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Information technology — JPSearch —

Part 1: System framework and components

Technologies de l'information — JPSearch —

Partie 1: Cadre système et composants

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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.

In exceptional circumstances, when the joint technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide to publish a Technical Report. A Technical Report is entirely informative in nature and shall be subject to review every five years in the same manner as an International Standard.

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 TR 24800-1 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

This second edition cancels and replaces the first edition (ISO/IEC 24800-1:2007) which has been technically revised.

ISO/IEC TR 24800 consists of the following parts, under the general title *Information technology — JPSearch*:

— *Part 1: System framework and components [Technical Report]*

— *Part 2: Registration, identification and management of schema and ontology*

— *Part 3: Query format*

— *Part 4: File format for metadata embedded in image data (JPEG and JPEG 2000)*

— *Part 5: Data interchange format between image repositories*

— *Part 6: Reference software*

Introduction

JPSearch aims at providing a standard for interoperability of still image search and retrieval systems. Many systems provide functionalities for storing, annotating, sharing, searching and retrieving images on computer desktops, on the World Wide Web, on imaging devices, and in other consumer and professional applications. Existing systems are implemented in a way that tightly couples the different functionalities, often providing only proprietary and restricted interfaces to the users and third-party applications. This severely constrains the users capacity to freely migrate their data and metadata between different systems. Moreover, it also limits the capacity of the different systems to interoperate.

JPSearch provides a set of standardized interfaces of an abstract image retrieval framework, facilitating the use and reuse of metadata and the use and reuse of metadata schemas to provide a common context for image data and metadata searching and interchanging. JPSearch also provides a common query language and a repository information interchange format, facilitating the deployment of distributed repositories and allowing users to easily migrate their data and metadata between different applications and devices.

In order to help the reader to understand the scope and usage of this part of ISO/IEC 24800, the informative Annexes A and B are provided. Annex A clarifies the scope of JPSearch by providing several use cases in different application domains. Annex B illustrates how to use ISO/IEC 24800 by presenting a representative use case and the way it would be implemented using ISO/IEC 24800.

Information technology — JPSearch —

Part 1:
System framework and components

1 Scope

This part of ISO/IEC 24800 provides a global view of the JPSearch framework. In the other parts of ISO/IEC 24800, several standardized technologies are specified. The scope and aims of the individual parts are highlighted in the following clauses.

2 Terms, definitions and abbreviated terms

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

2.1
annotation
metadata added to an image by way of definition or comment

NOTE It is normally in text and done by a human.

2.2
metadata
data about data

EXAMPLE An image is a data item. Metadata about the image may include information such as the size of the image, the date it was created, etc.

2.3
query
request for information from a search and retrieval system

2.4
query-by-example
type of query where an example of the answer desired is used as the input to the search system

2.5
semantics
mapping between elements of a language and the real world

2.6
syntax
set of rules that govern whether a sentence (or other unit of communication) is well formed

3 Motivation

There are many applications that provide image search and retrieval functionality on computer desktops, on the World Wide Web, on imaging devices, and in other consumer and professional applications. These implementations are characterized by significant limitations, including:

- **Lack of the ability to reuse metadata**: Some relevant functionality of still image management systems (search, cataloguing, digital rights management, etc.) rely on or can be benefited by the existence of metadata describing aspects of user's images and image collections. Independently of the way these metadata have been obtained (automatically, manually or cooperatively), they can have an inestimable value, because their generation often involves a cost (in whatever form), and sometimes it cannot be redo (e.g. geolocation metadata). The usage of proprietary interfaces and metadata models by image management systems severely constraints the exploitation and reuse of the metadata by their legitimate owners, the users.

- **Lack of a common query format and search semantics**: There is a trend towards shared image repositories. These could be on the web, but there are also systems that publish user repositories residing on their local (e.g., home) machines for (normally access controlled) public viewing and annotation. As the number and size of such repositories increase (a monotonic increasing trend), search becomes an essential function for users and applications to look up images. Unfortunately, the various systems providing image search, whether on the desktop or on the web, do not provide a common way of specifying neither precise input parameters to describe the search criteria nor a set of output parameters to describe the aggregated return result sets for user presentation or machine consumption. System providers need a reference standard to remove ambiguity and make searching over shared repositories consistent.

These are just the two main problems where still image search systems can benefit tremendously from standardization. The provision of uniform ways to interact with these systems greatly improves the users' capacity to manipulate and relocate their data and metadata, but also enables interoperability between systems in a distributed scenario (e.g. content providers, aggregators and clients). Finally, the provision of uniform interfaces for programmatic access enables platform independence (which benefits also non-distributed scenarios); developers can write their applications involving access to an image repository independently of the underlying technology of the repository, which fosters software reusability and maintainability.

4 Overview of JPSearch

ISO/IEC 24800 (JPSearch) provides a set of standardized interfaces for digital image management and retrieval systems. Figure 1 shows the three main processes of the digital image life cycle which are covered in ISO/IEC 24800:

- Creation/Maintenance: The client can create or maintain data on a repository using standardized data exchange format in which a digital image (resource) and its associated metadata are packed in a single data entity to guarantee their persistent association. The format can be used for client to download/upload data on repositories, so image and metadata portability from one repository to another can be easily implemented.

- Synchronization: The client can synchronize entire or partial set of image on a repository with local data. Through the synchronization of local data with different two repositories, data migration from one repository to another, for an example between cloud and a portable device, can be achieved.

- Search/retrieve: Clients can express a set of precise input parameters to describe their search criteria in addition to a set of preferred output parameters to depict the return result sets.

The fact that these different processes depend on a certain way of referring to or expressing image metadata poses a challenge in terms of metadata interoperability, as JPSearch is not restricted to a single metadata schema. In on hand, the standard provides a reference metadata schema so called the JPSearch's Core Metadata Schema, which serves as metadata basis supporting interoperability among various image retrieval systems. On the other hand, the standard provides a translation rule language, which allows the publication of machine-readable translations between metadata terms in the JPSearch Core Metadata Schema and metadata terms belonging to proprietary metadata schemas.

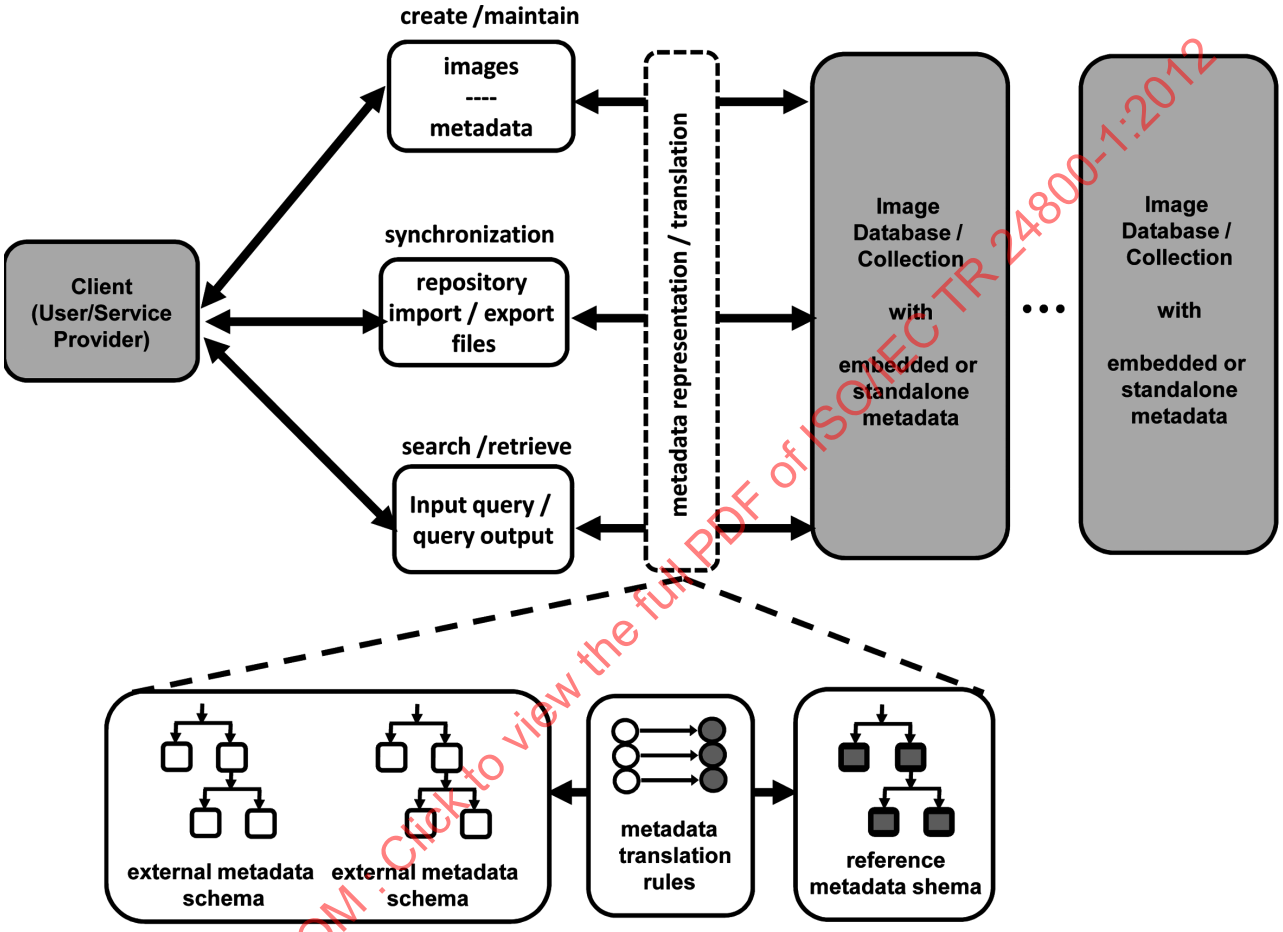

Figure 1 — Image search and management process

JPSearch is designed as a multi-part specification. Three main processes are standardized by JPSearch specification: search and retrieval by Part 3 (query format), the creation or maintenance of metadata by Part 4 (file format for metadata embedded in image data) and the synchronization or migration of repositories by Part 5 (data interchange format between image repositories). Part 2 (registration, identification and management of schema and ontology) links all the other parts to a common metadata interoperability model, which plays a key role in ISO/IEC 24800 and it is explained next. Part 1, i.e. this document, and Part 6 (reference software), are intended to help understanding and developing JPSearch compliant systems. Figure 2 shows the overall structure of the JPSearch standard. Note that it is not in the scope of JPSearch to standardize the individual components of an image retrieval repository (e.g., feature comparison, result generation, etc.). Instead, the standardization concentrates on specifying interface definitions among image retrieval components in order to ensure image search in a distributed heterogeneous environment.

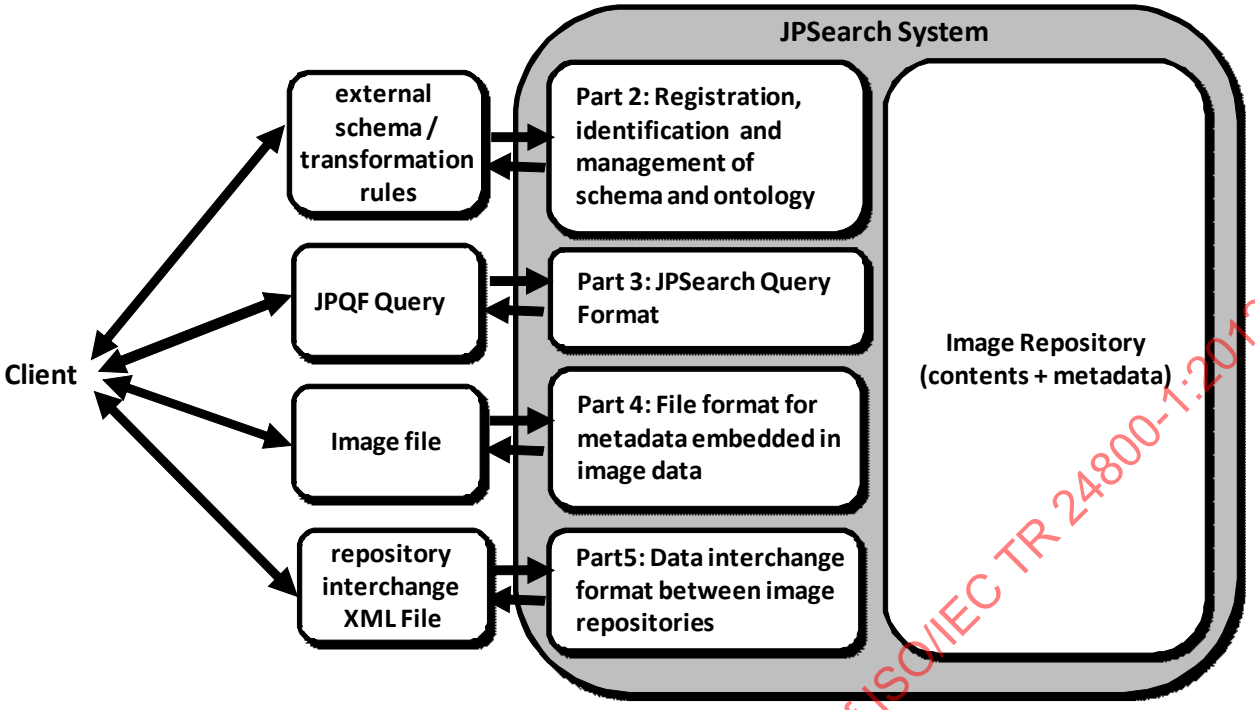

Figure 2 — Overall structure of ISO/IEC 24800 (JPSearch)

5 JPSearch metadata interoperability model

All JPSearch interfaces (querying, file format, synchronization) depend on a certain way of referring to or expressing image metadata, so metadata interoperability plays a crucial role in ISO/IEC 24800. The JPSearch framework is extremely flexible in terms of metadata management, and it is not restricted to a single metadata format. In order to achieve the maximum level of flexibility, the JPSearch framework supports image metadata compliant with any metadata format which can be serialized in XML. Examples of supported metadata formats include Dublin Core and MPEG-7. Figure 3 shows a graphical overview of the JPSearch Metadata Interoperability Model.

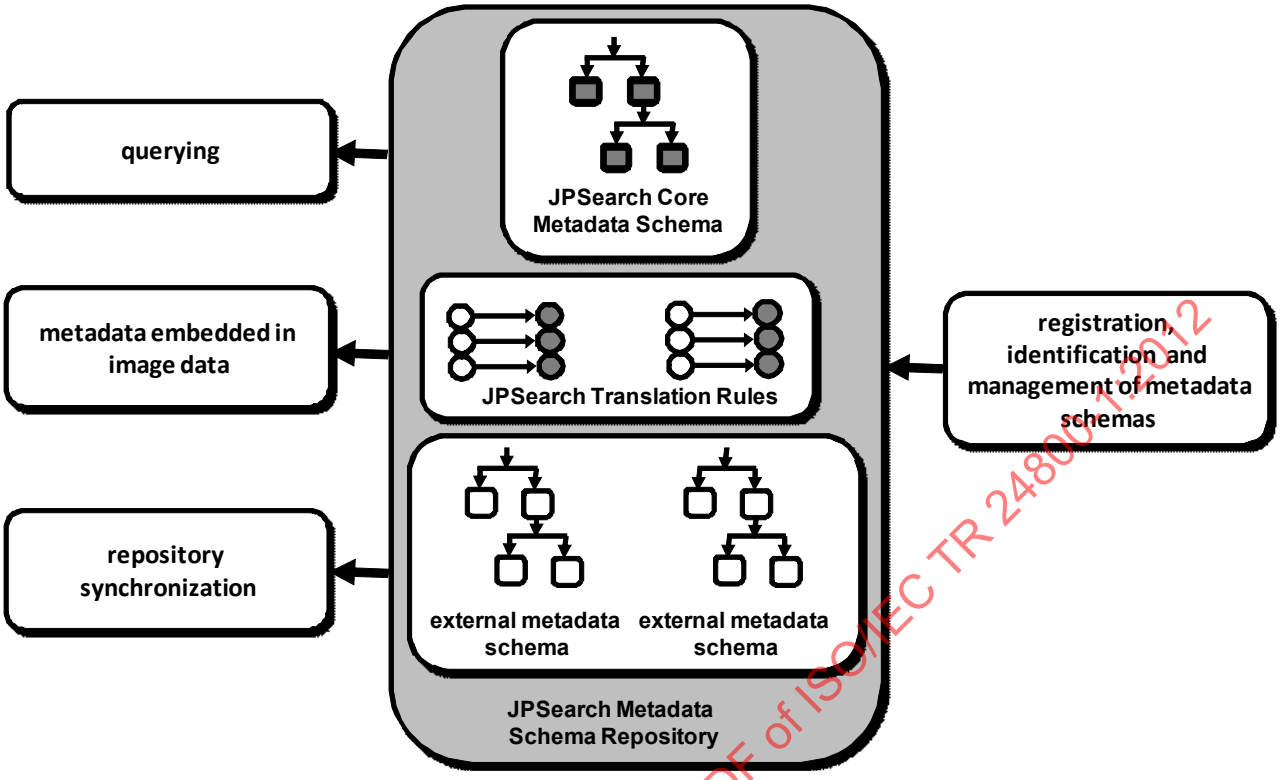

Figure 3 — JPSearch metadata interoperability model overview

Despite of the fact that any XML-based metadata format can be used, JPSearch specifies the JPSearch's Core Metadata Schema as the cornerstone of metadata interoperability in ISO/IEC 24800. The Core Schema specifies the structure and rules to which any metadata of images must conform in order to be considered valid within a JPSearch compliant system. In addition to the definition of JPSearch Core Metadata Schema, ISO/IEC 24800 provides a mechanism that allows a JPSearch compliant system taking profit from proprietary or community-specific metadata schemas. A translation rules language allows the publication of machine-readable translations between metadata terms belonging to proprietary metadata schemas and metadata terms in the JPSearch Core Metadata Schema. Users can choose which metadata language to use in a JPSearch-based interaction (annotation, querying, etc.) if the proper translations are available. ISO/IEC 24800-2 specifies the general rules which govern the usage of metadata in JPSearch.

6 JPSearch Part 2: Registration, identification and management of schema and ontology

6.1 Basic structure and benefits

ISO/IEC 24800-2 provides a specification which:

- Provides rules for the representation of image metadata descriptions, consisting in the definition of the JPSearch Core Metadata Schema.
- Provides rules for the publication of machine-readable translations between metadata terms belonging to proprietary metadata schemas and metadata terms in the JPSearch Core Metadata Schema.
- Provides rules for the registration and request of metadata schemas and its translation rules or links to them.

JPSearch is an extensible standard. The normative method of extending the structures and rules beyond the JPSearch Core Metadata Schema is provided in the standard.

6.2 JPSearch Core Metadata Schema

The JPSearch Core Metadata Schema is the main component of the metadata interoperability strategy in ISO/IEC 24800. It specifies the structure and rules to which any image metadata must conform in order to be considered valid within a JPSearch compliant system. The core schema serves as metadata basis supporting interoperability during search among multiple image retrieval systems. The core schema is used by clients to formulate, in combination with the JPEG Query Format, search requests to JPSearch compliant search systems. Note, that only metadata described by the core schema is guaranteed that its semantics is recognized by JPSearch compliant systems.

The following example shows the description of a fictional image.

```
<?xml version="1.0" encoding="iso-8859-1"?>
<ImageDescription xmlns="urn:jpeg:jpsearch:schema:coremetadata:2009"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="urn:jpeg:jpsearch:schema:coremetadata:2009 24800-2-core.xsd">
  <Identifier>urn:unique:identifier:1:2:3</Identifier>
  <Creators>
    <GivenName>John</GivenName>
    <FamilyName>Smith</FamilyName>
  </Creators>
  <CreationDate>2011-12-17T09:30:47.0Z</CreationDate>
  <ModifiedDate>2011-12-17T09:30:47.0Z</ModifiedDate>
  <Description>Sample description</Description>
  <Keyword>Sardinia</Keyword>
  <Keyword>Italy</Keyword>
  <Keyword>50th JPEG meeting</Keyword>
  <Title>Example Instance document of the JPSearch core schema</Title>
  <GPSPositioning latitude="34" longitude="34" altitude="10"/>
  <RegionOfInterest>
    <RegionLocator>
      <Region dim="2"> 0 0 100 100</Region>
    </RegionLocator>
    <Description>A short description about the selected region
    </Description>
    <Keyword>plenary meeting</Keyword>
  </RegionOfInterest>
  <Width>640</Width>
  <Height>480</Height>
</ImageDescription>
```

However, the core schema neither is intended to be the unique schema used for annotating images, nor is it intended to replace existing well-established metadata schemas such as MPEG-7 or Dublin Core. The JPSearch Core Metadata contains a set of minimal core terms that can be extended in two different ways:

1) By extending the Core Schema through ExternalDescription elements, as is in the following example:

```
<ImageDescription>
…
  <ExternalDescription>
      <TagName fromNamespace="urn:mpeg:mpeg7:schema:2004"
fromNamespacePrefix="mpeg7">mpeg7:ColorLayout</TagName>
      <StructuredValue fromNamespace="urn:mpeg:mpeg7:schema:2004">
        <mpeg7:Mpeg7 xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004"
xsi:schemaLocation="urn:mpeg:mpeg7:schema:2004 M7v2schema.xsd">
          <mpeg7:DescriptionUnit xsi:type="mpeg7:ColorLayoutType">
            <mpeg7:YDCCoeff>1</mpeg7:YDCCoeff>
            <mpeg7:CbDCCoeff>2</mpeg7:CbDCCoeff>
```

```
            <mpeg7:CrDCCoeff>3</mpeg7:CrDCCoeff>
            <mpeg7:YACCoeff2>1 2</mpeg7:YACCoeff2>
            <mpeg7:CbACCoeff2>1 2</mpeg7:CbACCoeff2>
            <mpeg7:CrACCoeff2>1 2</mpeg7:CrACCoeff2>
          </mpeg7:DescriptionUnit>
        </mpeg7:Mpeg7>
      </StructuredValue>
    </ExternalDescription>
</ImageDescription>
```

2) By directly using a different metadata schema in the JPSearch-based interactions (annotation, querying, etc.) and defining and registering the proper translations to the core schema with the JPSearch Translation Rules Declaration Language, introduced in the next section.

6.3 JPSearch Translation Rules Declaration Language (JPTRDL)

The JPSearch Translation Rules Declaration Language (JPTRDL) allows the publication of machine-readable translations between metadata terms belonging to proprietary metadata schemas and metadata terms in the JPSearch Core Metadata Schema. Users can choose which metadata language to use in a JPSearch-based interaction if the proper translations are available. JPTRDL is a key component of the metadata interoperability strategy in ISO/IEC 24800, and it aims to allow a JPSearch compliant system benefit from proprietary or community-specific metadata schemas.

The following example shows a one-to-many translation rule that maps the JPSearch Core Schema `date` element into three fields of an example target format:

```
<?xml version="1.0" encoding="iso-8859-1"?>
<TranslationRules xmlns="JPSearch:schema:translation"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="JPSearch:schema:translation 24800-2-translation.xsd"
fromFormat="urn:jpeg:jpsearch:schema:coremetadata:2009"
toFormat="urn:exampleformat">
  <!-- example : Date="05/10/2008" to Day="05" AND Month="10" AND Year="2008" -->
  <TranslationRule xsi:type="OneToManyFieldTranslationType">
    <FromField xsi:type="FilteredSourceFieldType">
      <XPathExpression>date</XPathExpression>
      <FilterWithRegExpr>(\d\d)/(\d\d)/(\d\d\d\d)</FilterWithRegExpr>
    </FromField>
    <ToField xsi:type="FormattedTargetFieldType">
      <XPathExpression>day</XPathExpression>
      <ReplaceWithRegExpr>$1</ReplaceWithRegExpr>
    </ToField>
    <ToField xsi:type="FormattedTargetFieldType">
        <XPathExpression>month</XPathExpression>
        <ReplaceWithRegExpr>$2</ReplaceWithRegExpr>
    </ToField>
    <ToField xsi:type="FormattedTargetFieldType">
        <XPathExpression>year</XPathExpression>
        <ReplaceWithRegExpr>$3</ReplaceWithRegExpr>
    </ToField>
  </TranslationRule>
</TranslationRules>
```

7 JPSearch Part 3: JPSearch query format

ISO/IEC 24800-3 contains the tools of the JPEG Query Format (JPQF) as an adaptation for the still images domain of ISO/IEC 15938-12 (MPEG Query Format). The goal of JPQF is to facilitate and unify access to search functionalities in distributed digital image repositories. To achieve this goal, the JPQF standard (in conjunction with ISO/IEC 15938-12) specifies precise input and output parameters to express requests and uniform client side processing of result sets, respectively. Moreover, the management component of JPQF covers searching and the choice of the desired services for retrieval. For this purpose, the standard provides a means to describe service capabilities and to undertake service discovery.

Essentially, JPQF is an XML-based query language that defines the format of the queries and replies exchanged between clients and servers in a distributed image search and retrieval system (see Figure 4). The two main benefits of standardization of such a language are 1) interoperability between parties in a distributed scenario (e.g. content providers, aggregators and clients) and 2) platform independence (which also offers benefits for non-distributed scenarios). As a result, developers can construct applications exploiting image queries independent of the used service; this fosters software reusability and maintainability.

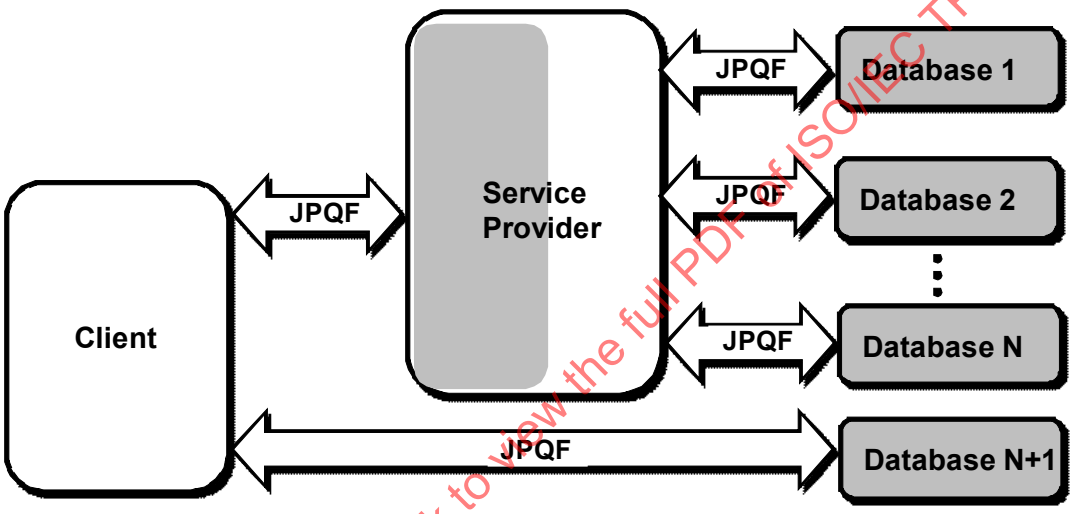

Figure 4 — Possible scenario for the use of the JPEG Query Format

JPQF instances are XML documents that can be validated against the JPQF XML Schema. A JPQF instance always includes the JPEGQuery element as the root element and beneath that the InputQuery element, the FetchResult element, the OutputResult element or the Management element (See Figure 5). JPQF instances with the InputQuery element or the OutputResult element are the usual requests/responses of an image multimedia search process. The JPEGQuery element can include the InputQuery element or the OutputResult element, dependent on whether the document is a request or a response. A special query input constitutes the FetchResult element which is used in asynchronous mode for collection search results. Alternatively, below the root element, a JPQF document can include the Management element. Management messages (which can be both requests and responses) provide a means for requesting service-level functionalities such as discovery of multimedia services or other kinds of service provision, interrogating the capabilities of a service, or configuring service parameters.

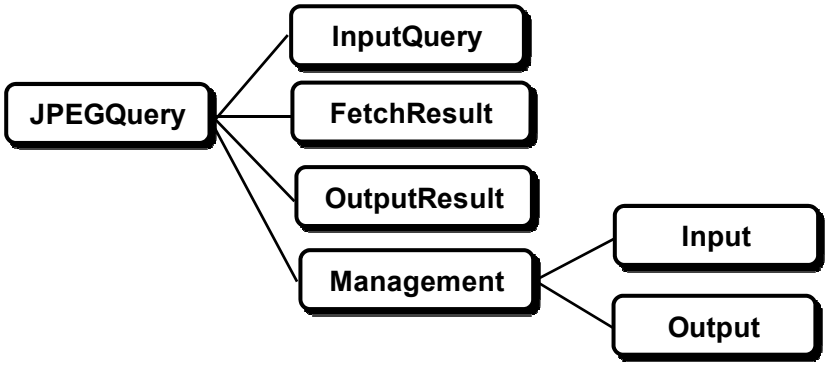

Figure 5 — Schema overview of the uppermost elements of the JPEG Query Format

The following example shows a JPQF query which asks for images created the 2009-10-07T08:46:45:

```
<?xml version="1.0" encoding="UTF-8"?>
<JPEGQuery xmlns="urn:jpeg:jpqf:schema:2008"
xmlns:mpqf="urn:mpeg:mpqf:schema:2008"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="urn:jpeg:jpqf:schema:2008 24800-3.xsd
urn:mpeg:mpqf:schema:2008 15938-12-Cor1-Cor2-Amd1.xsd"
jpqfID="http://www.mpqf.org/id1">
  <InputQuery>
    <OutputDescription maxItemCount="3" maxPageEntries="10"
outputNameSpace="urn:mpeg:mpeg7:schema:2004">
      <mpqf:ReqField typeName="jpcs:uri">ImageInstanceLocator[1]</mpqf:ReqField>
      <mpqf:ReqField typeName="jpcs:identifier">Identifier</mpqf:ReqField>
      <mpqf:ReqField
typeName="jpcs:Creators/GivenName">Creators/GivenName</mpqf:ReqField>
      <mpqf:ReqField
typeName="jpcs:Creators/FamilyName">Creators/FamilyName</mpqf:ReqField>
      <mpqf:ReqField typeName="jpcs:CreationDate">CreationDate</mpqf:ReqField>
      <mpqf:ReqField typeName="latitude">GPSPositioning/@latitude</mpqf:ReqField>
      <mpqf:ReqField
typeName="longitude">GPSPositioning/@longitude</mpqf:ReqField>
    </OutputDescription>
      <QueryCondition>

<EvaluationPath>/MovieBox/TrackBox/ItemMetaBox/JPSearchCore</EvaluationPath>
          <Condition xsi:type="mpqf:Equal">
            <mpqf:DateTimeField>CreationDate</mpqf:DateTimeField>
            <mpqf:DateTimeValue>2009-10-07T08:46:45</mpqf:DateTimeValue>
          </Condition>
      </QueryCondition>
  </InputQuery>
</JPEGQuery>
```

8 JPSearch Part 4: Metadata embedded in image data (JPEG and JPEG 2000) file format

8.1 Basic structure and benefits

ISO/IEC 24800-4 specifies the JPSearch file format. It provides a mechanism for exchanging image data and their associated metadata to provide a benefit of metadata portability among various archive services. The JPSearch file format is designed as extensions of JPEG (ISO/IEC 10918) and JPEG 2000 (ISO/IEC 15444) file formats. They are fully compatible with JPEG and JPEG 2000 respectively, and provide additional functionality to carry associated metadata within a file. Figure 6 shows an overview of JPSearch file format (JPEG or JPEG 2000 compatible). It contains several *JPSearchMetadata* blocks in a file. *JPSearchMetadata* block is a format-independent structure and has a role of container of various metadata instances. Each of them can have one or more *ElementaryMetadata* blocks inside. *ElementaryMetadata* block is a basic structure of the Part 4 specification. An *ElementaryMetadata* block stores an instance of a certain metadata schema by a certain author. The schema used and description about metadata creation is recorded in the ElementaryMetada, so the user can easily access to the expected metadata among various metadata instances. Multiple instances for the same schema can be instantiated simultaneously to allow the use of various metadata schemas and/or the social tagging by several users.

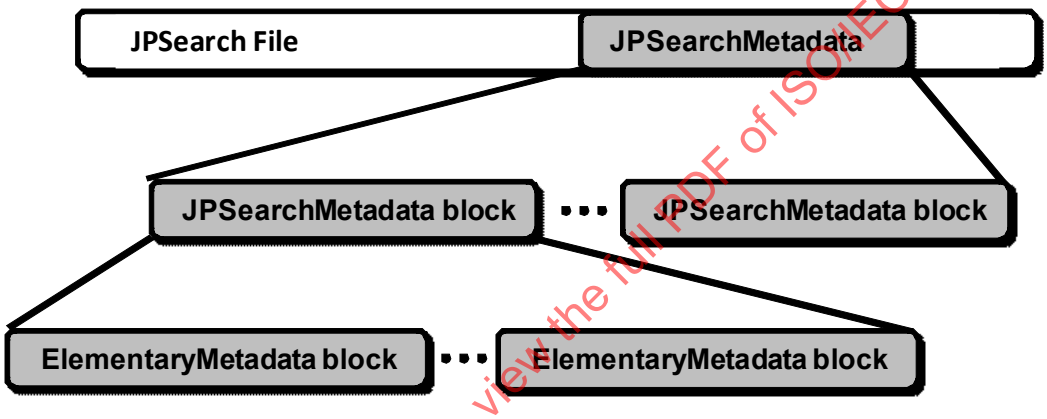

Figure 6 — Concept of JPSearch file format

A JPSearch Part 4 compliant file should contain at least one elementary metadata block whose *SchemaAndIdentifier* is "JPSearch:schema:coremetadata", which means that the block contains an instance of the JPSearch core metadata schema defined in JPSearch Part 2 specification so that any JPSearch compliant application can get basic metadata.

The benefit of the use of JPSearch file format can be summarized as follows:

- It allows metadata carriage along with content itself to avoid the lost of metadata which, in general, needs a lot of annotation tasks by human.
- It is completely compatible with corresponding existing file format so that any exisiting systems/tools/applications are fully applicable to JPSearch file format. Users are not forced to change their existing workflow.
- It can carry any kinds of metadata instances including user-defined local metadata. If the schema used inside is registered into JPSearch registration authority, the instances can enjoy the benefit to be understandable by other users.
- It allows multiple instantiation of metadata to support social tagging for the use of image in a community. Multiple instantiation of metadata of different schema is also available to use an image for various applications.

8.2 JPEG compatible file format

A JPSearch Metadata block can be stored in JPEG file format using the application marker segments, APP3. Multiple instantiation of APP3 block is allowed to store larger size metadata instance than the size limitation of APP3.

8.3 JPEG 2000 compatible file format

A JPSearch Metadata block can be stored in JPEG 2000 file format using UUID boxes with specific universal unique identifier. Since A JPEG 2000 file can have multiple JPEG 2000 contents inside, two different types of JPSearch Metadata blocks are specified, one is for globally applicable metadata, and the other is for locally applicable one. If the local metadata exists for a certain content inside, it overwrites the global one.

9 JPSearch Part 5: Data interchange format between image repositories

9.1 Basic structure and benefits

The flexibility within the metadata life cycle process is improved by embedding the metadata into the image raw data file format as specified in ISO/IEC 24800-4. However, the interchange of image data between JPSearch compliant systems remains an open issue. Reasons for such a need are manifold: consolidation of metadata generated on different systems, transferring data between system boundaries or synchronization of metadata and/or image data between repositories (e.g., between private and business platforms). For this purpose, ISO/IEC 24800-5 provides a data interchange format for the exchange of image collections and respective metadata between JPSearch compliant repositories.

The JPSearch data interchange format enables to easily and faithfully transfer data between different hardware and software system. In particular, it supports functions such as:

- Exchanging data between JPSearch repositories on different devices and platforms.
- Consolidating metadata generated on different systems.
- Transferring data to a newer and better system.
- Consolidating selected data to a centralized repository.
- Archiving data in a format which will survive current products.

In order to support these functions, ISO/IEC 24800-5 specifies two XML schemas, the JPSearch XML metadata interchange format schema, which acts as a container for metadata exchange in image repositories, and the JPSearch collection metadata schema, which allows exchanging collection metadata. Both schemas are introduced in the next sections.

9.2 JPSearch XML metadata interchange format schema

The JPSearch XML metadata interchange format schema specifies the schema that facilitates the interchange of XML metadata descriptions about images and collections. The `ImageRepository` element serves as the root element of the XML metadata interchange format schema. An example for the `ImageRepository` element is provided below:

```
<?xml version="1.0" encoding="iso-8859-1"?>
<ImageRepository xmlns="urn:jpeg:jpsearch:jpxif:2009"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:jpcs="urn:jpeg:jpsearch:schema:coremetadata:2009"
xmlns:jpcls="urn:jpeg:jpsearch:schema:collections:2009"
xsi:schemaLocation="urn:jpeg:jpsearch:jpxif:2009 24800-5-repository.xsd
urn:jpeg:jpsearch:schema:coremetadata:2009 24800-2-core.xsd
urn:jpeg:jpsearch:schema:collections:2009 24800-5-collections.xsd">
 <Image>
  <ImageData>
   <MediaUri>uncleben.jpg</MediaUri>
  </ImageData>
  <ImageMetadata>
   <JPSearchImageDescription>
    <jpcs:Identifier>uncleben</jpcs:Identifier>
```

```
    <jpcs:Creators>
     <jpcs:GivenName>Tester</jpcs:GivenName>
    </jpcs:Creators>
    <jpcs:CreationDate>2010-07-16T10:32:52</jpcs:CreationDate>
    <jpcs:ModifiedDate>2010-07-16T10:32:52</jpcs:ModifiedDate>
    <jpcs:Description>Image number 1</jpcs:Description>
    <jpcs:CollectionLabel>Family</jpcs:CollectionLabel>
    <jpcs:GPSPositioning latitude="12.0" longitude="12.0"/>
    <jpcs:RegionOfInterest>
     <jpcs:RegionLocator>
      <jpcs:Region dim="2">0 0 100 100</jpcs:Region>
     </jpcs:RegionLocator>
     <jpcs:ContentDescription/>
     <jpcs:ExternalDescription>
      <jpcs:TagName>aa</jpcs:TagName>
      <jpcs:LiteralValue>123412</jpcs:LiteralValue>
     </jpcs:ExternalDescription>
     <jpcs:ExternalDescription>
      <jpcs:TagName>aa</jpcs:TagName>
      <jpcs:StructuredValue fromNamespace="urn:mpeg:mpeg7:schema:2004"
xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004"
xsi:schemaLocation="urn:mpeg:mpeg7:schema:2004 M7v2schema.xsd">
       <mpeg7:Mpeg7>
        <mpeg7:DescriptionUnit xsi:type="mpeg7:MediaIdentificationType">
         <mpeg7:EntityIdentifier/>
        </mpeg7:DescriptionUnit>
       </mpeg7:Mpeg7>
      </jpcs:StructuredValue>
     </jpcs:ExternalDescription>
    </jpcs:RegionOfInterest>
    <jpcs:Width>640</jpcs:Width>
    <jpcs:Height>480</jpcs:Height>
   </JPSearchImageDescription>
  </ImageMetadata>
 </Image>
 <Image>
  <ImageData>
   <MediaUri>chieko.jpg</MediaUri>
  </ImageData>
  <ImageMetadata>
   <JPSearchImageDescription>
    <jpcs:Identifier>chieko</jpcs:Identifier>
    <jpcs:Creators>
     <jpcs:GivenName>Tester</jpcs:GivenName>
    </jpcs:Creators>
    <jpcs:CreationDate>2011-07-16T10:32:52</jpcs:CreationDate>
    <jpcs:ModifiedDate>2011-07-16T10:32:52</jpcs:ModifiedDate>
    <jpcs:Description>Image number 1</jpcs:Description>
    <jpcs:CollectionLabel>Family</jpcs:CollectionLabel>
    <jpcs:GPSPositioning latitude="12.0" longitude="12.0"/>
    <jpcs:RegionOfInterest>
     <jpcs:RegionLocator>
      <jpcs:Region dim="2">0 0 100 100</jpcs:Region>
     </jpcs:RegionLocator>
     <jpcs:ContentDescription/>
     <jpcs:ExternalDescription>
      <jpcs:TagName>aa</jpcs:TagName>
      <jpcs:LiteralValue>123412</jpcs:LiteralValue>
     </jpcs:ExternalDescription>
     <jpcs:ExternalDescription>
```

```
      <jpcs:TagName>aa</jpcs:TagName>
      <jpcs:StructuredValue fromNamespace="urn:mpeg:mpeg7:schema:2004"
xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004">
       <mpeg7:Mpeg7>
        <mpeg7:DescriptionUnit xsi:type="mpeg7:MediaIdentificationType">
         <mpeg7:EntityIdentifier/>
        </mpeg7:DescriptionUnit>
       </mpeg7:Mpeg7>
      </jpcs:StructuredValue>
     </jpcs:ExternalDescription>
    </jpcs:RegionOfInterest>
    <jpcs:Width>640</jpcs:Width>
    <jpcs:Height>480</jpcs:Height>
   </JPSearchImageDescription>
  </ImageMetadata>
 </Image>
</ImageRepository>
```

9.3 JPSearch collection metadata schema

The JPSearch collection metadata schema specifies the schema that facilitates the composition of XML metadata descriptions about image collections, for the purpose of information exchange between image repositories. An example is provided below:

```
<?xml version="1.0" encoding="iso-8859-1"?>
<Collections xmlns="urn:jpeg:jpsearch:schema:collections:2009"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:jpcs="urn:jpeg:jpsearch:schema:coremetadata:2009"
xsi:schemaLocation="urn:jpeg:jpsearch:schema:coremetadata:2009 24800-2-core.xsd
urn:jpeg:jpsearch:schema:collections:2009 24800-5-collections.xsd"
xsi:type="CollectionsType">
 <Collection>
  <Identifier>Col1</Identifier>
  <CreationDate>2009-07-16T10:32:52</CreationDate>
  <ModifiedDate>2009-07-16T10:32:52</ModifiedDate>
  <Description>The collection number 1</Description>
  <WithinCollectionID>Col2</WithinCollectionID>
  <WithinCollectionID>Col3</WithinCollectionID>
 </Collection>
 <Collection>
  <Identifier>Col2</Identifier>
  <CreationDate>2009-07-16T10:32:52</CreationDate>
  <ModifiedDate>2009-07-16T10:32:52</ModifiedDate>
  <Description>The collection number 2</Description>
 </Collection>
 <Collection>
  <Identifier>Col3</Identifier>
  <CreationDate>2009-07-16T10:32:52</CreationDate>
  <ModifiedDate>2009-07-16T10:32:52</ModifiedDate>
  <Description>The collection number 3</Description>
 </Collection>
</Collections>
```

Annex A
(informative)

Use Cases

This Annex provides several use cases in different application domains. The use cases are intended to help the reader to understand the scope of JPSearch. Each use case defines the input and output and refers to the parts needed to support the described functionality.

Use Case #1	**Searching images in stock photo collections for usage in magazine**
Description	The user wishes to buy a selection of images in order to illustrate a publication to be sold to consumers
Application Domains	Magazine editing, Trade journal publication, Corporate website/print publication/marketing collateral branding, etc. The magazine or publication editor may search for images given a story text or theme.
Input	• Entire text of the story. • Keywords + keyimages for query by example, e.g. “images that follow the theme of this cover image found”. • Image regions. • Relevance feedback on single items and on groups.
Output	• Collection of images and associated metadata including collection-level metadata.
Supporting functionality of each part	• Part 2 provides functionality to handle the metadata in distributed archives and also provides means to translate metadata among different domains. • Part 3 provides a uniform way to express the user query and to retrieve images from a number of different repositories without the need to know the way they handle the images and metadata internally.

Use Case #2	**Searching for and publishing authoritative themed sub-collections of images**
Description	The user has specific directives and procedures to annotate and manage themed collections of digital images, e.g., “Fake **Botticelli**Paintings”. The collections will then be accessed by third parties (e.g., professional users purchasing material for commercial use). In particular, this refers to creating sub-collections of themes that are not explicitly annotated in the repository.
Application Domains	Publishing, Archiving, Curator-ship (of museum, etc.), Scholarship
Issues – current problems and benefits	• Search is the first step in creating such a sub-collection; recall (completeness) is most important since the results are likely to be refined, annotated and cleaned up by the user, i.e., trade precision for recall. • Combination of search terms in words that are usually very specific e.g. author/location, as well as images to be used for query by example and/or image regions that could be used for a combined visual-semantic search.
User & Context	The collection curator or publisher has a new theme and wants to publish an authoritative database (sub-collection) of images in that theme.

Input	• Theme description. • Very specific metadata. • Images and image regions as exemplars.
Output	Collection of images and associated metadata
Supporting functionality of JPSearch	• Part 5 supports creating and managing collections and sub-collections. • Part 3 supports searching and retrieving images which share similar characteristics either text-based metadata or physical features (e.g. descriptors from ISO/IEC 15938-3 MPEG-7 Part 3), so that images without existing metadata can be retrieved.

Use Case #3	**Mobile Tourist Information**
Description	A user (tourist) is in an unfamiliar place, sees an interesting landmark and wants to know what it is. He takes a picture of the landmark on his mobile phone and sends it to a tourist information server that provides him back the information.
Application Domains	Tourism, Education
Issues – current problems and benefits	• This is an image retrieval scenario where an image is used to search for an object (the tourist landmark). - Supported by Part 3 QueryByExample. • The backend system needs to be able to match the query image against possible images (one or more) in its database. The problem is that there is no normalization in the query image, i.e., the user can be standing anywhere looking at the landmark and the angle and distance from the landmark may be very different from the reference image(s) in the database. The time of day (i.e., lighting, day/night, etc.) is also an issue. Not in the scope of JPSearch. • The object to be identified (signal) also has to be separated from its background (noise). • This search needs high precision. The system has to get the correct match at the top of the result list otherwise the wrong information will be sent to the user. Recall is irrelevant. • The system cannot just return a ranked list. It is better to return no answer (i.e., “don’t know”) then to give the wrong answer. • The system must return a result within a given time otherwise the context changes and the result is no longer relevant.
User & Context	Tourist or student wants to find out information about landmarks. May be extended to non-landmarks (e.g., botanical information in a park, etc.)
Input	Image
Output	Either “don’t know” or identify the object in the image
Supporting functionality of JPSearch	• Part 3 supports both sending images as a query and sending extracted feature as a query. Part 3 also supports limiting the format of output from the query (e.g. to names, text descriptions, etc.) as well as limiting the result set based on the matching score (threshold). • How the back-end engine identifies similar object is not in the scope of JPSearch.

Use Case #4	**Ad hoc search without time-consuming housekeeping tasks**
Description	Users wish to bring their private photo collection on their personal storage devices such as a memory card and to retrieve images using any terminal, i.e., computers in friends' homes, by connecting the devices to the terminal.
Application Domains	Personal or enterprise photo library
Issues – current problems and benefits	• There is no standardized way to exchange the metadata embedded in the picture data. This results in a lack of metadata portability although its creation cost is extremely high in general. • A user can plug-in his memory card to a library system on any computer. The library system provides immediately image retrieval function without performing indexing processes involving feature extraction and text annotation. • The system is also expected to offer automatic content categorization mechanism to assist photo browsing. • These search-related functionalities are offered not only among the private photos but also among the integrated ad-hoc database.
User & Context	The consumer who wants to bring his private photo data with him.
Input	Not Applicable. A conformant indexing system shall provide the file (or a standardized exchange format compliant code-stream) creation function from pure resource (image or collection of images) and its associated metadata.
Output	Not Applicable.
Supporting functionality of each part	• Part 4 provides a standardized file format with embedded metadata within the resource (image file of JPEG/JPEG 2000 format). • Part 5 provides a standardized data exchange format for a collection of images with metadata. • Part 2 provides a core metadata schema through which consistent understanding of metadata entries are guaranteed. • Part 2 also provides a translation rule declaration language, so that metadata based on different schema can be understood.

Use Case #5	**Rights clearance to publish a compliant business document**
Description	Business documents are often circulated in a company and sometimes their usage conditions are missing. This results in a critical business problem especially if it contains intellectual property of a 3rd party. Users should be able to check that the figures in their business documents are compliant to the usage conditions.
Application Domains	Creation of business documents
Issues – current problems and benefits	• Allow tracking of the figure creation process, i.e., a user/machine can understand from where components of the figure come. • The usage conditions (rights information) for each component are associated as metadata. They may also be embedded inside the final image or figure.

User & Context	Business document creators
Input	Any image or graphic used in a business document
Output	Rights information about the components used in the figure
Supporting functionality of each part	Part 2 provide right description so that the rights related information can be described based on any existing Intellectual Property Management and Protection (IPMP) standards.

Use Case #6	**Tracking a physical object creation process using a temporal series of photos**
Description	In several countries/regions, archiving of the huge amount of photos capturing the construction of a building is mandatory (by law or contract). Thus the user has a temporal series of photos which capture a certain object and the user can check what happened to the object and when it happened. But it is very hard to retrieve these photos in an efficient way.
Application Domains	Production process validation
User & Context	Architects, Product owners
Input	• A series of photos with evaluation point descriptions • An image with ROI. • A pair of photos or photo clusters.
Output	• A set of temporal clusters. Each of the group consists of similar photos from the view point of identified evaluation criteria. • An image where the specified changes are found • Differentiated regions.
Supporting functionality of JPSearch	• Part 2 provides the mechanism to annotate the images with structured metadata. External metadata schemas can be used for this task, as those describing a production process. • Part 3 specifies a query language which provides methods for metadata-based filtering. • Part 4 provides simple and interoperable mechanism to carry metadata with image.

Use Case #7	**Matching images between collections for synchronization**
Description	Consumers and other users of digital images end up with a large collection of images stored on multiple computers, laptops, external drives, portable USB drives, portable photo players, photo sharing websites, photo printing websites, mobile phones, etc. They upload new images to any subset of these. They organize parts of their collection independently. They annotate on some platforms. Consumers and other users of digital images thus end up with a large collection of images stored on multiple platforms. They need their collection to be synchronized across all platforms including file synchronization, collection structure and metadata synchronization and image metadata synchronization. Given an image on one platform they want to identify the matching image on another platform in order that synchronization can be performed. Also, images are edited and enhanced on different platforms, these different versions need to be reconciled so the user does not repeat work, or create inconsistencies.

	Consumers also typically will upgrade their image management application from time to time, or will have to reinstall the application when moving to a new computer. The consumer may have invested heavily into annotating or otherwise adding metadata to images and collections of images, including ordering, clustering, etc. Thus they need a way to move their metadata along with the image data (similar to synchronization) to the new application. Consumer images, e.g., of family, are important to the consumer for their entire life and likely to future generations. As such, it is important to be able to archive images along with metadata in a format that is independent of current products.
Application Domains	Consumer imaging, Publishing, Archiving
Issues – current problems and benefits	• Different storage platforms (the PC, the web-based photo site, camera card) need to be synchronized (or transferred or archived) even while keeping different organization structures. • Metadata added on one platform should be available for searching on any platform (whether current or in the future).
User & Context	Any user of digital images who stores, edits or annotates them on multiple platforms
Input	The user's collection on multiple platforms
Output	Synchronized collection on multiple platforms, or upgraded platform, or archive.
Supporting functionality of JPSearch	• Part 2 provides the mechanism to identify the schema used and translate the metadata instance to understandable description. • Part 3 provides the way to access an archive to pull out relevant data among several different archives. • Part 4 provides simple and interoperable mechanism to carry metadata with image. • Part 5 is provided to support synchronization and exchange of images and metadata among multiple repositories. • JPSearch is independent from any specific device or system.
Use Case #8	**Social metadata updating and sharing of images for searching**
Description	A user, Kim, takes many pictures with people in them. He uses an automatic face recognizer to annotate the pictures with the names of the people in it. However, there are faces that his system does not know even though they occur many times (i.e., not just incidental "noise"). This lack of information may be because Kim does not know the face, or has not entered the information. The image collection and metadata is shared with his family, colleagues and friends (which form his social circle(s)). Many of them also use face recognizers and annotation programs. By pooling their knowledge of faces and names, faces can be recognized and annotated even if Kim does not have the information in his system.
Application Domains	Consumer imaging; Professional imaging
Issues – current problems and benefits	• Data sharing standards (both the images and the metadata). If the same face recognizer is used, then only metadata (e.g., the face feature vector) has to be shared. If different systems are used, then the image has to be shared as well. • Privacy issues for data and metadata, i.e., can the same objectives be accomplished without compromising privacy issues.

User & Context	Generic user, part of a social circle, willing to share images, wants privacy as much as possible
Input	Image collection plus metadata
Output	Same image collection but more comprehensive metadata
Supporting functionality of JPSearch	• Part 2 provides the mechanism to identify the schema used and translate the metadata instance to understandable description including additional tagging information. • Part 3 provides the way to access an archive to pull out relevant data among several different archives. • Part 4 provides simple and interoperable mechanism to carry metadata with imagePart 5 supports creating collection from a certain set of images.

Use Case #9	**Image search in the medical domain**
Description	Much pathology has visual symptoms that are essential for doctors doing diagnosis. There are cases where the visual symptoms are not familiar and the doctor would like to consult visual reference material (an atlas, or previously diagnosed reference cases). The user (a doctor in a hospital clinic) searches them, for the best matches to the symptoms and retrieves case histories (including other images, metadata, text, etc.) to aid his/her diagnosis.
Application Domains	Computer Aided Diagnosis, Radiology, Pathology, Forensics. The doctor wants to retrieve the relevant medical images and associated medical history to make his diagnosis
Input	• Whole medical images or image regions • Iterative relevance feedback on previous search results • Keywords + key-images for query by example, query by ROI or both
Output	Ranked list of medical images and associated information including EHR (Electronic Health Records), image metadata, etc.
Supporting functionality of JPSearch	• Part 2 provides interoperable access to different repositories where different standards are used. • Part 3 provides text and context-based search if the archive supports various visual feature metadata using for an example MPEG-7. • Part 4 allows to record diagnosis history in visual contents to provide other doctors the reference image with useful medical information

Use Case #10	**Open federated repositories**
Description	Digital archives are going to set up access to part of their databases for being consulted from cultural and institutional search interfaces. The data provider manages the database or collections locally and provides a standardized protocol to consult the data. The service provider will manage the added value services (search and retrieval and presentation). The service provider also will harvests the collection and will provide the user interface respecting the middleware specifications. The upcoming use case depicts contents that self announce: JPSearch content could be OAI compliant allowing retrieval with low cost process and performance improvement.