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Part 12: Query format

Technologies de l'information — Interface de description du contenu multimédia —

Partie 12: Format de requête

Reference number
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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

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

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

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

ISO/IEC 15938-12 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

ISO/IEC 15938 consists of the following parts, under the general title *Information technology — Multimedia content description interface*:

— *Part 1: Systems*

— *Part 2: Description definition language*

— *Part 3: Visual*

— *Part 4: Audio*

— *Part 5: Multimedia description schemes*

— *Part 6: Reference software*

— *Part 7:* Conformance testing

— *Part 8: Extraction and use of MPEG-7 descriptions*

— *Part 9: Profiles and levels*

— *Part 10: Schema definition*

— *Part 11: MPEG-7 Profile schemas*

— *Part 12: Query format*

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Introduction

The MPEG-7 standard, also known as the "Multimedia Content Description Interface", aims at providing standardized core technologies allowing the description of audiovisual data content in multimedia environments. This is a challenging task given the broad spectrum of requirements and targeted multimedia applications, and the broad number of audiovisual features of importance in such a context. In order to achieve this broad goal, MPEG-7 standardizes:

- Datatypes that are description elements not specific to the audiovisual domain that corresponds to reusable basic types or structures employed by multiple Descriptors and Description Schemes.

- Descriptors (D) to represent Features. Descriptors define the syntax and the semantics of each feature representation. A Feature is a distinctive characteristic of the data, which signifies something to somebody. It is possible to have several descriptors representing a single feature, i.e. to address different relevant requirements. A Descriptor does not participate in many-to-one relationships with other description elements.

- Description Schemes (DS) to specify the structure and semantics of the relationships between their components, which may be both Ds and DSs. A Description Scheme shall have descriptive information and may participate in many-to-one relationships with other description elements.

- A Description Definition Language (DDL) to allow the creation of new DSs and, possibly, Ds and to allow the extension and modification of existing DSs.

- Systems tools to support multiplexing of descriptions or description and data, synchronization issues, transmission mechanisms, file format, etc.

The standard is subdivided into twelve parts:

1. Systems: Architecture of the standard, tools that are needed to prepare MPEG-7 Descriptions for efficient transport and storage, and to allow synchronization between content and descriptions. Also tools related to managing and protecting intellectual property.

2. Description Definition Language: Language for defining new DSs and eventually also new Ds, binary representation of DDL expressions.

3. Visual: Visual description tools (Ds and DSs).

4. Audio: Audio description tools (Ds and DSs).

5. Multimedia Description Schemes: Description tools (Ds and DSs) that are generic, i.e. neither purely visual nor purely audio.

6. Reference Software: Software implementation of relevant parts of the MPEG-7 Standard.

7. Conformance: Guidelines and procedures for testing conformance of MPEG-7 implementations.

8. Extraction and use of MPEG-7 descriptions.

9. Profiles and Levels.

10. Schema Definition.

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11. MPEG-7 Profile Schemas.

12. Query Format.

This part of ISO/IEC 15938 contains the tools of the MPEG Query Format (MPQF). It addresses the normative aspects of the MPQF and also illustrates some non-normative examples. The syntax of the Query Format is defined using the guidelines of DDL ISO/IEC 15938-2.

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Information technology — Multimedia content description interface —

Part 12: Query format

1 Scope

1.1 Organization of the document

This part of ISO/IEC 15938 describes the query format tools which may be used independently or in combination with other parts of ISO/IEC 15938. Each query format tool is described in two normative sections:

- Syntax: Normative specification of the query and management format.
- Semantic: Normative definition of the semantics of all the components of the corresponding query format specification.

In some instances the query format level tool is also described using either one or two informative sections:

- Examples: Optionally an informative section dealing with examples is appended.
- Definitions: Optionally an informative section dealing with definitions is appended.

1.2 Overview of the Query Format

The query format provides a standardized interface for multimedia content information retrieval systems (e.g. MPEG-7 databases) in three aspects which are input query format, output query format, and query managements. The input query format specifies the interface through which the users can describe their search criteria with a set of precise input parameters in addition to a set of preferred output parameters to depict the return result sets. The output query format specifies the interface format for the result set. The query management provides means for selecting services (e.g. MPEG-7 database) or aggregated services (e.g. service provider that administers a set of different services) based on service properties (e.g. supported query format).

2 Normative references

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

XQuery 1.0 and XPath 2.0 Data Model (XDM). W3C Recommendation, 23 January 2007. http://www.w3.org/TR/xpath-datamodel/

XML Path Language (XPath) 2.0. W3C Recommendation, 23 January 2007. http://www.w3.org/TR/xpath20/

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3 Terms, definitions, abbreviated terms and conventions

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

3.1 Terms and definitions

3.1.1
content
data and the associated **metadata**

3.1.2
evaluation item
EI
unit, against which the query condition is tested

NOTE By default, an EI is a **multimedia content** of the multimedia repository, but other types of EI are also possible. An EI can be:

1) A **multimedia content**;
2) A **segment** of a **multimedia resource**;
3) An **XPath-item** related to the **multimedia content's metadata** XML tree.

3.1.3
input query format
interface format going from a requester to one or more responders with two functionalities

— functionality provides a combination of syntax and semantics of the interface, through which the requester assigns search criteria and associated data;

— functionality provides syntax and semantics of the interface, through which the requester specifies the format of the result data.

NOTE The second functionality of the input query format provides tools by which the requester can express desired output format that should be conformant to the specification of **output query format**.

3.1.4
metadata
data expressed as a schema valid XML instance to carry additional information describing a **multimedia resource**, where the schema defines the information model of the data

3.1.5
multimedia content
coded representation of the information contained in or related to a **multimedia resource** in a formalized manner suitable for interpretation by human means

3.1.6
multimedia resource
URI identifiable portion of raw data of a video, an image, an audio or text in any format, that is associated with a MIME Content-Type

3.1.7
output query format
interface format going from the responder to the requester as a response to the request specified by the **input query format**

NOTE Output query format defines all possible structures of return from responder to the requester. The structure of an actual return shall be decided by OutputDescription element in **input query format**.

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3.1.8
query management tools
tools to support the functionality required to manage the query transaction between the requesters and the responders

NOTE The query management tools do not include tools that are supported by network protocols. The query management tools intend to be network agnostic and media agnostic.

3.1.9
segment
spatial, temporal, or spatio-temporal unit of multimedia, for example, a temporal segment of video, or a spatial segment of an image

3.1.10
XPath-item
either a node from the **multimedia content's metadata** XML tree or an atomic value

NOTE Details about the different types of nodes and atomic values can be found in the W3C Recommendation on XQuery 1.0 and XPath 2.0 Data Model. An XPath-item of a **multimedia content's metadata** may or may not be related to a **multimedia content's segment**. Also, a **multimedia content** or a **multimedia content's segment** may or may not be related to XML **metadata**. Within MPQF queries, XPath can be used to select a sequence of **multimedia content's segments** and/or **metadata** XPath-items. According to the W3C Recommendation on XQuery 1.0 and XPath 2.0 Data Model, a sequence is an ordered collection of zero or more XPath-items.

3.2 Abbreviated terms

MPEG: Moving Picture Experts Group

MPEG-7: ISO/IEC 15938

MPQF: MPEG Query Format, ISO/IEC 15938-12

URI: Uniform Resource Identifier (IETF Standard is RFC 2396)

URL: Uniform Resource Locator (IETF Standard is RFC 2396)

XML: Extensible Markup Language (W3C, http://www.w3.org/XML/)

3.3 Conventions

3.3.1 Query and query management tools

This part of ISO/IEC 15938 specifies the format for query and query management tools using XML-Schema.

- Query – A set of tools supporting the definition of the query request as well as the query response defined for the MPEG query format. The structure defined for the `Query` element provides a container for input query format or output query format.
    - Input query format – `Input` and `FetchResult` elements are defined for the query. The input query format structure provides a container for a query request. Such a request should contain a set of conditions and/or the output description which specifies the structure and content of the output query format and/or a set of declarations.
    - Output query format – The `Output` element is defined for the query. It provides a container for all the responses from a responder to a requester. It may contain not only query results but also any messages such as error and exceptions.
- Management tools – A set of tools for the query management defined for the MPEG query format including service discovery, querying service capability, and service capability description. The structure

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defined for the management tools provides a container for input management tools or the output management tools.

- Input management tools – An `Input` element is defined for the management tools intended to be sent from a requester to one or more responders.
- Output management tools – An `Output` element is defined for the management tools intended to be sent from a responder to one or more requesters.

3.3.2 Naming convention

In order to specify tools for the query format, this part of ISO/IEC 15938 uses constructs provided by the language specified in ISO/IEC 15938-2 [1], such as "element", "attribute", "simpleType" and "complexType". The names associated to these constructs are created on the basis of the following conventions:

- If the name is composed of various words, the first letter of each word is capitalized. The rule for the capitalization of the first word depends on the type of construct and is described below.
- Element naming: the first letter of the first word is capitalized (e.g. TimePoint element of TimeType).
- Attribute naming: the first letter of the first word is not capitalized (e.g. timeUnit attribute of IncrDurationType).
- complexType naming: the first letter of the first word is capitalized, the suffix "Type" is used at the end of the name, except the concrete types inherited from abstract types.
- simpleType naming: the first letter of the first word is not capitalized, the suffix "Type" may be used at the end of the name (e.g. timePointType).

NOTE The full name of the complexType or simpleType is used when referencing a complexType or simpleType in the definition of the query format.

3.3.3 Documentation convention

The syntax of each datatype, descriptor and description scheme is specified using the constructs provided by ISO/IEC 15938-2 [1], and is shown in this part of ISO/IEC 15938 using a specific font and background:

```
<complexType name="ExampleType">
   <sequence>
      <element name="Element1" type="string" minOccurs="1" maxOccurs="1"/>
   </sequence>
   <attribute name="attribute1" type="string" use="default" value="attrvalue1"/>
</complexType>
```

The semantics of each datatype, descriptor and description scheme is specified using a table format, where each row contains the name and a definition of a type, element or attribute:

Name	*Definition*
ExampleType	Specifies an ...
element1	Describes the …
attribute1	Describes the …

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Non-normative examples are included in separate sections, and are shown in this part of ISO/IEC 15938 using a separate font and background:

```
<Example attribute1="example attribute value">
   <Element1>example element content</Element1>
</Example>
```

Moreover, the schema defined in this part of ISO/IEC 15938 follows a type-centric approach. As a result, almost no elements (in the XML schema sense) are defined. Most of the description tools are specified only by defining a complexType or a simpleType. In order to create a description, it has to be assumed that an element of a given type (complexType or simpleType) has been declared somewhere in the schema, for example as a member of another complexType or simpleType.

The examples in the informative sections assume that the following declaration has been made:

```
<element name="Example" type="mpqf:MyToolType">
```

Therefore, the example shown above is a valid description.

3.3.4 Wrapper convention of the schema

The Syntax defined in this part of ISO/IEC 15938 assumes the following schema wrapper.

```
<schema xmlns:mpqf="urn:mpeg:mpqf:schema:2008"
xmlns="http://www.w3.org/2001/XMLSchema"
targetNamespace="urn:mpeg:mpqf:schema:2008" elementFormDefault="qualified"
attributeFormDefault="unqualified">
```

4 Structure and Data Model

4.1 Structure

The Query Format defines the interface between a requester and a responder. The requester may be any requester and the according responder might be the service provider, which can in turn additionally be a requester to a number of other databases. Additionally, one or more service providers can utilize the Query Format acting as responder from the requester side and as requester, when forwarding the messages to a number of databases. Furthermore, the service provider may have the capability to aggregate the results from different databases and to reply a combined result to the requester. Figure 1 depicts a possible setup for the use of the MPEG Query Format.

The part of the query format related to the messages from the requester to the responder, describing their search criteria, is called Input Query Format; the part of the query format related to the messages in return is called Output Query Format. Additionally, the format for the management messages provides means for selecting services (e.g., MPEG-7 database) or aggregated services (e.g., service provider that administers a set of different services) based on service properties (e.g., supported query format, etc.).

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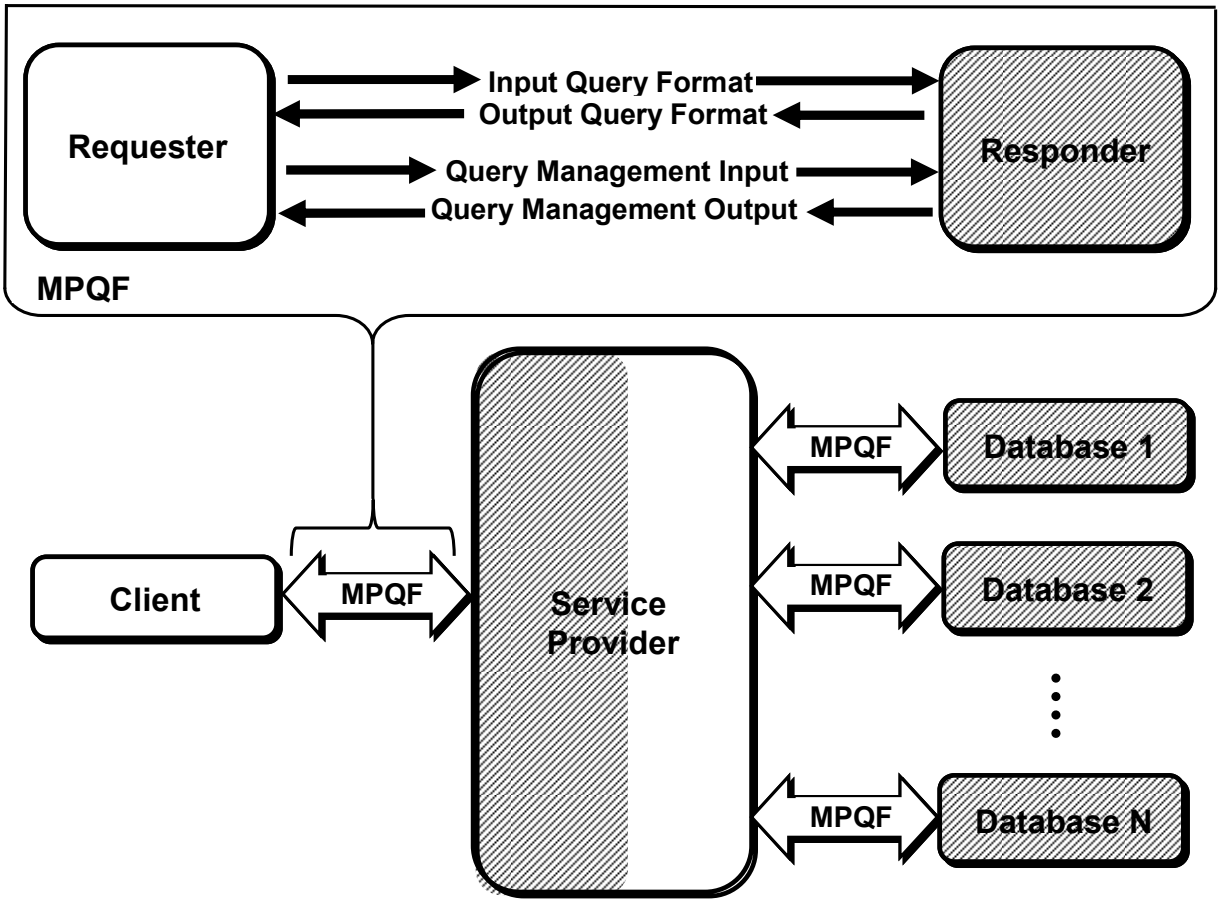

Figure 1 — Possible scenario for the use of the MPEG Query Format

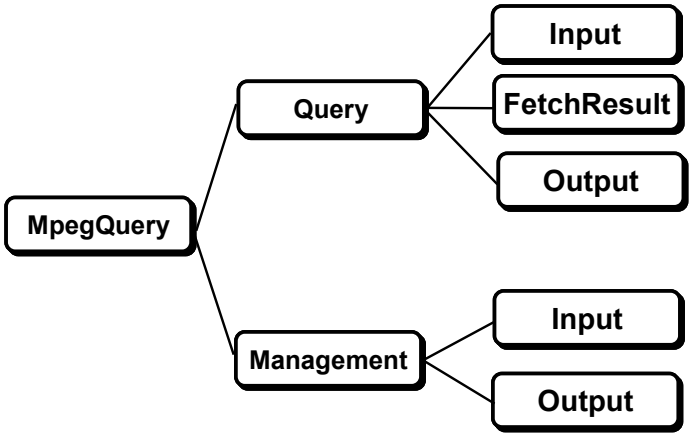

Figure 2 — Schema overview of the uppermost elements of the MPEG Query Format

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The root element of the MPEG Query Format is named “MpegQuery” and it contains a sequence of `Query` and `Management` elements. Table 1 explains both elements in more detail:

Table 1 — Query and Management elements

`Query`	A set of tools are defined for the query and response for the MPEG Query Format. The structure defined for the `Query` element provides a container for Input Query Format or Output Query Format.
`Management`	A set of tools for the query management defined for the MPEG Query Format including service discovery, querying service capability, and service capability description. The structure defined for the `Management` element provides a container for Management Input Tools or the Management Output Tools.

The `Query` element of the MPEG Query Format defines a set of tools for the query and its response. Table 2 depicts the containing elements in more detail. Note that the `Input` and the `FetchResult` elements belong to the Input Query Format, which provides a container for describing a query request (e.g., the query condition and/or the output description which specifies the structure and content of the output query format).

Table 2 — Elements in Query Tools

`Input`	The `Input` element is part of the Input Query Format. Its structure provides a container for describing a query request. Such a request can consist of a query condition and/or the output description which specifies the structure and content of the output query format and/or some declaration parts.
`FetchResult`	The `FetchResult` element is also part of the Input Query Format. It allows the user to request the results of a previous query issued using e.g., the asynchronous mode.
`Output`	The `Output` element describes the Output Query Format. It provides a container for all the responses from a responder to a requester. It may contain not only query results but also any messages such as errors, exceptions or comments.

The `Management` element of the MPEG Query Format represents the Query Management Tools of the Query Format. It describes a set of tools for the query management including service discovery, querying service capability, and service capability description. Similar to the query tools (Input Query Format and Output Query Format), the management part distinguishes the tools for the request (Input Management Type) and the response (Output Management Type). Table 3 depicts the containing elements in more detail.

Table 3 — Elements in Query Management Tools

`Input`	The `Input` element, which is defined for the management tools, is intended to be sent from a requester to one or more responders.
`Output`	The `Output` element, which is defined for the management tools, is intended to be sent from a responder to one requester.

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4.2 Data Model

Processing and evaluation of an MPQF query is executed against one or more multimedia repositories. Note, all introduced terms used within this subclause are explained in 3.1.

From the point-of-view of the MPQF, a multimedia repository is an unordered set of multimedia contents (MCs). An MPQF query specifies a search condition tree composed by conditions which may be interconnected by Boolean expressions. Conditions within the condition tree operate on one evaluation-item (EI) at a given time, or two EIs if a Join operation is used. By default, an evaluation-item (EI) is a multimedia content in the multimedia repository, but other types of EIs are also possible. An EI can be either a multimedia content (MC), a segment of a multimedia resource, or an XPath-item related to the MC's metadata XML tree. A segment of a multimedia content is a spatial and/or temporal unit of multimedia resource, for example, a temporal segment of a video, or a segment of an image.

According to the XQuery 1.0 and XPath 2.0 Data Model (XDM), an XPath-item is either a node from the MC's metadata XML tree or an atomic value. Details about the different types of nodes and atomic values can be found in the W3C Recommendation of the XQuery 1.0 and XPath 2.0 Data Model (XDM). An XPath-item of an MC's metadata may or may not be related to an MC's segment. A multimedia content or an MC's segment may or may not be related to XML metadata. Within MPQF queries, XPath can be used to select a sequence of MC's segments and/or metadata XPath-items.

The scope of query evaluation and the granularity of the result set shall be determined by the `EvaluationPath` element specified in the `QueryCondition` element. For example, if the `EvaluationPath` element points to a certain level of a video segment, then the result set is a collection of video segments with the requested metadata. If the `EvaluationPath` element points to a video resource, then the result set consists of a collection of video resources with the requested metadata. If the `EvaluationPath` element in the `QueryCondition` element is not specified, the output result is provided as a collection of multimedia contents, as stored in the repository, each satisfying the query condition.

XPath expressions appearing in MPQF can be absolute or relative. When absolute, independently of the kind of evaluation item being addressed, an XPath expression will always refer to the root of the metadata document related to the multimedia content which the evaluation-item belongs to (even if the evaluation-item is related just to a fragment of this document) .

When relative, an XPath expression will always refer to the root node of the metadata fragment (which can be the root of the metadata document or cannot) related to the evaluation item being addressed.

5 Root Element

5.1 Introduction

The `MpegQuery` element serves as the root element of the MPEG Query Format. The root element shall be used as the topmost element in all messages transmitted. This applies on the one side to the input query format and the output query format of a query request/response as well as on the other side to the query management messages of the input/output.

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5.2 Syntax

```
<element name="MpegQuery" type="mpqf:MpegQueryType"/>

<complexType name="MpegQueryType">
   <choice>
      <element name="Query">
         <complexType>
            <choice>
               <element name="Input" type="mpqf:InputQueryType"/>
               <element name="FetchResult">
                  <complexType>
                     <attribute name="queryID" type="anyURI"/>
                     <attribute name="retrievePageNum" type="positiveInteger"/>
                  </complexType>
               </element>
               <element name="Output" type="mpqf:OutputQueryType"/>
            </choice>
         </complexType>
      </element>
      <element name="Management">
         <complexType>
            <choice>
               <element name="Input" type="mpqf:InputManagementType"/>
               <element name="Output" type="mpqf:OutputManagementType"/>
            </choice>
         </complexType>
      </element>
   </choice>
   <attribute name="mpqfID" type="anyURI" use="required"/>
</complexType>
```

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5.3 Semantics

Semantics of the `MpegQueryType` type:

Name	*Definition*
MpegQuery	Serves as the root element of the MPEG Query Format. The MpegQuery element shall be used as the topmost element in any instance of MPEG Query Format.
MpegQueryType	Specifies the syntax of the root element. Within this element, either one of the Input, FetchResult or Output element of the Query or one of the Input or Output element of the Management element shall be instantiated, respectively.
Query	Wraps the user query request (an Input or a FetchResult element) or the responder response to a user query request (the Output element).
Input	Wraps the user query specified using the Input Query Format, which is to be sent from the requester to the responder.
FetchResult	Allows the user to request the result of a previous query. In case of a query request issued using the asynchronous mode (with the immediateResponse attribute of the InputQueryType type set to false), the FetchResult element shall be used to indicate the preparedness of the user to receive results. In case of a query request issued using the synchronous mode, the FetchResult element shall be used to receive individual pages of the result set (if paging is activated).
queryID	The requester is looking for a the result of a certain identifier in asynchronous mode. The attribute queryID specifies this identifier.
retrievePageNum	Specifies the number of page the requester wants the responder to return (optional) The default value is '1.'
Output	Wraps the responder response to a user query as described using the Output Query Format. The output is sent from the responder to the requester.
Management	Describes the Query Management tools which may be exchanged between responders and requesters. Within this element only one of Input or Output element shall be instantiated.
Input	Wraps a user request for service capabilities.
Output	Wraps the response to a user request for service capabilities.
mpqfID	Specifies a unique identifier which is assigned to every message sent between a requester and a responder.

5.4 Example

The following examples show the use of the root element for the MPEG Query Format. The first three examples demonstrate the use of the `Query` element. First, a user query request is simulated by using the `Input` element. Note, that no details have been specified. Second, the result of a previous asynchronous request is going to be fetched by the user. Finally, the result set of a query request is demonstrated by using the `Output` element.

The last example shows the use of a service discovery request by using the `Management` element followed by an `Input` element. In this case the response would contain a list of all available services which are registered.

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```
<MpegQuery mpqfID="idForMyRequest1">
  <Query>
    <Input>
      . . .
    </Input>
  </Query>
</MpegQuery>
```

```
<MpegQuery mpqfID="idForMyRequest2">
  <Query>
    <FetchResult queryID="idFromAsyncRequest1"/>
  </Query>
</MpegQuery>
```

```
<MpegQuery mpqfID="idForMyResponse1">
  <Query>
    <Output>
      . . .
    </Output>
  </Query>
</MpegQuery>
```

```
<MpegQuery mpqfID="idForMyRequest3">
  <Management>
    <Input>
      . . .
    </Input>
  </Management>
</MpegQuery>
```

6 Datatypes

6.1 MediaLocatorType

6.1.1 Introduction

The `MediaLocatorType` type serves as a basic datatype for locating a multimedia resource in the `MediaResource` element.

The `MediaLocatorType` type shall be composed of either a `MediaUri` element or `InlineMedia` element for locating a multimedia resource. The `InlineMedia` element enables an alternative method to a `MediaUri` for locating multimedia resource, by embedding the multimedia resource into the description.

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6.1.2 Syntax

```
<complexType name="MediaLocatorType">
    <sequence>
        <choice>
            <element name="MediaUri" type="anyURI"/>
            <element name="InlineMedia" type="mpqf:InlineMediaType"/>
        </choice>
    </sequence>
</complexType>
<complexType name="InlineMediaType">
    <choice>
        <element name="MediaData16" type="hexBinary"/>
        <element name="MediaData64" type="base64Binary"/>
    </choice>
    <attribute name="type" type="mpqf:mimeType" use="required"/>
</complexType>
```

6.1.3 Semantics

Semantics of the `MediaLocatorType` type:

Name	*Definition*
`MediaLocatorType`	Specifies the `MediaLocatorType` type. Describes the location of a multimedia resource in `MediaResource` element. The location of a multimedia resource should be specified either by reference to the external multimedia resource using the `MediaUri` element or by embedding the multimedia resource within the description as an `InlineMedia` instance.
`MediaUri`	Points to the actual resource that is used for querying.
`InlineMedia`	Describes the actual resource that is used for querying.

Semantics of the `InlineMediaType` type:

Name	*Definition*
`InlineMediaType`	Specifies the multimedia resource embedded in the resource. The `InlineMediaType` type is a container for the actual binary multimedia resource.
`MediaData16`	Describes the actual resource that is used for querying, encoded as a textual string in base-16 format.
`MediaData64`	Describes the actual resource that is used for querying encoded as a textual string in base-64 format.
`type`	This attribute specifies the `mimeType` of the multimedia resource.

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6.2 MimeType

6.2.1 Introduction

The `mimeType` type is defined to specify the syntax for a `mimeType` element which shall be used to identify the media type of a multimedia resource.

6.2.2 Syntax

```
<simpleType name="mimeType">
  <restriction base="string">
    <whiteSpace value="collapse"/>
    <pattern value='([Xx]\-)?[!#$%&#x27;*+.0-9A-Z\^-~&#x7f;]+/([Xx]\-
                   )?[!#$%&#x27;*+.0-9A-Z\^-~&#x7f;\-]+'/>
  </restriction>
</simpleType>
```

6.2.3 Semantics

Semantics of the `mimeType` type:

Name	*Definition*
`mimeType`	Specifies the syntax of the `mimeType` type, which is used to identify the type of multimedia resource.
`pattern value`	Specifies the allowed pattern for `mimeTypes` and corresponds to RFC 2045 MIME (Part 1).

6.3 XPathType

6.3.1 Introduction

XPath expressions are used to identify elements and attributes in the corresponding responder description (specified by the namespace of the description, e.g., MPEG-7) in Input Query or Output Query. The instance of `xPathType` shall be compliant to the specification XML Path Language (XPath) 2.0, W3C Recommendation 23 January 2007.

6.3.2 Syntax

```
<simpleType name="xPathType">
  <restriction base="token"/>
</simpleType>
```

6.3.3 Semantics

Semantics of the `xPathType` type:

Name	*Definition*
`xPathType`	Describes the valid `XPath` expression.

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6.4 ZeroToOneType

6.4.1 Introduction

The `zeroToOne` datatype represents a `float` value in the range of 0.0 to 1.0.

6.4.2 Syntax

```
<simpleType name="zeroToOneType">
  <restriction base="float">
    <minInclusive value="0.0"/>
    <maxInclusive value="1.0"/>
  </restriction>
</simpleType>
```

6.4.3 Semantics

Semantics of the `zeroToOneType` type:

Name	*Definition*
`zeroToOneType`	Describes a floating value in the range of 0.0 to 1.0 inclusive.

6.5 TermType

6.5.1 Introduction

The `TermType` type is to be used in the classification scheme and other tools to control the use of the terms inside the query format. The `Name` element allows the specification of the label of the term. The `Description` element allows the definition and the description in text format. The `href` attribute is required to point to the classification scheme, in which the terms are defined. A hierarchy of nested terms can be expressed by successive applying of the `Term` element.

6.5.2 Syntax

```
<complexType name="TermType">
  <sequence>
    <element name="Name" type="string" minOccurs="0"/>
    <element name="Description" type="string" minOccurs="0"/>
    <element name="Term" type="mpqf:TermType" minOccurs="0"
             maxOccurs="unbounded"/>
  </sequence>
  <attribute name="href" type="mpqf:SimpleTermType" use="required"/>
</complexType>

<simpleType name="SimpleTermType">
  <restriction base="anyURI"/>
</simpleType>
```


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6.5.3 Semantics

Semantics of the `TermType` type:

Name	*Definition*
`TermType`	Specifies a `TermType` type which is used for describing capabilities and its references to classification schemes.
`Name`	Specifies the name of the term.
`Description`	Specifies a detailed description of the term.
`Term`	Specifies a new term which supports nested term definitions.
`href`	Specifies the `SimpleTermType` type pointing to a specific term of a classification scheme.
`SimpleTermType`	Specifies the URN of the term.

6.5.4 Example

For the examples, check the classification schemes in Annex B.

6.6 ClassificationScheme

6.6.1 Introduction

The `ClassificationScheme` element is an element, which contains the classification scheme. It makes use of the `TermType` type, which allows a nested definition of terms.

6.6.2 Syntax

```
<element name="ClassificationScheme">
  <complexType>
    <sequence>
      <element name="Term" type="mpqf:TermType" maxOccurs="unbounded"/>
    </sequence>
    <attribute name="uri" type="anyURI" use="required"/>
    <attribute name="domain" use="optional">
      <simpleType>
        <list itemType="mpqf:xPathType"/>
      </simpleType>
    </attribute>
  </complexType>
</element>
```

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6.6.3 Semantics

Semantics of the `ClassificationScheme` element:

Name	*Definition*
`ClassificationScheme`	This element contains the actual classification scheme
`Term`	Describes the content of the classification scheme (the single terms including a description).
`uri`	Identifies the classification scheme with a Uniform Resource Identifier (URI). This URI shall uniquely identify a classification scheme. The use of a URN as a classification scheme URI is preferred.
`domain`	Indicates a set of description elements to which this `ClassificationScheme` applies. The set is specified using an XPath expression. This attribute is a hint on how the `ClassificationScheme` can be used in a description. One or more values may be specified. The XPath in this attribute is defined relative to a *description root*, not the DDL schema. For example: a value of ".//Classification/Genre" for domain indicates that the `ClassificationScheme` can be used for "Genre" elements inside of all "Classification" elements in the description.

6.6.4 Example

See Annex B for classification scheme examples.

6.7 RelationType

6.7.1 Introduction

The RelationType type describes a relation among DS instances and controlled terms. The arguments of a relation are categorized into the source (first) and the target (second) arguments. Both the source and target arguments for a relation are ordered. A relation may have a variable number of arguments in each of the source and the target.

6.7.2 Syntax

```
<complexType name="RelationType">
  <sequence/>
  <attribute        name="relationType"        type="mpqf:termReferenceListType"
use="required"/>
  <attribute name="sourceResource" type="IDREF" use="required"/>
  <attribute name="targetResource" type="IDREF" use="optional"/>
</complexType>
<simpleType name="termReferenceListType">
  <list itemType="anyURI"/>
</simpleType>
```


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6.7.3 Semantics

Semantics of the `RelationType` type:

Name	*Definition*
`RelationType`	Specifies the `RelationType` type of a spatial or temporal relation.
`relationType`	Describes the type of the Relation. Depending on the used QueryType (`SpatialQueryType`, `TemporalQueryType`) the allowed classification scheme types differ. The allowed classification schemes are defined at the corresponding query types
`sourceResource`	Specifies the source element of the specific relation. The source element shall be defined in the declaration part of type `DescriptionResourceType` type and point to a valid description according to the used query type (e.g., for a `SpatialQueryType` type only a MPEG-7 StillImage or comparable (of other metadata standards) description is allowed)
`targetResource`	Specifies the target element of the specific relation. The target element shall be defined in the declaration part of type `DescriptionResourceType` type and point to a valid description according to the used query type (e.g., for a `SpatialQueryType` type only a MPEG-7 StillImage or comparable (of other metadata standards) description is allowed)

6.7.4 Example

See the `SpatialQuery` and `TemporalQuery` type for the examples.

7 Input Query Format

7.1 Introduction

This clause specifies the `Input` element defined for the Input Query Format. The Input Query Format structure is defined by the `InputQueryType` type. It provides a container for describing a query request containing a set of conditions and/or the specification of the structure and content of the output query format and a declaration part. In general, this type provides all necessary constructs in order to express a multimedia query request to a set of databases.

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7.2 Syntax

```
<complexType name="InputQueryType">
  <sequence>
    <element name="QFDeclaration" type="mpqf:QFDeclarationType" minOccurs="0"/>
    <element name="OutputDescription" type="mpqf:OutputDescriptionType"
minOccurs="0"/>
    <element name="QueryCondition" type="mpqf:QueryConditionType" minOccurs="0"/>
    <element name="ServiceSelection" type="mpqf:ServiceSelectionType"
          minOccurs="0"/>
  </sequence>
  <attribute name="previousAnswerID" type="anyURI" use="optional"/>
  <attribute name="immediateResponse" type="boolean" use="optional"
default="true"/>
  <attribute name="timeout" type="duration" use="optional"/>
</complexType>
<complexType name="ServiceSelectionType">
  <sequence>
    <element name="ServiceID" type="anyURI" maxOccurs="unbounded"/>
  </sequence>
</complexType>
```

7.3 Semantics

Semantics of the `InputQueryType` type:

Name	*Definition*
InputQueryType	Specifies the syntax of the Input element, which describes the input query request to be sent from the requester to the responder.
QFDeclaration	Defines resources that can be referenced for describing query conditions and output data fields in the QueryCondition or OutputDescription element, respectively. A resource is either a multimedia resource or a description resource. A multimedia resource is specified either by the inlined raw data of an image, video, etc. or a pointer (URL) to its location. The description resource contains information of low level (e.g., color) or high level (e.g, objects) features of an example media. The description can be given by any valid XML-based multimedia metadata schema. Furthermore, one has the possibility to declare specific fields (e.g., MPEG-7 Creator element) of any XML-based multimedia metadata schema in order to reuse this information within the OutputDescription element or the QueryCondition element.
OutputDescription	Defines the content as well as the structure of the returned value from the responder. Here, the requester has the possibility to select the desired information which the result set should contain. For instance, in case of searching for songs, one would like to know the song title, location, etc. Depending on the used multimedia metadata standard (of the target service) the XML elements can vary. Furthermore, by using absolute path entries, the requester has the possibility to force the structure of the returned value.
QueryCondition	Defines the search and filter criteria within a single query.
ServiceSelection	Specifies the set of services where the query should be evaluated. This element is supposed to be used in case of communicating with an aggregation service in order to signalize which subset of the available services should evaluate the request. The syntax is specified by the ServiceSelectionType type.
previousAnswerID	Specifies a unique identifier to determine a query response already received (optional). This attribute is intended to be used in operations (e.g., relevance

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	feedback) such as a search within the previous result set.
immediateResponse	Defines the mode of operation. The default value of this optional attribute is “true”. When either the value is “true” or the attribute is not present, the requester expects to receive the response immediately (until timeOut). If the value of this attribute is “false”, the requester is expected to receive only a “mpqfID” as response (asynchronous mode). In the asynchronous mode, the requester will come later (after the timeOut) to harvest the response (sending a message including the FetchResult element). In case of a given value for the expirationDate attribute, the result set is required to be cached. In case of no expirationDate attribute is given, it is an implementation issue.
timeOut	Specifies the temporal duration during which the responder can perform searching the relevant databases. In the immediate response mode of operation, it can be interpreted as a time limit within which an aggregation responder can wait for the individual service provider’s response. In the asynchronous mode of operation, it can be interpreted as a way of specifying a time point, after which the requester intends to issue a FetchResult query.

Semantics of the `ServiceSelectionType` type:

Name	*Definition*
`ServiceSelectionType`	Specifies the syntax of the `ServiceSelection` element, which determines the set of services where the request should be sent to.
`ServiceID`	Defines one service by its ID of type `anyURI`. This information is the same as given by the service’s capability description and denotes the service’s entry point.

7.4 Example

Examples for the `Input` element are given in the following sub-clauses of `QFDeclaration`, `OutputDescription` and `QueryCondition`. An example for a service selection is presented below. The `ServiceSelection` element in the `input` element determines the set of databases that have been chosen for retrieval. The use of the `ServiceSelection` element assumes the existence of an aggregation service which takes care of on the one side distributing the query to the selected target databases and on the other side aggregating the individual result sets in a sophisticated manner. In case of a direct query request to a single database, the service selection element may be omitted.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Input>
      <ServiceSelection>
        <ServiceID>http://www.test-retrieval.com</ServiceID>
        <ServiceID>http://www.test-retrieval1.com</ServiceID>
      </ServiceSelection>
    </Input>
  </Query>
</MpegQuery>
```

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8 QFDeclaration

8.1 Introduction

The optional `QFDeclaration` element allows declaring reusable definitions of data paths and resources that can be referenced multiple times within a query. Its structure is defined by the `QFDeclarationType` type, which consists of a sequence of `DeclaredField` and `Resource` elements. A `DeclaredField` element allows declaring a reusable data path within an item's metadata. A `Resource` element allows declaring a reusable resource description using one of the subtypes of the `ResourceType` (the `MediaResourceType` type or the `DescriptionResourceType` type).

8.2 Syntax

```
<complexType name="QFDeclarationType">
  <sequence>
    <element name="DeclaredField" type="mpqf:DeclaredFieldType" minOccurs="0"
maxOccurs="unbounded"/>
    <element name="Resource" type="mpqf:ResourceType" minOccurs="0"
maxOccurs="unbounded"/>
  </sequence>
  <!-- Declaration of entities that can be reused in OutputDescription or
QueryCondition -->
</complexType>

<complexType name="DeclaredFieldType">
  <simpleContent>
    <extension base="mpqf:xPathType">
      <attribute name="id" type="ID" use="required"/>
      <attribute name="typeName" type="string" use="optional"/>
    </extension>
  </simpleContent>
</complexType>

<complexType name="ResourceType" abstract="true">
  <attribute name="resourceID" type="ID" use="required"/>
</complexType>

<complexType name="MediaResourceType">
  <complexContent>
    <extension base="mpqf:ResourceType">
      <sequence>
        <element name="MediaResource" type="mpqf:MediaLocatorType"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>

<complexType name="DescriptionResourceType">
  <complexContent>
    <extension base="mpqf:ResourceType">
      <sequence>
        <element name="AnyDescription">
          <complexType mixed="true">
            <sequence>
              <any namespace="##any"/>
            </sequence>
          </complexType>
        </element>
      </sequence>
    </extension>
  </complexContent>
</complexType>
```


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8.3 Semantics

Semantics of the `QFDeclarationType` type:

Name	*Definition*
`QFDeclarationType`	Specifies the syntax of the `QFDeclaration` element, which allows declaring reusable definitions of data paths and resources that can be referenced multiple times within a query.
`DeclaredField`	Allows declaring a reusable data path within an item's metadata. Its structure is defined by the `DeclardFieldType` type.
`Resource`	Allows declaring a reusable resource description using one of the subtypes of the abstract `ResourceType` type (the `MediaResourceType` type or the `DescriptionResourceType` type).

Semantics of the `DeclaredFieldType` type:

Name	*Definition*
`DeclaredFieldType`	Complex type which allows declaring a reusable data path within an item's metadata the same way as the `FieldType` type does, but adding an ID that can be referenced multiple times within a query. As the `FieldType` type, the `DeclaredFieldType` type is derived by extension from the `xPathType` type which is itself derived from the `token` type. It serves to specify a data path within an item's metadata using an XPath expression. XPath expressions appearing in MPQF can be absolute or relative. When absolute, independently of the kind of evaluation item being addressed (see the Terminology section), an XPath expression will always refer to the root of the metadata document related to the multimedia content to which the evaluation item belongs (even if the evaluation-item is related just to a fragment of this document). When relative, an XPath expression will refer to the root node of the metadata fragment (which can be the root of the metadata document or cannot) related to the evaluation item being addressed. If a `typeName` is specified, the XPath expression will refer to all the elements belonging to the named type appearing anywhere within the evaluation item being addressed. In this case only relative XPath expressions are allowed.
`id`	Specifies a unique identifier for the declared field. The attribute `id` can be used for referencing the field multiple times within the query.
`typeName`	Specifies the name of a complex data type defined in MPEG-7 or any other metadata schema, which will serve as the starting point of a relative XPath expression.

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Semantics of the `ResourceType` type:

Name	*Definition*
`ResourceType`	Specifies the root type of all resource types. It is abstract.
`resourceID`	Specifies a unique identifier for the declared resource. The identifier can be used for referencing the resource multiple times within the query.

Semantics of the `MediaResourceType` type:

Name	*Definition*
`MediaResourceType`	Subtype of the `ResourceType` type which allows describing one or more resources by containing or pointing to their raw media data.
`MediaResource`	Element of the `MediaLocatorType` type which allows describing a resource by containing or pointing to its raw media data.

Semantics of the `DescriptionResourceType` type:

Name	*Definition*
`DescriptionResourceType`	Specifies the `DescriptionResourceType` type which is an extension of the `ResourceType` type.
`DescriptionResource`	Specifies the container for any description based on a specific schema specified by the namespace declaration within the description.

8.4 Example

In this example, the `QFDeclaration` element allows to describe an image resource for retrieval. The following table shows a `QFDeclaration` example of an image “image.jpg” with the identifier `ImageResourceID`. By referring to `ImageResourceID`, a query condition that searches image files similar to the resource can be described in the `QueryCondition` element.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Input>
      <QFDeclaration>
        <Resource resourceID="ImageResourceID" xsi:type="MediaResourceType">
        <MediaResource>
          <MediaUri>image.jpg</MediaUri>
        </MediaResource>
        </Resource>
      </QFDeclaration>
    </Input>
  </Query>
</MpegQuery>
```


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The next example shows that the `QFDeclaration` element allows describing Dublin Core metadata as a resource. Any XML-schema valid metadata can be target with putting its namespace in the `AnyDescription` element.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Input>
      <QFDeclaration>
        <Resource resourceID="DC_title" xsi:type="DescriptionResourceType">
         <AnyDescription xmlns:dc="http://purl.org/dc/elements/1.1/"
                xsi:schemaLocation="http://purl.org/dc/elements/1.1/ dc.xsd">
          <dc:title>World Cup 2006</dc:title>
         </AnyDescription>
        </Resource>
      </QFDeclaration>
    </Input>
  </Query>
</MpegQuery>
```

9 Output Description

9.1 Introduction

The `OutputDescription` element is part of the `Input` element in the `Query` element which describes the structure of the returned data from the responder to the requester. It specifies which data shall be included in the response which is defined by the `Output` element of the `Query` element and how it is structured. Furthermore, it allows limiting the maximum number of items per output page and the overall item count. Besides, it also allows the users to use the aggregation and sorting processes in the `OutputDescription` element.

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9.2 Syntax

```
<complexType name="OutputDescriptionType">
  <sequence>
    <element name="ReqField" type="mpqf:FieldType" minOccurs="0"
maxOccurs="unbounded"/>
    <element name="ReqAggregateID" type="IDREF" minOccurs="0"
maxOccurs="unbounded"/>
    <element name="GroupBy" minOccurs="0">
      <complexType>
        <sequence>
          <element name="GroupByField" type="mpqf:FieldType"
maxOccurs="unbounded"/>
          <element name="Aggregate" type="mpqf:AggregateExpressionType"
minOccurs="0" maxOccurs="unbounded"/>
        </sequence>
      </complexType>
    </element>
    <element name="SortBy" type="mpqf:AbstractSortByType" minOccurs="0"
maxOccurs="unbounded"/>
  </sequence>
  <attribute name="maxPageEntries" type="positiveInteger" use="optional"/>
  <attribute name="maxItemCount" type="positiveInteger" use="optional"/>
  <attribute name="freeTextUse" type="boolean" use="optional"/>
  <attribute name="thumbnailUse" type="boolean" use="optional"/>
  <attribute name="mediaResourceUse" type="boolean" use="optional"/>
  <attribute name="outputNameSpace" type="anyURI" use="optional"/>
  <attribute name="distinct" type="boolean" use="optional"
default="false"/>
<!-- This indicates that if I want to receive a link to the actual media
resource. -->
</complexType>

<complexType name="FieldType">
  <simpleContent>
    <extension base="mpqf:xPathType">
      <attribute name="typeName" type="string" use="optional"/>
      <attribute name="fromREF" type="IDREF" use="optional"/>
      <attribute name="fieldREF" type="IDREF" use="optional"/>
    </extension>
  </simpleContent>
</complexType>
```

9.3 Semantics

Semantics of the `OutputDescriptionType` type:

Name	*Definition*
`OutputDescriptionType`	Describes the way how the information related to the selected digital items should be returned in the output pages.
`ReqField`	Describes a data path within the item's metadata, which a requester asks to be returned. Paths are specified by making use of absolute XPath expressions, which refer to the root of the item's metadata, or optionally using relative XPath expressions referred to a given schema's complex

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Name	*Definition*
	type.
ReqAggregateID	Describes the ID of the aggregate operation the requester asks to be returned. When one or more ReqAggregateIDs are used, the aggregate ID should be in the GroupBy element.
GroupBy	Describes the grouping operation the user wants to apply to the query results.
GroupByField	Describes the key for the grouping process. In a usual case, leaf nodes are intended to be used as an instance of the GroupByField. When a structured field (e.g. DS) is defined as a key, all the mandatory elements and attributes included in the pointed node shall be considered for grouping. For an optional field to be considered in the grouping, it should be specified individually. All used keys in the GroupByField element are required to appear as a ReqField element in the OutputDescription element.
Aggregate	Describes the aggregate operation the user wants to apply to the results of the specified grouping operation.
SortBy	Describes the sort operation the user wants to apply to the query results.
maxPageEntries	Describes the maximum number of items in one output page. (optional) The result items of a given query can be split among different output pages.
maxItemCount	Describes the maximum number of result items. (optional)
freeTextUse	Specifies the desire that the TextResult field appears in each result item. (optional) If the value of this attribute is false, the TextResult field shall not appear in the result items. If the value of this attribute is not specified, it is assumed that the requester does not care whether the values appear or not.
thumbnailUse	Specifies the desire that the Thumbnail field appears in each result item. (optional) If the value of this attribute is false, the Thumbnail field is not allowed to appear in the result items. If the value of this attribute is not specified, it is assumed that the requester does not care whether the values appear or not.
mediaResourceUse	Specifies the desire that the MediaResource field appears in each result item. (optional) If the value of this attribute is false, the MediaResource field is not allowed to appear in the result items. If the value of this attribute is not specified, it is assumed that the requester does not care whether the values appear or not.
outputNameSpace	Specifies the URI of the namespace associated to the desired metadata format to appear within the Description element of each result item. It may be a namespace related to MPEG-7 or to any other metadata specifications.
distinct	Specifies the desire that records containing exact the same metadata are required to be merged or not.

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Semantics of the `FieldType` type:

Name	*Definition*
`FieldType`	Specifies a data path within an item's metadata. This type is derived by extension from `xPathType` type. Paths are specified by making use of absolute XPath expressions, which refer to the root of the item's metadata, or optionally relative XPath expressions, which refer to a complex type of a schema given by the `outputNameSpace` attribute.
`typeName`	Specifies the name of a complex data type defined in MPEG-7 or any other metadata schema given by the `outputNameSpace` attribute, which will serve as the starting point of a relative XPath expression. (optional).
`fromREF`	Describes a reference to the Join object ID for use in the `OutputDescription` element for Join operation.
`fieldREF`	Describes a reference to the ID of a Field of other operations for reuse.

9.4 Example

The following example illustrates the use of the `OutputDescription` element for describing the desired output of an MPQF query. In this example, a simple free text query is specified which searches for textual descriptions containing "San Jose". In addition, the target domain is limited to images of the JPEG format. The `OutputDescription` element is used to select five fields from the metadata of the resulting digital items. Additionally, the `OutputDescription` element specifies that three result pages or less will be computed, that each one of these pages shall have at most ten items and that the `freeTextUse` field is desired.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Input>
      <OutputDescription maxItemCount="30" maxPageEntries="10" freeTextUse="true"
outputNameSpace="urn:mpeg:mpeg7:schema:2004" >
        <ReqField typeName="MediaLocatorType">/MediaUri</ReqField>
        <ReqField typeName="CreationInformationType">/Creation/Title</ReqField>
        <ReqField typeName="CreationInformationType">/Creation/Creator</ReqField>
        <ReqField typeName="MediaFormatType">/FileFormat</ReqField>
        <ReqField typeName="MediaFormatType">/FileSize</ReqField>
      </OutputDescription>
      <QueryCondition>
        <TargetMediaType xsi:type="mimeType">image/jpeg</TargetMediaType>
        <Condition xsi:type="QueryByFreeText">
          <FreeText>San Jose</FreeText>
        </Condition>
      </QueryCondition>
    </Input>
  </Query>
</MpegQuery>
```


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The following is the example of an expected output by the specified `OutputDescription` above.

```
<MpegQuery>
  <Query>
    <Output currPage="1" totalPages="1" expirationDate="2008-05-30T09:00:00">
      <ResultItem xsi:type="ResultItemType" recordNumber="1">
        <TextResult>Title 01</TextResult>
        <Description xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004">
          <mpeg7:Mpeg7>
            <mpeg7:DescriptionUnit xsi:type="mpeg7:CreationInformationType">
              <mpeg7:Creation>
                <mpeg7:Title>Title 01</mpeg7:Title>
              </mpeg7:Creation>
            </mpeg7:DescriptionUnit>
          </mpeg7:Mpeg7>
          <mpeg7:Mpeg7>
            <mpeg7:DescriptionUnit xsi:type="mpeg7:CreationType">
              <mpeg7:Title>Title 01</mpeg7:Title>
                <mpeg7:Creator xsi:type="mpeg7:CreatorType">
                  <mpeg7:Role href="http://www.roles.com/author"/>
                  <mpeg7:Agent xsi:type="mpeg7:PersonType">
                    <mpeg7:Name>
                      <mpeg7:GivenName>John</mpeg7:GivenName>
                      <mpeg7:FamilyName>Smith</mpeg7:FamilyName>
                    </mpeg7:Name>
                  </mpeg7:Agent>
                </mpeg7:Creator>
            </mpeg7:DescriptionUnit>
          </mpeg7:Mpeg7>
        </Description>
        <AggregationResult aggregateID="avgSize">256</AggregationResult>
      </ResultItem>
      <ResultItem recordNumber="2">
        <TextResult>Title 02</TextResult>
        <AggregationResult aggregateID="avgSize">512</AggregationResult>
      </ResultItem>
      <ResultItem recordNumber="3">
        <TextResult>Title 03</TextResult>
        <AggregationResult aggregateID="avgSize">1024</AggregationResult>
      </ResultItem>
    </Output>
  </Query>
</MpegQuery>
```

9.5 SortBy

9.5.1 Introduction

This sub clause specifies all the types of `SortBy` tools which are used in the `OutputDescription` element. The `AbstractSortByType` type is defined as an abstract data type from which the `SortByFieldType` type and `SortByAggregateType` type are derived.

9.5.2 Syntax

```
<complexType name="AbstractSortByType" abstract="true">
  <attribute name="order" use="required">
    <simpleType>
      <restriction base="string">
```

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```
            <enumeration value="ascending"/>
            <enumeration value="descending"/>
         </restriction>
      </simpleType>
   </attribute>
</complexType>

<complexType name="SortByFieldType">
   <complexContent>
      <extension base="mpqf:AbstractSortByType">
         <choice>
            <element name="Field" type="mpqf:FieldType"/>
         </choice>
      </extension>
   </complexContent>
</complexType>

<complexType name="SortByAggregateType">
   <complexContent>
      <extension base="mpqf:AbstractSortByType">
         <choice>
            <element name="Aggregate" type="mpqf:AggregateExpressionType"/>
            <element name="AggregateID" type="IDREF"/>
         </choice>
      </extension>
   </complexContent>
</complexType>
```

9.5.3 Semantics

Semantics of the `SortBy` types:

Name	*Definition*
`AbstractSortByType`	Defines the abstract data type for the two `SortBy` sub-types.
`order`	Indicates the order of the sorting. The current version supports either `ascending` or `descending` sort order.
`SortByFieldType`	Describes a sort type in which the `Field` element is used as a sorting key.
`SortByAggregateType`	Describes a sort type in which the result of an aggregate expression is used as a key.
`Aggregate`	Describes an aggregate expression, whose result is used as a key in sorting process.
`AggregateID`	Describes an aggregate expression by id reference, whose result is used as a key in the sorting process.

9.5.4 Example

The following example illustrates the use of the `OutputDescription` element for describing the desired output of an MPQF query in combination with a `GroupBy` and `SortBy` statement. In addition, the use of an

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aggregate function is demonstrated. Both statements (`ReqAggregateID` and `SortBy`) reference to the introduced `Aggregate` element in the `GroupBy`.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Input>
      <OutputDescription outputNameSpace="urn:mpeg:mpeg7:2004">
        <ReqField typeName="CreationInformation">/Creation/Title</ReqField>
        <ReqField typeName="Creator">/Character/FamilyName</ReqField>
        <ReqAggregateID>avgSize</ReqAggregateID>
        <GroupBy>
          <GroupByField typeName="Creator">/Character/FamilyName</GroupByField>
          <Aggregate xsi:type="AVG" aggregateID="avgSize">
            <Field typeName="MediaFormat">/FileSize</Field>
          </Aggregate>
        </GroupBy>
        <SortBy xsi:type="SortByAggregateType" order="ascending">
          <AggregateID>avgSize</AggregateID>
        </SortBy>
      </OutputDescription>
    </Input>
  </Query>
</MpegQuery>
```

The following is an example of expected output by the specified `OutputDescription` element above. Note that the actual output depends on the multimedia content stored in the repository.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Output currPage="1" totalPages="1" expirationDate="2008-05-30T09:00:00">
      <ResultItem xsi:type="ResultItemType" recordNumber="1">
        <TextResult>Title 01</TextResult>
        <Description xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004">
          <mpeg7:Mpeg7>
            <mpeg7:DescriptionUnit xsi:type="mpeg7:CreationInformationType">
              <mpeg7:Creation>
                <mpeg7:Title>Title 01</mpeg7:Title>
              </mpeg7:Creation>
            </mpeg7:DescriptionUnit>
          </mpeg7:Mpeg7>
        </Description>
        <AggregationResult aggregateID="avgSize">256</AggregationResult>
      </ResultItem>
      <ResultItem recordNumber="2">
        <TextResult>Title 02</TextResult>
        <AggregationResult aggregateID="avgSize">512</AggregationResult>
      </ResultItem>
      <ResultItem recordNumber="3">
        <TextResult>Title 03</TextResult>
        <AggregationResult aggregateID="avgSize">1024</AggregationResult>
      </ResultItem>
    </Output>
  </Query>
</MpegQuery>
```

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10 Query Condition

10.1 Introduction

The QueryCondition element, of the QueryConditionType type, is the part of the Input Query Format where the user specifies the properties of the media or the metadata to be retrieved. The QueryCondition element is defined as a sequence of desired target media types, an EvaluationPath element and a condition tree, which can be a simple (Condition element) or a Join operation (Join element). The sequence of the target media types declares the desired MIME types which the user expects as a result. The EvaluationPath element (optional) declares an XPath expression, which specifies the node of the metadata fragment related to the evaluation item being addressed (//VideoSegment for instance). It also determines the structure of the output; one result item will be returned for each evaluation item if it matches the condition. If the EvaluationPath element is not specified, the output result shall be provided as a collection of multimedia contents, as stored in the repository each of which satisfies the query condition. The condition tree can be specified using the Condition element, of the BooleanExpressionType type, which is the parent abstract type of all the types resulting in a value in the range of [0..1]. A more complex condition tree can be specified using the Join element. The Join operation allows the definition of filtering conditions which act over two sets of multimedia objects.

10.2 Syntax

```
<complexType name="QueryConditionType">
  <sequence>
    <element name="EvaluationPath" type="mpqf:xPathType" minOccurs="0"/>
    <element name="TargetMediaType" type="mpqf:mimeType" minOccurs="0"
maxOccurs="unbounded"/>
    <choice>
      <element name="Join" type="mpqf:JoinType"/>
      <element name="Condition" type="mpqf:BooleanExpressionType"/>
    </choice>
  </sequence>
</complexType>
```

10.3 Semantics

Semantics of the QueryConditionType type:

Name	*Definition*
QueryConditionType	Defines a sequence of desired target media types, an EvaluationPath element, and a condition tree, which can be simple (Condition element) or a Join operation (Join element).
EvaluationPath	Optional XPath expression, which specifies the node of the metadata fragment related to the evaluation item being addressed. It also determines the structure of the output; one result item will be returned for each evaluation item if it matches the condition. If the EvaluationPath element is not specified, the output result shall be provided as a collection of multimedia contents, as stored in the repository each of which satisfies the query condition.
TargetMediaType	The sequence of the target media types declares the desired MIME types which the user expects as a result. This element is required not to be used in case a Join element is stated.

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Name	*Definition*
`Condition`	The condition tree of the query is specified using a `BooleanExpressionType` type, which is the parent abstract type of all the types resulting in a value in the range of [0..1].
`Join`	Optionally, a `Join` element can be used instead of the `Condition` element. A Join operation allows the definition of filtering conditions which act over two sets of multimedia objects. With the Join operation, it is possible to specify conditions which define two separate filtered sets and combine them (see `JoinType` type).

10.4 Example

The following example illustrates the usage of the `QueryConditionType` type. It demonstrates a combined (by AND) retrieval for all items containing the word “Lausanne” somewhere in a textual description and where the annotated `Title` is equal to the string “Blade Runner”. In addition, the target domain is limited to images of the JPEG compression format (see `TargetMediaType` element). Note, that the target domain also can be restricted to all images by using *`image/*`*.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Input>
      <QueryCondition>
        <TargetMediaType>image/jpeg</TargetMediaType>
        <Condition xsi:type="AND">
          <Condition xsi:type="QueryByFreeText">
            <FreeText>Lausanne</FreeText>
          </Condition>
          <Condition xsi:type="Equal">
            <StringField typeName="CreationType">Title</StringField>
            <StringValue>Blade Runner</StringValue>
          </Condition>
       </Condition>
     </QueryCondition>
    </Input>
  </Query>
</MpegQuery>
```

The following example illustrates the use of the `EvaluationPath` element. It shows a query to search for all video segments containing the word “Lausanne” somewhere in a textual description. Note, that for each matching segment, one different result item will be returned.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Input>
      <QueryCondition>
        <EvaluationPath>//VideoSegment</EvaluationPath>
        <Condition xsi:type="QueryByFreeText">
          <FreeText>Lausanne</FreeText>
        </Condition>
      </QueryCondition>
    </Input>
  </Query>
</MpegQuery>
```

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11 Expression Types

11.1 Introduction

Expression Types allow to build expression trees. There are three main abstract Expression Types: the `BooleanExpressionType` type, which is the base type of all the expressions resulting in a value in the range of [0..1], the `ArithmeticExpressionType` type which is the base type of all the expressions resulting in a numeric value (Add, Subtract, Multiply, Divide, Modulus, Abs, Ceiling, Floor and Round), and the `StringExpressionType` type, which is the base type of all the expressions resulting in a string value (UpperCase and LowerCase).

11.2 Syntax

```
<complexType name="BooleanExpressionType" abstract="true">
  <attribute name="preferenceValue" type="mpqf:zeroToOneType"
                use="optional" default="1"/>
   <attribute name="thresholdValue" type="mpqf:zeroToOneType"
   use="optional" />
</complexType>
<complexType name="ArithmeticExpressionType" abstract="true"/>
<complexType name="StringExpressionType" abstract="true"/>
```

11.3 Semantics

Semantics of the abstract `Expression` types:

Name	*Definition*
`BooleanExpressionType`	An abstract type that is the base type for defining the boolean expressions.
`preferenceValue`	Used to indicate the importance, priority or weight assigned to a particular user preference component, relative to other components. The range of the preference values is from 0 to 1. Positive float value indicates the degree of desired preference. A default, positive, value of 1 corresponds to a nominal preference. The sum of all assigned preference values at one level is required to be 1.
`thresholdValue`	Used to indicate the minimum value the score of an evaluation-item based on a specific operation (query type, expression) is required to have. Otherwise the evaluation-item is not considered further during evaluation.
`ArithmeticExpressionType`	An abstract type that is the base type for defining the arithmetic expressions.
`StringExpressionType`	An abstract type that is the base type for defining the string expressions.

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11.4 Operands

11.4.1 ArithmeticOperands

11.4.1.1 Introduction

The `ArithmeticOperands` group allows specifying one element which has an arithmetic value content (the `DoubleValue`, the `LongValue`, the `ArithmeticField` and the `ArithmeticExpression`). The element contents may be arithmetic constants, arithmetic expressions (specified using the `ArithmeticExpressionType` type) or arithmetic fields that reference to numeric values within metadata descriptions (referenced using the `FieldType` type).

11.4.1.2 Syntax

```
<group name="ArithmeticOperands">
  <sequence>
    <choice>
      <element name="DoubleValue" type="double"/>
      <element name="LongValue" type="long"/>
      <element name="ArithmeticField" type="mpqf:FieldType"/>
      <element name="ArithmeticExpression" type="mpqf:ArithmeticExpressionType"/>
    </choice>
  </sequence>
</group>
```

11.4.1.3 Semantics

Semantics of the `ArithmeticOperands` group

Name	*Definition*
`ArithmeticOperands`	Defines the `ArithmeticOperands` group, which allows specifying one element which has to have an arithmetic value.
`DoubleValue`	Allows specifying a constant arithmetic value by using `double` type.
`LongValue`	Allows specifying a constant arithmetic value by using `long` type.
`ArithmeticField`	Allows specifying a path to a numeric value within the metadata of an evaluation item using `FieldType` type.
`ArithmeticExpression`	Allows specifying an expression that is required to be evaluated to an arithmetic value. The abstract type `ArithmeticExpressionType` is the base type of all operations with a numeric output (`Add`, `Subtract`, etc.).

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11.4.1.4 Example

The following example illustrates how the group `ArithmeticOperands` allows that the inputs of the `Equal` operation can be a constant numeric value and a path to a numeric value within the metadata of the evaluation item.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Input>
      <QueryCondition>
        <Condition xsi:type="Equal">
          <ArithmeticField typeName="MediaFormatType">FileSize</ArithmeticField>
          <LongValue>1000</LongValue>
        </Condition>
      </QueryCondition>
    </Input>
  </Query>
</MpegQuery>
```

11.4.2 BooleanOperands

11.4.2.1 Introduction

The `BooleanOperands` group allows specifying one element which has a Boolean value content. Each element can instantiate one of the three types which result in a Boolean value (the `boolean` type, the `FieldType` type and the `BooleanExpressionType` type).

11.4.2.2 Syntax

```
<group name="BooleanOperands">
  <sequence>
    <choice>
      <element name="BooleanValue" type="boolean"/>
      <element name="BooleanField" type="mpqf:FieldType"/>
      <element name="BooleanExpression" type="mpqf:BooleanExpressionType"/>
    </choice>
  </sequence>
</group>
```

11.4.2.3 Semantics

Semantics of the `BooleanOperands` group

Name	*Definition*
`BooleanOperands`	Defines the `BooleanOperands` group, which allows specifying one element that has a Boolean value.
`BooleanValue`	Allows specifying a constant Boolean value by using `boolean` type.
`BooleanField`	Allows specifying a path to a Boolean value within the metadata of an evaluation item, by using FieldType.
`BooleanExpression`	Allows specifying an expression evaluating to a Boolean value. The abstract type `BooleanExpressionType` is the base type from which all the operations with a Boolean output (`Equal`, etc.), the query types and the boolean operators (`AND`, `OR`, etc.) are inherited.

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11.4.2.4 Example

The following example illustrates how the group `BooleanOperands` allows that the inputs to the `Equal` operation can be a constant Boolean value and a path to a Boolean value within the metadata of the evaluation item.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Input>
      <QueryCondition>
        <Condition xsi:type="Equal">
          <BooleanField typeName="MediaFormatType">
            bitrate/@variable
          </BooleanField>
          <BooleanValue>true</BooleanValue>
        </Condition>
      </QueryCondition>
    </Input>
  </Query>
</MpegQuery>
```

11.4.3 StringOperands

11.4.3.1 Introduction

The `StringOperands` group allows specifying one element which consists of a string. Each element can instantiate one of the three types that result in a string value (the string type, the `FieldType` type and the `StringExpressionType` type).

11.4.3.2 Syntax

```
<group name="StringOperands">
  <sequence>
    <choice>
      <element name="StringValue" type="string"/>
      <element name="StringField" type="mpqf:FieldType"/>
      <element name="StringExpression" type="mpqf:StringExpressionType"/>
    </choice>
  </sequence>
</group>
```

11.4.3.3 Semantics

Semantics of the `StringOperands` group:

Name	*Definition*
`StringOperands`	Defines the `StringOperands` group, which allows specifying an element that can instantiate one of the three types which result in a string value.
`StringValue`	Allows specifying a constant string value by using `string` type.
`StringField`	Allows specifying a path to a string value within the metadata of an evaluation item, by using `FieldType` type.
`StringExpression`	Allows specifying an expression evaluating to a string value. The abstract type `StringExpressionType` is the base type, from which all the operations with a string output are inherited.

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11.4.3.4 Example

The following example illustrates how the group `StringOperand` allows that the inputs of the `Equal` operation can be a constant string value and a path to a string value within the metadata of the evaluation item.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Input>
      <QueryCondition>
        <Condition xsi:type="Equal">
          <StringField typeName="CreationType">Title</StringField>
          <StringValue>Blade Runner</StringValue>
        </Condition>
      </QueryCondition>
    </Input>
  </Query>
</MpegQuery>
```

11.4.4 DateTimeOperands

11.4.4.1 Introduction

The `DateTimeOperands` group allows specifying one element which has a date or time value as content. Each element can instantiate one of the four types which result in a date or a time value (the `date` type, the `time` type, the `dateTime` type and the `FieldType` type).

11.4.4.2 Syntax

```
<group name="DateTimeOperands">
  <sequence>
    <choice>
      <element name="DateTimeValue" type="dateTime"/>
      <element name="DateValue" type="date"/>
      <element name="TimeValue" type="time"/>
      <element name="DateTimeField" type="mpqf:FieldType"/>
    </choice>
  </sequence>
</group>
```

11.4.4.3 Semantics

Semantics of the `DateTimeOperands` group:

Name	*Definition*
`DateTimeOperands`	Defines the `DateTimeOperands` group, which allows specifying one element that can instantiate one of the four types which result in a date and/or a time value.
`DateTimeValue`	Allows specifying a constant date-time value by `dateTime` type.
`DateValue`	Allows specifying a constant date value by `date` type.
`TimeValue`	Allows specifying a constant time value by `time` type.
`DateTimeField`	Allows specifying a path to a date-time value within the metadata of a multimedia item by `FieldType` type.

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11.4.4.4 Example

The following example illustrates how the group `DateTimeOperands` allows that the input of the `Equal` operation can be a constant date-time value and a path to a date-time value within the metadata of the evaluation item.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Input>
      <QueryCondition>
        <Condition xsi:type="Equal">
          <DateTimeField
typeName="CreationType">/CreationCoordinates/Date/TimePoint</DateTimeField>
 <DateTimeValue>2002-05-30T09:00:00</DateTimeValue>
        </Condition>
      </QueryCondition>
    </Input>
  </Query>
</MpegQuery>
```

11.4.5 DurationOperands

11.4.5.1 Introduction

The `DurationOperands` group allows specifying one element which consists of a duration value. Each element can instantiate one of the two types that result in a duration value (the `duration` type and the `FieldType` type).

11.4.5.2 Syntax

```
<group name="DurationOperands">
  <sequence>
    <choice>
      <element name="DurationValue" type="duration"/>
      <element name="DurationField" type="mpqf:FieldType"/>
    </choice>
  </sequence>
</group>
```

11.4.5.3 Semantics

Semantics of the `DurationOperands` group:

Name	*Definition*
`DurationOperands`	Defines the `DurationOperands` group, which allows specifying one element from one of the two types that result in a duration value.
`DurationValue`	Allows specifying a constant duration value of `duration` type.
`DurationField`	Allows specifying a path to a duration value within the metadata of an evaluation item by `FieldType` type.

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11.4.5.4 Example

The following example illustrates how the group `DurationOperands` allows that the input of the `Equal` operation can be a constant duration value and a path to a duration value within the metadata of the object for example.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Input>
      <QueryCondition>
        <Condition xsi:type="Equal">
  <DurationField typeName="SomeVideoDescriptionType">Duration</DurationField>
  <DurationValue>P5Y2M10DT15H</DurationValue>
        </Condition>
      </QueryCondition>
    </Input>
  </Query>
</MpegQuery>
```

11.5 Boolean Expression Types

11.5.1 Introduction

The `BooleanExpressionType` type is an abstract type which is the base type of the Boolean operators (`AND`, `OR`, `NOT`, `XOR`), the `ComparisonExpressionType` type and the `QueryType` type. These types allow to build expressions evaluating to a value in the range of [0..1]. The `BooleanExpressionType` type provides one attribute that indicates the degree of preference (relative weight of importance) of the query condition. Preference values (if present) are always taken into account within the same hierarchy level of the XML tree (i.e. between siblings of the same sequence). The `AND` and the `OR` types should have two or more condition elements. The `XOR` type should have exactly two condition elements, and the `NOT` type should have exactly one condition element.

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11.5.2 Syntax

```
<complexType name="AND">
  <complexContent>
    <extension base="mpqf:BooleanExpressionType">
      <sequence>
        <element name="Condition" type="mpqf:BooleanExpressionType"
                      minOccurs="2" maxOccurs="unbounded"/>
      </sequence>
      <attribute name="scoringFunction" type="mpqf:SimpleTermType"
use="optional"/>
    </extension>
  </complexContent>
</complexType>
<complexType name="OR">
  <complexContent>
    <extension base="mpqf:BooleanExpressionType">
      <sequence>
        <element name="Condition" type="mpqf:BooleanExpressionType"
                      minOccurs="2" maxOccurs="unbounded"/>
      </sequence>
      <attribute name="scoringFunction" type="mpqf:SimpleTermType"
use="optional"/>
    </extension>
  </complexContent>
</complexType>
<complexType name="NOT">
  <complexContent>
    <extension base="mpqf:BooleanExpressionType">
      <sequence>
        <element name="Condition" type="mpqf:BooleanExpressionType"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
<complexType name="XOR">
  <complexContent>
    <extension base="mpqf:BooleanExpressionType">
      <sequence>
        <element name="Condition" type="mpqf:BooleanExpressionType"
                      minOccurs="2" maxOccurs="2"/>
      </sequence>
      <attribute name="scoringFunction" type="mpqf:SimpleTermType"
use="optional"/>
    </extension>
  </complexContent>
</complexType>
```

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11.5.3 Semantics

Semantics of the Boolean Expression Types:

Name	*Definition*
`BooleanExpressionType`	An abstract type that is the base type for defining the boolean expressions.
`scoringFunction`	An attribute referring to a classification scheme, which contains different scoring functions. If combining two different QueryTypes, such as `QueryByMedia` and `QueryByDescription` with an `AND`, a fuzzy logic may be applied. That means that values of type float are aggregated based on the desired scoring function (e.g,, `Min`, `Sum`, `Product`, etc.). The terms of supported scoring functions are required to be refered at a classification scheme. In case a responder may not support this attribute, it should be ignored.
`AND`	A complex type inherited from the `BooleanExpressionType` type, for using the Boolean “AND” operator in a query and it shall result to a value in the range of [0..1]. If the resulting values (scores) are not exactly 0 or 1, the computation of the result for the `AND` operation is up to the implementers, who may apply rules as provided in subclause 11.5.4.
`OR`	A complex type inherited from the `BooleanExpressionType` type, for using the Boolean “OR” operator in query and it shall result to a value in the range of [0..1]. If the resulting values (scores) are not exactly 0 or 1, the computation of the result for the `OR` operation is up to the implementers, who may apply rules as provided in subclause 11.5.4
`NOT`	A complex type inherited from the `BooleanExpressionType` type, for using the “NOT” operator in a query and it shall result to a value in the range of [0..1]. If the resulting values (scores) are not exactly 0 or 1, the computation of the result for the `NOT` operation is up to the implementers, who may apply rules as provided in subclause 11.5.4
`XOR`	A complex type inherited from the `BooleanExpressionType` type, for using the “XOR” operator in query and it shall result to a value in the range of [0..1]. If the resulting values (scores) are not exactly 0 or 1, the computation of the result for the `XOR` operation is up to the implementers, who may apply rules as provided in subclause 11.5.4

11.5.4 Definitions

This subclause is an informative section.

It is recommended that the scoring function of the `AND` operator may conform to the rules applied in Definition 1 (t-norm) and to the weighted t-norm in case of a given preference value. The final score is calculated by the (weighted) input values of the respective conditions.

It is recommended that the scoring function of the `OR` operator may conform to the rules applied in Definition 2 (t-conorm) and to the weighted t-conorm in case of a given preference value. The final score is calculated by the (weighted) input values of the respective conditions.

It is recommended that the evaluation of the `NOT` operator may conform to the rules applied in Definition 3. The final score is calculated by the (weighted) input values of the respective conditions.

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It is recommended that the scoring function of the XOR operator may conform to the rules applied in Definition 4 and to the same weighted rules as for t-conorm in case of a given preference value. The final score is calculated by the (weighted) input values of the respective conditions

In order to evaluate individual scores at the AND, OR or XOR element, this part of ISO/IEC 15938 recommends to use the scoring function T: [0,1] X [0,1] -> [0,1] which relates to the t-norms (for AND) and t-conorms (for OR).

Definition 1: Function T(AND): [0,1] x [0,1]-> [0,1] is a t-norm if it satisfies the following criteria:

1. $T(s_1, s_2) = T(s_2, s_1)$ (commutativity)
2. $T(s_1, T(s_2, s_3)) = T(T(s_1, s_2), s_3)$ (associativity)
3. $s_1 \leq s_2 \wedge s_3 \leq s_4 \rightarrow T(s_1, s_2) \leq T(s_3, s_4)$ (monotonicy)
4. $T(s_1, 1) = s_1$ (border condition)

Definition 2: Function T(OR): [0,1] x [0,1]-> [0,1] is a t-conorm if it satisfies the following criteria:

1. criteria 1-3 of the t-norm
2. $T(s_1, 0) = s_1$ (border condition)

The score evaluation for the NOT operation is defined as follows:

Definition 3: Function T(NOT): [0,1] -> [0,1] requires the following conditions:

1. $T(NOT)(T(NOT)(s_1)) = s_1$
2. DeMorgan laws are applied:
   a. $T(NOT)\ (T(AND)(s_1, s_2)) = T(OR)\ (T(NOT)(s_1), T(NOT)(s_2))$
   b. $T(NOT)\ (T(OR)(s_1, s_2)) = T(AND)\ (T(NOT)(s_1), T(NOT)(s_2))$

The score evaluation for the XOR operation is defined as follows:

Definition 4: Function T(XOR): $[0,1]^n$ -> [0,1] is realized by combining the operation AND, OR and NOT as follows:

1. $T(XOR)(s_1, s_2, ..., s_n) = T(OR)\ (\ T(AND_i)\ )$ with i=1..n
2. $T(AND_i) = T(AND)\ (T(NOT)\ s_1,.., T(NOT)\ s_{(i-1)}, s_i, T(NOT)_{(si+1)},..., T(NOT)\ s_n)$

In order to integrate preference values ($p \varepsilon [0,1]$), the weighted t-norm and t-conorm are defined:

$T(AND_p)$: $([0,1] \times [0,1])^n$ -> [0,1], where the first parameter identifies the preference. In addition, the following rules apply:

1. $T(AND_p)\ (0,s_1, p_2, s_2, \ldots, p_n, s_n) = T(AND_p)\ (p_2,s_2, \ldots., p_n, s_n)$
2. If for all $p_1, \ldots, p_n$ in the filter condition tree (at one level) it is true that: $p_1 = \ldots = p_n$ (all preference values have the same value) then:

$$T(AND_p)\ (p_1, s_1, p_2, s_2,\ldots, p_n, s_n) = T(AND)(s_1, s_2, \ldots, s_n)$$

3. The weighted scoring function T within the filter condition tree must be continuous concerning the scores (s_x) as well as its weights (p_x).

Note, the same rules apply to $T(OR_p)$. The function $T(NOT_p)$ is reduced to T(NOT). The function $T(XOR_p)$ is substituted by $T(AND_p)$, $T(OR_p)$ and $T(NOT_p)$ as defined in definition 4.

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11.5.5 Example

The following example illustrates compounding some Boolean operations. The top level “AND” operator, includes four nested operations (“AND”, “OR”, “XOR”, and “NOT”). The second level “AND” operator, with preference value “0.1”, includes two kinds of query conditions, and the “OR” and the “XOR” operators, with preference value “0.4”, include two query conditions. The “NOT” operator, with preference value “0.1”, includes only one query condition.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Input>
      <QueryCondition>
        <EvaluationPath>//VideoSegment</EvaluationPath>
        <Condition xsi:type="AND">
          <Condition xsi:type="AND" preferenceValue="0.1">
            <Condition xsi:type="QueryByFreeText" preferenceValue="0.7">
              <FreeText>Lausanne</FreeText>
            </Condition>
            <Condition xsi:type="QueryByXQuery" preferenceValue="0.3">
              <XQuery><![CDATA[
          $a := node()//MediaFormat/Content/Name
          $a/text()="Video" ]]></XQuery>
            </Condition>
          </Condition>
          <Condition xsi:type="OR" preferenceValue="0.4">
            <Condition xsi:type="Equal" >
              <DateTimeField
typeName="CreationType">/CreationCoordinates/Date/TimePoint</DateTimeField>
              <DateTimeValue>2002-05-30T09:00:00</DateTimeValue>
            </Condition>
            <Condition xsi:type="QueryByFreeText" >
              <FreeText>San Jose</FreeText>
            </Condition>
          </Condition>
          <Condition xsi:type="XOR" preferenceValue="0.4">
            <Condition xsi:type="Equal">
              <BooleanField
typeName="MediaFormatType">bitrate/@variable</BooleanField>
              <BooleanValue>true</BooleanValue>
            </Condition>
            <Condition xsi:type="QueryByFreeText">
              <FreeText>Marrakech</FreeText>
            </Condition>
          </Condition>
          <Condition xsi:type="NOT" preferenceValue="0.1">
            <Condition xsi:type="Equal">
              <ArithmeticField
typeName="MediaFormatType">FileSize</ArithmeticField>
              <LongValue>1000</LongValue>
            </Condition>
          </Condition>
        </Condition>
      </QueryCondition>
    </Input>
  </Query>
</MpegQuery>
```


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11.6 Comparison Expression Types

11.6.1 Introduction

The `ComparisonExpressionType` type is an abstract type which extends the `BooleanExpressionType` type and becomes the base type of all the expression types describing comparison expressions. All the comparison expression types should extend the abstract `ComparisonExpressionType` type. Comparison expressions in this part of ISO/IEC 15938 are required to return a Boolean value (expressed as either 0 or 1) as a result. Currently, this part of ISO/IEC 15938 specifies the following comparison expression types: `GreaterThan`, `GreaterThanEqual`, `LessThan`, `LessThanEqual`, `Equal`, `NotEqual` and `Contains`. These comparison expressions allow specifying a sequence of two elements which represents the operands. The `GreaterThan`, `GreaterThanEqual`, `LessThan`, and `LessThanEqual` expressions are required to have two group member elements of the same kind of `ArithmeticOperands`, `DateTimeOperands` or `DurationOperands`.

An element included in the `Equal` and `NotEqual` expressions can be instantiated by one member of the following operands groups: `ArithmeticOperands`, `DateTimeOperands`, `DurationOperands`, `BooleanOperands` and `StringOperands`.

The `Contains` comparison expression is required to have only string operands, represented in the `StringOperands` group. By default all comparison expressions that can be instantiated with `StringOperands ("Equal", "NotEqual", "Contains")` should be implemented in a way to process the `StringOperands` case sensitive.

11.6.2 Syntax

```
 <complexType name="ComparisonExpressionType" abstract="true">
    <complexContent>
        <extension base="mpqf:BooleanExpressionType"/>
     </complexContent>
 </complexType>

<complexType name="GreaterThan">
  <complexContent>
    <extension base="mpqf:ComparisonExpressionType">
      <choice>
        <group ref="mpqf:ArithmeticOperands" minOccurs="2" maxOccurs="2"/>
        <group ref="mpqf:DateTimeOperands" minOccurs="2" maxOccurs="2"/>
        <group ref="mpqf:DurationOperands" minOccurs="2" maxOccurs="2"/>
      </choice>
    </extension>
  </complexContent>
</complexType>
<complexType name="GreaterThanEqual">
  <complexContent>
    <extension base="mpqf:ComparisonExpressionType">
      <choice>
        <group ref="mpqf:ArithmeticOperands" minOccurs="2" maxOccurs="2"/>
        <group ref="mpqf:DateTimeOperands" minOccurs="2" maxOccurs="2"/>
        <group ref="mpqf:DurationOperands" minOccurs="2" maxOccurs="2"/>
      </choice>
    </extension>
  </complexContent>
</complexType>
<complexType name="LessThanEqual">
  <complexContent>
    <extension base="mpqf:ComparisonExpressionType">
      <choice>
```

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```
        <group ref="mpqf:ArithmeticOperands" minOccurs="2" maxOccurs="2"/>
        <group ref="mpqf:DateTimeOperands" minOccurs="2" maxOccurs="2"/>
        <group ref="mpqf:DurationOperands" minOccurs="2" maxOccurs="2"/>
      </choice>
    </extension>
</complexContent>
</complexType>
<complexType name="LessThan">
  <complexContent>
    <extension base="mpqf:ComparisonExpressionType">
      <choice>
        <group ref="mpqf:ArithmeticOperands" minOccurs="2" maxOccurs="2"/>
        <group ref="mpqf:DateTimeOperands" minOccurs="2" maxOccurs="2"/>
        <group ref="mpqf:DurationOperands" minOccurs="2" maxOccurs="2"/>
      </choice>
    </extension>
  </complexContent>
</complexType>
<complexType name="Equal">
  <complexContent>
    <extension base="mpqf:ComparisonExpressionType">
      <choice>
        <group ref="mpqf:ArithmeticOperands" minOccurs="2" maxOccurs="2"/>
        <group ref="mpqf:BooleanOperands" minOccurs="2" maxOccurs="2"/>
        <group ref="mpqf:DateTimeOperands" minOccurs="2" maxOccurs="2"/>
        <group ref="mpqf:DurationOperands" minOccurs="2" maxOccurs="2"/>
        <group ref="mpqf:StringOperands" minOccurs="2" maxOccurs="2"/>
      </choice>
    </extension>
  </complexContent>
</complexType>
<complexType name="NotEqual">
  <complexContent>
    <extension base="mpqf:ComparisonExpressionType">
      <choice>
        <group ref="mpqf:ArithmeticOperands" minOccurs="2" maxOccurs="2"/>
        <group ref="mpqf:BooleanOperands" minOccurs="2" maxOccurs="2"/>
        <group ref="mpqf:DateTimeOperands" minOccurs="2" maxOccurs="2"/>
        <group ref="mpqf:DurationOperands" minOccurs="2" maxOccurs="2"/>
        <group ref="mpqf:StringOperands" minOccurs="2" maxOccurs="2"/>
      </choice>
    </extension>
  </complexContent>
</complexType>
<complexType name="Contains">
  <complexContent>
    <extension base="mpqf:ComparisonExpressionType">
      <sequence>
        <group ref="mpqf:StringOperands" minOccurs="2" maxOccurs="2"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
```


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11.6.3 Semantics

Semantics of the Comparison Expression Types:

Name	*Definition*
`ComparisonExpressionType`	An abstract type based on the `BooleanExpressionType` type that is the base type for defining comparison expressions.
`GreaterThan`	A complex type based on the `ComparisonExpressionType` type, for using the comparable "greater than" operation in a query. This operation has two operands that are required to be values of `Arithmetic`, `DateTime`, or `Duration` operand type.
`GreaterThanEqual`	A complex type based on the `ComparisonExpressionType` type, for using the comparable "greater than" or "equal" operation in a query. This operation has two operands that are required to be values of `Arithmetic`, `DateTime`, or `Duration` operand type.
`LessThan`	A complex type based on the `ComparisonExpressionType` type, for using the comparable "less than" operation in a query. This operation has two operands that are required to be values of `Arithmetic`, `DateTime`, or `Duration` operand type.
`LessThanEqual`	A complex type based on the `ComparisonExpressionType` type, for using the comparable "less than" or "equal" operation in a query. This operation has two operands that are required to be values of `Arithmetic`, `DateTime`, or `Duration` operand type.
`Equal`	A complex type based on the `ComparisonExpressionType` type, for using the comparable "equal" operation in a query. This operation has two operands that are required to be values of `Arithmetic`, `Boolean`, `String`, `DateTime`, or `Duration` operand type. String operands are processed case sensitive by default.
`NotEqual`	A complex type based on the `ComparisonExpressionType` type, for using the comparable "not equal" operation in a query. This operation has two operands that are required to be values of `Arithmetic`, `Boolean`, `String`, `DateTime`, or `Duration` operand type. `String` operands are processed case sensitive by default.
`Contains`	A complex type based on the `ComparisonExpressionType` type, for using the comparable "contains" expression in a query. The `Contains` expression specifies the query expression for a text query and looks for the following string anywhere in the preceding string. This expression has two operands that are required to be values of `String` type. `String` operands are processed case sensitive by default.

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11.6.4 Example

The following example illustrates that comparison expression types are inherited from `ComparisonExpressionType` type.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Input>
      <QueryCondition>
        <Condition xsi:type="GreaterThan">
          <ArithmeticField
             typeName="MediaFormatType">/TargetChannelBitRate</ArithmeticField>
          <LongValue>340000</LongValue>
        </Condition>
      </QueryCondition>
    </Input>
  </Query>
</MpegQuery>
```

11.7 Arithmetic Expression Types

11.7.1 Introduction

The `ArithmeticExpressionType` type is an abstract type, which is the base type of all the arithmetic expressions. All the arithmetic expressions (including the aggregate expressions) are required to extend the `ArithmeticExpressionType` type. Currently, this part of ISO/IEC 15938 specifies the following arithmetic expressions: `Add`, `Subtract`, `Multiply`, `Divide`, `Modulus`, `Abs`, `Ceiling`, `Floor` and `Round`. The `Add`, `Subtract`, `Multiply`, `Divide` and `Modulus` arithmetic expressions should have two operands that reference member elements of the `ArithmeticOperand` group. The `Abs`, `Ceiling`, `Floor` and `Round` arithmetic expressions should have a single operand of type `ArithmeticExpressionType`.

11.7.2 Syntax

```
<complexType name="Add">
  <complexContent>
    <extension base="mpqf:ArithmeticExpressionType">
      <sequence>
        <group ref="mpqf:ArithmeticOperands" minOccurs="2" maxOccurs="2"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
<complexType name="Subtract">
  <complexContent>
    <extension base="mpqf:ArithmeticExpressionType">
      <sequence>
        <group ref="mpqf:ArithmeticOperands" minOccurs="2" maxOccurs="2"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
<complexType name="Multiply">
  <complexContent>
    <extension base="mpqf:ArithmeticExpressionType">
      <sequence>
        <group ref="mpqf:ArithmeticOperands" minOccurs="2" maxOccurs="2"/>
      </sequence>
```


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```
    </extension>
  </complexContent>
</complexType>
<complexType name="Divide">
  <complexContent>
    <extension base="mpqf:ArithmeticExpressionType">
      <sequence>
        <group ref="mpqf:ArithmeticOperands" minOccurs="2" maxOccurs="2"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
<complexType name="Modulus">
  <complexContent>
    <extension base="mpqf:ArithmeticExpressionType">
      <sequence>
        <group ref="mpqf:ArithmeticOperands" minOccurs="2" maxOccurs="2"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
<complexType name="Abs">
   <complexContent>
      <extension base="mpqf:ArithmeticExpressionType">
        <sequence>
          <group ref="mpqf:ArithmeticOperands"/>
        </sequence>
      </extension>
    </complexContent>
</complexType>
<complexType name="Ceiling">
    <complexContent>
      <extension base="mpqf:ArithmeticExpressionType">
        <sequence>
          <group ref="mpqf:ArithmeticOperands"/>
        </sequence>
      </extension>
    </complexContent>
</complexType>
<complexType name="Floor">
    <complexContent>
      <extension base="mpqf:ArithmeticExpressionType">
        <sequence>
          <group ref="mpqf:ArithmeticOperands"/>
        </sequence>
      </extension>
    </complexContent>
</complexType>
<complexType name="Round">
    <complexContent>
      <extension base="mpqf:ArithmeticExpressionType">
        <sequence>
          <group ref="mpqf:ArithmeticOperands"/>
        </sequence>
      </extension>
    </complexContent>
</complexType>
```

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11.7.3 Semantics

Semantics of the `ArithmeticExpressionType` type:

Name	*Definition*
`Add`	A complex type based on `ArithmeticExpressionType` type, for using the “Add” arithmetic operation.
`Subtract`	A complex type based on `ArithmeticExpressionType` type, for using the “Subtract” arithmetic operation.
`Multiply`	A complex type based on `ArithmeticExpressionType` type for using the “Multiply” arithmetic operation.
`Divide`	A complex type based on `ArithmeticExpressionType` type, for using the “Divide” arithmetic operation. The assumption here is that the result type of the arithmetic expression will depend on the type of the operands, following the conventions of the ANSI C implicit casting mechanism.
`Modulus`	A complex type based on `ArithmeticExpressionType` type, for using the “Modulus” arithmetic operation that returns the remainder of the integer division of the two operands.
`Abs`	A complex type based on `ArithmeticExpressionType` type, for using the “Abs” arithmetic operation that returns the absolute value of the operand.
`Ceiling`	A complex type based on `ArithmeticExpressionType` type, for using the “Ceiling” arithmetic operation that returns the ceiling of the operand.
`Floor`	A complex type based on `ArithmeticExpressionType` type, for using the “Floor” arithmetic operation that returns the floor of the operand.
`Round`	A complex type based on `ArithmeticExpressionType` type, for using the “Round” arithmetic operation that returns the rounded value of the operand.

11.7.4 Example

The following example illustrates the use of the arithmetic expressions in the context of comparison operators. In particular, the absolute value of a field, calculated using the “Abs” expression, is compared with a constant value.

```
<MpegQuery mpqfID="someID">
 <Query>
   <Input>
     <QueryCondition>
       <Condition xsi:type="GreaterThan">
        <ArithmeticExpression xsi:type="Abs">
         <ArithmeticField>Mpeg7/Description/AudioVisual/Semantic/SemanticBaseType/
           AttributeValuePair/IntegerValue</ArithmeticField>
        </ArithmeticExpression>
        <LongValue>40</LongValue>
       </Condition>
     </QueryCondition>
   </Input>
 </Query>
</MpegQuery>
```


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11.8 Aggregate Expression Types

11.8.1 Introduction

The abstract `AggregateExpressionType` type is the base type of all the aggregate expressions and extends the `ArithmeticExpressionType` type. All the aggregate expressions shall be inherited from the abstract `AggregateExpressionType` type. Currently, this part of ISO/IEC 15938 specifies the following aggregate expressions: `AVG`, `StdDev`, `Variance`, `SUM`, `Count`, `MAX` and `MIN`. All aggregate expressions are only allowed to be used in the OutputDescription element and shall not be used in the `QueryCondition` element.

11.8.2 Syntax

```
<complexType name="AggregateExpressionType" abstract="true">
  <complexContent>
    <extension base="mpqf:ArithmeticExpressionType">
      <attribute name="aggregateID" type="ID" use="optional"/>
    </extension>
  </complexContent>
</complexType>
<complexType name="AVG">
  <complexContent>
    <extension base="mpqf:AggregateExpressionType">
      <sequence>
        <element name="Field" type="mpqf:FieldType"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
<complexType name="StdDev">
  <complexContent>
    <extension base="mpqf:AggregateExpressionType">
      <sequence>
        <element name="Field" type="mpqf:FieldType"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
<complexType name="Variance">
  <complexContent>
    <extension base="mpqf:AggregateExpressionType">
      <sequence>
        <element name="Field" type="mpqf:FieldType"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
<complexType name="SUM">
  <complexContent>
    <extension base="mpqf:AggregateExpressionType">
      <sequence>
        <element name="Field" type="mpqf:FieldType"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
<complexType name="Count">
  <complexContent>
```

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```
    <extension base="mpqf:AggregateExpressionType">
      <sequence>
        <element name="Field" type="mpqf:FieldType"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
<complexType name="MAX">
  <complexContent>
    <extension base="mpqf:AggregateExpressionType">
      <sequence>
        <element name="Field" type="mpqf:FieldType"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
<complexType name="MIN">
  <complexContent>
    <extension base="mpqf:AggregateExpressionType">
      <sequence>
        <element name="Field" type="mpqf:FieldType"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
```

11.8.3 Semantics

Semantics of the `AggregateExpressionType` type:

Name	*Definition*
`AggregateExpressionType`	An abstract type that is the base type for defining aggregate expressions. Types that inherit from this type are not allowed to occur in the `QueryCondition` element.
`aggregateID`	An attribute of ID type used to give an unique identifier to an aggregate.
`AVG`	A complex type based on `AggregateExpressionType` type, for calculating the average value of a certain numeric field.
`StdDev`	A complex type based on `AggregateExpressionType` type, for calculating the standard deviation value of a certain numeric field.
`Variance`	A complex type based on `AggregateExpressionType` type, for calculating the variance value of a certain numeric field.
`SUM`	A complex type based on `AggregateExpressionType` type, for calculating the sum value of a certain numeric field.
`Count`	A complex type based on `AggregateExpressionType` type, for calculating the number of items within a group.
`MAX`	A complex type based on `AggregateExpressionType` type, for calculating the maximum value of a certain numeric field.
`MIN`	A complex type based on `AggregateExpressionType` type, for calculating the minimum value of a certain numeric field.

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11.8.4 Example

Significant examples are provided at the `GroupBy` element.

11.9 String Expression Types

11.9.1 Introduction

The `StringExpressionType` type is an abstract type, which is the base type of all the string expressions. All the string expressions shall extend the abstract type `StringExpressionType`. This part of ISO/IEC 15938 specifies the following string expressions: `LowerCase`, `UpperCase`. Their purpose is to facilitate case insensitive processing of `StringOperands`.

11.9.2 Syntax

```
<complexType name="UpperCase">
  <complexContent>
    <extension base="mpqf:StringExpressionType">
      <sequence>
        <group ref="mpqf:StringOperands"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
<complexType name="LowerCase">
  <complexContent>
    <extension base="mpqf:StringExpressionType">
      <sequence>
        <group ref="mpqf:StringOperands"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
```

11.9.3 Semantics

Semantics of the `StringExpressionType` type:

Name	*Definition*
`UpperCase`	A complex type based on `StringExpressionType` type, for transforming a string to upper case.
`LowerCase`	A complex type based on `StringExpressionType` type, for transforming a string to lower case.

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11.9.4 Example

The following example illustrates the use of the expressions in the context of comparison operators. In particular, the upper case value of a constant is compared to a field.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Input>
      <QueryCondition>
        <Condition xsi:type="Equal">
          <StringField typeName="CreationType">Title</StringField>
          <StringExpression xsi:type="LowerCase">
            <StringValue>Blade Runner</StringValue>
          </StringExpression>
        </Condition>
      </QueryCondition>
    </Input>
  </Query>
</MpegQuery>
```

12 Query Types

12.1 Introduction

The `QueryType` type is an abstract type which extends the `BooleanExpressionType` type and becomes the parent class of all the query types including the `QueryByMedia`, `QueryByDescription`, `QueryByFeatureRange`, `SpatialQuery`, `TemporalQuery`, `QueryByXQuery`, `QueryByFreeText`, and `QueryByRelevanceFeedback` types. All the subtypes inherited from the `QueryType` type shall return a value in the range of [0..1], denoting whether an evaluation item satisfies the condition specified by the operation (e.g. `QueryByMedia`) or not.

12.2 Syntax

```
<complexType name="QueryType" abstract="true">
  <complexContent>
    <extension base="mpqf:BooleanExpressionType"/>
  </complexContent>
</complexType>
```

12.3 Semantics

Semantics of the `QueryType` type:

Name	*Definition*
`QueryType`	Specifies an abstract type that extends the `BooleanExpressionType` type to be the base type of all the query types such as `QueryByMedia` or `QueryByFreeText`.

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12.4 QueryByMedia

12.4.1 Introduction

The `QueryByMedia` type extends the abstract `QueryType` type. The `QueryByMedia` type enables a requester to realize a search based on a given example media resource. It provides also an attribute to indicate the search criteria regarding similar-match or exact-match.

12.4.2 Syntax

```
<complexType name="QueryByMedia">
  <complexContent>
    <extension base="mpqf:QueryType">
      <choice>
        <element name="MediaResource" type="mpqf:MediaResourceType"/>
        <element name="MediaResourceREF" type="IDREF"/>
      </choice>
      <attribute name="matchType" use="optional" default="similar">
        <simpleType>
          <restriction base="string">
            <enumeration value="similar"/>
            <enumeration value="exact"/>
          </restriction>
        </simpleType>
      </attribute>
    </extension>
  </complexContent>
</complexType>
```

12.4.3 Semantics

Semantics of the `QueryByMedia` type:

Name	*Definition*
`QueryByMedia`	Specifies the tool for a search by example, which allows the requester to perform a similarity or exact match search based on a given multimedia content. This type extends the `QueryType` type and allows embedding either a `MediaResource` or a reference to a resource defined in the `QFDeclaration` element.
`MediaResource`	Specifies the actual resource that is used for querying. Is of `MediaLocatorType` type.
`MediaResourceRef`	Specifies a reference to the resource defined in the `QFDeclaration` element that is used for querying. Is of `IDREF` type. The referenced resource shall be of type MediaResourceType.
`matchType`	Specifies a search type of match (either a similar or an exact match).

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12.4.4 Example

The following example illustrates the use of the `QueryByMedia` type. The query requests video contents which are similar to the given image.

```
<MpegQuery mpqfID="someID">
 <Query>
  <Input>
   <QueryCondition>
    <TargetMediaType>video/mpeg</TargetMediaType>
     <Condition xsi:type="QueryByMedia" matchType="similar">
      <MediaResource resourceID="Image001">
        <MediaResource>
         <MediaUri>http://db.mpqf.mpeg/testdata001.jpg</MediaUri>
        </MediaResource>
      </MediaResource>
     </Condition>
    </QueryCondition>
   </Input>
  </Query>
</MpegQuery>
```

12.5 QueryByDescription

12.5.1 Introduction

The `QueryByDescription` type extends the abstract `QueryType` type. The `QueryByDescription` type enables a requester to realize a search based on a given example description. Any description, i.e. metadata can be embedded if the metadata is based on XML-schema and the description is conformant to the schema. It provides also an attribute to indicate the search criteria regarding similar-match or exact-match.

12.5.2 Syntax

```
<complexType name="QueryByDescription">
  <complexContent>
    <extension base="mpqf:QueryType">
      <choice>
        <element name="DescriptionResource" type="mpqf:DescriptionResourceType"/>
        <element name="DescriptionResourceREF" type="IDREF"/>
      </choice>
      <attribute name="matchType" use="optional" default="similar">
        <simpleType>
          <restriction base="string">
            <enumeration value="similar"/>
            <enumeration value="exact"/>
          </restriction>
        </simpleType>
      </attribute>
    </extension>
  </complexContent>
</complexType>
```


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12.5.3 Semantics

Semantics of the `QueryByDescription` type:

Name	*Definition*
`QueryByDescription`	Specifies the tool for a search by example, which allows the requester to perform a similarity or exact match search based on a given description. This type extends the `QueryType` type and allows embedding either a `DescriptionResource` or a reference to a resource defined in the `QFDeclaration`.
`DescriptionResource`	Specifies the actual resource that is taken for querying. The resource shall be the description of a low or high level feature according to the used metadata schema.
`DescriptionResourceRef`	Specifies a reference to the resource defined in the `QFDeclaration` that is taken for querying. The referenced resource shall be of type DescriptionResourceType.
`matchType`	Specifies a search type of match (either a similar or an exact match).

12.5.4 Example

The following example illustrates the use of the `QueryByDescription` type. The query requests images whose MPEG-7 metadata has the `CreationInformation`/`Creation`/`Title` element with the value “Miracle Query Format” exactly.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Input>
      <QueryCondition>
        <TargetMediaType>image/jpeg</TargetMediaType>
        <Condition xsi:type="QueryByDescription" matchType="exact">
          <DescriptionResource resourceID="desc001">
            <AnyDescription xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004"
               xsi:schemaLocation="urn:mpeg:mpeg7:schema:2004 M7v2schema.xsd">
              <mpeg7:Mpeg7>
                <mpeg7:DescriptionUnit xsi:type="mpeg7:CreationInformationType">
                  <mpeg7:Creation>
                    <mpeg7:Title>Miracle Query Format</mpeg7:Title>
                  </mpeg7:Creation>
                </mpeg7:DescriptionUnit>
              </mpeg7:Mpeg7>
            </AnyDescription>
          </DescriptionResource>
        </Condition>
      </QueryCondition>
    </Input>
  </Query>
</MpegQuery>
```

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12.6 QueryByFreeText

12.6.1 Introduction

The `QueryByFreeText` type enables the user to perform a free text search, i.e. a search based on the use of free-text. The `QueryByFreeText` type extends the `QueryType` type and contains either a mandatory `FreeText` element containing text description or a mandatory `RegExp` element containing a regular expression as a condition. It has also an optional choice of fields, which allow the user to state (in the `SearchField` elements) if the search should be performed in specific elements only or if specific elements should be ignored during the search (stated in the `IgnoreField` elements). If no `SearchField` or `IgnoreField` elements are specified, the search will take the whole description into account.

12.6.2 Syntax

```
<complexType name="QueryByFreeText">
  <complexContent>
    <extension base="mpqf:QueryType">
      <sequence>
         <choice>
          <element name="FreeText" type="string"/>
          <element name="RegExp" type="string"/>
         </choice>
         <choice minOccurs="0">
          <element name="SearchField"
                        type="mpqf:FieldType" maxOccurs="unbounded"/>
          <element name="IgnoreField"
                        type="mpqf:FieldType" maxOccurs="unbounded"/>
        </choice>
      </sequence>
    </extension>
  </complexContent>
</complexType>
```

12.6.3 Semantics

Semantics of the `QueryByFreeTextType` type:

Name	*Definition*
`QueryByFreeText`	Describes a search of multimedia content based on the given text. This type extends the `QueryType` type and contains an element of string to describe the search condition.
`FreeText`	Specifies the actual free text term describing the multimedia content of desire.
`RegExp`	Specifies a regular expression describing the multimedia content of desire.
`SearchField`	Specifies the element(s) on which the search shall be performed.
`IgnoreField`	Specifies the element(s) that shall be ignored during the search.

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12.6.4 Examples

The following example illustrates the use of the `QueryByFreeText` type, without any `SearchField` and `IgnoreField` elements.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Input>
      <QueryCondition>
        <Condition xsi:type="QueryByFreeText">
          <FreeText>Testquery</FreeText>
        </Condition>
      </QueryCondition>
    </Input>
  </Query>
</MpegQuery>
```

The example below modifies the previous one so as to search within the `TextAnnotation` elements of the descriptions only.

```
<MpegQuery mpqfID="someID">
 <Query>
  <Input>
    <QueryCondition>
      <Condition xsi:type="QueryByFreeText">
        <FreeText>
          Testquery
        </FreeText>
        <SearchField>Mpeg7/Description/AudioVisual/TextAnnotation</SearchField>
      </Condition>
    </QueryCondition>
  </Input>
 </Query>
</MpegQuery>
```

The following example modifies the first one so as to ignore the `TextAnnotationValue` elements of the descriptions.

```
<MpegQuery mpqfID="someID">
 <Query>
  <Input>
    <QueryCondition>
      <Condition xsi:type="QueryByFreeText">
        <FreeText>
          Testquery
        </FreeText>
        <IgnoreField>
          Mpeg7/Description/AudioVisual/Semantic/SemanticBaseType/
AttributeValuePair/TextAnnotationValue
        </IgnoreField>
      </Condition>
    </QueryCondition>
  </Input>
 </Query>
</MpegQuery>
```

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12.7 QueryByFeatureRange

12.7.1 Introduction

The `QueryByFeatureRange` type extends the abstract `QueryType` type. It enables a requester to realize two different range searches. The first option enables a range search based on given descriptions denoting the start and the end range of the retrieval area. The second option allows a range search based on a given description (e.g. an audio low-level feature as AudioSpectrumFlatness) and a distance. The distance element denotes the distance in feature space from the center of mass, whereas the center is described by the `Center` element. The example description shows the usage of this descriptor in more detail. In the first example, the first option is described by the `AnyDescription` element within the `QFDeclaration` element and referenced within the `QueryByFeatureRange` type by the `RangeStart` element and `RangeEnd` element, respectively. The second option is described in the second example by an `AnyDescription` element within the `QFDeclaration` element and referenced within the `QueryByFeatureRange by Center and a distance`.

12.7.2 Syntax

```
<complexType name="QueryByFeatureRange">
  <complexContent>
    <extension base="mpqf:QueryType">
      <sequence>
        <choice>
          <element name="Range">
            <complexType>
              <attribute name="RangeStart" type="IDREF" use="required"/>
              <attribute name="RangeEnd" type="IDREF" use="required"/>
            </complexType>
          </element>
          <element name="Distance">
            <complexType>
              <attribute name="Center" type="IDREF" use="required"/>
              <attribute name="Radius" type="mpqf:zeroToOneType" use="required"/>
              <attribute    name="DistanceFunction"    type="mpqf:SimpleTermType"
use="optional"/>
            </complexType>
          </element>
        </choice>
      </sequence>
    </extension>
  </complexContent>
</complexType>
```

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12.7.3 Semantics

Semantics of the `QueryByFeatureRange` type:

Name	*Definition*
`QueryByFeatureRange`	Specifies the `QueryByFeatureRange` type which is an extension of the `QueryType` type. This type allows the definition of range queries by defining the start and end range of the desired search region.
`Range`	Describes the first option for the range search. Here the query indicates a start and an end point of the range and the search engine shall return items between these points.
`RangeStart`	Specifies the start of a range and is required to reference to a feature within the `QFDeclaration` element. Both, `rangeStart` and `rangeEnd` has to point to the same type of description.
`RangeEnd`	Specifies the end of a range and is required to reference to a feature within the `QFDeclaration` element. Both, `rangeStart` and `rangeEnd` have to point to the same type of description
`Distance`	Describes the second mode of the `QueryByFeatureRange` type. It is specified by a center and a distance, whereas all items from the center within a certain distance around shall be returned. Since the feature space is dependend on the distance function, the `DistanceFunction` attribute refers to a classification scheme term specifying the distance function.
`Center`	Specifies the center of the range search in the feature space and is required to reference to a feature within the `QFDeclaration` element.
`Radius`	Specifies the distance from the center to the furthermost distant point in the feature space which shall be considered for the result. This element contains a floating value, which is between zero and one.
`DistanceFunction`	The distance from the center to the furthermost distant point in the feature space is dependent on a distance function (e.g. Eucledian distance). In order to signal the required distance function to the server, the `TermType` type is used, which refers to a classification scheme. If the distance function is not further specified, always the Eucledian distance is adopted.

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12.7.4 Example

The following example illustrates the use of the `QueryByFeatureRange` type in the first mode. To indicate the range, two pieces of `DominantColor` instance are declared within `QFDeclaration` element. The query requests any contents whose `DominantColor` feature is in the specified range.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Input>
      <QFDeclaration>
        <Resource xsi:type="DescriptionResourceType" resourceID="startID">
          <AnyDescription xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004"
xsi:schemaLocation="urn:mpeg:mpeg7:schema:2004 M7v2schema.xsd">
            <mpeg7:Mpeg7>
              <mpeg7:DescriptionUnit xsi:type="mpeg7:DominantColorType">
                <mpeg7:ColorSpace type="RGB"/>
                <mpeg7:SpatialCoherency>28</mpeg7:SpatialCoherency>
                <mpeg7:Value>
                  <mpeg7:Percentage>12</mpeg7:Percentage>
                  <mpeg7:Index>1 1 1</mpeg7:Index>
                  <mpeg7:ColorVariance>1 1 1</mpeg7:ColorVariance>
                </mpeg7:Value>
              </mpeg7:DescriptionUnit>
            </mpeg7:Mpeg7>
          </AnyDescription>
        </Resource>
        <Resource xsi:type="DescriptionResourceType" resourceID="endID">
          <AnyDescription xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004"
xsi:schemaLocation="urn:mpeg:mpeg7:schema:2004 M7v2schema.xsd">
            <mpeg7:Mpeg7>
              <mpeg7:DescriptionUnit xsi:type="mpeg7:DominantColorType">
                <mpeg7:ColorSpace type="RGB"/>
                <mpeg7:SpatialCoherency>28</mpeg7:SpatialCoherency>
                <mpeg7:Value>
                  <mpeg7:Percentage>30</mpeg7:Percentage>
                  <mpeg7:Index>5 5 6</mpeg7:Index>
                  <mpeg7:ColorVariance>1 1 1</mpeg7:ColorVariance>
                </mpeg7:Value>
              </mpeg7:DescriptionUnit>
            </mpeg7:Mpeg7>
          </AnyDescription>
        </Resource>
      </QFDeclaration>
      <QueryCondition>
        <Condition xsi:type="QueryByFeatureRange">
          <Range RangeEnd="endID" RangeStart="startID"/>
        </Condition>
      </QueryCondition>
    </Input>
  </Query>
</MpegQuery>
```

The following example illustrates the use of the `QueryByFeatureRange` type in the second mode by specifying a center and a distance. To indicate this range, a piece of a `DominantColor` instance is declared within the `QFDeclaration` element and a distance is given. The query requests any contents whose `DominantColor` feature is in a distance of 0.5.

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```
<MpegQuery mpqfID="someID">
  <Query>
    <Input>
      <QFDeclaration>
        <Resource xsi:type="DescriptionResourceType" resourceID="centerID">
          <AnyDescription xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004"
xsi:schemaLocation="urn:mpeg:mpeg7:schema:2004 M7v2schema.xsd">
            <mpeg7:Mpeg7>
              <mpeg7:DescriptionUnit xsi:type="mpeg7:DominantColorType">
                <mpeg7:ColorSpace type="RGB"/>
                <mpeg7:SpatialCoherency>28</mpeg7:SpatialCoherency>
                <mpeg7:Value>
                  <mpeg7:Percentage>12</mpeg7:Percentage>
                  <mpeg7:Index>1 1 1</mpeg7:Index>
                  <mpeg7:ColorVariance>1 1 1</mpeg7:ColorVariance>
                </mpeg7:Value>
              </mpeg7:DescriptionUnit>
            </mpeg7:Mpeg7>
          </AnyDescription>
        </Resource>
      </QFDeclaration>
      <QueryCondition>
        <Condition xsi:type="QueryByFeatureRange">
          <Distance Radius="0.5" Center="centerID"/>
        </Condition>
      </QueryCondition>
    </Input>
  </Query>
</MpegQuery>
```

12.8 SpatialQuery

12.8.1 Introduction

This query type allows requests in the spatial domain where one or two regions (e.g., MPEG-7 `StillRegion`, etc.) are involved. Relationships among those regions and possible matching regions are expressed by the `RelationType` type. Note, that the query type allows two different `RelationType` types. One is the SpatialRelation CS and the other is the BaseRelation CS (see Annex B). The `RelationType` type provides three attributes. The `relationType` attribute is mandatory and denotes the relation. The `sourceResource` attribute is also mandatory and indicates a specific region. Furthermore, another optional attribute `targetResource` is provided to indicate another specific region. Combining these attributes allows a requester to generate various queries involving spatial relation of regions.

12.8.2 Syntax

```
<complexType name="SpatialQuery">
  <complexContent>
    <extension base="mpqf:QueryType">
      <sequence>
        <element name="SpatialRelation"
                 type="mpqf:RelationType"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
```

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12.8.3 Semantics

Semantics of the `SpatialQuery` type:

Name	*Definition*
`SpatialQuery`	Specifies the `SpatialQuery` type which is an extension of the `QueryType` type. It allows the retrieval of spatial elements within media objects by defining `SpatialRelation` element. The spatial element to be retrieved is decided by `EvaluationPath` element in `QueryCondition` element.
`SpatialRelation`	Specifies the spatial relation based on the `RelationType` type. It provides means for describing a spatial relation among segment decompositions. Allowed relations are defined in SpatialRelation CS and BaseRelation CS.

12.8.4 Example

The following illustrates some scenarios using the 'north'-related relation. Three relations for 'north' are defined in SpatialRelation CS, i.e., 'north,' 'northOf' and 'northIn.' The 'north' is used only when both `sourceResource` and `targetResource` attributes are defined, and then the region that includes two defined sub-regions satisfying the specified relationship is returned. The return region varies based on the `EvaluationPath` element. In the case, the `EvaluationPath` element is //Image, all images in the database that satisfy the condition are returned. If the `EvaluationPath` element is //StillRegion sub-regions of images which satisfy the condition are returned.

On the other hand, the relations 'northOf' and 'northIn' are used only when the `targetResource` attribute is omitted. In the case of a 'northOf'-relation and an `EvaluationPath` element that indicates an image (i.e., //Image,) the image containing the `sourceResource` attribute is north of something (a sub-region) is returned. If the `EvaluationPath` element indicates a sub-region (i.e., //StillRegion,) the sub-region that is south of `sourceResource` attribute is returned.

In the case of a 'northIn'-relation, the region containing the `sourceResource` attribute in the north of it is returned. In the example, if the `EvaluationPath` element is //Image, Img1 and Img2 are returned. Although Img3 contains Id1, its location is not in the north of Img3, so Img3 is not returned. In the case that the `EvaluationPath` element is //StillRegion, SR1, SR3 and SR4 are returned.

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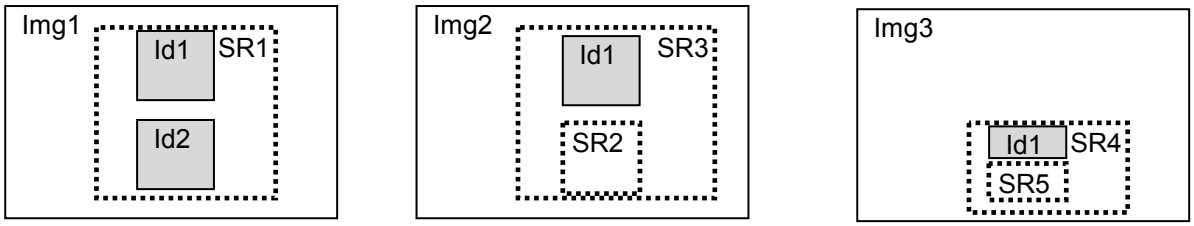

Expression \ EvaluationPath=	//Image	//StrillRegion
<SpatialRelation sourceResouce="id1" targetResource="id2" relationType="north">	Img1	SR1
<SpatialRelation sourceResource="id1" relationType="north-Of">	Img1,2	SR2,5
<SpatialRelation sourceResource="id1" relationType="north-In">	Img1,2	SR1,3,4

Note that the size of the retrieved sub region (SR1, 2, 3, 4) is left to implementor.

The following example illustrates the use of the `SpatialQueryType` type, in which `sourceResource` and `relationType` attributes are specified.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Input>
      <QFDeclaration>
        <Resource resourceID="stillImage1" xsi:type="DescriptionResourceType">
          <AnyDescription xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004"
xsi:schemaLocation="urn:mpeg:mpeg7:schema:2004 M7v2schema.xsd">
            <mpeg7:Mpeg7>
              <mpeg7:DescriptionUnit xsi:type="mpeg7:StillRegionType">
                <mpeg7:VisualDescriptor xsi:type="mpeg7:DominantColorType">
                  <mpeg7:ColorSpace type="RGB"/>
                  <mpeg7:SpatialCoherency>30</mpeg7:SpatialCoherency>
                  <mpeg7:Value>
                    <mpeg7:Percentage>12</mpeg7:Percentage>
                    <mpeg7:Index>1 1 1</mpeg7:Index>
                    <mpeg7:ColorVariance>1 0 0</mpeg7:ColorVariance>
                  </mpeg7:Value>
                </mpeg7:VisualDescriptor>
                <mpeg7:VisualDescriptor xsi:type="mpeg7:HomogeneousTextureType">
                  <mpeg7:Average>1</mpeg7:Average>
                  <mpeg7:StandardDeviation>1</mpeg7:StandardDeviation>
                  <mpeg7:Energy>1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
                            18 19 20 21 22 23 24 25 26 27 28 29
30</mpeg7:Energy>
                </mpeg7:VisualDescriptor>
              </mpeg7:DescriptionUnit>
            </mpeg7:Mpeg7>
          </AnyDescription>
        </Resource>
      </QFDeclaration>
      <QueryCondition>
        <EvaluationPath>//Image</EvaluationPath>
        <Condition xsi:type="SpatialQuery">
          <SpatialRelation sourceResource="stillImage1"
relationType="urn:mpeg:mpqf:cs:SpatialRelationCS:2008:northwest"/>
        </Condition>
      </QueryCondition>
    </Input>
  </Query>
</MpegQuery>
```

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12.9 TemporalQuery

12.9.1 Introduction

This query type allows requests in the temporal domain where one or two segments (e.g., `VideoSegment`, `AudioVisualSegment`, etc.) are involved. Relationships among those segments and possible matching segments are expressed by the `RelationType` type. Note, that the query type only allows terms of the TemporalRelation CS (see Annex B). The `RelationType` type provides three attributes. The `relationType` attribute is mandatory and denotes the relation. The `sourceResource` attribute is also mandatory and indicates a specific segment. Furthermore, another optional attribute `targetResource` is provided to indicate another specific segment. Combining these attributes allows a requester to generate various queries involving temporal relation of segments.

12.9.2 Syntax

```
<complexType name="TemporalQuery">
  <complexContent>
    <extension base="mpqf:QueryType">
      <sequence>
        <element name="TemporalRelation" type="mpqf:RelationType"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
```

12.9.3 Semantics

Semantics of the `TemporalQuery` type:

Name	***Definition***
`TemporalQuery`	Specifies the `TemporalQuery` type which is an extension of the `QueryType` type. It allows the retrieval of temporal elements within media objects by defining `TemporalRelation` element. The temporal element to be retrieved is decided by `EvaluationPath` element in `QueryCondition`.
`TemporalRelation`	Specifies the temporal relation based on the `RelationType` type. It provides means for describing a temporal relation among segment decompositions. Allowed classification scheme is TemporalRelation CS.

12.9.4 Example

The following illustrates the two possible combinations of attributes in the `TemporalRelation` element and its expected results. There are two videos named ‘v1’ and ‘v2’ and two pre-declared segments named ‘id1’ and ‘id2.’ The table below shows what would be retrieved with the combination of attributes and `EvaluationPath`**s**.

The following illustrates some scenarios using the ‘precedes’-related relation. Two relations for ‘precedes’ are defined in TemporalRelationCS, i.e., ‘precedes’ and ‘precedesOf’. The ‘precedes’ is used only when both `sourceResource` and `targetResource` attributes are defined, and then the region that includes two defined sub-regions satisfying the specified relationship is returned. The return region varies based on the value of the `EvaluationPath` element. In the example, in the case the `EvaluationPath` element is

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//Video, all videos in the database that satisfy the condition are returned. If the `EvaluationPath` element is //VideoSegment, video segments which satisfy the condition are returned.

On the other hand, the relations 'precedesOf' is used only when the `targetResource` attribute is omitted. If the `EvaluationPath` element indicates a video (i.e., //Video,) the video containing the `sourceResource` attribute preceding something (a video segment) is returned. If the `EvaluationPath` element indicates a sub-segment (i.e., //VideoSegment,) the sub-segment that follows the `sourceResource` attribute is returned.



Expression \ EvaluationPath=	//Video	//VideoSegment
<TemporalRelation sourceResouce="id1" targetResource="id2" relationType="precede">	V1	VS1
<TemporalRelation sourceResource="id1" relationType="precedeOf">	V1,2	VS2

Note that the period of the retrieved segments (VS1, VS2) is left to implementor.

The following example illustrates the use of the `TemoralQuery` type, in which all three attributes are specified.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Input>
      <QFDeclaration>
        <Resource resourceID="silenceID" xsi:type="DescriptionResourceType">
          <AnyDescription xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004"
xsi:schemaLocation="urn:mpeg:mpeg7:schema:2004 M7v2schema.xsd">
            <mpeg7:Mpeg7>
              <mpeg7:DescriptionUnit xsi:type="mpeg7:AudioSegmentType">
                <mpeg7:AudioDescriptor xsi:type="mpeg7:SilenceType"/>
              </mpeg7:DescriptionUnit>
            </mpeg7:Mpeg7>
          </AnyDescription>
        </Resource>
        <Resource resourceID="melodyID" xsi:type="DescriptionResourceType">
          <AnyDescription xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004"
xsi:schemaLocation="urn:mpeg:mpeg7:schema:2004 M7v2schema.xsd">
            <mpeg7:Mpeg7>
              <mpeg7:DescriptionUnit xsi:type="mpeg7:AudioSegmentType">
                <mpeg7:AudioDescriptionScheme xsi:type="mpeg7:MelodyType">
                  <mpeg7:Meter>
                    <mpeg7:Numerator>3</mpeg7:Numerator>
                    <mpeg7:Denominator>4</mpeg7:Denominator>
                  </mpeg7:Meter>
                  <mpeg7:MelodyContour>
                    <mpeg7:Contour>-1</mpeg7:Contour>
                    <mpeg7:Beat>80</mpeg7:Beat>
                  </mpeg7:MelodyContour>
                </mpeg7:AudioDescriptionScheme>
              </mpeg7:DescriptionUnit>
            </mpeg7:Mpeg7>
          </AnyDescription>
        </Resource>
      </QFDeclaration>
```

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```
      <QueryCondition>
        <Condition xsi:type="TemporalQuery">
          <TemporalRelation sourceResource="silenceID" targetResource="melodyID"
relationType="urn:mpeg:mpqf:cs:TemporalRelationCS:2008:follows"/>
        </Condition>
      </QueryCondition>
    </Input>
  </Query>
</MpegQuery>
```

12.10 Query By XQuery

12.10.1 Introduction

The `QueryByXQuery` type extends the abstract `QueryType` type and denotes a query operation for the use of XQuery expressions. The type is structured as a sequence of strings representing XQuery expressions. The XQuery expression is restricted to the use of constructs that produce a Boolean true or false decision on a single evaluation item at the target database. So, the scope of the XQuery expression is the root element of one evaluation item's metadata XML tree. Furthermore, within the XQuery expression included in the `QueryByXQuery` type, no output description is allowed.

12.10.2 Syntax

```
<complexType name="QueryByXQuery">
  <complexContent>
    <extension base="mpqf:QueryType">
      <sequence>
        <element name="XQuery" type="string"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
```

12.10.3 Semantics

Semantics of the `QueryByXQuery` type:

Name	*Definition*
`QueryByXQuery`	Extends the abstract `QueryType` type and denotes a query operation for the use of XQuery expressions.
`XQuery`	Specifies the XQuery expression that is used to filter information. Only XQuery expressions that operate on a single evaluation item and do respond either true or false based on the provided condition are allowed. No output description is allowed in the XQuery expression. The return of a Boolean value may be guaranteed by the use of the fn:boolean function provided by XQuery.

12.10.4 Examples

The following example illustrates the use of the `QueryByXQuery` type. In this example, the used XQuery expression filters all evaluation-item, i.e. in this case it is an XPath-item related to the MC's metadata XML

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tree containing the term *Video* in the `Name` element of the `MediaFormat` element. The expressions can become any complexity as long as they result in a Boolean decision on a true/false basis.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Input>
      <QueryCondition>
        <Condition xsi:type="QueryByXQuery">
          <XQuery>
                  <![CDATA[
                      let $a := node()//MediaFormat/Content/Name
                      return
                      $a/text()="Video"]]>
          </XQuery>
        </Condition>
      </QueryCondition>
    </Input>
  </Query>
</MpegQuery>
```

12.11 Query By Relevance Feedback

12.11.1 Introduction

The `QueryByRelevanceFeedback` type extends the `QueryType` type and describes a query operation that takes the result of the previous retrieval into consideration. The query operation allows the requester to identify good and/or bad examples within a previous result set like e.g., “Give me more examples like this one”. Bad examples can be described by using the Boolean `NOT` operator accordingly.

The type is structured as a sequence of `ResultItem` elements of type `positiveInteger`. The appearance of the element is bound from zero to unbounded. If no `ResultItem` element is provided, the whole previous result set is dealt as input for a relevance feedback query. The required attribute `answerID` is of type `anyURI` and refers to a previous result set (indicated through its query ID) received from the responder.

12.11.2 Syntax

```
<complexType name="QueryByRelevanceFeedback">
  <complexContent>
    <extension base="mpqf:QueryType">
      <sequence>
        <element    name="ResultItem"    type="positiveInteger"    minOccurs="0"
maxOccurs="unbounded"/>
      </sequence>
      <attribute name="answerID" type="anyURI" use="required"/>
    </extension>
  </complexContent>
</complexType>
```

12.11.3 Semantics

Semantics of the `QueryByRelevanceFeedback` type:

Name	*Definition*

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Name	*Definition*
QueryByRelevanceFeedback	Extends the QueryType type and describes a query operation that takes the result of the previous retrieval into consideration. The query operation allows the requester to identify good examples within a previous result set like e.g., “Give me more examples like this one”.
ResultItem	Specifies the good examples from the ResultItem that refers to a record which is identified by its recordNumber (see ResultItemType) of a previous result. This record serves as input for the new query.
answerID	Specifies the identifier of the result set where the relevance feedback operation shall be performed. The previous result set delivered to the requester is identified by the mpqfID of the MpegQueryType type.

12.11.4 Example

The following example illustrates the use of the QueryByRelevanceFeedback operation for describing a relevance feedback request based on a previous result set. In this example, the requester has chosen the original result set items 4, 8 and 10 of the previously received query result as input for a new query. By using this query, a requester indicates to the retrieval system the wish to retrieve more results as the provided ones. In order to identify bad examples, one needs to use the Boolean NOT operator in combination with the QueryByRelevanceFeedback operation.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Input>
      <QueryCondition>
        <Condition xsi:type="QueryByRelevanceFeedback"
answerID="IDofPreviousQuery">
          <ResultItem>4</ResultItem>
          <ResultItem>8</ResultItem>
          <ResultItem>10</ResultItem>
        </Condition>
      </QueryCondition>
    </Input>
  </Query>
</MpegQuery>
```

12.12 Query By ROI

12.12.1 Introduction

The QueryByROI type extends the QueryByMedia type and describes a query operation that takes a media resource as input and allows the specification of a region of interest. During the evaluation of this query type the region of interest is required to be considered for search (exact or similar). Depending on the used domain (spatial, temporal), the query type provides two different elements, namely TemporalRegionOfInterest and SpatialRegionOfInterest. It is required that for the spatial domain (images) the SpatialRegionOfInterest element is to be used. Furthermore, it is required that for the temporal domain (audio, video) the TemporalRegionOfInterest element is to be used.

For the SpatialRegionOfInterest element, a region is defined by the IntegerMatrixType type which allows the specification of a list of positive integer values describing individual points. The amount of necessary integer values per point is defined by the dim (dimension) attribute of the IntegerMatrixType

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type. If the `dim` attribute is set to two then two successive integer values specify one point in 2 D space. If the dim attribute is set to three then three successive integer values specify one point in 3 D space. The individual points define the region where for instance for 2 D, three points identify a triangle, four points a rectangular, and so on. The order of the individual points is demonstrated by the examples below (see Figure 3) and goes contraclockwise.

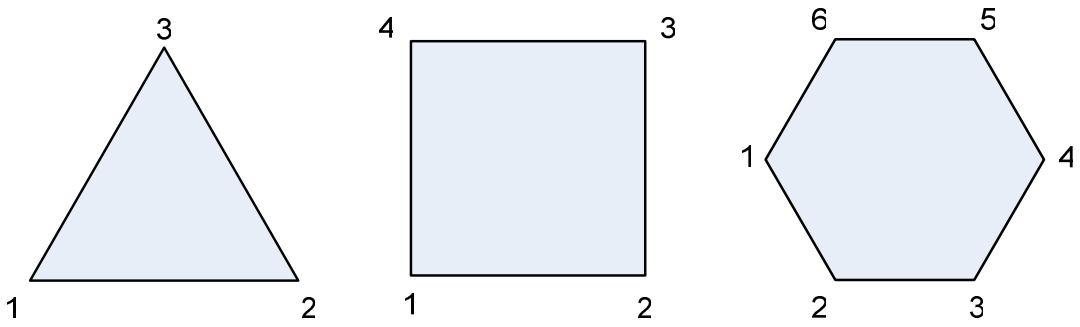

Figure 3 – Example point ordering for 2D objects

For 3D objects the individual 2D shapes need to be specified. The order is demonstrated by the example below (see Figure 4) and goes again contraclockwise. The letters mark the individual planes which need to be specified as 2D objects like above.

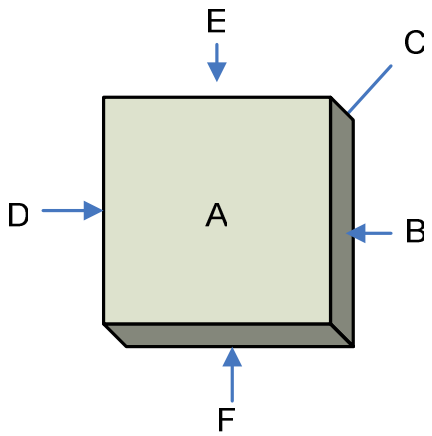

Figure 4 – Example plane ordering for 3D objects

For the `TemporalRegionOfInterest` element, a region is defined by the `TemporalRegionType` type. This type provides two elements, namely `StartTime` and `Duration`. The `StartTime` element specifies the beginning point in time of the temporal region. The value of the `Duration` element added to the value of the `StartTime` element specifies the end point in time of the temporal region.

12.12.2 Syntax

```
<complexType name="QueryByROI">
  <complexContent>
    <extension base="mpqf:QueryByMedia">
```

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```
      <sequence>
        <choice>
          <element name="TemporalRegionOfInterest" type="mpqf:TemporalRegionType"
minOccurs="1" maxOccurs="unbounded"/>
          <element  name="SpatialRegionOfInterest"  type="mpqf:IntegerMatrixType"
minOccurs="1" maxOccurs="unbounded"/>
          </choice>
          </sequence>
      </extension>
  </complexContent>
</complexType>

<complexType name="IntegerMatrixType">
  <simpleContent>
    <extension base="mpqf:listOfPositiveInteger">
       <attribute name="dim" type="positiveInteger" use="required"/>
    </extension>
  </simpleContent>
</complexType>

<simpleType name="listOfPositiveInteger">
  <list itemType="positiveInteger"/>
</simpleType>

<complexType name="TemporalRegionType">
  <sequence>
    <element   name="StartTime"   type="mpqf:startTimePointType"   minOccurs="1"
maxOccurs="1"/>
    <element    name="Duration"    type="mpqf:mediaDurationType"    minOccurs="1"
maxOccurs="1"/>
  </sequence>
</complexType>

<simpleType name="startTimePointType">
  <restriction base="string">
    <pattern                                                value="(\-?\d+(\-\d{2}(\-
\d{2})?)?)?(T\d{2}(:\d{2}(:\d{2}(:\d+)?)?)?)?(F\d+)?"/>
  </restriction>
</simpleType>

<simpleType name="mediaDurationType">
  <restriction base="string">
    <pattern value="\-?P(\d+D)?(T(\d+H)?(\d+M)?(\d+S)?(\d+N)?)?(\d+F)?"/>
  </restriction>
</simpleType>
```


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12.12.3 Semantics

Semantics of the `QueryByROI` type:

Name	*Definition*
`QueryByROI`	The `QueryByROI` type extends the `QueryByMedia` type and describes a query operation that takes a media resource as input and allows the specification of a region of interest. During the evaluation of this query type the region of interest is required to be considered for search (exact or similar).
`TemporalRegionOfInterest`	Specifies a temporal region within a media resource where it is required that the media resource belongs to the temporal domain (audio, video). The temporal region is described by the `TemporalRegionType` type.
`SpatialRegionOfInterest`	Specifies a spatial region within a media resource where it is required that the media resource belongs to the spatial domain (image). The spatial region is described by the `IntegerMatrixType` type.
`IntegerMatrixType`	Specifies a spatial region. A spatial region is defined by the `IntegerMatrixType` type which allows the specification of a list of positive integer values describing individual points. The amount of necessary integer values per point is defined by the `dim` attribute of `IntegerMatrixType` type. The individual points define the region where two points mean a rectangular, three points a triangle and so on.
`dim`	Attribute that defines the dimension of the individual points (e.g., 2 means that 2 integer values are required to define one point)
`listOfPositiveInteger`	Simple type that specifies a list of positive integer values which describes individual points. The amount of necessary integer values per point is defined by the `dim` attribute of the `IntegerMatrixType` type.
`TemporalRegionType`	Specifies a temporal region within an audio-visual resource.
`StartTime`	Specifies the beginning point in time of the temporal region. The beginning point in time is described in relation to the beginning of the given media resource whose time point is required to be T00:00:00.
`Duration`	Specifies the duration of the temporal region. The end point in time of the temporal region may be calculated by adding the value of the `Duration` element to the value of the `StartTime` element.
startTimePointType	Specifies the pattern for describing the beginning point in time of the temporal region.
mediaDurationType	Specifies the pattern for describing the duration of the temporal region.

12.12.4 Example

The following example illustrates the use of the `QueryByROI` operation. The query request declares two media resources, one image (`resourceID` is image1) and one video (`resourceID` is video1). The query condition presents both scenarios for defining regions based on the given media resource. The first `QueryByROI` condition operates on the spatial domain and points to the image media resource. The region of

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interest specifies a rectangle based on the four points (20, 20), (50, 20), (50, 50) and (20, 50) which has to be considered for search. The second `QueryByROI` condition operates on the temporal domain and points to the video media resource. The region of interest specifies a beginning point in time of T00:00:00:0F30000 and a duration of PT4M.

```
<MpegQuery mpqfID="exampleROI">
 <Query>
   <Input>
     <QFDeclaration>
       <Resource xsi:type="MediaResourceType" resourceID="image1">
         <MediaResource>
           <MediaUri>http://testimage</MediaUri>
         </MediaResource>
       </Resource>
       <Resource xsi:type="MediaResourceType" resourceID="video1">
         <MediaResource>
           <MediaUri>http://testvideo</MediaUri>
         </MediaResource>
       </Resource>
     </QFDeclaration>
     <QueryCondition>
       <Condition xsi:type="AND">
         <Condition xsi:type="QueryByROI">
           <MediaResourceREF>image1</MediaResourceREF>
           <SpatialRegionOfInterest dim="2" >20 20 50 20 50 50 20
50</SpatialRegionOfInterest>
         </Condition>
         <Condition xsi:type="QueryByROI">
           <MediaResourceREF>video1</MediaResourceREF>
           <TemporalRegionOfInterest>
             <StartTime>T00:00:00:0F30000</StartTime>
             <Duration>PT4M</Duration>
           </TemporalRegionOfInterest>
         </Condition>
       </Condition>
     </QueryCondition>
   </Input>
 </Query>
</MpegQuery>
```

12.13 Join Query

12.13.1 Introduction

The Join operation allows the definition of filtering conditions which act over multiple sets of multimedia objects. In the Join operation, it is possible to specify conditions which define separate filtered sets and combine them.

The `JoinType` type defines separate filtering flows by using separate `Condition` elements along with an identifier. It defines a combined `JoinCondition` which will act over the pairs of objects resulting from the cross product of the different filtering sets.

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12.13.2 Syntax

```
<complexType name="JoinType">
  <sequence>
    <element name="From" maxOccurs="2">
      <complexType>
        <sequence>
          <element name="EvaluationPath" minOccurs="0" type="mpqf:xPathType"/>
          <element name="TargetMediaType" type="mpqf:mimeType" minOccurs="0"
maxOccurs="unbounded"/>
          <element name="Condition" type="mpqf:BooleanExpressionType"/>
        </sequence>
        <attribute name="id" type="ID" use="required"/>
      </complexType>
    </element>
    <element name="JoinCondition" type="mpqf:BooleanExpressionType"/>
  </sequence>
</complexType>
```

12.13.3 Semantics

Semantics of the `JoinType` type:

Name	*Definition*
`JoinType`	Describes Join operation. The number of set to which the Join operation applies is fixed to two at a time.
`From`	Describes an operand of Join operation, i.e. a set of multimedia objects.
`EvaluationPath`	Specifies an element or an attribute in XML documents using an XPath expression. This indicates the granularity of multimedia objects.
`TargetMediaType`	The sequence of the target media types declares the desired MIME types which the user expects as a result.
`Condition`	Specifies the filtering condition that makes a set of multimedia objects.
`id`	Indicates the identifier of the `From` element in order to be referred by other elements
`JoinCondition`	Specifies the Join condition of the two sets of multimedia objects defined by the `From` elements.

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12.13.4 Examples

The following example shows a query asking for pairs of audio and video objects which share the same creation title. It specifies that the media URI of each pair of selected objects is be returned.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Input previousAnswerID="http://www.altova.com">
      <OutputDescription outputNameSpace="urn:mpeg:mpeg7:schema:2004">
        <ReqField fromREF="id1">/MediaUri</ReqField>
        <ReqField fromREF="id2">/MediaUri</ReqField>
      </OutputDescription>
      <QueryCondition>
        <Join>
          <From id="id1">
            <EvaluationPath>/Mpeg7</EvaluationPath>
            <Condition xsi:type="QueryByXQuery">
              <XQuery><![CDATA[
                       let $a := node()//MediaFormat/Content/Name
                       return
                       $a/text()="Video"]]></XQuery>
            </Condition>
          </From>
          <From id="id2">
            <EvaluationPath>/Mpeg7</EvaluationPath>
            <Condition xsi:type="QueryByXQuery">
              <XQuery><![CDATA[
                           let $a := node()//MediaFormat/Content/Name
                           return
                           $a/text()="Audio"]]></XQuery>
            </Condition>
          </From>
          <JoinCondition xsi:type="QueryByXQuery">
            <XQuery><![CDATA[
                               node(id1)//Creation/Title =
                               node(id2)//Creation/Title ]]></XQuery>
          </JoinCondition>
        </Join>
      </QueryCondition>
    </Input>
  </Query>
</MpegQuery>
```

13 Output Query Format

13.1 Output

13.1.1 Introduction

The Output Query Format is defined by the `OutputQueryType` type. It provides a container for all the results from a responder to a requester. It may contain not only query results but also any messages such as error and exception.

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13.1.2 Syntax

```
<complexType name="OutputQueryType">
   <sequence>
      <element name="GlobalComment" type="string" minOccurs="0"/>
      <element    name="ResultItem"    type="mpqf:ResultItemType"    minOccurs="0"
maxOccurs="unbounded"/>
      <element name="SystemMessage" type="mpqf:SystemMessageType" minOccurs="0"/>
   </sequence>
   <attribute name="currPage" type="positiveInteger" default="1"/>
   <attribute name="totalPages" type="positiveInteger" default="1"/>
   <attribute name="expirationDate" type="dateTime" use="optional"/>
  </complexType>
```

13.1.3 Semantics

Semantics of the `OutputQueryType` type:

Name	*Definition*
`OutputQueryType`	Describes all the responses from a responder in respect to an input query request. It may contain results of queries and/or message from the responder. It may also include the page information and expiration date of the results.
`GlobalComment`	Describes information about the query results (optional). It may also be a message from the responder to the requester.
`ResultItem`	Describes a single result returned from a responder (optional).
`SystemMessage`	Describes the message related to the responder system (optional).
`currPage`	Indicates the current page of the results. If no value is specified, the `currPage` attribute is assumed to be 1.
`totalPages`	Indicates the total page of the results. If no value is specified, the `totalPages` attribute is assumed to be 1.
`expirationDate`	Indicates the time point when the responder expires the results (optional).

--`,,```,,,,````-`-`,,`,,`,`,,`---

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13.1.4 Example

The following example illustrates the use of the `OutputQueryType` type. It conveys both results and a system message related to the responder at the same time.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Output>
      <GlobalComment>This is the message from the responder</GlobalComment>
      <ResultItem recordNumber="001" rank="1" confidence="1.0">
        <MediaResource>http://www.mpeg7qf/db/video/19701221.mpg</MediaResource>
      </ResultItem>
      <ResultItem recordNumber="002" rank="2" confidence="0.99">
        <MediaResource>http://www.mpeg7qf/db/video/19690117.mpg</MediaResource>
      </ResultItem>
      <ResultItem recordNumber="003" rank="2" confidence="0.98">
        <MediaResource>http://www.mpeg7qf/db/video/19980212.mpg</MediaResource>
      </ResultItem>
      <ResultItem recordNumber="004" rank="3" confidence="0.87">
        <MediaResource>http://www.mpeg7qf/db/video/19990414.mpg</MediaResource>
      </ResultItem>
      <ResultItem recordNumber="005" rank="3" confidence="0.85">
        <MediaResource>http://www.mpeg7qf/db/video/20071119.mpg</MediaResource>
      </ResultItem>
      <SystemMessage>
        <Status>
          <Code>001</Code>
          <Description>Query was successful</Description>
        </Status>
      </SystemMessage>
    </Output>
  </Query>
</MpegQuery>
```

13.2 ResultItem

13.2.1 Introduction

The `ResultItem` element describes a single result item within the output query format and is specified by the `ResultItemType` type. The `ResultItem` element is described by a media resource represented by `anyURI` type, MPEG-7 or other metadata descriptions, or free text. The `ResultItem` element also provides `identifier`, `rank` and `confidence` attributes for each result.

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13.2.2 Syntax

```
<complexType name="ResultItemBaseType" abstract="true"/>
  <complexType name="ResultItemType">
    <complexContent>
      <extension base="mpqf:ResultItemBaseType">
        <sequence>
          <element name="Comment" minOccurs="0" maxOccurs="2">
            <complexType>
              <simpleContent>
                <extension base="string">
                  <attribute name="fromREF" type="string" use="optional"/>
                </extension>
              </simpleContent>
            </complexType>
          </element>
          <!-- Need for comment for each individual item should be cleared. -->
          <!-- One use case can be for each individual responder to identify the
origin of        the result. -->
          <element name="TextResult" minOccurs="0" maxOccurs="2">
            <complexType>
              <simpleContent>
                <extension base="string">
                  <attribute name="fromREF" type="string" use="optional"/>
                </extension>
              </simpleContent>
            </complexType>
          </element>
          <element name="Thumbnail" minOccurs="0" maxOccurs="2">
            <complexType>
              <simpleContent>
                <extension base="anyURI">
                  <attribute name="fromREF" type="string" use="optional"/>
                </extension>
              </simpleContent>
            </complexType>
          </element>
          <element name="MediaResource" minOccurs="0" maxOccurs="2">
            <complexType>
              <simpleContent>
                <extension base="anyURI">
                  <attribute name="fromREF" type="string" use="optional"/>
                </extension>
              </simpleContent>
            </complexType>
          </element>
          <!-- The media resource is expected to lead the customer to the
location
         of the actual full size media. -->
          <element name="Description" minOccurs="0" maxOccurs="2">
            <complexType mixed="true">
              <sequence>
                <any namespace="##any" processContents="strict"
maxOccurs="unbounded"/>
              </sequence>
              <attribute name="fromREF" type="string" use="optional"/>
            </complexType>
          </element>
```

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```
          <!-- If you want to return embedded in-line media, you should use the
Description. For example, you should instantiate a mpeg7:MediaLocator with inline
media -->
          <element name="AggregationResult" minOccurs="0" maxOccurs="unbounded">
            <complexType>
              <simpleContent>
                <extension base="string">
                  <attribute name="aggregateID" type="string" use="required"/>
                </extension>
                <!-- This aggregateID is given in the Aggregate element
                  of the Input Query. -->
              </simpleContent>
            </complexType>
          </element>
          <!--  elements with names of each aggregate expression -->
        </sequence>
        <attribute name="recordNumber" type="positiveInteger" use="required"/>
        <attribute name="rank" type="positiveInteger" use="optional"/>
        <attribute name="confidence" type="mpqf:zeroToOneType" use="optional"/>
        <attribute name="originID" type="anyURI" use="optional"/>
        <!-- Can contain the serviceID  or URL of the responder responding to the
Input
Query, when there are multiple services responding to the single request. -->
      </extension>
    </complexContent>
  </complexType>
```

13.2.3 Semantics

Semantics of the `ResultItemType` type:

Name	*Definition*
`ResultItemBaseType`	Specifies a base class for the `ResultItemType` type.
`ResultItemType`	Specifies the `ResultItem` element. Describes a single result item of the query.
`Comment`	Describes a message related to a result item from responders to a requester.
`fromREF`	Indicates a condition from which the result comes. This intends to be used in the case of Join operation.
`TextResult`	Describes a result in string form (optional). It may be just a number like “65”, or XML data which is packed as CDATA.
`Thumbnail`	Describes a link to a thumbnail of the result item (optional).
`MediaResource`	Describes a link to the result media resource by anyURI type (optional).
`Description`	Describes a result in XML with specifying its namespace (optional). The XML data may be MPEG-7 description.
`AggregationResult`	Describes the result of an aggregation expression.
`aggregateID`	Specifies a unique id of the aggregation. This `aggregateID` is given in the `Aggregate` element of the Input Query.

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Name	*Definition*
`recordNumber`	Indicates the number assigned to the result item. The number may also be used to point to the result when relevance feedback retrieval is activated.
`Rank`	Indicates the rank of the item (optional). More than one item may have the same rank.
`Confidence`	Indicates the confidence of the item in the correctness of the result (optional). The value zero represents no confidence and the value 1.0 perfect confidence. All other values between zero and one represent intermediate levels of confidence.
`originID`	Specifies a point from where the result item comes. It may be the URL indicating the service ID of the responder replying to the query request, when there are multiple services responding to the single request.

13.2.4 Examples

The following example illustrates the use of the `ResultItemType` type. The output conveys four `ResultItem` elements which includes all three kinds of expression, such as by URL, free text, XML data. The examples of XML data are MPEG-7 complete descriptions and description units. Note, that this example does not simulate a real world scenario and should only highlight all different possibilities. In general, every `ResultItem` element should contain the same structure and same amount of elements.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Output>
       <GlobalComment>This is the message from the responder</GlobalComment>
       <ResultItem recordNumber="001" rank="1" confidence="1.0">
          <MediaResource>http://www.mpeg7qf/db/video/19701221.mpg</MediaResource>
       </ResultItem>
       <ResultItem recordNumber="002">
          <TextResult>WorldCup 2002</TextResult>
       </ResultItem>
       <ResultItem recordNumber="003" confidence="0.98">
          <Description xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004">
             <mpeg7:Mpeg7>
                <mpeg7:Description xsi:type="mpeg7:ContentEntityType">
                   <mpeg7:MultimediaContent xsi:type="mpeg7:ImageType">
                      <mpeg7:Image/>
                   </mpeg7:MultimediaContent>
                </mpeg7:Description>
             </mpeg7:Mpeg7>
          </Description>
       </ResultItem>
       <ResultItem recordNumber="004" confidence="0.78">
          <Description xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004">
             <mpeg7:Mpeg7>
                <mpeg7:DescriptionUnit xsi:type="mpeg7:PersonType">
                   <mpeg7:Name>
                      <mpeg7:GivenName>Mari</mpeg7:GivenName>
                   </mpeg7:Name>
                </mpeg7:DescriptionUnit>
             </mpeg7:Mpeg7>
          </Description>
       </ResultItem>
    </Output>
  </Query>
</MpegQuery>
```

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13.3 SystemMessageType

13.3.1 Introduction

The `SystemMessageType` type describes a message related to the responder system. A system message may contain the following information: `status`, `warning`, `exception`.

13.3.2 Syntax

```
<complexType name="SystemMessageType">
  <choice>
    <element name="Status" type="mpqf:InformationType" maxOccurs="unbounded"/>
    <element name="Warning" type="mpqf:InformationType" maxOccurs="unbounded"/>
    <element name="Exception" type="mpqf:InformationType" maxOccurs="unbounded"/>
  </choice>
</complexType>

<complexType name="InformationType">
  <sequence>
    <element name="Code" type="positiveInteger"/>
    <element name="Description" type="string"/>
  </sequence>
</complexType>
```

13.3.3 Semantics

Semantics of the `SystemMessageType` type:

Name	*Definition*
`SystemMessageType`	Specifies the `SystemMessageType` type. Describes a set of messages related to the responder.
`Status`	Describes the status of the responder.
`Warning`	Describes the warning from the responder.
`Exception`	Describes the exception the responder encountered during the process.

Semantics of the `InformationType`:

Name	*Definition*
`Code`	Describes the number assigned for the information.
`Description`	Describes the details of the information.

The code number and its description are defined in Annex A.

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13.3.4 Examples

The following example illustrates the use of the `SystemMessageType` type. It tells the requester that the responder is busy.

```
<MpegQuery mpqfID="someID">
  <Query>
    <Output>
      <SystemMessage>
        <Warning>
          <Code>101</Code>
          <Description>Server resource busy </Description>
        </Warning>
      </SystemMessage>
    </Output>
  </Query>
</MpegQuery>
```

14 Query Management Tools

14.1 Introduction

This subclause defines the types used within query management message instances. The message exchange is based on a request-response style of communication between peers and supports the processes of service discovery and service selection based on service capability descriptions and service identification.

14.2 InputManagementType

14.2.1 Introduction

The `InputManagementType` type is used for service discovery. A service denotes a single multimedia repository or an aggregated service providing access to a set of multimedia repositories. The capability of every service is described by its `CapabilityType` type. Each service capability description determines the supported query format, the supported metadata, supported media formats (in examples and resultset), query types (e.g., `QueryByMedia`), supported expressions (e.g. `AND`) and usage conditions (e.g., payment required, etc.).

14.2.2 Syntax

```
<complexType name="InputManagementType">
    <sequence>
      <element name="DesiredCapability" type="mpqf:CapabilityType"
minOccurs="0"/>
      <element name="ServiceID" type="anyURI" minOccurs="0"
maxOccurs="unbounded"/>
    </sequence>
</complexType>

<complexType name="CapabilityType">
  <sequence>
    <element name="SupportedQFProfile" type="mpqf:CapabilityTermType"
                minOccurs="0"/>
    <element name="SupportedMetadata" type="anyURI" minOccurs="0"
                maxOccurs="unbounded"/>
    <element name="SupportedExampleMediaTypes" minOccurs="0">
      <simpleType>
        <list itemType="mpqf:mimeType"/>
      </simpleType>
    </element>
```

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```
    <element name="SupportedResultMediaTypes" minOccurs="0">
      <simpleType>
        <list itemType="mpqf:mimeType"/>
      </simpleType>
    </element>
    <element name="SupportedQueryTypes" type="mpqf:CapabilityTermType"
                minOccurs="0" maxOccurs="unbounded"/>
    <element name="SupportedExpressions" type="mpqf:CapabilityTermType"
                minOccurs="0" maxOccurs="unbounded"/>
    <element name="UsageConditions" minOccurs="0" maxOccurs="unbounded">
      <complexType>
        <complexContent>
          <extension base="mpqf:TermType">
            <attribute name="usageID" type="ID" use="optional"/>
          </extension>
        </complexContent>
      </complexType>
    </element>
  </sequence>
</complexType>

<complexType name="CapabilityTermType">
  <complexContent>
    <extension base="mpqf:TermType">
      <attribute name="usageRefList" type="IDREFS" use="optional"/>
    </extension>
  </complexContent>
</complexType>
```

14.2.3 Semantics

Semantics of the `InputManagementType` type:

Name	*Definition*
`InputManagementType`	Defines the syntax of the `InputManagementType` type, which allows message instances be used for service discovery, service selection and service capability description
`DesiredCapability`	The content of this element is an instance of a service capability description specifying the users desired service capabilities using the `CapabilityType` type.
`ServiceID`	Indicates the `identifier` (by an URI) of a service. This can either be a URN or a URL.

Service discovery is supported by message instances of type `InputManagementType` that a requesting peer sends to a service, where the following additional semantic rules apply to all instances:

- When this element is empty, a requester is requesting all available service capabilities.
  - As result a requester receives all available services with their capability as return with `ServiceID`.

- When there is only the `DesiredCapability` element presented, one is requesting the `serviceID`'s who support this capability.

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- As result a requester receives a description of the available capability in return with the `ServiceID` of those services who support the desired capability.

- When there are only `ServiceID` elements in the `Input` element, a requester is requesting the capability of the specific services.
  - As result a requester receives the available capability as return with `serviceID`.

- When both `DesiredCapability` element and the `ServiceID` element are present, a requester is asking whether the specified service supports the desired capability.
  - As result the requester receives available capability in return with the `ServiceID` element of those services that support the desired capability among the given `serviceID`'s specified in the input.

Semantics of the `CapabilityType` type:

Name	*Definition*
`CapabilityType`	Defines the syntax of the `CapabilityType` type, which allows the description of service capabilities
`SupportedQFProfile`	Describes the supported query format profile of the specific service by a URN. A `QFProfile` is a defined set of supported metadata, query types and expressions that a service is capable to process. The profile of this part of ISO/IEC 15938 is defined in a classification scheme (see Annex B) and can be identified by its URN.
`SupportedMetadata`	Describes the metadata that can be processed by a certain service using a list of URIs. The set of metadata is identified either by their namespace URN or by the URL of it's definition (DTD/Schema location).
`SupportedExampleMediaTypes`	Describes the supported MIME media types of media resources a certain service can process as input.
`SupportedResultMediaTypes`	Describes the supported MIME media types of media resources a certain service can deliver in the output (result set).
`SupportedQueryTypes`	Describes the supported query types of a certain service. Query types are listed in a classification scheme (see Annex B) and can be identified by their URN.
`SupportedExpressions`	Describes the supported expressions of a certain service. Expressions are listed in a classification scheme (see Annex B) and can be identified by their URN.
`UsageConditions`	Describes the usage conditions of a certain service. Usage conditions are listed in a classification scheme (see Annex B) and can be identified by their URN. Several different usage conditions can be supported by a service. They can be one by one related to query types, expressions or a QueryFormat Profile being referenced respectively.

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Semantics of the `CapabilityTermType` type:

Name	*Definition*
`CapabilityTermType`	Defines the syntax of the `CapabilityTermType` type, which represents a specific term denoting a certain e.g., query type. The respective terms shall be defined in the corresponding classification scheme.
`usageRefList`	Describes the reference list which points to a set of specified usage conditions where the capability belongs to. They are identifiably listed in the usageConditions element. For instance, if a `QueryByMedia` query requires authorization and payment, then both respective IDs need to be enlisted in this attribute at the respective supported query type (`QueryByMediaType`) capability description.

14.2.4 Example

In the following, examples for all four possible service discovery scenarios, provided by the `InputManagement` element, are presented. Examples of possible responses, namely the list of matching service capability descriptions, are given in subclause 14.3.4.

Scenario 1: Give me whatever you have!

In this scenario, a requester is interested in a list of available services the aggregation service is able to access. In this case an empty `Input` element needs to be sent by the requester to the responder.

```
<MpegQuery mpqfID="someID">
  <Management>
    <Input/>
  </Management>
</MpegQuery>
```

Scenario 2: Give me everything which matches at least my desired capabilities.

In this scenario, the requester needs to provide a minimum service capability description which expresses its desired retrieval functionality. For instance, the example below requests for all services that support the MPQF version 2008 and the MPEG-7 standard for describing the multimedia data. In addition, the services shall support Boolean expressions (100.3.1) and the two query types, `QueryByMedia` (100.3.6.1) and `QueryByXQuery` (100.3.6.4), respectively. Furthermore, the query types shall satisfy the corresponding usage conditions. In case of the `QueryByMedia` type, Authentication (200.1) and Payment (200.3) should be required. The `QueryByXQuery` type should be of free use (200.4).

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```
<MpegQuery mpqfID="someID">
  <Management>
    <Input>
      <DesiredCapability>
        <SupportedQFProfile href="urn:mpeg:mpqf:2008:CS:Full"/>
        <SupportedMetadata>urn:mpeg:mpeg7:2004</SupportedMetadata>
        <SupportedExampleMediaTypes>audio/mp3
                                    video/mpg
        </SupportedExampleMediaTypes>
        <SupportedResultMediaTypes>audio/aac
video/mpg</SupportedResultMediaTypes>
        <SupportedQueryTypes href="urn:mpeg:mpqf:2008:CS:full:100.3.6.1"
                             usageRefList="id1 id3"/>
        <SupportedQueryTypes href="urn:mpeg:mpqf:2008:CS:full:100.3.6.4"
                             usageRefList="id2"/>
        <SupportedExpressions href="urn:mpeg:mpqf:2008:CS:full:100.3.1"/>
        <UsageConditions href="urn::mpeg:mpqf:2008:CS:full:200.1" usageID="id1"/>
        <UsageConditions href="urn:mpeg:mpqf:2008:CS:full:200.4" usageID="id2"/>
        <UsageConditions href="urn:mpeg:mpqf:2008:CS:full:200.3" usageID="id3"/>
      </DesiredCapability>
    </Input>
  </Management>
</MpegQuery>
```

Scenario 3: Give me the service description of the following services.

In this scenario, the requester already knows the location of some services but has no idea about their capabilities. In this case, one has to send an input management request, containing all known `ServiceID` elements, to the aggregation service. The aggregation service then returns their capabilities.

```
<MpegQuery mpqfID="someID">
  <Management>
    <Input>
      <ServiceID>http://exampleservice-1.com</ServiceID>
      <ServiceID>http://exampleservice-2.com</ServiceID>
    </Input>
  </Management>
</MpegQuery>
```

Scenario 4: Give me all services out of the given list of services that matches the desired capabilities.

In this scenario, the requester already knows the location of some services but wants to receive a filtered list according to the desired capabilities. In order to avoid requesting all capabilities of all services and performing the filtering at the requesters side (maybe due limited resource capabilities), the aggregation service takes care of this tasks.

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```
<MpegQuery mpqfID="someID">
  <Management>
    <Input>
      <DesiredCapability>
        <SupportedQFProfile href="urn:mpeg:mpqf:2008:CS:Full"/>
        <SupportedMetadata>urn:mpeg:mpeg7:2004</SupportedMetadata>
        <SupportedExampleMediaTypes>audio/mp3
video/mpg</SupportedExampleMediaTypes>
        <SupportedResultMediaTypes>audio/aac
video/mpg</SupportedResultMediaTypes>
        <SupportedQueryTypes href="urn:mpeg:mpqf:2008:CS:full:100.3.6.1"
                             usageRefList="id1 id3"/>
        <SupportedQueryTypes href="urn:mpeg:mpqf:2008:CS:full:100.3.6.4"
                             usageRefList="id2"/>
        <SupportedExpressions href="urn:mpeg:mpqf:2008:CS:full:100.3.1"/>
        <UsageConditions                href="urn::mpeg:mpqf:2008:CS:full:200.1"
usageID="id1"/>
        <UsageConditions href="urn:mpeg:mpqf:2008:CS:full:200.4" usageID="id2"/>
        <UsageConditions href="urn:mpeg:mpqf:2008:CS:full:200.3" usageID="id3"/>
      </DesiredCapability>
      <ServiceID>http://exampleservice-1.com</ServiceID>
      <ServiceID>http://exampleservice-2.com</ServiceID>
      <ServiceID>http://exampleservice-3.com</ServiceID>
      <ServiceID>http://exampleservice-4.com</ServiceID>
      <ServiceID>http://exampleservice-5.com</ServiceID>
      <ServiceID>http://exampleservice-6.com</ServiceID>
    </Input>
  </Management>
</MpegQuery>
```

14.3 OutputManagementType

14.3.1 Introduction

The `OutputManagementType` type provides means for replying to service discovery requests initiated by the requester. A service or aggregated service provider returns either a list of available service capability descriptions or a system message in case of an error. If no service is available or matches the given capabilities, then an empty `Output` element should be returned.

14.3.2 Syntax

```
<complexType name="OutputManagementType">
  <sequence>
    <choice>
      <element name="AvailableCapability" type="mpqf:AvailableCapabilityType"
                    minOccurs="0" maxOccurs="unbounded"/>
      <element name="SystemMessage" type="mpqf:SystemMessageType"
                    minOccurs="0"/>
    </choice>
  </sequence>
</complexType>

<complexType name="AvailableCapabilityType">
 <complexContent>
   <extension base="mpqf:CapabilityType" >
     <attribute name="serviceID" type="anyURI" use="required"/>
   </extension>
 </complexContent>
</complexType>
```

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14.3.3 Semantics

Semantics of the `OutputManagementType` type:

Name	*Definition*
`OutputManagementType`	Specifies the syntax of the `OutputManagementType` type, which describes the result of a service discovery request.
`AvailableCapability`	Describes the capability of one available service (of `AvailableCapabilityType` type) fitting the request. The occurrence of an `AvailableCapability` element can be multiple in case of a response from an aggregation service.
`SystemMessage`	Describes a system message in case of an error. They shall be of `SystemMessageType` type.

Semantics of the `AvailableCapabilityType` type:

Name	*Definition*
`serviceID`	Indicates the `identifier` (by an URI) of a service. This can either be a URN or a URL.

14.3.4 Example

In the following examples, the `OutputManagement` datatype is used to describe some service capability descriptions which may result by service discovery requests. The first example shows a possible response for one of the given service discovery requests of the previous subclause. The response contains the capability description of two services matching the request (scenario 1 to 4).

```
<MpegQuery mpqfID="someID">
  <Management>
    <Output>
      <AvailableCapability serviceID="http://exampleservice-1.com">
          <SupportedQFProfile href="urn:mpeg:mpqf:2008:CS:Full"/>
          <SupportedMetadata>urn:mpeg:mpeg7:2004</SupportedMetadata>
          <SupportedExampleMediaTypes>audio/mp3 video/mpg
          </SupportedExampleMediaTypes>
          <SupportedResultMediaTypes>audio/aac
video/mpg</SupportedResultMediaTypes>
          <SupportedQueryTypes href="urn:mpeg:mpqf:2008:CS:full:100.3.6.1"
                               usageRefList="ex1id1 ex1id3"/>
          <SupportedQueryTypes href="urn:mpeg:mpqf:2008:CS:full:100.3.6.4"
                                 usageRefList="ex1id2"/>
          <SupportedExpressions href="urn:mpeg:mpqf:2008:CS:full:100.3.1"/>
          <UsageConditions href="urn::mpeg:mpqf:2008:CS:full:200.1"
                           usageID="ex1id1"/>
          <UsageConditions href="urn:mpeg:mpqf:2008:CS:full:200.4"
                           usageID="ex1id2"/>
          <UsageConditions href="urn:mpeg:mpqf:2008:CS:full:200.3"
                           usageID="ex1id3"/>
      </AvailableCapability>
      <AvailableCapability serviceID="http://exampleservice-2.com">
          <SupportedQFProfile href="urn:mpeg:mpqf:2008:CS:full"/>
```

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```
          <SupportedMetadata>urn:mpeg:mpeg7:2004</SupportedMetadata>
          <SupportedExampleMediaTypes>video/mpg</SupportedExampleMediaTypes>
          <SupportedResultMediaTypes>image/*
video/mpg</SupportedResultMediaTypes>
          <SupportedQueryTypes href="urn:mpeg:mpqf:2008:CS:full:100.3.6.1"
                               usageRefList="ex2id1 ex2id3"/>
          <SupportedExpressions href="urn:mpeg:mpqf:2008:CS:full:100.3.1"/>
          <UsageConditions href="urn::mpeg:mpqf:2008:CS:full:200.1"
                           usageID="ex2id1"/>
          <UsageConditions href="urn:mpeg:mpqf:2008:CS:full:200.3"
                           usageID="ex2id3"/>
      </AvailableCapability>
    </Output>
  </Management>
</MpegQuery>
```

The following example demonstrates the result where no services are available or none of the existing services (registered at the aggregation service) matches the requester's requirements. In this case, an empty `Output` element is returned.

```
<MpegQuery mpqfID="someID">
  <Management>
    <Output>
    </Output>
  </Management>
</MpegQuery>
```

The last example presents a possible result in case of an error which occurred during the processing of the request. Depending on the type of error, the messages can vary. Please see Annex A for a list of defined error codes.

```
<MpegQuery mpqfID="someID">
  <Management>
    <Output>
      <SystemMessage>
        <Exception>
          <Code>202</Code>
          <Description>Error while processing the request</Description>
        </Exception>
      </SystemMessage>
    </Output>
  </Management>
</MpegQuery>
```


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Annex A
(normative)

System Messages

A.1 Status messages

Code	*Description*
001	Query was successful

A.2 Warning messages

Code	*Description*
101	Server resource busy
102	Identifier is too long
103	Too many query results
104	Too many group-by/sort-by expressions
105	Value of requested field is NULL

A.3 Exception messages

Code	*Description*
201	No data found
202	Error while processing the request
203	Unimplemented feature
204	Cannot connect to the service
205	Connection lost contact
206	The server session terminated by fatal error
207	Request string is too long
208	Request not supported in this configuration
209	Resource type not supported
210	Query type not supported

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Code	*Description*
211	Expression not supported
212	Time limit exceeded – query aborted
213	Timeout occurred while waiting for a resource
214	Missing or invalid value for attribute *string*
215	Invalid attribute *string*
216	Value of *string* is null
217	Value of attribute *string* is too long
218	Invalid value *string* for parameter *string*
219	Invalid path *string*
220	Query syntax error
221	Element/attribute *string* does not exist
222	Invalid number of values specified
223	This name is currently reserved for use by system
224	Obsolete feature
225	Cannot locate specified resource
226	Resource size limit was exceeded
227	Illegal DateTime found
228	Invalid length for DATE or NUMBER bind variable
229	Zero divide error
230	Numeric overflow
231	Unsupported character set
232	Invalid character
233	A non-numeric character found where a numeric expected
234	A non-alphabetic character found where an alphabetic expected

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Annex B
(normative)

Classification Scheme

B.1 Introduction

This clause specifies a classification scheme that may be used by applications using description tools specified in this part of ISO/IEC 15938. Applications need not use these classification schemes, they can use proprietary or third party ones. However, if they choose to use the classification schemes defined in this clause, no modifications or extensions are allowed to these classification schemes. The classification schemes in this clause are specified by making use of the `TermType` type defined in subclause 6.5. See in 4.6.1. for the syntax and semantics of the elements and attributes of classification schemes. All of the classification schemes defined in this clause are uniquely identified by a URN starting with the "`urn:mpeg:mpqf:cs:`" namespace identifier, followed by the name of the classification scheme and the year of its appearance. The URN "`urn:mpeg:mpqf:cs:ServiceCapabilityCS:2008`" identifies the classification scheme provided for the service capabilities.

In some cases, several classification schemes are associated with a single descriptor. In such a case, any one of these classification schemes (as well as classification schemes not defined in this specification) may be used depending on the application domain.

The names of some classification schemes (e.g. for parental rating) include the name of organizations other than ISO. This is only to indicate and acknowledge the source of a classification scheme and the terms defined therein. This does not imply that the referenced organization is responsible for the maintenance of such a classification scheme (defined in this part of ISO/IEC 15938). Furthermore, ISO is not responsible for the maintenance of classification schemes produced by these other organizations.

B.2 ServiceCapabilityCS

```
<ClassificationScheme uri="urn:mpeg:mpqf:cs:ServiceCapabilityCS:2008">
    <Term href="100">
        <Name>QueryOperations</Name>
        <Term href="100.1">
            <Name>Operands</Name>
            <Term href="100.1.1">
                <Name>ArithmeticOperands</Name>
            </Term>
            <Term href="100.1.2">
                <Name>BooleanOperands</Name>
            </Term>
            <Term href="100.1.3">
                <Name>StringOperands</Name>
            </Term>
            <Term href="100.1.4">
                <Name>DateTimeOperands</Name>
            </Term>
            <Term href="100.1.5">
                <Name>DurationOperands</Name>
            </Term>
        </Term>
        <Term href="100.2">
            <Name>JoinType</Name>
```

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```
        </Term>
        <Term href="100.3">
            <Name>ConditionType</Name>
            <Term href="100.3.1">
                <Name>BooleanExpressionType</Name>
            </Term>
            <Term href="100.3.2">
                <Name>ComparisonExpressionType</Name>
                <Term href="100.3.2.1">
                    <Name>AND</Name>
                </Term>
                <Term href="100.3.2.2">
                    <Name>OR</Name>
                </Term>
                <Term href="100.3.2.3">
                    <Name>NOT</Name>
                </Term>
                <Term href="100.3.2.4">
                    <Name>XOR</Name>
                </Term>
                <Term href="100.3.2.5">
                    <Name>GreaterThan</Name>
                </Term>
                <Term href="100.3.2.6">
                    <Name>GreaterThanEqual</Name>
                </Term>
                <Term href="100.3.2.7">
                    <Name>LessThan</Name>
                </Term>
                <Term href="100.3.2.8">
                    <Name>LessThanEqual</Name>
                </Term>
                <Term href="100.3.2.9">
                    <Name>Equal</Name>
                </Term>
                <Term href="100.3.2.10">
                    <Name>NotEqual</Name>
                </Term>
                <Term href="100.3.2.11">
                    <Name>Contains</Name>
                </Term>
            </Term>
            <Term href="100.3.3">
                <Name>ArithmeticExpressionType</Name>
                <Term href="100.3.3.1">
                    <Name>Add</Name>
                </Term>
                <Term href="100.3.3.2">
                    <Name>Subtract</Name>
                </Term>
                <Term href="100.3.3.3">
                    <Name>Multiply</Name>
                </Term>
                <Term href="100.3.3.4">
                    <Name>Divide</Name>
                </Term>
                <Term href="100.3.3.5">
                    <Name>Modulus</Name>
                </Term>
                <Term href="100.3.3.6">
```


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```
                <Name>Abs</Name>
            </Term>
            <Term href="100.3.3.7">
                <Name>Ceil</Name>
            </Term>
            <Term href="100.3.3.8">
                <Name>Floor</Name>
            </Term>
            <Term href="100.3.3.9">
                <Name>Round</Name>
            </Term>
        </Term>
        <Term href="100.3.4">
            <Name>AggregateExpressionType</Name>
            <Term href="100.3.4.1">
                <Name>AVG</Name>
            </Term>
            <Term href="100.3.4.2">
                <Name>StdDev</Name>
            </Term>
            <Term href="100.3.4.3">
                <Name>variance</Name>
            </Term>
            <Term href="100.3.4.4">
                <Name>sum</Name>
            </Term>
            <Term href="100.3.4.5">
                <Name>count</Name>
            </Term>
            <Term href="100.3.4.6">
                <Name>MAX</Name>
            </Term>
            <Term href="100.3.4.7">
                <Name>MIN</Name>
            </Term>
        </Term>
        <Term href="100.3.5">
            <Name>StringExpressionType</Name>
            <Term href="100.3.5.1">
                <Name>UpperCase</Name>
            </Term>
            <Term href="100.3.5.2">
                <Name>LowerCase</Name>
            </Term>
        </Term>
    </Term>
    <Term href="100.3.6">
        <Name>QueryType</Name>
        <Term href="100.3.6.1">
            <Name>QueryByMedia</Name>
        </Term>
        <Term href="100.3.6.2">
            <Name>QueryByDescription</Name>
        </Term>
        <Term href="100.3.6.3">
            <Name>QueryByFreeText</Name>
        </Term>
        <Term href="100.3.6.4">
            <Name>QueryByXQuery</Name>
        </Term>
```

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```
            <Term href="100.3.6.5">
                <Name>QueryByRelevanceFeedback</Name>
            </Term>
            <Term href="100.3.6.6">
                <Name>QueryByFeatureRange</Name>
            </Term>
            <Term href="100.3.6.7">
                <Name>SpatialQuery</Name>
            </Term>
            <Term href="100.3.6.8">
                <Name>TemporalQuery </Name>
            </Term>
        </Term>
    </Term>
    <Term href="200">
        <Name>UsageConditions</Name>
        <Term href="200.1">
            <Name>Authentication</Name>
        </Term>
        <Term href="200.2">
            <Name>Registration</Name>
        </Term>
        <Term href="200.3">
            <Name>Payment</Name>
        </Term>
        <Term href="200.4">
            <Name>FreeUse</Name>
        </Term>
        <Term href="200.5">
            <Name>FreeForPersonalUse</Name>
        </Term>
    </Term>
    <Term href="300">
        <Name>QFProfile: Profile for QueryFormat</Name>
        <Term href="300.1">
            <Name>Full</Name>
        </Term>
    </Term>

</ClassificationScheme>
```

B.3 SpatialRelationCS

Introduction

The `SpatialRelation CS` defines spatial relations for the `SpatialQuery` type. Each relation has a condition on when it can be used. The region to be returned varies based on the relation and the `EvaluationPath` element. These are all specified in the following schema and table. For explanation, an MPEG-7 example is used, i.e., the XPath indicating an image is //Image and the XPath indicating a sub-region is //StillRegion.

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```
<!-- ########################################### -->
<!--  Definition of SpatialRelation CS              -->
<!-- ########################################### -->

<ClassificationScheme uri=" urn:mpeg:mpqf:cs:SpatialRelationCS:2008">

<Term href="south">
<Description>
B south C if and only if, in the dimension x, B starts after or at the same time
as C starts and B ends at the same time as or before C ends, or B starts at the
same time as or before C starts and B ends after or at the same time as C ends;
and, in the dimension y, B ends at the same time as or before C starts.
</Description>
</Term>

<Term href="southOf">
<Description>
B southOf C if and only if, C includes B and any region D, and then B is located
in the south of D.
The region to be retrieved varies based on the EvaluationPath element.
In case the EvaluationPath element indicates an image (i.e. //Image,) C must be
an image and C containing B and D that satisfies the relation 'B south D' is
returned.
In case the EvaluationPath element indicates a sub-region (i.e. //StillRegion) D
which satisfies the relation 'B south D' is returned.
</Description>
</Term>

<Term href="southIn">
<Description>
B southIn C if and only if B is completely located inside the lower region of C,
which is formed by the horizontal line dividing C into two equal sub-regions. The
region to be retrieved varies based on EvaluationPath.
In case EvaluationPath indicates an image (i.e. //Image) C must be an image and
is returned.
In case the EvaluationPath indicates a sub-region (i.e. //StillRegion) C must be
any region which satisfies this relation and is returned.
</Description>
</Term>

<Term href="north">
<Description> Inverse relation of south </Description>
</Term>

<Term href="northOf">
<Description> Inverse relation of southOf </Description>
</Term>

<Term href="northIn">
<Description> Inverse relation of southIn </Description>
</Term>

<Term href="west">
<Description>
B west C if and only if, in the dimension x, B ends at the same time as or before
C starts; and, in the dimension y, B starts after or at the same time as C starts
and B ends at the same time as or before C ends, or B starts at the same time as
or before C starts and B ends after or at the same time as C ends.
</Description>
</Term>

<Term href="westOf">
<Description>
B westOf C if and only if, C includes B and any region D, and then B is located
on the west of D.
The region to be retrieved varies based on the EvaluationPath element.
In case the EvaluationPath element indicates an image (i.e. //Image,) C must be
an image and the image containing B and D that satisfy the relation 'B west D' is
returned.
```

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```
In case the EvaluationPath element indicates a sub-region (i.e. //StillRegion) D
which satisfies the relation 'B west D' is returned.
</Description>
</Term>

<Term href="westIn">
<Description>
B westIn C if and only if B is completely located inside the left region of C,
which is formed by the vertical line dividing C into two equal sub-regions. The
region to be retrieved varies based on EvaluationPath.
In case EvaluationPath indicates an image (i.e. //Image) C must be an image and
is returned.
In case the EvaluationPath indicates a sub-region (i.e. //StillRegion) C must be
any region which satisfies this relation and is returned.
</Description>
</Term>

<Term href="east">
<Description> Inverse relation of west </Description>
</Term>

<Term href="eastOf">
<Description> Inverse relation of westOf </Description>
</Term>

<Term href="eastIn">
<Description> Inverse relation of westIn </Description>
</Term>


<Term href="northwest">
<Description>
B northwest C if and only if, in the dimension x, B ends at the same time as or
before C starts; and, in the dimension y, B starts after or at the same time as C
ends.
</Description>
</Term>

<Term href="northwestOf">
<Description>
B northwestOf C if and only if, C includes B and any region D, and then B is
located on the northwest of D.
The region to be retrieved varies based on the EvaluationPath element.
In case the EvaluationPath element indicates an image (i.e. //Image,) C must be
an image and C containing B and D that satisfy the relation 'B northwest D' is
returned.
In case the EvaluationPath element indicates a sub-region (i.e. //StillRegion) D
which satisfies the relation 'B northwest D' is returned.
</Description>
</Term>

<Term href="northwestIn">
<Description>
B northwestIn C if and only if B is completely located inside the upper left
region of C, which is formed by the horizontal and the vertical lines dividing C
into four equal sub-regions. The region to be retrieved varies based on
EvaluationPath.
In case EvaluationPath indicates an image (i.e. //Image) C must be an image and
is returned.
In case the EvaluationPath indicates a sub-region (i.e. //StillRegion) C must be
any region which satisfies this relation and is returned.
</Description>
</Term>

<Term href="southeast">
<Description> Inverse relation of northwest </Description>
</Term>

<Term href="southeastOf">
```

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```
<Description> Inverse relation of northwestOf </Description>
</Term>

<Term href="southeastIn">
<Description> Inverse relation of northwestIn </Description>
</Term>

<Term href="southwest">
<Description>
B southwest C if and only if, in the dimension x, B ends at the same time as or
before C starts; and, in the dimension y, B ends at the same time as or before C
starts.
</Description>
</Term>

<Term href="southwestOf">
<Description>
B southwestOf C if and only if, C includes B and any region D, and then B is
located on the southwest of D.
The region to be retrieved varies based on EvaluationPath.
In case the EvaluationPath indicates an image (i.e. //Image,) C must be an image
and C containing B and D that satisfy the relation 'B southwest D' is returned.
In case the EvaluationPath indicates a sub-region (i.e. //StillRegion) D which
satisfies the relation 'B southwest D' is returned.
</Description>
</Term>

<Term href="southwestIn">
<Description>
B southwestIn C if and only if B is completely located inside the lower left
region of C, which is formed by the horizontal and the vertical lines dividing B
into four equal sub-regions. The region to be retrieved varies based on
EvaluationPath.
In case EvaluationPath indicates an image (i.e. //Image) C must be an image and
is returned.
In case the EvaluationPath indicates a sub-region (i.e. //StillRegion) C must be
any region which satisfies this relation and is returned.
</Description>
</Term>

<Term href="northeast">
<Description> Inverse relation of southwest </Description>
</Term>

<Term href="northeastOf">
<Description> Inverse relation of southwestOf </Description>
</Term>

<Term href="northeastIn">
<Description> Inverse relation of southwestIn </Description>
</Term>

<Term href="left">
<Description>
B left C if and only if, in the dimension x, B ends at the same time as or before
C starts.
</Description>
</Term>

<Term href="leftOf">
<Description>
B leftOf C if and only if, C includes B and any region D, and then B is located
on the left hand side of D.
The region to be retrieved varies based on EvaluationPath.
In case the EvaluationPath indicates an image (i.e. //Image,) C must be an image
and C contains B and D that satisfy the relation 'B left D' is returned.
If the EvaluationPath indicates a sub-region (i.e. //StillRegion) D which
satisfies the relation 'B left D' is returned.
</Description>
```

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```
</Term>

<Term href="leftIn">
<Description>
B leftIn C if and only if B is completely located inside the left region of C,
which is formed by the vertical line dividing B into two equal sub-regions. This
relation is the superset of ‘westIn’, ‘southwestIn’, and ‘northwestIn’. The
region to be retrieved varies based on EvaluationPath.
In case EvaluationPath indicates an image (i.e. //Image) C must be an image and
is returned.
In case the EvaluationPath indicates a sub-region (i.e. //StillRegion) C must be
any region which satisfies this relation and is returned.
</Description>
</Term>

<Term href="right">
<Description> Inverse relation of left </Description>
</Term>

<Term href="rightOf">
<Description> Inverse relation of leftOf </Description>
</Term>

<Term href="rightIn">
<Description> Inverse relation of leftIn </Description>
</Term>

<Term href="below">
<Description>
B below C if and only if, in the dimension y, B ends at the same time as or
before C starts.
</Description>
</Term>

<Term href="belowOf">
<Description>
B belowOf C if and only if, C includes B and any region D, and then B is located
below D.
The region to be retrieved varies based on EvaluationPath.
In case the EvaluationPath indicates an image (i.e. //Image,) C must be an image
and C containing B and D that satisfy the relation ‘B below D’ is returned.
In case the EvaluationPath indicates a sub-region (i.e. //StillRegion) D which
satisfies the relation ‘B below D’ is returned.
</Description>
</Term>


<Term href="belowIn">
<Description>
B belowIn C if and only if B is completely located inside the lower region of C,
which is formed by the horizontal line dividing B into two equal sub-regions.
This relation is the superset of ‘southIn’, ‘southwestIn’, and ‘southeastIn’.
The region to be retrieved varies based on EvaluationPath.
In case the EvaluationPath indicates an image (i.e. //Image) C must be an image
and is returned.
In case the EvaluationPath indicates a sub-region (i.e. //StillRegion) C must be
any region which satisfies this relation and is returned.
</Description>
</Term>

<Term href="above">
<Description> Inverse relation of below </Description>
</Term>

<Term href="aboveOf">
<Description> Inverse relation of belowOf </Description>
</Term>

<Term href="aboveIn">
```


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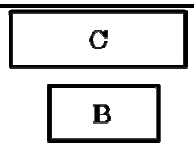
```
<Description> Inverse relation of belowIn </Description>
</Term>

<Term href="over">
<Description>
B over C if and only if, in the dimension x, B starts at the same time as or
before C starts and B ends after C starts, or B starts after C starts and B
starts before C ends; and, in the dimension y, B starts at the same time as C
ends.
</Description>
</Term>

<Term href="overOf">
<Description>
B overOf C if and only if, C includes B and any region D, and then B is located
over D.
The region to be retrieved varies based on EvaluationPath.
In case the EvaluationPath indicates an image (i.e. //Image,) C must be an image
and C containing B and D that satisfy the relation 'B over D' is returned.
In case the EvaluationPath indicates a sub-region (i.e. //StillRegion) D which
satisfies the relation 'B over D' is returned.
</Description>
</Term>

<Term href="under">
<Description> Inverse relation of over </Description>
</Term>

<Term href="underOf">
<Description> Inverse relation of overOf </Description>
</Term>
</ClassificationScheme>
```

SpatialRelation CS semantics

The following Table defines the semantics of the relations in the `SpatialRelation CS`. Each entry identifies the name of the relation and its inverse relation, defines the relation mathematically, indicates when it can be used by check (case 1 indicates that both, `sourceResource` and `targetResource` attributes are defined, and case 2 indicates that only the `sourceResource` attribute is defined) and gives an informative example of its use. In defining the spatial relations, all arguments (*B* and C) and an arbitrary region (D) are represented by a rectangular 2-D bounding box that includes the spatial extent of the argument in the 2-D spatial dimensions. For each *B*, the *x* and *y* spatial coordinates are represented by *B.x* and *B.y*, respectively. Furthermore, for spatial dimension *x*, the start and end points are denoted by *B.x.a* (start) and *B.x.b* (end), respectively and similarly for spatial dimension y. The inverse relations are defined as follows: "*B Relation C*" is equivalent to "*C InverseRelation B",* where *B* is the source and *C* is the target of the *Relation*, and *C* is the source and *B* is the target of the *InverseRelation*.

Table B.1 — Semantics of relations in the `SpatialRelation CS`

Relation Name	*Inverse Relation*	*Definition*	*Use case 1*	*Use case 2*	*Examples*
`south`	`north`	B `south` C if and only if ((B.x.a ≥ C.x.a AND B.x.b ≤ C.x.b) OR (B.x.a ≤ C.x.a AND B.x.b ≥ C.x.b)) AND B.y.b ≤ C.y.a	X		

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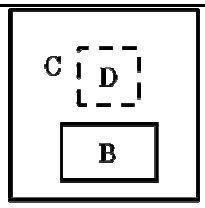
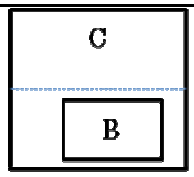
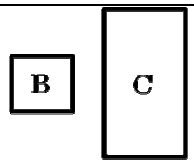
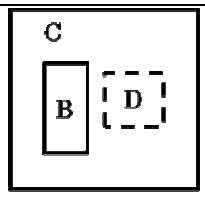
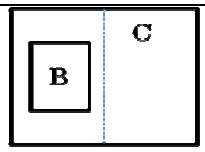
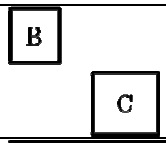
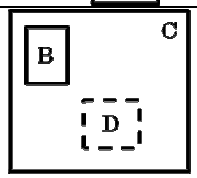
Relation Name	*Inverse Relation*	*Definition*	*Use case 1*	*Use case 2*	*Examples*
`southOf`	`northOf`	B `southOf` C if and only if C includes B and region D, and then B is south D. ((B.x.a ≥ D.x.a AND B.x.b ≤ D.x.b) OR (B.x.a ≤ D.x.a AND B.x.b ≥ D.x.b)) AND B.y.b ≤ D.y.a		X	
`southIn`	`northIn`	B `southIn` C if and only if C includes B and (B.y.b ≤ (C.y.a + C.y.b)/2) AND (B.x.a ≤ (C.x.a + C.x.b)/2) AND ((C.x.a + C.x.b)/2 ≤ B.x.b).		X	
`west`	`east`	B `west` C if and only if B.x.b ≤ C.x.a AND ((B.y.a ≥ C.y.a AND B.y.b ≤ C.y.b) OR (B.y.a ≤ C.y.a AND B.y.b ≥ C.y.b))	X		
`westOf`	`eastOf`	B `westOf` C if and only if C includes region B and a region D B.x.b ≤ D.x.a AND ((B.y.a ≥ D.y.a AND B.y.b ≤ D.y.b) OR (B.y.a ≤ D.y.a AND B.y.b ≥ D.y.b))		X	
`westIn`	`eastIn`	B `westIn` C if and only if C includes B and (B.x.b ≤ (C.x.a + C.x.b)/2) AND (B.y.a ≤ (C.y.a + C.y.b)/2) AND ((C.y.a + C.y.b)/2 ≤ B.y.b)		X	
`northwest`	`southeast`	B `northwest` C if and only if B.x.b ≤ C.x.a AND B.y.a ≥ C.y.b	X		
`northwestOf`	`southeastOf`	B `northwestOf` C if and only if C includes B and region D, and then B northwest D. B.x.b ≤ D.x.a AND B.y.a ≥ D.y.b		X	

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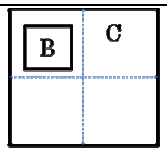
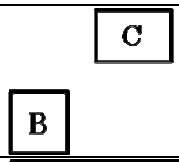
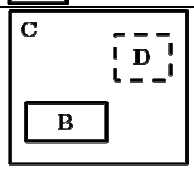
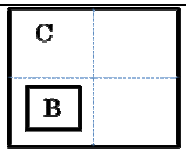
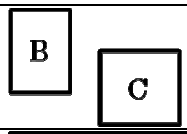
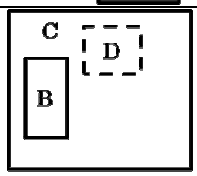
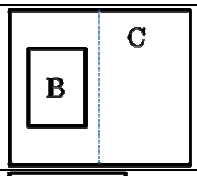
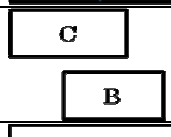
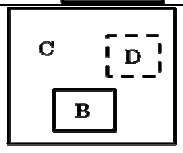
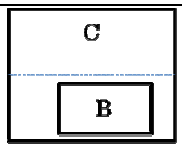
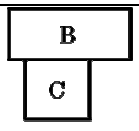
Relation Name	*Inverse Relation*	*Definition*	*Use case 1*	*Use case 2*	*Examples*
`northwestIn`	`southeastIn`	B `northwestIn` C if and only if C includes B and B.x.b ≤ (C.x.a + C.x.b)/2 AND B.y.a ≥ (C.y.a + C.y.b)/2		X	
`southwest`	`northeast`	B `southwest` C if and only if B.x.b ≤ C.x.a AND B.y.b ≥ C.y.a	X		
`southwestOf`	`northeastOf`	B `southwestOf` C if and only if C includes B and region D, and then B southwest D. B.x.b ≤ D.x.a AND B.y.b ≥ D.y.a		X	
`southwestIn`	`northeastIn`	B `southwestIn` C if and only if C includes B and B.x.b ≤ (C.x.a + C.x.b)/2 AND B.y.b ≤ (C.y.a + C.y.b)/2		X	
`left`	`right`	B `left` C if and only if B.x.b ≤ C.x.a	X		
`leftOf`	`rightOf`	B `left` C if and only if C includes B and region D, and then B left D. B.x.b ≤ D.x.a		X	
`leftIn`	`rightIn`	B `leftIn` C if and only if C includes B and B.x.b ≤ (C.x.a + C.x.b)/2		X	
`below`	`above`	B `below` C if and only if B.y.b ≤ C.y.a	X		
`belowOf`	`aboveOf`	B `belowOf` C if and only if C includes B and region D, and then B.y.b ≤ D.y.a		X	
`belowIn`	`aboveIn`	B `belowIn` C if and only if C includes B and B.y.b ≤ (C.y.a + C.y.b)/2		X	
`over`	`under`	B `over` C if and only if ((B.x.a ≤ C.x.a AND B.x.b > C.x.a) OR	X		

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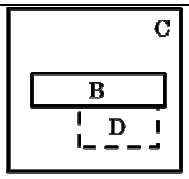
Relation Name	*Inverse Relation*	*Definition*	*Use case 1*	*Use case 2*	*Examples*
		(B.x.a > C.x.a AND B.x.a < C.x.b)) AND B.y.a = C.y.b			
`overOf`	`underOf`	B `overOf` C if and only if C includes B and region D, and then B over D. ((B.x.a ≤ D.x.a AND B.x.b > D.x.a) OR (B.x.a > D.x.a AND B.x.a < D.x.b)) AND B.y.a = D.y.b		X	

B.4 BaseRelationCS

Introduction

The `BaseRelation CS` defines set-theoretic and topological relations for the `SpatialQuery` type. It includes relations that describe different topological relations (i.e. contains, touches) which can be used for both segment and semantic entities, and set-theoretic relations like union and intersection, which are application to many different kinds of description tools (e.g. collections or semantic entities). In the following specification of the `BaseRelation CS`, symbols *B* and *E* are used to refer to the source of the relation and symbols *C* and *O* are used to refer to the target of the relation.

```
<!-- ################################################ -->
<!--  Definition of BaseRelation CS                   -->
<!-- ################################################ -->

<ClassificationScheme uri="urn:mpeg:mpqf:cs:BaseRelationCS:2008">
 <Term href="equals">
  <Description>
   B equals C if and only if B is equal to C.
  </Description>
 </Term>

 <Term href="inside">
  <Description>
  B1, B2, ..., Bn is inside C if and only if the union of B1, ..., Bn is a subset
of C
  </Description>
 </Term>

 <Term href="insideOf">
  <Description>
  B1, B2, ..., Bn is insideOf C if and only C includes B1, B2, ..., Bn
  and region D, and then the union of B1, ..., Bn is a subset of D.
  The region to be retrieved varies based on EvaluationPath.
  If the EvaluationPaht indicates an image (i.e. //Image) C must be image and the
image containing B and D that satisfy the relation 'inside' is return.
 If the EvaluationPath indicates a sub-region (i.e. //StillRegion) D is returned,
i.e., the sub-region forming the relation 'inside' with sourceResource is
returned
  </Description>
 </Term>

 <Term href="contains">
```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```
 <Description> Inverse relation of inside </Description>
</Term>

<Term href="containsOf">
 <Description> Inverse relation of insideOf </Description>
</Term>

<Term href="covers">
 <Description>
 B1, B2, ..., Bn covers argument C if and only if the union of B1, B2, ..., Bn
contains C AND that union is not equal to C
 </Description>
</Term>

<Term href="coversOf">
 <Description>
 B1, B2, ..., Bn is coversOf C if and only C includes B1, B2, ..., Bn
 and region D, and then the union of B1, ..., Bn contains D AND that union is
not equal to D.
 The region to be retrieved varies based on EvaluationPath.
 If the EvaluationPaht indicates an image (i.e. //Image) C must be image and the
image containing B and D that satisfy the relation 'covers' is return.
If the EvaluationPath indicates a sub-region (i.e. //StillRegion) D is returned,
i.e., the sub-region forming the relation 'covers' with sourceResource is
returned
 </Description>
</Term>

<Term href="coveredBy">
 <Description> Inverse relation of covers </Description>
</Term>

<Term href="coveredByOf">
 <Description> Inverse relation of coversOf </Description>
</Term>

<Term href="overlaps">
 <Description>
 B overlaps C if and only if B intersect C has non-empty interior
 </Description>
</Term>

<Term href="overlapsOf">
 <Description>
 B1, B2, ..., Bn is overlapsOf C if and only C includes B and region D, and then
B intersect D has non-empty interior.
 The region to be retrieved varies based on EvaluationPath.
 If the EvaluationPaht indicates an image (i.e. //Image) C must be image and the
image containing B and D that satisfy the relation 'overlaps' is return.
If the EvaluationPath indicates a sub-region (i.e. //StillRegion) D is returned,
i.e., the sub-region forming the relation 'overlaps' with sourceResource is
returned
 </Description>
</Term>

<Term href="touches">
 <Description>
 B1, B2, ..., Bn touches argument C if and only if B union C is is connected
 </Description>
</Term>

<Term href="touchesOf">
```

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```
  <Description>
  B1, B2, ..., Bn is overlapsOf C if and only C includes B and region D, and then
B union D is connected.
  The region to be retrieved varies based on EvaluationPath.
  If the EvaluationPaht indicates an image (i.e. //Image) C must be image and the
image containing B and D that satisfy the relation 'touches' is return.
 If the EvaluationPath indicates a sub-region (i.e. //StillRegion) D is returned,
i.e., the sub-region forming the relation 'touches' with sourceResource is
returned
  </Description>
 </Term>

 <Term href="disjoint">
  <Description>
  B is disjoint with C if and only if the intersection of B and C is empty.
   </Description>
 </Term>

 <Term href="disjointOf">
  <Description>
  B1, B2, ..., Bn is disjointOf C if and only C includes B and region D, and then
the intersection of B and D is empty.
  The region to be retrieved varies based on EvaluationPath.
  If the EvaluationPaht indicates an image (i.e. //Image) C must be image and the
image containing B and D that satisfy the relation 'disjoint' is return.
 If the EvaluationPath indicates a sub-region (i.e. //StillRegion) D is returned,
i.e., the sub-region forming the relation 'disjoint' with sourceResource is
returned
  </Description>
 </Term>

 <Term href="separated">
  <Description>
 E is separated from O if and only if the intersection of E and the closure of A
is empty AND the intersection of the closure of E with O is empty.
  </Description>
 </Term>

 <Term href="separatedOf">
  <Description>
  E is separatedOf O if and only O includes E and region D, and then the
intersection of E and the closure of A is empty AND the intersection of the
closure of E with D is empty.
  The region to be retrieved varies based on EvaluationPath.
  If the EvaluationPaht indicates an image (i.e. //Image) O must be image and the
image containing B and D that satisfy the relation 'separated' is return.
 If the EvaluationPath indicates a sub-region (i.e. //StillRegion) D is returned,
i.e., the sub-region forming the relation 'separated' with sourceResource is
returned
  </Description>
 </Term>
 </ClassificationScheme>
```

BaseRelation CS semantics

For each normative topological and set-theoretic relation, the Table includes the name, the inverse relation, the formal definition, the properties, and informative examples.

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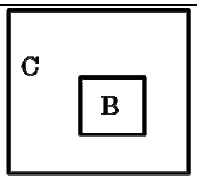
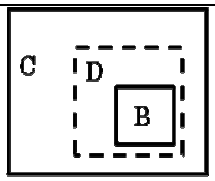
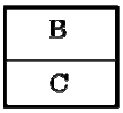
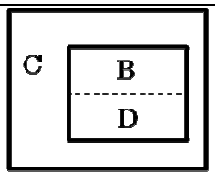
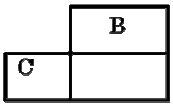
Table B.2 — Formal definition, inverse relations and properties of the normative topological and set-theoretic relations with informative examples

Relation Name	*Inverse Relation*	*Definition*	*Use case 1*	*Use case 2*	*Examples*
`equals`	`equals`	B `equals` C if and only if *B = C*	X		
`inside`	`contains`	*B_1, B_2, … B_n* `inside` C if and only if *(B_1, B_2, … B_n)* ⊆ C	X		
`insideOf`	`containsOf`	*B_1, B_2, … B_n* `insideOf` C if and only if C includes B_1, B_2, ... B_n and region D, and then B_1, B_2, ... B_n inside D. *(B_1, B_2, … B_n)* ⊆ D		X	
`covers`	`coveredBy`	*B_1, B_2, … B_n* `covers` C if and only if *B_1.* ∪ *B_2.* ∪…∪ *B_n.*∪C ⊃ C AND (*B_1.* ∪ *B_2.* ∪…∪ *B_n.*∪C) ≠ C	X		
`coversOf`	`coveredByOf`	*B_1, B_2, … B_n* `covers` C if and only if C includes B and region D, and then *B_1, B_2, … B_n* `covers` D *B_1.* ∪ *B_2.* ∪…∪ *B_n.*∪D ⊃ D AND (*B_1.* ∪ *B_2.* ∪…∪ *B_n.*∪D) ≠ D		X	
`overlaps`	`overlaps`	B `overlaps` C if and only if *B* ∩ C has non-empty interior	X		

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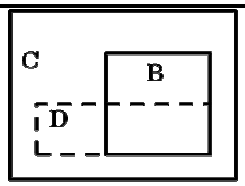
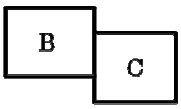
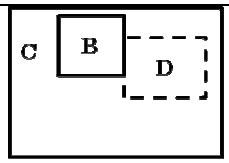
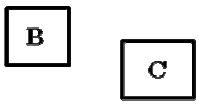
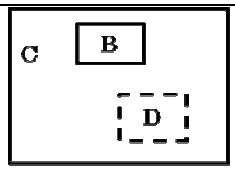
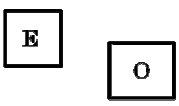
Relation Name	*Inverse Relation*	*Definition*	*Use case 1*	*Use case 2*	*Examples*
`overlapsOf`	`overlapsOf`	B `overlaps` C if and only if C includes B and region D, and then B overlaps D *B* ∩ C has non-empty interior		X	
`touches`	`touches`	$B_1, B_2, \ldots B_n$ `touches` C if and only if $B_1. \cup B_2. \cup \ldots \cup B_n. \cup$C is connected	X		
`touchesOf`	`touchesOf`	$B_1, B_2, \ldots B_n$ `touches` C if and only if C includes $B_1, B_2, \ldots B_n$ and region D, and then $B_1, B_2, \ldots B_n$ `touches` D $B_1. \cup B_2. \cup \ldots \cup B_n. \cup$D is connected		X	
`disjoint`	`disjoint`	*B* `disjoint` C if and only if *B* ∩ C = ∅	X		
`disjointOf`	`disjointOf`	*B* `disjointOf` C if and only if C includes B and region D, and then *B* `disjoint` D. *B* ∩ C = ∅		X	
`separated`	`separated`	*E* `separated` *O* if and only if *E* ∩ *cl(O)* = ∅ AND *cl(E)* ∩ *O* = ∅ where cl(S) indicates the closure of a set S.	X		

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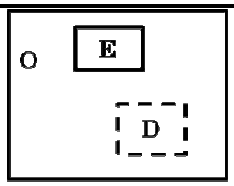
Relation Name	*Inverse Relation*	*Definition*	*Use case 1*	*Use case 2*	*Examples*
`separatedOf`	`separatedOf`	*E* `separatedOf` *O* if and only if O includes E and region *D*, and then *E* `separated` *D*. *E* ∩ *cl(D)* = ∅ AND *cl(E)* ∩ *D* = ∅ where cl(S) indicates the closure of a set S.		X	

B.5 TemporalRelationCS

Introduction

The `TemporalRelation CS` defines temporal relations for the `TemporalQuery` type. Each relation has a condition on when it can be used, and the temporal segment to be returned varies based on the relation and the value of the `EvaluationPath` element. These are all specified in the following schema and table. For explanation, an MPEG-7 example is used, i.e., the XPath indicating a content having temporal length is //Video and the XPath indicating a sub-temporal-segment is //VideoSegment.

```
<!-- ############################################ -->
<!--  Definition of TemporalRelation CS              -->
<!-- ############################################ -->

<ClassificationScheme uri="urn:mpeg:mpqf:cs:TemporalRelationCS:2008">

<Term href="precedes">
<Description>
B precedes C if and only if B ends before C starts.
</Description>
</Term>

<Term href="precedesOf">
<Description>
B precedesOf C if and only if C includes B and segment D, and then B ends before
D starts.
The segment to be retrieved varies based on EvaluationPath.
If the EvaluationPath indicates a video(i.e. //Video,) C must be video and the
video containing B and D that satisfy the relation 'precedes' is returned.
If the EvaluationPath indicates a sub-segment (i.e. //VideoSegment) D is
returned, i.e., the sub-segment forming the relation 'precedes' with
sourceResource is returned.
</Description>
</Term>

<Term href="follows">
<Description> Inverse relation of precedes </Description>
</Term>
```

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```
<Term href="followsOf">
<Description> Inverse relation of precedesOf </Description>
</Term>

<Term href="meets">
<Description>
B meets C if and only if B ends at the same time as C starts.
</Description>
</Term>

<Term href="meetsOf">
<Description>
B meetsOf C if and only if C includes B and segment D, and then B ends at the
same time as D starts.
The segment to be retrieved varies based on EvaluationPath.
If the EvaluationPath indicates a video(i.e. //Video,) C must be video and the
video containing B and D that satisfy the relation 'meets' is returned.
If the EvaluationPath indicates a sub-segment (i.e. //VideoSegment) D is
returned, i.e., the sub-segment forming the relation 'meets' with sourceResource
is returned.
</Description>
</Term>

<Term href="metBy">
<Description> Inverse relation of meets </Description>
</Term>

<Term href="metByOf">
<Description> Inverse relation of meetsOf </Description>
</Term>

<Term href="overlaps">
<Description>
B overlaps C if and only if B starts before C starts, B ends after C starts and B
ends before C ends.
</Description>
</Term>

<Term href="overlapsOf">
<Description>
B overlapsOf C if and only if C includes B and segment D, and then B starts
before D starts, B ends after D starts and B ends before D ends.
The segment to be retrieved varies based on EvaluationPath.
If the EvaluationPath indicates a video(i.e. //Video,) C must be video and the
video containing B and D that satisfy the relation 'overlaps' is returned.
If the EvaluationPath indicates a sub-segment (i.e. //VideoSegment) D is
returned, i.e., the sub-segment forming the relation 'overlaps' with
sourceResource is returned.
</Description>
</Term>

<Term href="overlappedBy">
<Description> Inverse relation of overlaps </Description>
</Term>

<Term href="overlappedByOf">
<Description> Inverse relation of overlapsOf </Description>
</Term>

<Term href="contains">
```


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```
<Description>
B contains C if and only if C starts after B starts and C ends at the same time
as or before B ends, or C starts after or at the same time as B starts and C ends
before B ends.
</Description>
</Term>

<Term href="containsOf">
<Description>
B containsOf C if and only if C includes B and segment D, and then D starts after
B starts and D ends at the same time as or before B ends, or D starts after or at
the same time as B starts and D ends before B ends.
The segment to be retrieved varies based on EvaluationPath.
If the EvaluationPath indicates a video(i.e. //Video,) C must be video and the
video containing B and D that satisfy the relation 'containsOf' is returned.
If the EvaluationPath indicates a sub-segment (i.e. //VideoSegment) D is
returned, i.e., the sub-segment forming the relation 'containsOf' with
sourceResource is returned.
</Description>
</Term>

<Term href="during">
<Description> Inverse relation of contains </Description>
</Term>

<Term href="duringOf">
<Description> Inverse relation of containsOf </Description>
</Term>

<Term href="strictContains">
<Description>
B strictContains C if and only if C starts after B starts and C ends before B
ends.
</Description>
</Term>

<Term href="strictContainsOf">
<Description>
B strictContainsOf C if and only if C includes B and segment D, and then B
strictContains D if and only if Dstarts after B starts and D ends before B ends.
The segment to be retrieved varies based on EvaluationPath.
If the EvaluationPath indicates a video(i.e. //Video,) C must be video and the
video containing B and D that satisfy the relation 'strictContainsOf' is
returned.
If the EvaluationPath indicates a sub-segment (i.e. //VideoSegment) D is
returned, i.e., the sub-segment forming the relation 'strictContainsOf' with
sourceResource is returned.
</Description>
</Term>

<Term href="strictDuring">
<Description> Inverse relation of strictContains </Description>
</Term>

<Term href="strictDuringOf">
<Description> Inverse relation of strictContainsOf </Description>
</Term>

<Term href="starts">
<Description>
```

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```
B starts C if and only if B starts at the same time as C starts and B ends before
C ends.
</Description>
</Term>

<Term href="startsOf">
<Description>
B startsOf C if and only if C includes B and segment D, and then B starts at the
same time as D starts and B ends before D ends.
The segment to be retrieved varies based on EvaluationPath.
If the EvaluationPath indicates a video(i.e. //Video,) C must be video and the
video containing B and D that satisfy the relation 'startsOf' is returned.
If the EvaluationPath indicates a sub-segment (i.e. //VideoSegment) D is
returned, i.e., the sub-segment forming the relation 'startsOf' with
sourceResource is returned.
</Description>
</Term>

<Term href="startedBy">
<Description> Inverse relation of starts </Description>
</Term>

<Term href="startedByOf">
<Description> Inverse relation of startsOf </Description>
</Term>

<Term href="finishes">
<Description>
B finishes C if and only if B starts after C starts and B ends at the same time
as C ends.
</Description>
</Term>

<Term href="finisesOf">
<Description>
B finisesOf C if and only if C includes B and segment D, and then B starts after
D starts and B ends at the same time as D ends.
The segment to be retrieved varies based on EvaluationPath.
If the EvaluationPath indicates a video(i.e. //Video,) C must be video and the
video containing B and D that satisfy the relation 'finisesOf' is returned.
If the EvaluationPath indicates a sub-segment (i.e. //VideoSegment) D is
returned, i.e., the sub-segment forming the relation 'finisesOf' with
sourceResource is returned.
</Description>
</Term>

<Term href="finishedBy">
<Description> Inverse relation of finishes </Description>
</Term>

<Term href="finishedByOf">
<Description> Inverse relation of finishesOf </Description>
</Term>

<Term href="coOccurs">
<Description>
B coOccurs if and only if B starts at the same time as C starts and B ends at the
same time as C ends.
</Description>
</Term>
```


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```
<Term href="coOccursOf">
<Description>
B coOccursOf C if and only if C includes B and segment D, and then B starts at
the same time as D starts and B ends at the same time as D ends.
The segment to be retrieved varies based on EvaluationPath.
If the EvaluationPath indicates a video(i.e. //Video,) C must be video and the
video containing B and D that satisfy the relation 'coOccursOf' is returned.
If the EvaluationPath indicates a sub-segment (i.e. //VideoSegment) D is
returned, i.e., the sub-segment forming the relation 'coOccursOf' with
sourceResource is returned.
</Description>
</Term>

<Term href="contiguous">
<Description>
A1, A2, … An contiguous if and only if they are temporally disjoint and
connected.
</Description>
</Term>

<Term href="contiguousOf">
<Description>
A1, A2, … An contiguousOf if and only if A1, A2, … An and another segment D are
temporally disjoint and connected.
The segment to be retrieved varies based on EvaluationPath.
If the EvaluationPath indicates a video(i.e. //Video,) the video containing A1,
A2, … An that satisfy the relation 'contiguousOf' is returned.
If the EvaluationPath indicates a sub-segment (i.e. //VideoSegment) D is
returned, i.e., the sub-segment forming the relation 'contiguousOf' with
sourceResource is returned.
</Description>
</Term>

<Term href="sequential">
<Description>
A1, A2, … An sequential if and only if they are temporally disjoint and not
necessarily connected.
</Description>
</Term>

<Term href="sequentialOf">
<Description>
A1, A2, … An sequentialOf if and only if A1, A2, … An and another segment D are
temporally disjoint and not necessarily connected.
The segment to be retrieved varies based on EvaluationPath.
If the EvaluationPath indicates a video(i.e. //Video,) the video containing A1,
A2, … An that satisfy the relation 'sequentialOf' is returned.
If the EvaluationPath indicates a sub-segment (i.e. //VideoSegment) D is
returned, i.e., the sub-segment forming the relation 'sequentialOf' with
sourceResource is returned.
</Description>
</Term>

<Term href="coBegin">
<Description>
A1, A2, … An coBegin if and only if they start at the same time.
</Description>
</Term>

<Term href="coBeginOf">
<Description>
```

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```
A1, A2, … An coBeginOf if and only if A1, A2, … An and another segment D start at
the same time.
The segment to be retrieved varies based on EvaluationPath.
If the EvaluationPath indicates a video(i.e. //Video,) the video containing A1,
A2, … An that satisfy the relation 'coBeginOf' is returned.
If the EvaluationPath indicates a sub-segment (i.e. //VideoSegment) D is
returned, i.e., the sub-segment forming the relation 'coBeginOf' with
sourceResource is returned.
</Description>
</Term>

<Term href="coEnd">
<Description>
A1, A2, … An coEnd if and only if they end at the same time.
</Description>
</Term>

<Term href="coEndOf">
<Description>
A1, A2, … An coEndOf if and only if A1, A2, … An and another segment D end at the
same time.
The segment to be retrieved varies based on EvaluationPath.
If the EvaluationPath indicates a video(i.e. //Video,) the video containing A1,
A2, … An that satisfy the relation 'coEndOf' is returned.
If the EvaluationPath indicates a sub-segment (i.e. //VideoSegment) D is
returned, i.e., the sub-segment forming the relation 'coEndOf' with
sourceResource is returned.
</Description>
</Term>

<Term href="parallel">
<Description>
A1, A2, … An parallel if and only if the intersection of A1, A2, … An has one
non-empty interior.
</Description>
</Term>

<Term href="parallelOf">
<Description>
A1, A2, … An parallelOf if and only if the intersection of A1, A2, … An and
another segment D has one non-empty interior.
The segment to be retrieved varies based on EvaluationPath.
If the EvaluationPath indicates a video(i.e. //Video,) the video containing A1,
A2, … An that satisfy the relation 'parallelOf' is returned.
If the EvaluationPath indicates a sub-segment (i.e. //VideoSegment) D is
returned, i.e., the sub-segment forming the relation 'parallelOf' with
sourceResource is returned.
</Description>
</Term>

<Term href="overlapping">
<Description>
A1, A2, … An overlapping if and only if the union of A1, A2, … An is connected
and each Ai intersects at least one other Aj with non-empty interior.
</Description>
</Term>

<Term href="overlappingOf">
<Description>
```


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```
A1, A2, … An overlappingOf if and only if the union of A1, A2, … An and another
segment D is connected and each Ai or D intersects at least one other Aj orD with
non-empty interior.
The segment to be retrieved varies based on EvaluationPath.
If the EvaluationPath indicates a video(i.e. //Video,) the video containing A1,
A2, … An that satisfy the relation 'overlappingOf' is returned.
If the EvaluationPath indicates a sub-segment (i.e. //VideoSegment) D is
returned, i.e., the sub-segment forming the relation 'overlappingOf' with
sourceResource is returned.
</Description>
</Term>
</ClassificationScheme>
```

TemporalRelation CS semantics

The following two Tables define the semantics of the temporal relations. Each entry identifies the name of the relation and its inverse relation, defines the relation mathematically, indicates when it can be used by check (case 1 indicates both sourceResource and targetResource attributes are defined, and case 2 indicates only sourceResource is defined,) and gives examples of its use. Each entry in Table B.3 identifies the name of the relation, defines the relation mathematically, indicates when it can be used by check (case 1 indicates both sourceResource and targetResource attributes are defined, and case 2 indicates only sourceResource is defined,) and gives examples of its use.

In defining the temporal relations, each argument is represented by the smallest temporal interval that includes the extent of the argument in the time dimension. For each *B*, the start and end times are denoted by *B.a* (start) and *B.b (*end), respectively. The inverse relations are defined as follows: "*B Relation C*" is equivalent to "*C InverseRelation B*", where *B* is the source and *C* is the target of the *Relation*, and *C* is the source and *B* is the target of the *InverseRelation*. This definition applies also in the case of each *n*-ary relation that has an inverse relation, where *B=(b1, …, bn)* is the *n*-tuple of sources and *C=(c1, …, cm)* is the *m*-tuple of the targets of the *Relation*.

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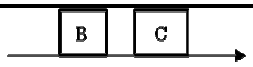
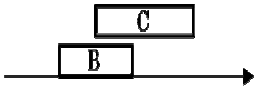
Table B.3 — Semantics of relations in the `TemporalRelation CS` (binary relations)

Relation Name	*Inverse Relation*	*Definition*	*Use case 1*	*Use case 2*	*Examples*
`precedes`	`follows`	B `precedes` C if and only if B.b < C.a	X		
`precedesOf`	`followsOf`	B `precedesOf` C if and only if C includes B and segment D, and then B precedes D. B.b < D.a		X	
`meets`	`metBy`	B `meets` C if and only if B.b = C.a	X		
`meetsOf`	`metByOf`	B `meetsOf` C if and only if C includes b and segment D, and then B meets D. B.b = D.a		X	
`overlaps`	`overlapped By`	B `overlaps` C if and only if B.a < C.a AND B.b > C.a AND B.b < C.b	X		
`overlapsOf`	`overlapped ByOf`	B `overlapsOf` C if and only if C includes B and segment D, and then B overlaps D. B.a < D.a AND B.b > D.a AND B.b < D.b		X	
`contains`	`during`	B `contains` C if and only if (C.a > B.a AND C.b ≤ B.b) OR (C.a ≥ B.a AND C.b < B.b)	X		Any of the examples for strictContains, startedBy, and finishedBy.

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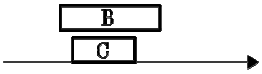
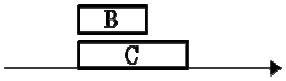
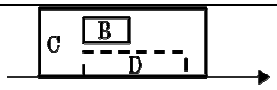
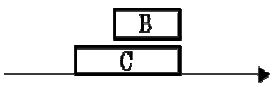
Relation Name	*Inverse Relation*	*Definition*	*Use case 1*	*Use case 2*	*Examples*
containsOf	duringOf	B containsOf C if and only if C includes B and segment D, and then B contains D. (D.a > B.a AND D.b ≤ B.b) OR (D.a ≥ B.a AND D.b < B.b)		X	Any of the examples for strictContainsOf, startedByOf, and finishedByOf.
strictContains	strictDuring	B strictContains C if and only if C.a > B.a AND C.b < B.b	X		
strictContainsOf	strictDuringOf	B strictContainsOf C if and only if C includes B and segment D, and then B strictcontains D. D.a > B.a AND D.b < B.b		X	
starts	startedBy	B starts C if and only if B.a = C.a AND B.b < C.b	X		
startsOf	startedByOf	B startsOf C if and only if C includes B and segment D, and then B starts D. B.a = D.a AND B.b < D.b		X	
finishes	finishedBy	B finishes C if and only if B.a > C.a AND B.b = C.b	X		

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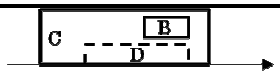
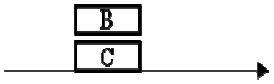
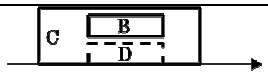
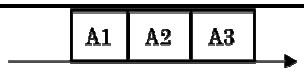
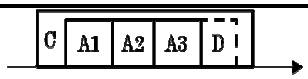
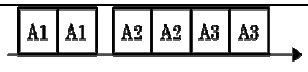
Relation Name	*Inverse Relation*	*Definition*	*Use case 1*	*Use case 2*	*Examples*
`finishesOf`	`finishedByOf`	B `finishesOf` C if and only if C includes B and segment D, and then B finishes D. B.a > D.a AND B.b = D.b		X	
`coOccurs`	`coOccurs`	B `coOccurs` C if and only if B.a = C.a AND B.b = C.b	X		
`coOccursOf`	`coOccursOf`	B `coOccursOf` C if and only if C includes B and segment D, and then B coOccurs D. B.a = D.a AND B.b = D.b		X	

Table B.4 — Semantics of relations in the `TemporalRelation CS` (n-ary relations)

Relation Name	*Definition*	*Use case 1*	*Use case 2*	*Examples*
`contiguous`	$A_1, A_2, \ldots A_n$ `contiguous` if and only if $A_i.b = A_{i+1}.a$ for i=1, .., n-1 That is, $A_1, A_2, \ldots A_n$ `contiguous` if and only if they are temporally disjoint and connected.	X		
`contiguousOf`	$A_1, A_2, \ldots A_n$ `contiguousOf` if and only if C includes $A_1, A_2, \ldots A_n$ and segment D, and then $A_1, A_2, \ldots A_n$ D `contiguous`		X	
`sequential`	$A_1, A_2, \ldots A_n$ `sequential` if and only if	X		

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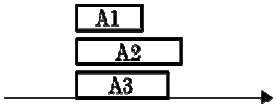
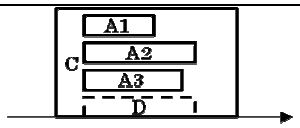
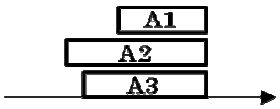
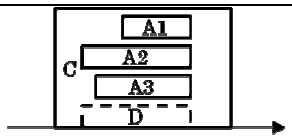
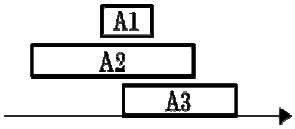
Relation Name	*Definition*	*Use case 1*	*Use case 2*	*Examples*
	$A_i.b \le A_{i+1}.a$ for i=1, .., n-1 That is, A_1, A_2, … A_n `sequential` if and only if they are temporally disjoint and not necessarily connected.			
`sequentialOf`	A_1, A_2, … A_n `sequentialOf` if and only if C includes A_1, A_2, … A_n and segment D, and then A_1, A_2, … A_n D `sequential`.		X	
`coBegin`	A_1, A_2, … A_n `coBegin` If and only if $A_i.a = A_{i+1}.a$ for i=1, .., n-1 That is, A_1, A_2, … A_n `coBegin` if and only if they start at the same time.	X		
`coBeginOf`	A_1, A_2, … A_n `coBeginOf` If and only if C includes A_1, A_2, … A_n and segment D, and then A_1, A_2, … A_n D `coBegin`.		X	
`coEnd`	A_1, A_2, … A_n `coEnd` if and only if $A_i.b = A_{i+1}.b$ for i=1, .., n-1 That is, A_1, A_2, … A_n `coEnd` if and only if they end at the same time.	X		
`coEndOf`	A_1, A_2, … A_n `coEndOf` if and only if C includes A_1, A_2, … A_n and segment D, and then A_1, A_2, … A_n D `coEnd`.		X	
`parallel`	A_1, A_2, … A_n `parallel` if and only if the intersection of A_1, A_2, … A_n has one non-empty interior.	X		

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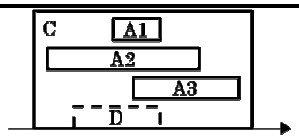
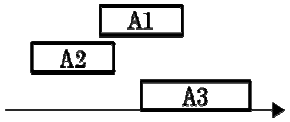
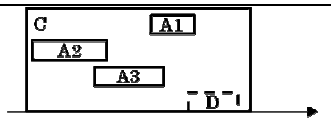
Relation Name	*Definition*	*Use case 1*	*Use case 2*	*Examples*
`parallelOf`	A_1, A_2, … A_n `parallelOf` if and only if C includes A_1, A_2, … A_n and segment D, and then A_1, A_2, … A_n D `parallel`.		X	
`overlapping`	A_1, A_2, … A_n `overlapping` if and only if the union of A_1, A_2, … A_n is connected and each A_i intersects at least one other A_j with non-empty interior.	X		
`overlapping Of`	A_1, A_2, … A_n `overlappingOf` if and only if C includes A_1, A_2, … A_n and segment D, and then A_1, A_2, … A_n D `overlapping`.		X	

B.6 ScoringfunctionCS

Introduction

The Scoringfunction CS defines functions that may be used by users in order to signal the responder which mathematical approach is desired for the evaluation of a Boolean expression (AND, OR, XOR).

```
<ClassificationScheme uri="urn:mpeg:mpqf:cs:ScoringfunctionCS:2008">
  <Term href="100">
    <Name>Scoringfunction</Name>
    <Term href="100.1">
      <Name>Sum</Name>
    </Term>
    <Term href="100.2">
      <Name>Max</Name>
    </Term>
    <Term href="100.3">
      <Name>Min</Name>
    </Term>
    <Term href="100.3">
      <Name>Product</Name>
    </Term>
    <Term href="100.4">
      <Name>Average</Name>
    </Term>
  </Term>
</ClassificationScheme>
```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B.7 DistancefunctionCS

Introduction

The Distancefunction CS defines functions that may be used by users in order to signal the responder which mathematical approach is desired for the evaluation of a range search (QueryByFeatureRange).

```
<ClassificationScheme uri="urn:mpeg:mpqf:cs:DistancefunctionCS:2008">
  <Term href="100">
    <Name>Distancefunction</Name>
    <Term href="100.1">
      <Name>Manhattan</Name>
    </Term>
    <Term href="100.2">
      <Name>Eucledian</Name>
    </Term>
    <Term href="100.3">
      <Name>Cosine</Name>
    </Term>
  </Term>
</ClassificationScheme>
```

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