The licenses produced by the MPEG 21/ISO/IEC 21000 REL are designed to work within a security system that can enforce to the extent legally and feasibly possible the conditions of a legal contract, the legal version of the license between supplier and user. It is not the intent of this International Standard to supplant this system, but to extend the parts that describe the granting of license rights to include geographic data and processing resources to take advantage of those same security features.

Further, the license structure is constrained by the semantics of its interpretation as given in the description of authorization presented in ISO/IEC 21000-5. This interpretation is not always “obvious” to the uninformed reader of the license. A digital license, even when written in an unencrypted XML format, would not be expected to be interpretable by anyone unless they are conversant with the authorization algorithms and element semantics described in ISO/IEC 21000.

The public users should never be encouraged to read an XML license in order to understand their contract. Licenses published in unencrypted form should carry a caveat that expresses this concern, and refers the user back to the legally binding contract, or other “plain text” explanation of the meaning of the license.

The general approach is to extend the principal, right, resource and conditions of the ISO REL to include geometric properties. To ensure that the baseline functions of the ISO REL are preserved, these extensions have been made by using conditions within the license to describe, and thereby restrict, these entities.

The patterns used in the following clauses follow one of the following abstract structures:

```
GeoResource implements Resource
        Sequence
            (
        Resource
            )

GeoCondition implements Condition
        Sequence
            (
            License Part   —— usually by reference or variable
            Service        —— service to calculate the conditions if needed
            Boolean statement or condition to match by the License Part
            )
```

In each specific property to be used in conditions defined below, and in specifications using this International Standard as a base, care should be taken to completely define and understand the semantics of the property so that there is no ambiguity in license processing by the GateKeeper as defined in ISO 19153. The validity of actions with respect to a license is defined in ISO/IEC 21000-5 (with the geographic interpretation of conditions supplied by ISO 19153).

When properly interpreted by conformant "gatekeeper" software, a valid license shall always allow actions valid under the license, and shall always disallow actions not valid under the license.

For continuity of the narrative, the semantics of terms from the references are often included in the text of this International Standard. **If this semantics text is different from the ISO 19153 text or the ISO/IEC 21000 text, the base standard text takes precedence and should be considered the primary source of the normative semantics of the terms used.**

8.2 Spatial entities used in conditions

A common entity used in conditions is a geographic place specified by geometry, name or other text, such as an address or telephone number that can be associated with a place. Most of these names would be included in an ISO-compliant gazetteer or similar data store available to the license GateKeeper.

Geometry to express geographic location requires information on coordinate system and mechanisms for interpretation. A geoPlace element uses GML geometry elements, defined in ISO 19136, to properly describe such geometry as needed. GeoPlace is essentially a data-type that can be used to realize SI_LocationInstance from ISO 19112 or AD_AbstractAddress from ISO 19133. Schema 1 gives an XML Schema description of these elements. This and all other schema examples in this International Standard are combined in a full XML schema document (geoRel.xsd) given in Annex B.

Schema 1: GeoPlace

```
<xsd:complexType name="GeoPlace" mixed="false">
<xsd:annotation>
   <xsd:documentation>
      GeoPlace is a named place, described elsewhere in some gazetteer. This
      allows the license to avoid large coordinate strings, and makes the
      license more readable
   </xsd:documentation>
</xsd:annotation>
<xsd:choice minOccurs="0">
   <xsd:element ref="gml:_Geometry"/>
   <xsd:element name="location">
      <xsd:complexType>
         <xsd:sequence>
            <xsd:element name="country" type="xsd:QName" minOccurs="0"/>
            <xsd:element name="region" type="xsd:QName" minOccurs="0"/>
            <xsd:element name="state" type="xsd:string" minOccurs="0"/>
            <xsd:element name="city" type="xsd:string" minOccurs="0"/>
            <xsd:element name="postalCode" type="xsd:string"
                minOccurs="0"/>
            <xsd:element name="street" type="xsd:string" minOccurs="0"/>
         </xsd:sequence>
      </xsd:complexType>
   </xsd:element>
</xsd:choice>
<xsd:attribute name="placeName" type="xsd:string" use="optional"/>
<xsd:attribute name="gazetteer" type="xsd:anyURI" use="optional"/>
</xsd:complexType>

<xsd:element name="geoPlace" type="grm:GeoPlace"/>
```

The place may be presented as either an element value of geometry or as a “placeName” attribute value, usually either well-known or linked to some sort of gazetteer where its limits may be found. Further, an Address structure can be used. The pattern for address is taken from ISO/IEC 21000-5 and parallels the similar structure in ISO 19133. It can be extended for local use in the same manner as done in r:territory in the ISO REL.

NOTE Other text used as place names, such as telephone numbers, would be included as a placeName attribute value, and a gazetteer describing their semantics would be included.

In cases where geometry is included, the placeName and gazetteer may be ignored. **The local geometry description should take precedent over the implied extent of the place name from the gazetteer service (ISO 19112). These redundant location expressions should be consistent with the location expressed in the geometry.**

In general, properties and parameters are used in conditions to restrict license parts based on conditions. The only difference between a parameter and a property is that a parameter shall have a name, usually referring to a name used in a properly formatted service request, but potentially using a WSDL (or similar) offset such as “wsdl-4” which would be the 4th parameter in the description of a WSDL structure as specified in the **parameterOrder** attribute of the **operation** element (2.4.6 Parameter Order within an Operation http://www.w3.org/TR/wsdl#_parameter) in the WSDL description – see References [9], [10], [11] and [12] in the Bibliography. The use of WSDL offsets is consistent with the expression of service calls in conditions as expressed in ISO/IEC 21000 licenses for such items as “tracking” services (defined in ISO 19133). Schema 2 gives the basic structure of properties and parameters to be used in expressing geoCondition elements.

Schema 2: Property and parameter schema

```
<xsd:complexType name="Property" mixed="true">
   <xsd:annotation>
      <xsd:documentation>
         Properties are descriptions of any item in a licence. The only
         current restriction is that they shall have a name, a description
         and a value from this namespace.
      </xsd:documentation>
   </xsd:annotation>
   <xsd:attribute name="name" type="xsd:string" use="optional"/>
   <xsd:attribute name="definition" type="xsd:anyURI" use="optional"
      default="urn:ogc:geodrm:properties"/>
</xsd:complexType>

<xsd:complexType name="Parameter" mixed="true">
   <xsd:complexContent mixed="true">
      <xsd:extension base="grm:Property">
         <xsd:sequence>
            <xsd:element ref="grm:property"/>
         </xsd:sequence>
      </xsd:extension>
   </xsd:complexContent>
</xsd:complexType>

<xsd:complexType name="ParameterList">
   <xsd:sequence>
      <xsd:element ref="grm:parameter" maxOccurs="unbounded"/>
   </xsd:sequence>
</xsd:complexType>

<xsd:element name="property" type="grm:Property"/>

<xsd:element name="parameter" type="grm:Parameter"
    substitutionGroup="grm:property"/>

<xsd:element name="parameters" type="grm:ParameterList"/>
```

8.3 Resources

8.3.1 Resources from ISO/IEC 21000

The geographic rights expression language extensions – GeoREL – define only a limited number of extensions to the ISO REL as defined in ISO/IEC 21000-5. Where possible, GeoREL uses element definitions directly from the ISO REL as originally intended; for example, GeoREL uses the r:resource element from the ISO REL to identify resources. Schema 3 quotes from the ISO/IEC 21000 schemas of the root type for resource.

Schema 3: Resource from ISO/IEC 21000

```
<xsd:complexType name="Resource">
   <xsd:complexContent>
      <xsd:extension base="r:LicensePart"/>
   </xsd:complexContent>
</xsd:complexType>

<xsd:element name="resource" type="r:Resource"
   substitutionGroup="r:licensePart"/>
```

NOTE The r:resource element in ISO REL is “conceptually abstract”, meaning that if it is used in a license, it will not contain information about the resource, but contain a reference to another element or variable which defined it.

8.3.2 GeoResource

Resources not fully describable in ISO/IEC 21000 are expressed as geoResource or geoProcess elements. Both of these elements contain an ISO/IEC 21000 resource element and thus may potentially have two “logically equivalent” values for the licensePartID defined in the r:licensePart element. **Care should be taken to use the attribute of the geoResource or geoProcess element in preference to the one of the embedded resource, since substitution in references follow the licensePartID value and may result in invalid licenses if the value leads to the embedded resource as opposed to the container.** This is especially true for the geoProcess elements, which can be granted licenses (as principals) for conformance to standards, which is not the case for all of the possible embedded resource types. **When using geoResources in a GeoREL license, where the resources are processes or potentially parameter values for other geographic processes, the license should use either geoResource or geoProcess elements to prevent confusion on execute rights which may involve both, and thus the license will need to distinguish between resources playing the role of process and those playing the role of parameter.**

From the resource base type in the ISO REL, the geoResource structures are defined in Schema 4.

Schema 4: GeoResource and GeoProcess schema

```
<xsd:complexType name="GeoResource">
   <xsd:complexContent>
      <xsd:extension base="r:Principal">
         <xsd:sequence minOccurs="0">
            <xsd:element ref="r:resource" minOccurs="0"/>
         </xsd:sequence>
      </xsd:extension>
   </xsd:complexContent>
</xsd:complexType>

<xsd:complexType name="GeoProcess">
   <xsd:complexContent>
      <xsd:extension base="grm:GeoResource">
         <xsd:attribute name="formalName" type="xsd:string"
            use="optional"/>
         <xsd:attribute name="implementor" type="xsd:anyURI"
            use="optional"/>
      </xsd:extension>
   </xsd:complexContent>
</xsd:complexType>

<xsd:element name="geoResource" type="grm:GeoResource"
          substitutionGroup="r:principal"/>

<xsd:element name="geoProcess" type="grm:GeoProcess"
          substitutionGroup="grm:geoResource"/>
```

NOTE The substitution group for r:principal is included by the ISO REL in the group for r:resource. The usage above (putting a resource into the principal substitution group) allows geoResources to hold licenses for proof of conformance while still being in the substitution group for r:resource and thus being able to play the part of the resource in any r:grant element.

The use of “minOccurs=0” in the r:resource component above is required by ISO/IEC 21000-5 and is intended to allow licenses to refer to groups of resources by their license Part ID or a variable reference alone, as required by ISO/IEC 21000. In some cases, the geoResource element may be a free variable whose domain is restricted by an r:forAll element or by conditions in the same grant or grant group.

From this type and element definition, a GeoResource is like any other resource, but can have licenses (because it is also a principal) and geographically specific properties in geoCondition elements to further restrict it.

8.3.3 Data resources: GeoInformation resource metadata

The above schema fragment is sufficient to define digital data resources as in this simplified example (expressed as a license document), as in Example 1. This document would be a valid license if and only if the URI references and the signature it contained were valid. For information on the digital signature process to determine these values for a particular license and issuer, see ISO/IEC 21000-5.

Example 1: geoResource License

```
<r:license xmlns:grm="urn:ogc:geodrm" xmlns:r="urn:mpeg:mpeg21:2003:01-REL-R-
NS" xmlns:sx="urn:mpeg:mpeg21:2003:01-REL-SX-NS"
xmlns:mx="urn:mpeg:mpeg21:2003:01-REL-MX-NS"
xmlns:dsig="http://www.w3.org/2000/09/xmldsig#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:gml="http://www.opengis.net/gml" xsi:schemaLocation="urn:ogc:geodrm geo-
rel.xsd" >
   <r:inventory>
      <grm:geoResource licensePartId="MasterMap">
         <r:digitalResource>
            <r:nonSecureIndirect URI="urn:OrdSvy:MasterMap"/>
         </r:digitalResource>
      </grm:geoResource>
   </r:inventory>
   <r:grant>
      <r:keyHolder licensePartId="RSAholder">
         <r:info>
            <dsig:KeyValue>
               <dsig:RSAKeyValue>
                  <dsig:Modulus>7QzxAprs</dsig:Modulus>
                  <dsig:Exponent>AQABAA==</dsig:Exponent>
               </dsig:RSAKeyValue>
            </dsig:KeyValue>
         </r:info>
      </r:keyHolder>
      <grm:use/>
      <grm:geoResource licensePartIdRef="MasterMap"/>
      <r:allConditions>
         <grm:geoCondition>
            <grm:geoResource licensePartIdRef="MasterMap"/>
            <grm:property name="theme">Transportation</grm:property>
         </grm:geoCondition>
         <r:validityInterval>
            <r:notBefore>2007-01-01T00:00:01Z</r:notBefore>
            <r:notAfter>2008-01-01T00:00:01Z</r:notAfter>
         </r:validityInterval>
      </r:allConditions>
   </r:grant>
   <r:issuer>
      <r:keyHolder licensePartId="OrdSvy">
         <r:info>
            <dsig:KeyValue>
               <dsig:RSAKeyValue>
                  <dsig:Modulus>X0j9q99yzA==</dsig:Modulus>
                  <dsig:Exponent>AQABAA==</dsig:Exponent>
               </dsig:RSAKeyValue>
            </dsig:KeyValue>
         </r:info>
      </r:keyHolder>
   </r:issuer>
</r:license>
```

The “all conditions” element is conjunctive. To be satisfied, each and every condition in its children shall be satisfied. The “all principals” element is ISO/IEC 21000-5, but not used in examples in this International Standard, is similar, in that to match an all principals construct, the principal in the authorization shall match each and every condition on the children of the all principals elements. There are no “all” elements for rights or resources.

This example also uses a `<r:inventory>` element from the ISO REL, which allows the issuer to create globally visible items and assign variable names to them, to be referenced in later parts of the license.

This license example (if its signature were properly verifiable) gives the "key holder" specified the rights to "use" (as defined by the right specified below in 8.5.1.2) the Transportation layer from the data store specified by the URN "`urn:OrdSvy:MasterMap`". The mechanisms for verification of the license are defined in ISO/IEC 21000-5. Definitions and semantics for any ISO REL entity discussed in this International Standard can also be found in ISO/IEC 21000-5.

There is a logical problem, in that the resource above is probably not a file (depending on its size, it may be implemented as a database). As such, such actions as copy or extract might be implicit in use, but the mechanism would probably have to specify a copy format. This would mean essentially that a non-execute right against a large holding would have to include a format in its description so that it could be transferred to a local copy. More likely, the owners of large repository would grant more specific rights than "use", such as a WFS access service, and not expose their resource to such unlimited copy possibilities. If the resource in the above license is actually a relatively small data set (as opposed to a large database), then this would not be a problem, and the holders of the above fragment in a valid license context could copy the file to local storage, and use at their leisure as long as they do so within the time frame of the condition. This means that resources copied locally would have the same license protection as afforded the original remote version of the resource unless otherwise specified by a condition.

8.3.4 Service resources: GeoProcessing resource metadata

The GeoProcess, generally a service, is defined like any other resource, but its formal name (usually the name specified by the standard) and limitations on its parameters shall be specified in the license or given by the various mechanisms based on UDDI and WSDL in the ISO/IEC 21000 base schemas. With large data holdings, most such resources will be accessed only through restricted "execute-style" licenses, as illustrated in the license fragments below. The schema for a GeoProcess XML complex type and an associated geoProcess global element is given in Schema 4. Normally, the formal name attribute would be required, but ISO/IEC 21000 requires that all content of any element derived from license part be capable of being empty so that license part ID reference can be used properly. **If an instance of this element is not a reference, then the formal name attribute should be non-NULL.**

The following license document (Example 2) would give rights to execute a particular WFS interface found at the URI given. The only right to the data is through the WFS interface. This makes it a more restrictive license than the one discussed before. This license fragment gives access to a fictional WFS service but only for the data specified. Again, this document would be a valid license if and only if the URI references and the signature it contained were valid. In particular, the key value in the digital signature would not be the same as in a valid Example 1, since it is affected by the "canonical" form of the XML document it validates.

Beyond this point in this International Standard, the license examples are given as fragments so that the license framework and validation structure need not be repeated each time.

Example 2: geoResource License for a Restricted Area by Name

```
<r:license xmlns:grm="urn:ogc:geodrm" xmlns:r="urn:mpeg:mpeg21:2003:01-REL-R-
NS" xmlns:sx="urn:mpeg:mpeg21:2003:01-REL-SX-NS"
xmlns:mx="urn:mpeg:mpeg21:2003:01-REL-MX-NS"
xmlns:dsig="http://www.w3.org/2000/09/xmldsig#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:gml="http://www.opengis.net/gml" xsi:schemaLocation="urn:ogc:geodrm geo-
rel.xsd" >
   <r:inventory>
      <grm:geoProcess formalName="WFS 2.6.3" licensePartId="WFS">
         <r:digitalResource>
            <r:nonSecureIndirect URI="urn:OrdSvy:MasterMap"/>
         </r:digitalResource>
      </grm:geoProcess>
   </r:inventory>
   <r:grant>
      <r:keyHolder licensePartIdRef="RSAholder"/>
      <grm:execute/>
      <grm:geoProcess licensePartIdRef="WFS"/>
      <r:allConditions>
         <grm:geoCondition>
            <grm:geoProcess licensePartIdRef="WFS"/>
            <grm:property name="theme">Transportation</grm:property>
         </grm:geoCondition>
         <grm:geoCondition>
            <grm:geoProcess licensePartIdRef="WFS"/>
            <grm:spatialLimits>
               <grm:geoPlace placeName="England"/>
            </grm:spatialLimits>
         </grm:geoCondition>
         <r:validityInterval>
            <r:notBefore>2007-01-01T00:00:01Z</r:notBefore>
            <r:notAfter>2008-01-01T00:00:01Z</r:notAfter>
         </r:validityInterval>
      </r:allConditions>
   </r:grant>
   <r:issuer>
      <r:keyHolder licensePartId="OrdSvy">
         <r:info>
            <dsig:KeyValue>
               <dsig:RSAKeyValue>
                  <dsig:Modulus>X0j9q99yzA==</dsig:Modulus>
                  <dsig:Exponent>AQABAA==</dsig:Exponent>
               </dsig:RSAKeyValue>
            </dsig:KeyValue>
         </r:info>
      </r:keyHolder>
   </r:issuer>
</r:license>
```

NOTE The same URI can be used for data resources and several process resources because it will be included in a Web service request specifying the distinction between the various service interfaces available.

The parameter list is a set of named properties (see Schema 2). **New parameters in profiles of this International Standard should be in the "grm:parameter" substitution group or one of its descendents.**

Depending on mechanisms for orchestration available, such as using a WFS feature service to feed the needs of a WMS mapping service, it may be possible to give generic (based on type of service as opposed to a particular instance of the service) execute services against a data set based on such things as standard interfaces and standard process flows. In its most restrictive form, a data resource holder could publish a list of WFS service instances to which a request can be directed (always to be accompanied by license information) or it may specify service instance by the service version for which the instance can provide proof of conformance.

Example 3: geoProcess License

```
<r:license>
   <r:inventory>
      <grm:geoResource licensePartId="MasterMap">
         <r:digitalResource>
            <r:nonSecureIndirect URI="urn:OrdSvy:MasterMap"/>
         </r:digitalResource>
      </grm:geoResource>
   </r:inventory>
   <r:grant>
      <r:keyHolder licensePartIdRef="RSAholder"/>
      <grm:execute/>
      <grm:geoProcess licensePartIdRef="WFS"/>
      <r:allConditions>
         <grm:geoCondition>
            <grm:geoProcess licensePartIdRef="WFS"/>
            <grm:standard>urn:ogc:wfs-2.6.3</grm:standard>
         </grm:geoCondition>
         <grm:geoCondition>
            <grm:geoProcess licensePartIdRef="WFS"/>
            <grm:format>urn:ogc:GML-*</grm:format>
         </grm:geoCondition>
         <grm:geoCondition>
            <grm:geoProcess licensePartIdRef="WFS"/>
            <grm:property name="theme">Transportation</grm:property>
         </grm:geoCondition>
         <grm:geoCondition>
            <grm:geoProcess licensePartIdRef="WFS"/>
            <grm:spatialLimits>
               <grm:geoPlace placeName="England"/>
            </grm:spatialLimits>
         </grm:geoCondition>
         <grm:geoCondition>
            <grm:geoProcess licensePartIdRef="WFS"/>
            <grm:timeInterval>
               <grm:notAfter>2008-01-01T00:00:01Z</grm:notAfter>
            </grm:timeInterval>
         </grm:geoCondition>
         <r:validityInterval>
            <r:notBefore>2007-01-01T00:00:01Z</r:notBefore>
         </r:validityInterval>
      </r:allConditions>
   </r:grant>
</r:license>
```

Because ISO/IEC 21000 uses element equality to determine entity equality, the restrictions on the parameters of a process shall be expressed in a separate condition and not in the geoProcess element. Since not all parameters will usually be restricted, the use of name/restriction pairs allows for a sparse specification.

NOTE Services that wish to restrict a large number of parameters would construct “wrapper” façade services with this information in the WSDL entry for the façade. The use of multiple façades for a single service is quite common, and is considered good practice for the specification and enforcing restrictions. The façade will usually only check parameters and then call the base service to accomplish the task requested.

The license fragment shown in Example 3 would be nearly functionally equivalent to the one shown in Example 2 for a time (except this one only outputs GML), since this also grants the same access that the one above does for the time during the year 2007. The difference is what occurs afterwards. Here the data is time-limited to the end of 2007 or earlier, but the service is not time limited. That means that for all time, the licensee may resubmit old requests that were valid during the normal period of the license, and get the map feature data as of the “data date” specified up to as late as the end of 2007.

8.4 Principals

For the purposes of this International Standard, direct derivation from the ISO REL principal type with the exception of the geoResource is not required. GeoResource elements are classified as principals so that they might receive as principals “certificate licenses” which use a “possess property” construct to grant the right to claim conformance to some standard through the possession of a property in a license issued to the geoProcess (see Reference [9], p. 162 for an example). In a GeoREL license, each principal will usually be expressed using an element directly from the ISO REL.

Geographic restrictions on principals are best handled within the framework of geographic conditions. The most geo-specific use of this functionality may be in location-restrictive services, where suppliers have chosen to restrict their service to users within a fixed radius of their home base so that it can be used by local residents and visitors to a particular geographic place. For example, the license fragment in Example 4 would be interpreted as granting anyone whose location (as determined by an LBS service) could be placed within New Hampshire in the US. Note that an empty principal variable such as the one used here as “public user” matches everything, and so the only restrictions on this sort of principal is that given in the conditions. In this case, the condition says that a particular service shall be run to determine the location of a principal, and that upon passing the condition principal has a right to run the service.

The use of the common variable in the parameter to the service sends the same credentials to the service that was received by the original request. The usual mechanism for this would be dependent on the service façade being used, probably one façade for each service broker linked to a particular location tracking service. This shows how to grant a license to anyone holding a key value (essentially a user ID that allows them to be tracked) and thus can be shown to be within a certain area where tourist information is available. The proof of position is provided by a location tracking service which can take the key value and use it to locate the user. **There are privacy concerns here, since the “free-service” is using a form of identification, which should be treated with care. In the conformance class for the underlying service using a technique such as this, care should be taken to specify how such personal information is treated. This is a security issue and has not be dealt with in detail in this International Standard.**

NOTE ISO 19153 defines a “break the glass” principle, which allows anyone, in an emergency, to use a public license like the one below to do things that would otherwise not be covered by their private licenses. Depending on the operational concept, limitations on the “breaker” can be included by adding conditions to the license as was done here, to limit access to a qualified public safety worker (such as a check of credential) or to track such usage by tracking information using the ISO/IEC 21000-5 `sx:trackReport` element.

Example 4: “public user” geoPrincipal defined by functional property

```
<r:license>
   <r:grant>
      <r:forAll varName="publicUser"/>
      <r:keyHolder varRef="publicUser"/>
      <grm:execute/>
      <grm:geoProcess formalName="WFS 2.6.3" licensePartId="WFS">
         <r:digitalResource>
            <r:nonSecureIndirect URI="urn:NewHampshire-US:TouristMap:WFS"/>
         </r:digitalResource>
      </grm:geoProcess>
      <grm:preCondition>
         <r:serviceReference>
            <sx:wsdlAddress>
               <sx:kind>
                  <sx:wsdl>
                     <r:nonSecureIndirect
               URI="http://services.ogc.org/wsdl/trackingService.wsdl"/>
                  </sx:wsdl>
                  <sx:binding>ts:TrackingSoapBinding</sx:binding>
               </sx:kind>
               <sx:address>
                  <soap:address
                   location="http://services.ogc.org/trackingService"/>
               </sx:address>
            </sx:wsdlAddress>
            <r:serviceParameters>
               <r:datum>
                  <r:keyHolder varRef="publicUser"/>
               </r:datum>
            </r:serviceParameters>
         </r:serviceReference>
         <grm:geoCondition>
            <r:principal licensePartIdRef="publicUser"/>
            <grm:parameter name="LBS:location">
               <grm:geoPlace>New Hampshire, US</grm:geoPlace>
            </grm:parameter>
         </grm:geoCondition>
      </grm:preCondition>
   </r:grant>
</r:license>
```

8.5 Rights

8.5.1 Usage Rights

8.5.1.1 GeoRight

The GeoRight (see Schema 5) is an abstract Root for all rights in the GeoREL other than those found natively in the ISO REL. It is abstract and will never occur in a license. Since it could never be used, no usable global element is included. In this case, not only is the element “conceptually abstract”, it is abstract and only provides a substitution group for the rights specified in this International Standard.

Schema 5: GeoRight

```
<xsd:complexType name="GeoRight" abstract="true">
   <xsd:annotation>
      <xsd:documentation>
         This is a root class for special GeoDRM rights not found elsewhere.
         This is abstract since granting it would cover all rights in this
         schema.
      </xsd:documentation>
   </xsd:annotation>
   <xsd:complexContent>
      <xsd:extension base="r:Right"/>
   </xsd:complexContent>
</xsd:complexType>

<xsd:element name="geoRight" type="grm:GeoRight"
   substitutionGroup="r:right" abstract="true"/>
```

8.5.1.2 Use

The use right in the GeoREL is the base right for all processes. Holding a license for this right essentially allows the licensee to do all that can logically be done to a resource. It is probably not a reasonable right to include in any but the most restricted cases (such as rights to a particular file), and an unconstrained use right to a GeoResource would be a rarity. Schema 6 contains the XML definitions (Schema 6) for the complex type and the element associated with this right.

Schema 6: Use

```
<xsd:complexType name="Use">
   <xsd:annotation>
      <xsd:documentation>
         This is the root class for usage rights. Granting of this right
         grants all of its subtypes.
      </xsd:documentation>
   </xsd:annotation>
   <xsd:complexContent>
      <xsd:extension base="grm:GeoRight"/>
   </xsd:complexContent>
<xsd:complexType>

<xsd:element name="use" type="grm:Use" substitutionGroup="grm:geoRight"/>
```

8.5.1.3 View, Display, Print

The view right in GeoREL unlike the one in the ISO REL includes the ability to display on a screen or print on any device. This may often be combined with constraints on rights on reuse of the printed or displayed material. Schema 7 contains the XML definitions for the complex type and the element associated with this right.

Schema 7: Display

```
<xsd:complexType name="Display">
   <xsd:annotation>
      <xsd:documentation>
         This is the general display right, but includes rights to reproduce
         the image, to display it  and to print it.
</xsd:documentation>
   </xsd:annotation>
   <xsd:complexContent>
      <xsd:extension base="grm:Use"/>
   </xsd:complexContent>
</xsd:complexType>

<xsd:element name="display" type="grm:Display" substitutionGroup="grm:use"/>
```

8.5.1.4 Combine, merge

The combine right allows the licensee to merge multiple resources together. This will normally be associated with constraints that describe restrictions of use on the conflated product – the result of the act of merging the two original resources. Schema 8 contains the XML definitions for the complex type and the element associated with this right.

Schema 8: Merge

```
<xsd:complexType name="Merge">
   <xsd:complexContent>
      <xsd:extension base="grm:Use"/>
   </xsd:complexContent>
</xsd:complexType>

<xsd:element name="merge" type="grm:Merge" substitutionGroup="grm:use"/>
```

8.5.1.5 Extract, Copy

The extract right allows the licensee to subset a resource as a local copy, or simply to make a full copy. This will normally be associated with constraints that describe restrictions of use on the copy so produced. Schema 9 contains the XML definitions for the complex type and the element associated with this right.

Schema 9: Extract

```
<xsd:complexType name="Extract">
   <xsd:complexContent>
      <xsd:extension base="grm:Use"/>
   </xsd:complexContent>
</xsd:complexType>

<xsd:element name="extract" type="grm:Extract" substitutionGroup="grm:use"/>
```

8.5.1.6 Spatial transform, Adjust

The transform right allows the licensee to fix or to adjust the geometry of a resource in a local copy, or simply to make a full copy in a different coordinate reference system. This will normally be associated with constraints that describe restrictions of use on the transformed or adjusted copy so produced. Schema 10 contains the XML definitions for the complex type and the element associated with this right.

Schema 10: Transform

```
<xsd:complexType name="Transform">
   <xsd:complexContent>
      <xsd:extension base="grm:Use"/>
   </xsd:complexContent>
</xsd:complexType>

<xsd:element name="transform" type="grm:Transform"
   substitutionGroup="grm:use"/>
```

8.5.1.7 Derive, Further Develop

The derive right allows the licensees to extend the data in some value-added manner to fit their needs in a local copy. This will normally be associated with constraints that describe restrictions of use on the enhanced copy so produced, or to restrict the manner in which the enhancement may occur. Schema 11 contains the XML definitions for the complex type and the element associated with this right.

Schema 11: Derive

```
<xsd:complexType name="Derive">
   <xsd:complexContent>
      <xsd:extension base="grm:Use"/>
   </xsd:complexContent>
</xsd:complexType>

<xsd:element name="derive" type="grm:Derive" substitutionGroup="grm:use"/>
```

8.5.1.8 Edit or Adapt

The edit right allows the licensees to modify the data in some manner to fit their needs in a local copy. This will normally be associated with constraints that describe restrictions of use on the modified copy so produced, or to restrict the manner in which the modification may occur. Schema 12 contains the XML definitions for the complex type and the element associated with this right.

Schema 12: Edit

```
<xsd:complexType name="Edit">
   <xsd:complexContent>
      <xsd:extension base="grm:Use"/>
   </xsd:complexContent>
</xsd:complexType>

<xsd:element name="edit" type="grm:Edit" substitutionGroup="grm:use"/>
```

8.5.1.9 Modify

The modify right allows the licensee to modify the data in some manner in the original resource. The intent of this right is to support distributed editing and sharing of updated resources. This will normally be associated with constraints that describe restrictions on the manner in which the modification may occur. The resource owners or their data management agents are responsible for general database administration routines like backup copies of older data in case a need arises to remove particular edits from the commonly maintained resource. Schema 13 contains the XML definitions for the complex type and the element associated with this right.

Schema 13: Modify

```
<xsd:complexType name="Modify">
   <xsd:complexContent>
      <xsd:extension base="grm:Edit"/>
   </xsd:complexContent>
</xsd:complexType>

<xsd:element name="modify" type="grm:Modify" substitutionGroup="grm:edit"/>
```

8.5.1.10 Derive Graphic

The derive-graphic right is associated with the display right, but differs in that the derivation may include the use of other resources such as in the merging of feature layers. The right will probably be associated with constraints on the types of licenses usable on the derived product. Schema 14 contains the XML definitions for the complex type and the element associated with this right.

Schema 14: Derive Graphic

```
<xsd:complexType name="DeriveGraphic">
   <xsd:complexContent>
      <xsd:extension base="grm:Display"/>
   </xsd:complexContent>
</xsd:complexType>

<xsd:element name="deriveGraphic" type="grm:DeriveGraphic"
   substitutionGroup="grm:display"/>
```

8.5.1.11 Encode

The encode right allows the licensee to encode the resource in some new format and make it available under rights similar to those of the original or a copy of the original. Like the copy grant, the encoded resource may be constrained on what type of licenses that may be issued for it. Schema 15 contains the XML definitions for the complex type and the element associated with this right.

Schema 15: Encode

```
<xsd:complexType name="Encode">
   <xsd:complexContent>
      <xsd:extension base="grm:Use"/>
   </xsd:complexContent>
</xsd:complexType>

<xsd:element name="encode" type="grm:Encode" substitutionGroup="grm:use"/>
```

8.5.1.12 Execute

The execute right allows the licensee to execute a geoProcess using the resource. Like the derive grant, the result of the execution, viewed as a new resource, may be constrained on what type of licenses that may be issued for it. The execute right may have both geoData and geoProcess resources associated with it, or one or the other may be specified by property constraints. Schema 16 contains the XML definitions for the complex type and the element associated with this right.

Schema 16: Execute

```
<xsd:complexType name="Execute">
   <xsd:complexContent>
      <xsd:extension base="grm:GeoRight"/>
   </xsd:complexContent>
</xsd:complexType>

<xsd:element name="execute" type="grm:Execute"
   substitutionGroup="grm:geoRight"/>
```

The act of executing something usually requires two things, access to the process and access to the parameters. The resource in a grant contains only one of these two things – the other being restricted in the conditions. When the geoProcess is given, the condition will be on the parameters of that process. When the data resource is given in the grant's resource, the geoProcess to be executed is specified or limited through use of the mx:renderer element from ISO/IEC 21000-5 (see Example 5 below, and the explanation of mx:renderer in C.5). The ISO/IEC 21000 authorization routines use an element equality testing procedure, so rights have to be individually granted in a series of grants (unless a r:forAll rights pattern is used). The license fragment in Example 5 uses this mechanism to give WMS and WFS execute rights to a common data resource.

Example 5: geoProcess used as execute conditions

```
<r:license>
   <r:inventory>
      <grm:geoProcess licensePartId="WMS" formalName="urn:ogc:WMS-2.1.1"/>
      <grm:geoProcess licensePartId="WFS" formalName="urn:ogc:WFS-2.1.1"/>
      <r:digitalResource licensePartId="OS">
         <r:nonSecureIndirect URI="urn:OrdSvy:MasterMap"/>
      </r:digitalResource>
   </r:inventory>
   <r:grantGroup>
      <r:keyHolder licensePartIdRef="RSAholder"/>
      <r:validityInterval>
         <r:notBefore>2007-01-01T00:00:01Z</r:notBefore>
         <r:notAfter>2008-01-01T00:00:01Z</r:notAfter>
      </r:validityInterval>
      <r:grant>
         <grm:execute/>
         <r:digitalResource licensePartIdRef="OS"/>
         <mx:renderer>
            <grm:geoProcess licensePartIdRef="WFS"/>
         </mx:renderer>
      </r:grant>
      <r:grant>
         <grm:execute/>
         <r:digitalResource licensePartIdRef="OS"/>
         <mx:renderer>
            <grm:geoProcess licensePartIdRef="WMS"/>
         </mx:renderer>
      </r:grant>
   </r:grantGroup>
</r:license>
```

NOTE In a grant group, a common principal and condition (or all condition) can be specified for the group. The semantics is one of distribution, and the grant group is equivalent to a sequence of grants each with the common elements distributed into each grant, incorporated as the principal or condition if no local one exists, and as part of a logical “all” principal or condition if a local one already exists. See ISO/IEC 21000-5 for the complete semantics of this distribution process across the grants in a grant group.

Example 5 does not describe logically two rights, but a single right with two renderer options. The default logic (lacking an orchestration capability) would be that the data resource had WMS and WFS services available from interfaces associated with the resource URI. Note that the “all principals” construction here is usable because geoProcesses are principals as well as being processing resources.

8.5.2 Meta-rights

Meta-rights are rights associated with the granting or lending of licenses to others based on grants through a valid license chain from the owner of the resource (a chain of agency). See ISO 19153 for a definition of these terms and relations. The License right in GeoDRM is the issue right in ISO REL, and the sublicense right in the GeoDRM is the delegation control in ISO REL. No GeoREL extensions are needed.

8.6 Conditions

8.6.1 Semantics

Conditions specify limitations on rights by specifying limits (most often as properties or limits on properties) on the various grant components, usually the resource, the principal, the renderer and the parameters and output of the processes involved either as resource or renderer. The following can be specified for any of the rights specified above. In general, conditions are restrictions on properties of other components or upon the outputs of geoProcesses. If not specified in the particular element, the geoCondition target constraint is given in the name of the property, in the form “`<licensePartIdentity>::<propertyName>`”. Schema 17 contains the XML definitions for the complex type and the element associated with this type of condition.

Schema 17: GeoCondition

```
<xsd:complexType name="GeoCondition">
   <xsd:complexContent>
      <xsd:extension base="r:Condition">
         <xsd:sequence minOccurs="0">
            <xsd:element ref="r:licensePart"/>
            <xsd:element ref="grm:property"/>
         </xsd:sequence>
      </xsd:extension>
   </xsd:complexContent>
</xsd:complexType>

<xsd:element name="geoCondition" type="grm:GeoCondition"
   substitutionGroup="r:condition"/>
```

8.6.2 Property conditions and grant component patterns

In any of the grant components defined with the “geo” prefix as defined in 8.1, in the absence of the corresponding ISO REL component, the intent of the specification is that any item that fits the properties in the property list is a match for that component. See ISO 19153 for some abstract examples.

Because of the consistent use of the XML pattern matching in 8.1, no additional XML schema constructs are needed to support “by properties” components.

8.6.3 Standards-defined operations

Operations defined by standards can be identified by associations with their “proof of compliance”. Since integration with the GeoDRM system will require compliance with DRM standards, they will carry both base functionality proof and GeoDRM proof of compliance. Since this property only restricts a geoProcess resource, in many cases it can be placed in the resource clauses of the license as opposed to the conditions elements. Schema 18 contains the XML definitions for the complex type and the element associated with this type of condition.

Schema 18: Standard compliance conditions

```
<xsd:complexType name="Standard" mixed="true">
   xsd:complexContent mixed="true">
      <xsd:extension base="grm:Property"/>
   </xsd:complexContent>
</xsd:complexType>

<xsd:element name="standard" type="grm:Standard"
   substitutionGroup="grm:property"/>
```

8.6.4 Output conditions

The license may place conditions on the state of any “new” resource for each act (associated with a right) and for each named output of that act. The format of those conditions will usually be the assignment of meta-rights and properties for this new resource. The following is the XML definitions for the complex type and the property element associated with this condition. The “output” element may be used in conditions, the “format” element may be used anywhere a grm:property is appropriate. Schema 19 contains the XML definitions for the complex type and the element associated with this type of condition.

Schema 19: Output format conditions

```
<xsd:complexType name="Format" mixed="true">
   <xsd:complexContent mixed="true">
      <xsd:extension base="grm:Property"/>
   </xsd:complexContent>
</xsd:complexType>

<xsd:element name="format" type="grm:Format"
   substitutionGroup="grm:property"/>

<xsd:element name="output" type="grm:Format"
   substitutionGroup="grm:property"/>
```

8.6.5 Transfer right and sublicense conditions on meta-rights

Meta-rights that allow one principal to enable another principal with grants, either as a license or sublicense, may be restricted by the type of right so conveyed, or the persons or type of persons to whom the right may be conveyed. Schema 20 contains the XML definitions for the complex type and the element associated with this type of condition.

Schema 20: Transfer conditions

```
<xsd:complexType name="Transfer" mixed="true">
   <xsd:complexContent>
      <xsd:extension base="grm:Property">
         <xsd:sequence>
            <xsd:element ref="r:grant"/>
         </xsd:sequence>
      </xsd:extension>
   </xsd:complexContent>
</xsd:complexType>

<xsd:element name="transfer" type="grm:Transfer"
   substitutionGroup="grm:property"/>
```

8.6.6 Spatial temporal conditions

A spatial condition may limit the spatial or temporal extent of the resource that the actions allowed by the right may address. Schema 21 contains the XML definitions for the complex type and the element associated with this type of condition.

Schema 21: Spatial temporal conditions

```
<xsd:complexType name="SpatialLimits" mixed="true">
   <xsd:complexContent mixed="true">
      <xsd:extension base="grm:Property">
         <xsd:choice>         <xsd:element ref="gml:geometryMembers"/>
      <xsd:element ref="grm:geoPlace"/>
            <xsd:element ref="grm:spatialOperation"/>
         </xsd:choice>     </xsd:extension>
   </xsd:complexContent> </xsd:complexType>

<xsd:complexType name="SpatialOperation" mixed="true">
   <xsd:complexContent mixed="true">
      <xsd:extension base="grm:Property">
         <xsd:sequence minOccurs="2" maxOccurs="2">
            <xsd:choice>
               <xsd:element ref="gml:geometryMembers"/>
               <xsd:element ref="grm:geoPlace"/>
               <xsd:element ref="grm:spatialOperation"/>
            </xsd:choice>
         </xsd:sequence>
         <xsd:attribute name="opName" type="xsd:string" use="optional"
            default="intersection"/>
         <xsd:attribute name="egenhoferMask" type="xsd:string"
            use="optional"/>
      </xsd:extension>
   </xsd:complexContent>
</xsd:complexType>

<xsd:complexType name="TimeInterval">
   <xsd:complexContent mixed="true">
      <xsd:extension base="grm:Property">
         <xsd:sequence>
            <xsd:choice minOccurs="0">
               <xsd:element ref="grm:notBefore"/>
               <xsd:element ref="grm:after"/>
            </xsd:choice>
            <xsd:choice minOccurs="0">
               <xsd:element ref="grm:before"/>
               <xsd:element ref="grm:notAfter"/>
            </xsd:choice>
         </xsd:sequence>
      </xsd:extension>
   </xsd:complexContent>
</xsd:complexType>
```

```
<xsd:element name="spatialLimits" type="grm:SpatialLimits"
       substitutionGroup="grm:property"/>

<xsd:element name="spatialOperation" type="grm:SpatialOperation"
       substitutionGroup="grm:property"/>

<xsd:element name="timeInterval" type="grm:TimeInterval"
       substitutionGroup="grm:property"/>
<xsd:element name="notBefore" type="xsd:dateTime"/>

<xsd:element name="notAfter" type="xsd:dateTime"/>

<xsd:element name="before" type="xsd:dateTime"/>

<xsd:element name="after" type="xsd:dateTime"/>
```

8.6.7 Layer conditions

Layer conditions may be used to limit what resource layers can be used or modified in conjunction with a right. For resources, this subsets the resource based on internal layer structures. For processing rights, this determines what types of layers may be processed by the software, possibly regardless of the underlying resource.

Since layers are not universally typed as layers, this type of condition may use a named property “parameter” element with an appropriately chosen name for the concept in the information community being used.

8.6.8 Implementation conditions

Implementation rights may be used to specify which implementations of functionality may be used in using a right. If unspecified, any provably conformant implementation of the functionality is allowed. If specific implementations are identified, they may be allowed or disallowed specifically.

This type of condition may use a named property element with an appropriately chosen name such as “implementor” or “ServiceProvider”.

8.6.9 Parameter range conditions

In functional rights that pass parameters, the allowable range of any parameter may be limited. The format of the range is type specific. For parameters that do not have any ordering or dimensional structure, the usual representation is a “white space separated” list of values. **Values with internal white space should be quoted or the white space escaped appropriately for the licensing encoding mechanism being used. For ordered or dimensionally structured parameters, a set of ranges or extents should be specified in accordance with the semantics of the parameter type.**

This type of condition may use a named property element with an appropriately chosen name such as the parameter's name followed by range, maximum or minimum.

8.6.10 Derived right conditions

If the right to derive resources is granted, then the condition DerivedRight may be used to restrict or expand the rights that may be licensed by the creator of the derived resource in conjunction with the derived resource. The following is the XML definitions (Schema 22) for the element associated with this type of condition.

Schema 22: Derived right conditions

```
<xsd:element name="derivedRights" type="grm:Transfer"
   substitutionGroup="grm:property"/>
```

8.6.11 Encoding condition

If a right to duplicate or derive resources is given, the Encoding condition may restrict the form in which the particular resource may be presented. If absent, the default logic of the condition is that all lossless encodings are allowed. The encoding property may be defined just as the format property. The following is the XML definitions (Schema 23) for the element associated with this type of condition.

Schema 23: Encoding conditions

```
<xsd:element name="encoding" type="grm:Format"
   substitutionGroup="grm:property"/>
```

8.6.12 Side effect and associated conditions

The use of a right may have side effects listed in the contract. To support this, each right may be associated with the conditions that cause the GeoDRM Gatekeeper to add processes to the process flows. The return value of these extra processes may affect the completion of the action. The contents of a side effect element define an action that may be required to occur before, after or independently of the servicing of the request. For example, the message-to-user style of side effect may kick-off a user interaction specified by the license that reminds the users of their obligation, or requires a “log-in dialog” to confirm identity for specific security requirements. “After” effects may be the posting of a change to a bill for service, which would only be valid after the service has completed successfully. The “independent” side effect may simply be a notification of use to a statistical program tracking the “identity neutral” use of the underlying resource.

Pre-condition side effects may execute extra checks on the license, may cause extra validation on the resource or may be linked into the billing system of the Licensor. Return values may affect process flow.

Post-condition side effects may cause extra validation on the output resources or may be linked into the billing system of the Licensor. Such conditions may use the following grant structure. Return valued do not affect process flow but may be involved with the licensee contract and billing.

Neutral-condition side effects that do not affect the access to the resource but simply keep tracking information (usually user-identity neutral) that can be used for system tuning or similar load analysis for the resource. Return values have no effect.

Schema 24 contains the XML definitions for the complex type and the element associated with this type of condition.

Schema 24: Side effects

```
<xsd:complexType name="SideEffect">
   <xsd:complexContent>
      <xsd:extension base="sx:StatefulCondition">
         <xsd:attribute name="timeRelation" type="xsd:string"
            use="optional"
            default="after"/>
         <xsd:attribute name="typeEffect" type="xsd:string" use="optional"
            default="message to user"/>
      </xsd:extension>
   </xsd:complexContent>
</xsd:complexType>

<xsd:element name="sideEffect" type="grm:SideEffect"
   substitutionGroup="r:condition"/>
```

```
<xsd:complexType name="PreCondition">
   <xsd:complexContent>
   <xsd:extension base="grm:SideEffect">
          <xsd:sequence>
             <xsd:element ref="grm:geoCondition"/>
          </xsd:sequence>
      </xsd:extension>
   </xsd:complexContent>
</xsd:complexType>

<xsd:complexType name="Action">
   <xsd:complexContent>
      <xsd:extension base="grm:SideEffect"/>
   </xsd:complexContent>
</xsd:complexType>

<xsd:complexType name="ResultContains">
   <xsd:complexContent>
      <xsd:extension base="grm:Action"/>
   </xsd:complexContent>
</xsd:complexType>

<xsd:complexType name="Warning">
   <xsd:complexContent>
      <xsd:extension base="grm:Action"/>
   </xsd:complexContent>
</xsd:complexType>

<xsd:element name="preCondition" type="grm:PreCondition"
   substitutionGroup="grm:sideEffect"/>

<xsd:element name="action" substitutionGroup="grm:sideEffect"/>

<xsd:element name="resultContains" type="grm:ResultContains"
   substitutionGroup="grm:action"/>

<xsd:element name="warning" type="grm:Warning"
   substitutionGroup="grm:action"/>
```

Annex A
(normative)

Abstract test suite

A.1 The two test cases

Compliant systems enforce those licenses during transaction involving the holders of the license and the digital resource named, to the extent that they express in their public claim of conformance. Thus, there are two types of conformance:

a) license conformance which ensures a well-formed and unambiguous expression of the contract between the license holder and the owners (or their agent) of the digital resource in a manner both necessary and sufficient to protect both the rights of the resource owner and those of the license holder. Licenses have two types as follows:

   1) licenses that use the standard ISO REL (ISO/IEC 21000-5) use the practices described here but are still interpretable by standard DRM software;

   2) licenses that use the extensions for geoProcess and geoCondition and use the practices specified here but require extensions to the DRM software to interpret the geographic aspects;

b) enforcement conformance for a system. This is a statement of assurance and a guarantee that the digital resource named will be protected to the extent of that statement when access is granted through that system.

Since standard ISO/IEC 21000 conformance adequately covers systems using only the first type of license, conformance for a system to this International Standard will require coverage of both types of licenses, and be an extension of the ISO/IEC 21000 conformance tests.

The ISO/IEC 21000 conformance, through the use of digital signatures, ensures that licenses cannot be modified by the licensee after they have been granted unless a valid issuer of that type license first “signs” the new version of the license.

A.2 License conformance

A.2.1 Introduction

This class tests that licenses are produced that match the legal contract to which they are associated. The text is needed for producers of licenses. There are two tests to be conducted as outlined in A.2.2 and A.2.3.

A.2.2 XML schema conformance

The license shall be consistent with the XML Schema as defined in this International Standard and its normative references, especially ISO/IEC 21000-5: ISO REL. This test shall be conducted by an XML Schema validation routine[3)].

3) The choice of validation software will be done by the conformance testing authority to best ensure compliance with XML Schema semantics.

a) Test purpose: Verify that all elements in the license and the license itself are valid with respect to all necessary XML schemata, and that the license carries a valid digital signature.

b) Test method: Use of schema-aware validation software as chosen by the testing authority.

c) Reference: 6.

d) Test type: basic.

A.2.3 Proper interpretation

The license produced shall be consistent with the contract from which it is derived. This second test will most likely be by inspection since contracts are not formally constructed documents.

a) Test purpose: Verify that effects of the document under the algorithms defined in ISO/IEC 21000 are consistent with the intent of the contract from which it is derived.

b) Test method: Use of an inspection mechanism as chosen by the testing authority, to ensure that when the license is analysed by the algorithm in ISO/IEC 21000, that its allow/not-allow decisions are consistent with its formal contract.

c) Reference: 8.1

d) Test type: capability

A.3 Enforcement conformance

This class tests that licenses are enforced according to the specified semantics. This test will be needed to certify a GeoDRM GateKeeper as defined in ISO 19153. This test is conducted by comparing the Boolean decision of the candidate GateKeeper against reference implementations.

a) Test purpose: Verify that effects of the gatekeeper software in interpreting the document under the algorithms defined in ISO/IEC 21000 are consistent with the intent of the contract from which it is derived.

b) Test method: Use of a candidate software in a wide set of circumstances as chosen by the testing authority, to see if the right decision is made under the direct analysis of the license.

c) Reference: 8.1.

d) Test type: capability.

Annex B
(normative)

geoRel.xsd

The following XML schema is the full text of the GeoREL extension to the MPEG 21 ISO REL. The references to “Schema ##” are references to the schema blocks in Clause 8.

```
<?xml version="1.0" encoding="UTF-8"?>
<xsd:schema xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:grm="urn:ogc:geodrm" xmlns:r="urn:mpeg:mpeg21:2003:01-REL-R-NS"
xmlns:mx="urn:mpeg:mpeg21:2003:01-REL-MX-NS"
xmlns:sx="urn:mpeg:mpeg21:2003:01-REL-SX-NS"
xmlns:gml="http://www.opengis.net/gml" targetNamespace="urn:ogc:geodrm"
elementFormDefault="qualified" attributeFormDefault="unqualified">
   <xsd:import namespace="urn:mpeg:mpeg21:2003:01-REL-R-NS"
schemaLocation="http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-
21_schema_files/rel-r/rel-r.xsd"/>
   <xsd:import namespace="urn:mpeg:mpeg21:2003:01-REL-SX-NS"
schemaLocation="http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-
21_schema_files/rel-r/rel-sx.xsd"/>
   <xsd:import namespace="urn:mpeg:mpeg21:2003:01-REL-MX-NS"
schemaLocation="http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-
21_schema_files/rel-r/rel-mx.xsd"/>
   <xsd:import namespace="http://www.opengis.net/gml"
schemaLocation="http://schemas.opengis.net/gml/3.1.1/base/gml.xsd"/>
   <!-- -->
   <!-- == Properties & Parameters == -->
   <!--  Schema 1: GeoPlace -->
   <xsd:complexType name="GeoPlace" mixed="false">
      <xsd:annotation>
         <xsd:documentation>GeoPlace is a named place, described elsewhere in
some gazetteer. This allows the license to avoid large coordinate strings, and
makes the license more readable
</xsd:documentation>
      </xsd:annotation>
      <xsd:choice minOccurs="0">
         <xsd:element ref="gml:_Geometry"/>
         <xsd:element name="location">
            <xsd:complexType>
               <xsd:sequence>
                  <xsd:element name="country" type="xsd:QName"
minOccurs="0"/>
                  <xsd:element name="region" type="xsd:QName" minOccurs="0"/>
                  <xsd:element name="state" type="xsd:string" minOccurs="0"/>
                  <xsd:element name="city" type="xsd:string" minOccurs="0"/>
                  <xsd:element name="postalCode" type="xsd:string"
minOccurs="0"/>
                  <xsd:element name="street" type="xsd:string"
minOccurs="0"/>
               </xsd:sequence>
            </xsd:complexType>
         </xsd:element>
      </xsd:choice>
      <xsd:attribute name="placeName" type="xsd:string" use="optional"/>
      <xsd:attribute name="gazetteer" type="xsd:anyURI" use="optional"/>
```

```
    </xsd:complexType>
    <xsd:element name="geoPlace" type="grm:GeoPlace"/>
    <!--   End Schema 1: GeoPlace  -->
    <!--  -->
    <!-- == Parameters == -->
    <!--  Schema 2: Property and parameter schema -->
    <xsd:complexType name="Property" mixed="true">
       <xsd:annotation>
          <xsd:documentation>
Properties are descriptions of any item in a licence. The only current
restriction is that they shall have a name, a description and a value from
this namespace.
</xsd:documentation>
       </xsd:annotation>
       <xsd:attribute name="name" type="xsd:string" use="optional"/>
       <xsd:attribute name="definition" type="xsd:anyURI" use="optional"
default="urn:ogc:geodrm:properties"/>
    </xsd:complexType>
    <xsd:complexType name="Parameter" mixed="true">
       <xsd:complexContent mixed="true">
          <xsd:restriction base="grm:Property">
             <xsd:attribute name="name" type="xsd:string" use="required"/>
             <xsd:attribute name="definition" type="xsd:anyURI" use="optional"
default="urn:ogc:geodrm:properties"/>
          </xsd:restriction>
       </xsd:complexContent>
    </xsd:complexType>
    <xsd:complexType name="ParameterList">
       <xsd:sequence>
          <xsd:element ref="grm:parameter" maxOccurs="unbounded"/>
       </xsd:sequence>
    </xsd:complexType>
    <xsd:element name="property" type="grm:Property"/>
    <xsd:element name="parameter" type="grm:Parameter"
substitutionGroup="grm:property"/>
    <xsd:element name="parameters" type="grm:ParameterList"/>
    <!--  end Schema 2: Property and parameter schema -->
    <!-- -->
    <!-- == Principals as defined in ISO/IEC 21000-5, are in the rel imports
above == -->
    <!-- -->
    <!-- == Rights as defined in ISO/IEC 21000-5, are in the rel imports above,
the extensions for geoResorces are defined here  == -->
    <!-- -->
    <!-- Schema 5: GeoRight -->
    <xsd:complexType name="GeoRight" abstract="true">
       <xsd:annotation>
          <xsd:documentation>This is a root class for special GeoDRM rights
not found elsewhere. This is abstract since granting it would cover all rights
in this schema.</xsd:documentation>
       </xsd:annotation>
       <xsd:complexContent>
          <xsd:extension base="r:Right"/>
       </xsd:complexContent>
    </xsd:complexType>
    <xsd:element name="geoRight" type="grm:GeoRight" abstract="true"
substitutionGroup="r:right"/>
    <!-- end Schema 5: GeoRight -->
    <!-- Schema 6: Use -->
    <xsd:complexType name="Use">
```

```
      <xsd:annotation>
         <xsd:documentation>This is the root class for usage rights. Granting
of this right grants all of its subtypes. </xsd:documentation>
      </xsd:annotation>
      <xsd:complexContent>
         <xsd:extension base="grm:GeoRight"/>
      </xsd:complexContent>
   </xsd:complexType>
   <xsd:element name="use" type="grm:Use" substitutionGroup="grm:geoRight"/>
   <!-- end Schema 6: Use -->
   <!-- Schema 7: Display Use -->
   <xsd:complexType name="Display">
      <xsd:annotation>
         <xsd:documentation>This is the general display right, but includes
rights to reproduce the image, to display it and to print it.
   </xsd:documentation>
      </xsd:annotation>
      <xsd:complexContent>
         <xsd:extension base="grm:Use"/>
      </xsd:complexContent>
   </xsd:complexType>
   <xsd:element name="display" type="grm:Display"
substitutionGroup="grm:use"/>
   <!-- end Schema 7: Display Use -->
   <!-- Schema 8: Merge  -->
   <xsd:complexType name="Merge">
      <xsd:complexContent>
         <xsd:extension base="grm:Use"/>
      </xsd:complexContent>
   </xsd:complexType>
   <xsd:element name="merge" type="grm:Merge" substitutionGroup="grm:use"/>
   <!-- end Schema 8: Merge  -->
   <!-- Schema 9: Extract  -->
   <xsd:complexType name="Extract">
      <xsd:complexContent>
         <xsd:extension base="grm:Use"/>
      </xsd:complexContent>
   </xsd:complexType>
   <xsd:element name="extract" type="grm:Extract"
substitutionGroup="grm:use"/>
   <!-- end Schema 9: Extract  -->
   <!-- Schema 10: Transform  -->
   <xsd:complexType name="Transform">
      <xsd:complexContent>
         <xsd:extension base="grm:Use"/>
      </xsd:complexContent>
   </xsd:complexType>
   <xsd:element name="transform" type="grm:Transform"
substitutionGroup="grm:use"/>
   <!-- end Schema 10: Transform  -->
   <!-- Schema 11: Derive  -->
   <xsd:complexType name="Derive">
      <xsd:complexContent>
         <xsd:extension base="grm:Use"/>
      </xsd:complexContent>
   </xsd:complexType>
   <xsd:element name="derive" type="grm:Derive" substitutionGroup="grm:use"/>
   <!-- end Schema 11: Derive  -->
   <!-- Schema 12: Edit    -->
   <xsd:complexType name="Edit">
```

```
      <xsd:complexContent>
         <xsd:extension base="grm:Use"/>
      </xsd:complexContent>
   </xsd:complexType>
   <xsd:element name="edit" type="grm:Edit" substitutionGroup="grm:use"/>
   <!-- end Schema 12: Edit   -->
   <!-- Schema 13: Modify   -->
   <xsd:complexType name="Modify">
      <xsd:complexContent>
         <xsd:extension base="grm:Edit"/>
      </xsd:complexContent>
   </xsd:complexType>
   <xsd:element name="modify" type="grm:Modify" substitutionGroup="grm:edit"/>
   <!-- end Schema 13: Modify   -->
   <!-- Schema 14: Derive Graphic   -->
   <xsd:complexType name="DeriveGraphic">
      <xsd:complexContent>
         <xsd:extension base="grm:Display"/>
      </xsd:complexContent>
   </xsd:complexType>
   <xsd:element name="deriveGraphic" type="grm:DeriveGraphic"
substitutionGroup="grm:display"/>
   <!-- end Schema 14: Derive Graphic   -->
   <!-- Schema 15: Encode    -->
   <xsd:complexType name="Encode">
      <xsd:complexContent>
         <xsd:extension base="grm:Use"/>
      </xsd:complexContent>
   </xsd:complexType>
   <xsd:element name="encode" type="grm:Encode" substitutionGroup="grm:use"/>
   <!-- end Schema 15: Encode    -->
   <!-- Schema 16: Execute    -->
   <xsd:complexType name="Execute">
      <xsd:complexContent>
         <xsd:extension base="grm:GeoRight"/>
      </xsd:complexContent>
   </xsd:complexType>
   <xsd:element name="execute" type="grm:Execute"
substitutionGroup="grm:geoRight"/>
   <!-- end Schema 16: Execute    -->
   <!-- -->
   <!-- == Resources == -->
   <!-- -->
   <!-- Schema 4: GeoResource schema  -->
   <xsd:complexType name="GeoResource">
      <xsd:complexContent>
         <xsd:extension base="r:Principal">
            <xsd:sequence minOccurs="0">
               <xsd:element ref="r:resource" minOccurs="0"/>
            </xsd:sequence>
         </xsd:extension>
      </xsd:complexContent>
   </xsd:complexType>
   <xsd:complexType name="GeoProcess">
      <xsd:complexContent>
         <xsd:extension base="grm:GeoResource">
            <xsd:attribute name="formalName" type="xsd:string"
use="optional"/>
            <xsd:attribute name="implementor" type="xsd:anyURI"
use="optional"/>
```

```
            </xsd:extension>
         </xsd:complexContent>
      </xsd:complexType>
      <xsd:element name="geoResource" type="grm:GeoResource"
substitutionGroup="r:principal"/>
      <xsd:element name="geoProcess" type="grm:GeoProcess"
substitutionGroup="grm:geoResource"/>
      <!--  end Schema 4: GeoResource schema  -->
      <!-- -->
      <!-- == Conditions == -->
      <!-- -->
      <!-- Geo Item  Conditions -->
      <!--  Schema 17: GeoCondition -->
      <xsd:complexType name="GeoCondition">
         <xsd:complexContent>
            <xsd:extension base="r:Condition">
               <xsd:sequence minOccurs="0">
                  <xsd:element ref="r:licensePart"/>
                  <xsd:element ref="grm:property"/>
               </xsd:sequence>
            </xsd:extension>
         </xsd:complexContent>
      </xsd:complexType>
      <xsd:element name="geoCondition" type="grm:GeoCondition"
substitutionGroup="r:condition"/>
      <!--  end Schema 17: GeoCondition -->
      <!--  Schema 24: Side Effects  -->
      <xsd:complexType name="SideEffect">
         <xsd:complexContent>
            <xsd:extension base="sx:StatefulCondition">
               <xsd:attribute name="timeRelation" type="xsd:string"
use="optional" default="after"/>
               <xsd:attribute name="typeEffect" type="xsd:string" use="optional"
default="message to user"/>
            </xsd:extension>
         </xsd:complexContent>
      </xsd:complexType>
      <xsd:complexType name="PreCondition">
         <xsd:complexContent>
            <xsd:extension base="grm:SideEffect">
               <xsd:sequence>
                  <xsd:element ref="grm:geoCondition"/>
               </xsd:sequence>
            </xsd:extension>
         </xsd:complexContent>
      </xsd:complexType>
      <xsd:complexType name="Action">
         <xsd:complexContent>
            <xsd:extension base="grm:SideEffect"/>
         </xsd:complexContent>
      </xsd:complexType>
      <xsd:complexType name="ResultContains">
         <xsd:complexContent>
            <xsd:extension base="grm:Action"/>
         </xsd:complexContent>
      </xsd:complexType>
      <xsd:complexType name="Warning">
         <xsd:complexContent>
            <xsd:extension base="grm:Action"/>
         </xsd:complexContent>
```

```
    </xsd:complexType>
    <xsd:element name="sideEffect" type="grm:SideEffect"
substitutionGroup="r:condition"/>
    <xsd:element name="preCondition" type="grm:PreCondition"
substitutionGroup="grm:sideEffect"/>
    <xsd:element name="action" substitutionGroup="grm:sideEffect"/>
    <xsd:element name="resultContains" type="grm:ResultContains"
substitutionGroup="grm:action"/>
    <xsd:element name="warning" type="grm:Warning"
substitutionGroup="grm:action"/>
    <!-- end  Schema 24: Side Effects  -->
    <!-- -->
    <!-- == Properties  Types == -->
    <!-- -->
    <!--  Schema 21: Spatial Temporal Conditions  -->
    <xsd:complexType name="SpatialLimits" mixed="true">
       <xsd:complexContent mixed="true">
          <xsd:extension base="grm:Property">
             <xsd:choice>
                <xsd:element ref="gml:geometryMembers"/>
                <xsd:element ref="grm:geoPlace"/>
                <xsd:element ref="grm:spatialOperation"/>
             </xsd:choice>
          </xsd:extension>
       </xsd:complexContent>
    </xsd:complexType>
    <xsd:complexType name="SpatialOperation" mixed="true">
       <xsd:complexContent mixed="true">
          <xsd:extension base="grm:Property">
             <xsd:sequence minOccurs="2" maxOccurs="2">
                <xsd:choice>
                   <xsd:element ref="gml:geometryMembers"/>
                   <xsd:element ref="grm:geoPlace"/>
                   <xsd:element ref="grm:spatialOperation"/>
                </xsd:choice>
             </xsd:sequence>
             <xsd:attribute name="opName" type="xsd:string" use="optional"
default="intersection"/>
             <xsd:attribute name="egenhoferMask" type="xsd:string"
use="optional"/>
          </xsd:extension>
       </xsd:complexContent>
    </xsd:complexType>
    <xsd:complexType name="TimeInterval" mixed="true">
       <xsd:complexContent mixed="true">
          <xsd:extension base="grm:Property">
             <xsd:sequence>
                <xsd:choice minOccurs="0">
                   <xsd:element ref="grm:notBefore"/>
                   <xsd:element ref="grm:after"/>
                </xsd:choice>
                <xsd:choice minOccurs="0">
                   <xsd:element ref="grm:before"/>
                   <xsd:element ref="grm:notAfter"/>
                </xsd:choice>
             </xsd:sequence>
          </xsd:extension>
       </xsd:complexContent>
    </xsd:complexType>
```

```
   <xsd:element name="spatialLimits" type="grm:SpatialLimits"
substitutionGroup="grm:property"/>
   <xsd:element name="spatialOperation" type="grm:SpatialOperation"
substitutionGroup="grm:property"/>
   <xsd:element name="timeInterval" type="grm:TimeInterval"
substitutionGroup="grm:property"/>
   <xsd:element name="notBefore" type="xsd:dateTime"/>
   <xsd:element name="notAfter" type="xsd:dateTime"/>
   <xsd:element name="before" type="xsd:dateTime"/>
   <xsd:element name="after" type="xsd:dateTime"/>
   <!--  end Schema 21: Spatial Temporal Conditions  -->
   <!--  Schema 18: Standard compliance condition -->
   <xsd:complexType name="Standard" mixed="true">
      <xsd:complexContent mixed="true">
         <xsd:extension base="grm:Property"/>
      </xsd:complexContent>
   </xsd:complexType>
   <xsd:element name="standard" type="grm:Standard"
substitutionGroup="grm:property"/>
   <!--  end Schema 18: Standard compliance condition -->
   <!--  Schema 19: Output format conditions -->
   <xsd:complexType name="Format" mixed="true">
      <xsd:complexContent mixed="true">
         <xsd:extension base="grm:Property"/>
      </xsd:complexContent>
   </xsd:complexType>
   <xsd:element name="format" type="grm:Format"
substitutionGroup="grm:property"/>
   <xsd:element name="output" type="grm:Format"
substitutionGroup="grm:property"/>
   <!--  end Schema 19: Output format conditions -->
   <!--Schema 20: Transfer conditions -->
   <xsd:complexType name="Transfer" mixed="true">
      <xsd:complexContent mixed="true">
         <xsd:extension base="grm:Property">
            <xsd:sequence>
               <xsd:element ref="r:grant"/>
            </xsd:sequence>
         </xsd:extension>
      </xsd:complexContent>
   </xsd:complexType>
   <xsd:element name="transfer" type="grm:Transfer"
substitutionGroup="grm:property"/>
   <!--end Schema  20: Transfer conditions -->
   <!-- Schema 22: Derived rights conditions  -->
   <xsd:element name="derivedRights" type="grm:Transfer"
substitutionGroup="grm:property"/>
   <!-- end Schema 22: Derived rights conditions  -->
   <!-- Schema 23: Encoding conditions -->
   <xsd:element name="encoding" type="grm:Format"
substitutionGroup="grm:property"/>
   <!-- end Schema 23: Encoding conditions -->
</xsd:schema>
```

Annex C
(informative)

Notes on the ISO REL, ISO/IEC 21000-5

C.1 Overview

The purpose of this annex is to give a partial overview of the ISO REL, to aid in the understanding of the framework in which the GeoREL works. Nothing can replace the reading of the original standards (ISO/IEC 21000, all parts), but this exposition is to provide notes on the motivation of some of the design decisions in this International Standard that were affected or controlled by an interpretation of the meanings and semantics of ISO/IEC 21000-5.

The following clauses take concepts presented in the ISO REL and explain their intended use and limitations as those concerns affect the design of the GeoREL presented in this International Standard.

The examples in this annex use formats for URIs, place names and addresses that could be replaced by any local or regional standard common in a location. The license uses such opaque “names” as indexes to authorities such as URI naming authorities or gazetteers.

C.2 License parts

The r:LicensePart complex type and associated element, r:licensePart in the ISO REL is the root of most of the important derivation trees used in ISO REL schema. It is essentially to define a common reference mechanism to be used in licenses. This is done by defining three attributes, a license part ID, a license part ID reference and a variable reference. The following XML is taken from rel-r.xsd:

Schema C.1: License part from ISO REL

```
<xsd:complexType name="LicensePart">
<xsd:attribute name="licensePartId" type="r:LicensePartId"
    use="optional"/>
<xsd:attribute name="licensePartIdRef" type="r:LicensePartId"
    use="optional"/>
<xsd:attribute name="varRef" type="r:VariableName" use="optional"/>
</xsd:complexType>

<xsd:element name="licensePart" type="r:LicensePart"/>
```

Of these three, only one can be present in any instance of any license part. The semantics is as follows.

— If the license part ID is not NULL or if all are NULL, then the value of the element is given within the current element.

— If the license part ID reference is not NULL, then the value of the element is given elsewhere within the XML document and that value has a license part ID equal to this reference. The current element shall otherwise be empty.

— If the variable reference is not NULL, then the value of the element can take on any valid value of the variable as defined in the r:forAll element elsewhere in the current XML document, which has this value as its r:varName attribute value. The current element shall otherwise be empty.

As a consequence of this use of references, any element or type that derives from license part shall be able to have an empty content. This means that any element or type defining a derivation of license part, principal, grant, right, resource, condition, etc., shall have, at best, an optional content, so that the license part ID reference mechanism can be used. ISO/IEC 21000-5 specifically makes this a requirement of any derivation using ISO REL as its base vocabulary.

Test for equality shall first de-reference all license parts, and ignore these attribute values. For this reason, ISO/IEC 21000 specifies that circular references cause a license to be invalid.

C.3 Issuer

An r:licenseIssuer is the system entity responsible for granting the particular license in question to the licensee in question. Multiple instance of license issuer elements is interpreted as the equivalent to multiple licenses, one for each issuer, containing all the grants specified in each listing of this single issuer.

C.4 For all declaration of variables

An r:forAll element defines a variable name, a set of possible values and a scope for a “named variable”. The XML is as follows:

Schema C.2: For all variable definition from ISO REL

```
<xsd:element name="forAll" block="#all" substitutionGroup="r:licensePart"
       final="#all">
   <xsd:complexType>
      <xsd:complexContent>
         <xsd:extension base="r:LicensePart">
            <xsd:sequence>
               <xsd:element ref="r:anXmlPatternAbstract"
                  minOccurs="0" maxOccurs="unbounded"/>
            </xsd:sequence>
            <xsd:attribute name="varName" type="r:VariableName"/>
         </xsd:extension>
      </xsd:complexContent>
   </xsd:complexType>
</xsd:element>
```

The required attribute “varName” can be used to reference this set of values from elsewhere in the XML document (cross-document references present a validation problem and are not allowed). The use of “varRef” in r:licensePart and its derivatives reference this set. The content of the element is a pattern of some description that, if it matches a correctly typed variable value, indicates that value's inclusion in the range of this variable.

The use of a variable reference in an element essentially allows that element to be replaced by any instance of the same type matching one of the patterns in the “r:forAll” content.

ISO/IEC 21000-5:2004, D.3, gives the following example of a variable declaration:

Example C.1: Property for all elements using “certificate license” from ISO REL

```
<r:license …> …
    <r:forAll varName="AcmeMusicClubMember">
       <r:propertyPossessor>
          <sx:propertyUri definition="urn:acme:musicClubMember"/>
          <r:trustedRootIssuers>
             <r:keyHolder licensePartId="Acme">
                <r:info>
                   <dsig:KeyValue>
                      <dsig:RSAKeyValue>
                         <dsig:Modulus>aaaM4ccyzA==</dsig:Modulus>
                         <dsig:Exponent>AQABAA==</dsig:Exponent>
                      </dsig:RSAKeyValue>
                   </dsig:KeyValue>
                </r:info>
             </r:keyHolder>
          </r:trustedRootIssuers>
       </r:propertyPossessor>
    </r:forAll>
…
    <r:grant> …
       <r:principal varRef="AcmeMusicClubMember"/>
       …
    </r:grant>
    …
</r:license
```

This declaration, occurring within the opening tag of the license, is valid for anywhere in the license or its nested elements. The variable “AcmeMusicClubMember” defines the licensing authority by specifying who has the owner's rights to issue licenses proving that a principal has the right to claim possession of the property so named. Later in the license, a grant uses the variable to define its principal. This means that anyone who can exhibit a valid license issued by the key holder showing that he can claim the property can use this license.

This is a powerful concept because it can be used to equate several concepts. If a principal can claim a property for membership in a club, then a similar mechanism can be used for a principal to claim that a resource has a “conformance to a standard” property within a similar license. This puts actions by principals and properties of principals and resources in the same game, and thus allows “proofs” of various types to be expressible by properly authenticable licenses. Thus, OGC can essentially frame a signed XML license document to be put on file as proof of compliance for a particular instance of a service to a particular OGC implementation specification. That puts all authorization verification into the same process, all based on off-the-shelf DRM Gatekeepers as defined in ISO 19153.

C.5 Renderer

The mx:renderer is a condition that can restrict the principals that can be used in a “render right”. What this may be used for is to specify devices (as principals) that can be used in print, play or other rights that “render a perceivable representation of all or part of a resource”. Thus, in our set of geographic rights, the renderer of a display can be specified as a principal representing a particular service or a set of services (as in the “forAll” example, see C.4). The XML for renderer from rel-mx.xsd is as follows:

Schema C.3: Renderer from ISO REL, MX extension

```
<xsd:complexType name="Renderer">
<xsd:complexContent>
   <xsd:extension base="r:Condition">
      <xsd:sequence>
         <xsd:element ref="r:principal" minOccurs="0"
            maxOccurs="unbounded"/>
         <xsd:element name="wildcard" minOccurs="0"
            maxOccurs="unbounded">
            <xsd:complexType>
               <xsd:sequence>
                  <xsd:element ref="r:anXmlPatternAbstract"
                     minOccurs="0" maxOccurs="unbounded"/>
               </xsd:sequence>
            </xsd:complexType>
         </xsd:element>
      </xsd:sequence>
   </xsd:extension>
   </xsd:complexContent>
</xsd:complexType>

<xsd:element name="renderer" type="mx:Renderer"
       substitutionGroup="r:condition"/>
```

The identity of a renderer as given in the mx:renderer element shall be in the substitution group for r:principal. But r:principal is in the substitution group of r:resource, and geoProcess and geoResource are in the substitution group for r:principal, and therefore can be used as an mx:renderer. This means that a geoProcess or a variable whose value range contains geoProcesses can be used to identify renderer in render rights.

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4) This document uses XML Schema to describe structural data types for this standard. In some cases such descriptions fall short in describing the full restrictions on use, and the associated text often describes additional restrictions on usage and allowable format options within a compliant license.

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