Oracle® *inter*Media

User's Guide

10*g* Release 2 (10.2)

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Oracle *inter*Media is a feature that enables Oracle Database to store, manage, and retrieve images, audio, video, or other heterogeneous media data in an integrated fashion with other enterprise information. Oracle *inter*Media extends Oracle Database reliability, availability, and data management to multimedia content in traditional, Internet, electronic commerce, and media-rich applications.

Oracle *inter*Media User's Guide, 10*g* Release 2 (10.2)

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Preface

This guide describes how to use Oracle *inter*Media ("*inter*Media").

Oracle *inter*Media ships with Oracle Database Standard and Enterprise Editions.

For information about Oracle Database and the features and options that are available to you, see *Oracle Database New Features*.

Audience

This guide is for application developers and database administrators who are interested in storing, retrieving, and manipulating audio, image, video, and heterogeneous media data in a database, including developers of audio, heterogeneous media data, image, and video specialization options.

If you are interested in an overview and how to use Oracle *inter*Media, see Chapter 1 for general introductory information.

For information about medical imaging, see Chapter 5.

For information about image metadata handling, see Chapter 5.

For tuning tips on storing media in the database, see Chapter 8.

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Related Documents

Note: For information added after the release of this guide, refer to the online `README.txt` file under your *`<ORACLE_HOME>`* directory. Depending on your operating system, this file may be in:

`<ORACLE_HOME>``/ord/im/admin/README.txt`

Please see your operating system-specific installation guide for more information.

For more information about using *inter*Media in a development environment, see the following documents in the Oracle Database software documentation set:

- *Oracle interMedia Reference*
- *Oracle Call Interface Programmer's Guide*
- *Oracle Database Application Developer's Guide - Fundamentals*
- *Oracle Database Application Developer's Guide - Large Objects*
- *Oracle Database Concepts*
- *Oracle Database PL/SQL User's Guide and Reference*
- *Oracle Database Java Developer's Guide*

For more information about using JDBC, see *Oracle Database JDBC Developer's Guide and Reference*.

For more information about using XML, see *Oracle XML DB Developer's Guide*.

For reference information on both Oracle *inter*Media Java Classes and Oracle *inter*Media Java Classes for Servlets and JSP in Javadoc format, see the following Oracle API documentation (also known as Javadoc): *Oracle interMedia Java Classes API Reference* and *Oracle interMedia Java Classes for Servlets and JSP API Reference*. The API documentation is available in the Oracle Database 10*g* Release 2 (10.2) Online Documentation Library and also from the documentation section of the Oracle Technology Network (OTN) Web site at

`http://www.oracle.com/technology/documentation/`

For information about using Oracle Application Server 10*g* Multimedia Tag Library for JSP, see *Oracle Application Server 10g Multimedia Tag Library for JSP User's Guide and Reference* in the Oracle Application Server 10*g* Online Documentation Library.

For more information about Java, see the API documentation provided by Sun Microsystems at

`http://java.sun.com/docs`

For more information about the Java Advanced Imaging (JAI) API, see the following Web site (which is maintained by Sun Microsystems)

`http://java.sun.com/products/java-media/jai/index.html`

Printed documentation is available for sale in the Oracle Store at

`http://oraclestore.oracle.com/`

To download free release notes, installation documentation, white papers, or other collateral, please visit the Oracle Technology Network (OTN). You must register online before using OTN; registration is free and can be done at

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Conventions

In this guide, Oracle *inter*Media is sometimes referred to as *inter*Media.

In examples, an implied carriage return occurs at the end of each line, unless otherwise noted. You must press the Return key at the end of a line of input.

Although Boolean is a proper noun, it is presented as boolean in this guide when its use in Java code requires case-sensitivity.

The following conventions are also used in this guide:

Convention	Meaning
. . .	Vertical ellipsis points in an example mean that information not directly related to the example has been omitted.
. . .	Horizontal ellipsis points in statements or commands mean that parts of the statement or command not directly related to the example have been omitted.
boldface text	Boldface text indicates a term defined in the text.
italic text	Italic text is used for emphasis, book titles, variable names, and user-supplied information.
< >	Angle brackets enclose user-supplied names.
[ ]	Brackets enclose optional clauses from which you can choose one or none.

Changes to This Guide

The following substantive changes have been made to this guide since release 10.1:

- Added Section 1.5.3, "Metadata in Images" in Chapter 1 on the new Metadata and DICOM features.
- Revised the PL/SQL Web Toolkit Photo Album sample application and the *inter*Media Code Wizard application in Chapter 3 to add support for the new Metadata feature.
- Revised the IMExample Java Sample Application in Chapter 4 to add support for the new Metadata feature.
- Added Chapter 5 on the new Metadata and DICOM features.
- Removed outdated material about products, features, and methods that Oracle *inter*Media no longer supports.
- Revised material as needed to reflect minor bug fixes and ongoing improvements.

1

Introduction to Oracle *inter*Media

Oracle *inter*Media ("*inter*Media") is a feature that enables Oracle Database to store, manage, and retrieve images, audio, video, or other heterogeneous media data in an integrated fashion with other enterprise information. Oracle *inter*Media extends Oracle Database reliability, availability, and data management to multimedia content in traditional, Internet, electronic commerce, and media-rich applications. Oracle *inter*Media does not control media capture or output devices; this function is left to application software.

*inter*Media manages multimedia content by providing the following:

- Storage and retrieval (see Section 1.7.1, Section 1.8, and Section 1.9)
- Media and application metadata management (see Section 1.3, Section 1.4, Section 1.5, and Section 1.6)
- Support for popular formats (see the audio, image, and video data format appendixes in *Oracle interMedia Reference*)
- Access through traditional and Web interfaces (see Section 1.9)
- Querying using associated relational data (see Section 1.7)
- Querying using extracted metadata (see Section 1.5.4)
- Querying using media content with optional specialized indexing (see Section 1.7.2)

*inter*Media provides media content services to Oracle JDeveloper, Oracle Content Management SDK, Oracle Application Server Portal, and Oracle partners. This guide describes the management and integration of audio, image, and video, or other heterogeneous media data with other Oracle tools and software, as well as with third-party tools and software.

1.1 Object Relational Technology

Oracle Database is an object relational database management system. This means that in addition to its traditional role in the safe and efficient management of relational data, it provides support for the definition of object types, including the data associated with objects and the operations (methods) that can be performed on them. Object relational technology includes integral support for BLOBs to provide the basis for adding complex objects, such as digitized audio, image, and video, to databases.

Within *inter*Media, audio data characteristics have an object relational type known as **ORDAudio**, heterogeneous data characteristics have an object relational type known as **ORDDoc**, image data characteristics have an object relational type known as **ORDImage**, and video data characteristics have an object relational type known as

ORDVideo. All four types store data source information in an object relational type known as **ORDSource**.

See the following references for extensive information about using BLOBs and BFILEs:

- *Oracle Database Application Developer's Guide - Large Objects*
- *Oracle Database Concepts* -- see the chapter on Object Types.

See *Oracle interMedia Reference* for more information about the multimedia object types and methods, and for more information about the ORDSource object type and methods.

1.2 *inter*Media Capabilities

The capabilities of *inter*Media include the storage, retrieval, management, and manipulation of multimedia data managed by Oracle Database.

Multimedia applications have common and unique requirements. *inter*Media object types support common application requirements and can be extended to address application-specific requirements. With *inter*Media, multimedia data can be managed as easily as standard attribute data.

*inter*Media is accessible to applications through both relational and object interfaces. Database applications written in Java, C++, or traditional third-generation languages (3GLs) can interact with *inter*Media through modern class library interfaces, or PL/SQL and Oracle Call Interface (OCI).

*inter*Media supports storage of the popular file formats, including desktop publishing images, and streaming audio and video formats in databases. *inter*Media provides the means to add audio, image, and video, or other heterogeneous media columns or objects to existing tables, and insert and retrieve multimedia data. This enables database designers to extend existing databases with multimedia data, or to build new end-user multimedia database applications. *inter*Media developers can use the basic functions provided here to build specialized multimedia applications.

*inter*Media uses object types, similar to Java or C++ classes, to describe multimedia data. These object types are called ORDAudio, ORDDoc, ORDImage, and ORDVideo. An instance of these object types consists of attributes, including metadata and the media data, and methods. **Media data** is the actual audio, image, or video, or other heterogeneous media data. **Metadata** is information about the data, such as object length, compression type, or format. **Methods** are procedures that can be performed on the object, such as getContent( ) and setProperties( ).

The *inter*Media objects have a common media data storage model. The media data component of these objects can be stored in the database, in a BLOB under transaction control. The media data can also be stored outside the database, without transaction control. In this case, a pointer is stored in the database under transaction control, and the media data is stored in:

- File-based large object (BFILE)
- An HTTP server-based URL
- A user-defined source on a specialized media data server, or other server

Media data stored outside the database can provide a convenient mechanism for managing large, existing or new, media repositories that reside as flat files on erasable or read-only media. This data can be imported into BLOBs at any time for transaction control. Section 1.8 describes several ways of loading multimedia data into a database.

Media metadata is stored in the database under *inter*Media control. Whether media data is stored within or outside the database, *inter*Media manages metadata for all the media types and may automatically extract it for audio, image, and video. This metadata includes the following attributes:

- Storage information about audio, image, and video, or other heterogeneous media data, including the source type, location, and source name, and whether the data is stored locally (in the database) or externally
- Update time stamp information for audio, image, and video, or other heterogeneous media data
- Audio and video data description
- Audio, image, and video, or other heterogeneous media data format
- MIME type of the audio, image, and video, or other heterogeneous media data
- Audio characteristics: encoding type, number of channels, sampling rate, sample size, compression type, and play time (duration)
- Image characteristics: height and width, image content length, image content format, and image compression format
- Video characteristics: frame width and height, frame resolution, frame rate, play time (duration), number of frames, compression type, number of colors, and bit rate
- Extracted metadata in XML, such as the director or producer of a movie

In addition to metadata extraction methods, a minimal set of image manipulation methods is provided. For images, this includes performing format conversion, page selection, and quantize operations, and compression, scaling, cropping, copying, flipping, mirroring, rotating, and adjusting the gamma (brightness) of images.

*inter*Media is extensible. It supports a base set of popular audio, image, and video data formats for multimedia processing that also can be extended, for example, to support additional formats, new digital compression and decompression schemes (**codecs**), data sources, and even specialized data processing algorithms for audio and video data. See Chapter 7 for more information about extending *inter*Media.

*inter*Media is a building block for various multimedia applications rather than being an end-user application. It consists of object types along with related methods for managing and processing multimedia data. Some example applications for *inter*Media are:

- Repositories for digital check images
- Electronic health records, including DICOM medical images
- Call centers (for example, 911 and product call centers)
- Physical asset inventories
- Distance learning and online learning
- Real estate marketing
- Stock photography archives (for example, digital art galleries and professional photographers)
- Document imaging archives
- Financial news service customer information
- Web publishing

- Audio and video Web stores

1.3 Audio Concepts

This section contains information about digitized audio concepts and using the ORDAudio object type to build audio applications or specialized ORDAudio objects.

1.3.1 Digitized Audio

ORDAudio integrates the storage, retrieval, and management of digitized audio data in a database.

Audio may be produced by an audio recorder, an audio source such as a microphone, digitized audio, other specialized audio recording devices, or even by program algorithms. Audio recording devices take an analog or continuous signal, such as the sound picked up by a microphone or sound recorded on magnetic media, and convert it into digital values with specific audio characteristics such as format, encoding type, number of channels, sampling rate, sample size, compression type, and audio duration.

1.3.2 Audio Components

Digitized audio consists of the audio data (digitized bits) and attributes that describe and characterize the audio data. Audio applications sometimes associate application-specific information, such as the description of the audio clip, date recorded, author or artist, and so forth, with audio data by storing descriptive text in an attribute or column in the database table.

The audio data can have different formats, encoding types, compression types, numbers of channels, sampling rates, sample sizes, and playing times (duration) depending upon how the audio data was digitally recorded. ORDAudio can store and retrieve audio data of any supported data format. ORDAudio can automatically extract metadata from audio data of a variety of popular audio formats. ORDAudio can also extract application attributes and store them in the comments field of the object in XML form. See *Oracle interMedia Reference* for a list of supported data formats from which ORDAudio can extract and store attributes and other audio features. ORDAudio is extensible and can be made to recognize and support additional audio formats.

The size of digitized audio (number of bytes) tends to be large compared to traditional computer objects, such as numbers and text. Therefore, several encoding schemes are used that squeeze audio data into fewer bytes, thus putting a smaller load on storage devices and networks.

1.4 ORDDoc or Heterogeneous Media Data Concepts

This section contains information about heterogeneous media data concepts and using the ORDDoc object type to build applications or specialized ORDDoc objects.

1.4.1 Digitized Heterogeneous Media Data

ORDDoc integrates the storage, retrieval, and management of heterogeneous media data in a database.

The ORDDoc type can store any heterogeneous media data including audio, image, and video data in a database column. Instead of having separate columns for audio, image, text, and video objects, you can use one column of ORDDoc objects to represent all types of multimedia.

1.4.2 Heterogeneous Media Data Components

Heterogeneous media data components consist of the data (digitized bits) and attributes that describe and characterize the heterogeneous media data.

Heterogeneous media data can have different formats, depending upon the application generating the media data. *inter*Media can store and retrieve media data of any supported data format. The ORDDoc type can be used in applications that require you to store different types of heterogeneous media data (such as audio, image, video, and any other type of media data) in the same column so you can build a common metadata index on all the different types of media data. Using this index, you can search across all the different types of heterogeneous media data. Note that you cannot use this same search technique if the different types of heterogeneous media data are stored in different types of objects, in different columns of relational tables.

ORDDoc can automatically extract metadata from data of a variety of popular audio, image, and video data formats. ORDDoc can also extract application attributes and store them in the comments attribute of the object in XML form. See *Oracle interMedia Reference* for a list of supported data formats from which *inter*Media can extract and store attributes. ORDDoc is extensible and can be made to recognize and support other heterogeneous media data formats.

1.5 Image Concepts

This section contains information about digitized image concepts and using the ORDImage object type to build image applications or specialized ORDImage objects.

1.5.1 Digitized Images

ORDImage integrates the storage, retrieval, and management of digitized images in a database.

ORDImage supports two-dimensional, static, digitized raster images stored as binary representations of real-world objects or scenes. Images may be produced by a document or photograph scanner, a video source such as a digital camera or VCR connected to a video digitizer or frame grabber, other specialized image capture devices, or even by program algorithms. Capture devices take an analog or continuous signal such as the light that falls onto the film in a camera, and convert it into digital values on a two-dimensional grid of data points known as pixels. Devices involved in the capture and display of images are under application control.

1.5.2 Image Components

Digitized images consist of the image data (digitized bits) and attributes that describe and characterize the image data. Image applications sometimes associate application-specific information, such as the name of the person pictured in a photograph, description of the image, date photographed, photographer, and so forth, with image data by storing this descriptive text in an attribute or column in the database table.

The image data (pixels) can have varying depths (bits per pixel) depending on how the image was captured, and can be organized in various ways. The organization of the image data is known as the data format. ORDImage can store and retrieve image data of any data format. ORDImage can process and automatically extract properties of images of a variety of popular data formats. See *Oracle interMedia Reference* for a list of supported data formats for which ORDImage can process and extract metadata. In addition, certain foreign images (formats not natively supported by ORDImage) have limited support for image processing. See *Oracle interMedia Reference* for more information.

The storage space required for digitized images can be large compared to traditional attribute data such as numbers and text. Many compression schemes are available to squeeze an image into fewer bytes, thus reducing storage device and network load. Lossless compression schemes squeeze an image so that when it is decompressed, the resulting image is bit-for-bit identical with the original. Lossy compression schemes do not result in an identical image when decompressed, but rather, one in which the changes may be imperceptible to the human eye. As compared with lossless schemes, lossy schemes generally provide higher compression.

Image interchange format describes a well-defined organization and use of image attributes, data, and often compression schemes, allowing different applications to create, exchange, and use images. Interchange formats are often stored as disk files. They may also be exchanged in a sequential fashion over a network and be referred to as a **protocol**. There are many application subdomains within the digitized imaging world and many applications that create or utilize digitized images within these. ORDImage supports storage and retrieval of all image data formats, and processing and attribute extraction of many image data formats (see *Oracle interMedia Reference*).

1.5.3 Metadata in Images

Oracle Database 10*g*, Release 2 adds an image metadata feature to *inter*Media. The Metadata feature enhances the current behavior of the *inter*Media ORDImage object type by adding the ability to read (or extract) and write (or embed) application metadata in images. In addition, this feature adopts a standard way to represent metadata when it is separate from an image file. Metadata can be stored in a database, indexed, searched, and made available to applications using the standard mechanisms of Oracle Database.

See Chapter 5 for more information about the Metadata feature.

Oracle Database 10*g*, Release 2 also adds the Digital Imaging and Communications in Medicine (DICOM) feature to *inter*Media. The DICOM feature enhances the current behavior of the *inter*Media ORDImage object type by allowing *inter*Media to recognize standalone DICOM objects and extract a subset of embedded DICOM attributes relating to patient, study, and series.

See Chapter 5 for more information about the DICOM feature.

1.5.4 Metadata Extraction

*inter*Media provides the ability to extract content and format metadata from media sources (audio and video files), and collects and organizes this metadata as an XML formatted CLOB. Once metadata has been extracted and stored, you can index the metadata for powerful full text and thematic media searches using Oracle Text. Thus, the database can be queried to locate the media data based on the metadata extracted from the media. See the setProperties( ) method in *Oracle interMedia Reference* for more information.

1.5.5 Image Processing

*inter*Media supports image processing, such as image format transcoding, image cutting, image scaling, and generating thumbnail images. In addition, specifically when the destination image file format is RAW Pixel (RPIX) format or Microsoft Windows Bitmap (BMPF) image format, *inter*Media supports a variety of operators for changing the format characteristics. See *Oracle interMedia Reference* for more information.

1.5.6 Content-Based Retrieval of Images

Content-based retrieval of images with extensible indexing is supported for image matching. An overview of the benefits of content-based retrieval is described in Chapter 6 along with how content-based retrieval works, including definitions and explanation of the visual attributes (color, texture, shape, and location) and why you might emphasize specific attributes in certain situations. In addition, the use of indexing to improve search and retrieval performances is described in Section 6.4 in that chapter.

Note: All *inter*Media features are available with the Standard Edition of Oracle Database, except image indexing, which uses the ORDImageSignature object. The image indexing feature requires bit-mapped indexing, which is available only when you install the Enterprise Edition of Oracle Database.

1.5.7 SQL/MM Still Image Standard Support

*inter*Media also provides support for the first edition of the ISO/IEC 13249-5:2001 SQL MM Part5:StillImage standard (commonly referred to as the SQL/MM Still Image standard), which includes these object relational types for image characteristics: SI_StillImage, SI_AverageColor, SI_Color, SI_ColorHistogram, SI_FeatureList, SI_PositionalColor, and SI_Texture.

The following ORDImage features are not specified by the SQL/MM Still Image Standard, and therefore are not available for StillImage objects:

- Storing image data outside the database
- Image processing operations (such as scaling up, compressing, and so on) that are specific to ORDImage
- Java client API

In addition, the following image-matching features are not specified by the SQL/MM Still Image Standard, and therefore are not available for StillImage objects:

- Image matching based on shape
- Indexing (averagecolor, texture, positionalcolor, and colorhistogram)

Finally, the SI_Score methods do not provide the same performance as the *inter*Media ORDImageSignature methods for image matching.

See *Oracle interMedia Reference* for more information about the SQL/MM Still Image Standard object types. The remainder of this chapter applies to the ORDAudio, ORDVideo, ORDDoc, ORDImage, and ORDSource object types.

1.6 Video Concepts

This section contains information about digitized video concepts and using ORDVideo to build video applications or specialized ORDVideo objects.

1.6.1 Digitized Video

ORDVideo integrates the storage, retrieval, and management of digitized video data in a database.

Video may be produced by a video recorder, a video camera, digitized animation video, other specialized video recording devices, or even by program algorithms. Some video recording devices take an analog or continuous signal, such as the video picked up by a video camera or video recorded on magnetic media, and convert it into digital values with specific video characteristics such as format, encoding type, frame rate, frame size (width and height), frame resolution, video length, compression type, number of colors, and bit rate.

1.6.2 Video Components

Digitized video consists of the video data (digitized bits) and the attributes that describe and characterize the video data. Video applications sometimes associate application-specific information, such as the description of the video training tape, date recorded, instructor's name, producer's name, and so forth, within the video data.

The video data can have different formats, compression types, frame rates, frame sizes, frame resolutions, playing times, compression types, number of colors, and bit rates depending upon how the video data was digitally recorded. ORDVideo can store and retrieve video data of any supported data format. ORDVideo can:

- Automatically extract metadata from video data of a variety of popular video formats
- Extract application attributes and store them in the comments attribute of the object in XML form

  See *Oracle interMedia Reference* for a list of supported data formats from which *inter*Media can extract and store attributes and other video features/
- Be made to recognize and support additional video formats (because it is extensible)

The size of digitized video (number of bytes) tends to be large compared to traditional computer objects, such as numbers and text. Therefore, several encoding schemes are used that squeeze video data into fewer bytes, thus putting a smaller load on storage devices and networks.

1.7 Multimedia Storage and Querying

Media can be stored in *inter*Media object types, or directly in BLOBs or BFILEs. You will realize the most benefit by storing media in *inter*Media object types. However, many of the features of *inter*Media are available to media stored in BLOBs and BFILEs using the relational interface.

The *inter*Media relational interface lets developers use static methods of *inter*Media object types with existing and new media stored in BLOBs and BFILEs. Specifically, developers can move media data between the local file system and the database; parse and extract the properties of the media data; and store these properties in an XMLType or an XML formatted CLOB, and optionally, in individual relational columns. Developers are not required to make changes to their existing application schema or to instantiate *inter*Media object types to take advantage of this relational interface. *inter*Media static methods can also be used to perform image processing operations such as cut, scale, compress, and convert format. See *Oracle interMedia Reference* for more information.

The ORDAudio, ORDDoc, ORDImage, and ORDVideo object types all contain an attribute of type ORDSource and methods for multimedia data source manipulation.

Note: ORDSource methods should not be called directly. Instead, invoke the wrapper method of the media object corresponding to the ORDSource method. This information is presented for users who want to write their own user-defined sources.

1.7.1 Storing Multimedia Data

*inter*Media can store multimedia data as an internal source within the database, under transactional control as a BLOB. It can also externally reference digitized multimedia data stored as an external source in an operating system-specific file in a local file system, as a URL on an HTTP server, or as a user-defined source on other servers, such as media servers. Although these external storage mechanisms are particularly convenient for integrating existing sets of multimedia data with a database, the multimedia data will not be under transactional control if it is not stored in the database.

BLOBs are stored in the database tablespaces in a way that optimizes space and provides efficient access. Large BLOBs may not be stored inline (BLOBs under 4 kilobytes can be stored inline) with other row data. Depending on the size of the BLOB, a locator is stored in the row and the actual BLOB (up to 4 gigabytes) is stored in other tablespaces. The locator can be considered a pointer to the actual location of the BLOB value. When you select a BLOB, you are selecting the locator instead of the value, although this is done transparently. An advantage of this design is that multiple BLOB locators can exist in a single row. For example, you might want to store a short video clip of a training tape, an audio recording containing a brief description of its contents, a syllabus of the course, a picture of the instructor, and a set of maps and directions to each training center all in the same row.

Because BFILEs are not under the transactional control of the database, users could change the external source without updating the database, thus causing an inconsistency with the BFILE locator. See *Oracle Database Application Developer's Guide - Large Objects* and *Oracle Call Interface Programmer's Guide* for detailed information about using BLOBs and BFILEs.

*inter*Media ORDAudio, ORDDoc, ORDImage, and ORDVideo object types provide wrapper methods to do the following:

- Set the source of the data as local or external
- Modify the time an object was last updated
- Set information about the external source type, location, and name of the data
- Transfer data into or out of the database
- Obtain information about the local data content such as its length, location, or its handle to the BLOB, put the content into a temporary BLOB, or delete it
- Access source data by opening it, reading it, writing to it, trimming it, and closing it

1.7.2 Querying Multimedia Data

Once stored within a database, multimedia data can be queried and retrieved by using the various alphanumeric columns or object attributes of the table to find a row that contains the desired data. For example, you can select a video clip from the Training table where the course name is 'Oracle Database Concepts'.

Multimedia data can be queried by extracted metadata, by other relational table columns, and by content, such as image content-based retrieval with optional specialized indexing.

1.8 Loading Multimedia Data

Multimedia data can be managed best by Oracle Database. Your multimedia data should be loaded into the database to take advantage of its reliability, scalability, availability, and data management capabilities. To bulk load multimedia data into the database, you can use:

- SQL*Loader

  SQL*Loader is an Oracle utility that lets you load data, and in this case, multimedia data (LOB data), from external multimedia files into a table of a database containing *inter*Media object type columns.

- PL/SQL

  A procedural extension to SQL, PL/SQL is an advanced fourth-generation programming language (4GL) of Oracle. You can write PL/SQL procedures to load multimedia data from BLOB, file system, and URL media data sources into *inter*Media object type columns.

An advantage of using SQL*Loader is that it is easy to create and test the control file that controls your data loading operation. See Section 8.3 in Chapter 8 for a description of a sample control file. See also *Oracle Database Utilities* for more information.

An advantage of using PL/SQL scripts to load your data is that you can call methods as you load data to generate thumbnail images, or extract properties. See Section 8.3 in Chapter 8 for a description of a sample PL/SQL multimedia data load script. See also *PL/SQL User's Guide and Reference* for more information.

1.9 Accessing Multimedia Data

Applications access and manipulate multimedia data using SQL, PL/SQL, OCI, or Java through the object relational types OrdAudio, OrdDoc, OrdImage, and OrdVideo.

The following subsections describe ways in which applications, Oracle development tools, and third-party development tools can access multimedia data stored in the database using *inter*Media object types.

1.9.1 Oracle *inter*Media Java Classes

Oracle *inter*Media Java Classes enables Java applications on any tier (client, application server, or database) to manipulate and modify audio, image, and video data, or heterogeneous media data stored in a database. Oracle *inter*Media Java Classes makes it possible for Java database connectivity (JDBC) result sets to include both traditional relational data and *inter*Media media objects. This support enables applications to easily select and operate on a result set that contains sets of *inter*Media columns plus other relational data. These classes also enable access to object attributes and invocation of object methods. See *Oracle interMedia Java Classes API Reference* and *Oracle interMedia Java Classes for Servlets and JSP API Reference* for more information.

1.9.2 Streaming Content from Oracle Database

You can stream audio and video content stored in Oracle Database using an *inter*Media plug-in that supports a third-party streaming server, and deliver this content for play on a client that uses the browser-supported streaming player.

Oracle *inter*Media Plug-in for RealNetworks Streaming Servers

Oracle *inter*Media Plug-in for RealNetworks Streaming Server is a data source plug-in that enables RealNetworks Streaming Server to stream media data directly from Oracle Database to a media player client. The plug-in is installed with RealNetworks Streaming Server and configured and managed using the administration tool of the streaming server. The plug-in is format neutral; any format supported by the streaming server can be sourced by Oracle Database.

See *Oracle interMedia Plug-in for RealNetworks Streaming Servers Readme* for more information about this plug-in. Oracle *inter*Media Plug-in for RealNetworks Streaming Server can be downloaded from the Oracle *inter*Media Software section of the Oracle Technology Network Web site at

`http://www.oracle.com/technology/products/intermedia/index.html`

For more information about streaming servers from RealNetworks, see the RealNetworks Web site at

`http://www.realnetworks.com/`

Oracle *inter*Media Plug-in for Microsoft Windows Media Services

Oracle *inter*Media Plug-in for Microsoft Windows Media Services allows Microsoft Windows Media servers to stream multimedia content to a client directly from Oracle Database. This package also includes a Plug-in Property Page that can be accessed from the Windows Media Services Administrative interfaces. The Plug-in Property Page allows users to inspect, define, and edit the Plug-in mount points that map to media content in Oracle Database. The Plug-in mount points are used to configure the source URL of a server publishing point, from which a Microsoft Windows Media Player client requests media content stored in Oracle Database.

See *Oracle interMedia Plug-in for Microsoft Windows Media Services Readme* for more information about this plug-in. Oracle *inter*Media Plug-in for Microsoft Windows Media Services can be downloaded from the Oracle *inter*Media Software section of the Oracle Technology Network Web site at

`http://www.oracle.com/technology/products/intermedia/index.html`

1.9.3 Support for Web Technologies

Using *inter*Media support for Web technologies, you can easily integrate multimedia data into Web and Java applications. You can also store, retrieve, and manage rich media content in a database.

Oracle *inter*Media Java Classes for Servlets and JSP

Oracle *inter*Media Java Classes for Servlets and JSP facilitates the upload and retrieval of multimedia data stored in a database using the *inter*Media OrdAudio, OrdDoc, OrdImage, and OrdVideo object types. Oracle *inter*Media Java Classes for Servlets and JSP uses Oracle *inter*Media Java Classes to access data stored in the *inter*Media object types. However, Oracle *inter*Media Java Classes for Servlets and JSP can also be used to handle upload and retrieval of data using BLOBs directly.

The `OrdHttpResponseHandler` class facilitates the retrieval of multimedia data from a database and its delivery to a browser or other HTTP client from a Java servlet. The `OrdHttpJspResponseHandler` class provides the same features for JavaServer Pages (JSP).

> **Note:** JSP engines are not required to support access to the servlet binary output stream. Therefore, not all JSP engines support the delivery of multimedia data using the `OrdHttpJspResponseHandler` class. See *Oracle interMedia Java Classes for Servlets and JSP API Reference* for more information.

Form-based file uploading using HTML forms encodes form data and uploaded files in Post requests using the multipart/form-data format. The `OrdHttpUploadFormData` class facilitates the processing of such requests by parsing the Post data and making the contents of regular form fields and the contents of uploaded files readily accessible to a Java servlet or JavaServer Pages. The handling of uploaded files is facilitated by the `OrdHttpUploadFile` class, which provides an easy-to-use API that applications call to load audio, image, and video data, or heterogeneous media data into a database.

To read the Javadoc documentation that describes how to use Oracle *inter*Media Java Classes for Servlets and JSP, see the API documentation, which can be found in the Oracle Database 10*g* Online Documentation Library as *Oracle interMedia Java Classes for Servlets and JSP API Reference*.

Integration with Oracle Application Server Portal

Oracle Application Server Portal is used to create useful and appealing enterprise portals. A key feature of the Oracle Application Server Portal framework are portlets, which provide a convenient way to access any type of data including rich content such as images, audio, and video. Oracle Application Server Portal has components that give the developer a declarative way to create objects that capture, act upon, and display data from an Oracle table or view. These Oracle Application Server Portal components can be connected together to create Web applications that can be applied directly to enterprise databases. And, as *inter*Media objects are stored in Oracle tables, they can be included in the types of data available to Oracle Application Server Portal components.

Two Oracle Application Server Portal components are predefined: Forms and Reports. Oracle Application Server Portal contains wizards to help easily create a form to interact with the data in one or more database tables or views. The Forms component builds an appealing Web interface that lets users interact with data -- they can add, query, update, and delete information stored in the database. Rich content can be both uploaded and downloaded between the database and the portal framework by building a form on tables containing *inter*Media objects.

In addition to a form component, Oracle Application Server Portal offers a report component. The Reports component is used to display dynamic data in a columnar report format through a Web interface. Rich media content stored in tables can be downloaded, and again, wizards facilitate the creation of reports.

For more information about the use of Oracle Application Server Portal and *inter*Media, see *Oracle Application Server Portal Developer's Guide* in the Oracle Application Server 10*g* Online Documentation Library.

Integration with Oracle Application Development Framework Business Components

For rapid development of media-rich Web applications, Oracle offers developers a Java integrated development environment (IDE), Oracle JDeveloper, that maximizes developer productivity. Oracle JDeveloper enables developers to build multitier, component-based Internet applications in Java that use *inter*Media features to create visually attractive applications. Oracle Application Development Framework Business Components (ADF Business Components) is the component of JDeveloper that provides a set of intelligent software building blocks to manage common facilities. An Oracle *inter*Media/ADF Business Components integration package includes media-specific domain classes and a set of utilities. The domain classes are wrappers of the classes of Oracle *inter*Media Java Classes, and inherit all the underlying multimedia retrieval, upload, and manipulation methods. The domain classes support the ADF Business Components APIs and provide built-in integrated multimedia capabilities, while the utility classes support the retrieval, rendering, and uploading of multimedia content. Together, they provide a fully featured, integrated application development environment that enables a developer to create a wide variety of media-rich applications.

For more information, see the Oracle *inter*Media/ADF Business Components Interactive Demonstration in the *inter*Media Training section on the Oracle Technology Network Web site at

`http://www.oracle.com/technology/products/intermedia/index.html`

1.9.4 *inter*Media Custom DataSource and DataSink Classes for JMF 2.0/2.1

Oracle *inter*Media Custom DataSource and DataSink classes are an extension to the current Java Media Framework (JMF) version 2.0/2.1 developed by Sun Microsystems. This software allows a JMF application to upload and retrieve time-based media data stored in a database using *inter*Media OrdAudio and OrdVideo objects.

For more information about these classes, see *Oracle interMedia Custom DataSource and DataSink Classes Readme*. These classes can be downloaded from the Oracle *inter*Media Software section of the Oracle Technology Network Web site at

`http://www.oracle.com/technology/products/intermedia/index.html`

For more information about JMF, see the Sun Microsystems Web site at

`http://www.java.sun.com/jmf`

1.9.5 *inter*Media Support for Java Advanced Imaging (JAI)

Oracle *inter*Media Java Classes describes three types of stream objects, which provide interfaces to BLOB and BFILE data, that can be used by Java Advanced Imaging (JAI). These classes allow a JAI application to read and write image data stored in a database using *inter*Media OrdImage objects, or in BLOBs or BFILEs.

For more information about the *inter*Media Java classes for JAI stream objects, see *Oracle interMedia Java Classes API Reference*.

For more information about JAI, see the Sun Microsystems Web site at

`http://java.sun.com/products/java-media/jai/index.html`

1.10 *inter*Media Architecture

*inter*Media is a single, integrated feature that extends the database by storing, managing, and retrieving image, audio, and video data, and by supporting Web technologies for multimedia data.

The *inter*Media architecture defines the framework (see Figure 1–1) through which media-rich content as well as traditional data are supported in the database. This content and data can then be securely shared across multiple applications written with popular languages and tools, easily managed and administered by relational database management and administration technologies, and offered on a scalable database that supports thousands of users.

Figure 1–1 shows the *inter*Media architecture from a three-tier perspective: database tier -- Oracle Database; application server tier -- Oracle Application Server; and client tier -- thin and thick clients.

In the first tier, through the use of *inter*Media, Oracle Database holds rich content in tables along with traditional data. Through a database-embedded JVM, a server-side media parser is supported as well as an image processor. The media parser has object-oriented and relational interfaces, supports format and application metadata parsing, and can be extended to support additional formats. The image processor includes JAI and provides image processing for operations such as producing thumbnail-sized images, converting image formats, and image indexing and matching.

Using *inter*Media methods, import and export operations between the database and operating system files (external file storage) are possible. *inter*Media also supports special delivery types of servers, such as streaming content from a database. Using the *inter*Media Plug-ins for RealNetworks or Windows Media Services, the Helix Universal Server or Windows Media Streaming Server can stream multimedia data to a client directly out of the database using Real-Time Streaming Protocol (RTSP). In addition, third-party media processors such as speech recognition engines can run external to the database to process media stored in the database and return results to the database.

In the second or middle tier, Oracle Application Server provides access to *inter*Media through Oracle *inter*Media Java Classes, which enables Java applications on any tier (client, application server, or database) to access, manipulate, and modify audio, image, and video data stored in a database.

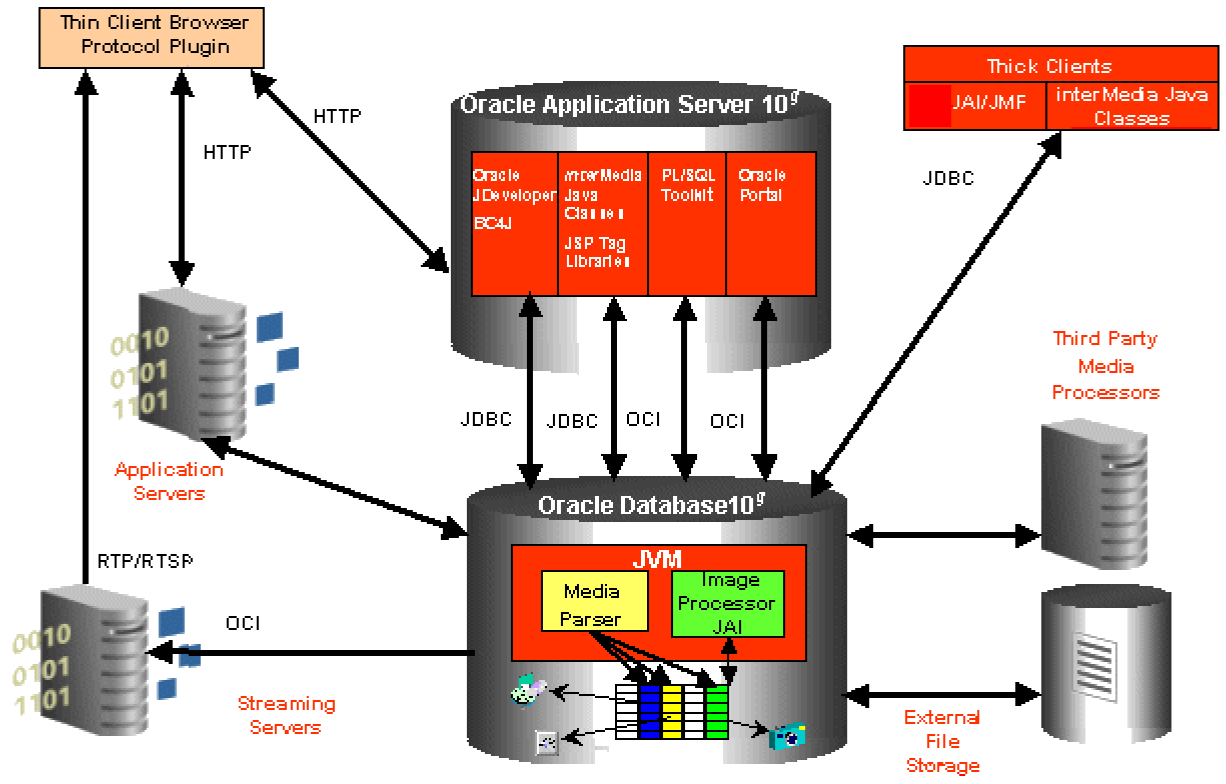
In addition, Oracle *inter*Media Java Classes for Servlets and JSP facilitates the upload and retrieval of multimedia data stored in a database using the *inter*Media OrdAudio, OrdDoc, OrdImage, and OrdVideo object types. Oracle *inter*Media Java Classes for Servlets and JSP can access data stored in the *inter*Media objects or BLOBs or BFILEs directly.

Developers can also use Oracle JDeveloper and *inter*Media to build media-rich Java applications quickly and easily using the *inter*Media/ADF Business Components integration package. *inter*Media rich content can also be easily and transparently incorporated into Oracle Portal forms and reports, which can then be published as portlets.

SQL developers familiar with the database can develop Web applications that use Oracle Application Server exclusively, and Oracle Database using the PL/SQL development environment. The steps include using the PL/SQL Gateway (mod_plsql) feature of the Oracle HTTP Server and the PL/SQL Web Toolkit. Web application developers can write PL/SQL servlets and PL/SQL server pages (PSP) that invoke PL/SQL procedures stored in the database through an Oracle Net connection and OCI.

In the third or client tier, the ability to perform local processing is supported through Oracle *inter*Media Java Classes, JAI, and JMF. JAI and JMF provide a set of APIs for media processing on the client and *inter*Media Java Classes supply direct access to all media types from the client.

Figure 1–1 Oracle interMedia Architecture



Oracle *inter*Media features available only on Oracle Technology Network (OTN) include the following:

- *inter*Media Plug-in for RealNetworks Streaming Servers, see Section 1.9.2
- *inter*Media Plug-in for Microsoft Windows Media Services, see Section 1.9.2
- *inter*Media Custom DataSource and DataSink classes JMF 2.0/2.1 (requires JMF 2.0 or higher), see Section 1.9.4

1.11 Extending Oracle *inter*Media

*inter*Media can be extended to support:

- Other external sources of media data not currently supported (other than BLOB, BFILE, or URL)
- Other media data formats not currently supported

Note: *inter*Media can store any format. However, it can only extract metadata and process (image only) media data for formats that are supported or known to *inter*Media. See the audio, image, and video data format appendixes in *Oracle interMedia Reference* for lists of supported formats.

- Audio and video data processing

For more information about extending *inter*Media, see Chapter 7.

2
Application Development

You can develop traditional client/server or two-tier applications, or you can develop multitier applications. Either method can then deploy Web applications to run on an application server tier, be tightly integrated with Oracle Database, and allow users access to the application from their desktop through a Web browser.

Using a complete development framework supported by class library interfaces, you can create production quality Oracle *inter*Media ("*inter*Media") applications for use in a production environment where users can interact with the application through either the standalone client interface or a Web browser. For Web applications, which are based on standards such as TCP/IP, HTTP, HTML, XML, and XHTML, this is all facilitated by rapid developments in the underlying technology. As key software components become more tightly integrated, developers' tasks to design, create, and manage Web applications become faster, easier, and simpler to implement.

Using either the object type interface or the relational interface, *inter*Media provides Internet support for Oracle Application Server and Oracle Database and authoring tools so you can quickly develop Web-based applications to upload to the database, retrieve from it, and manipulate multimedia data for delivery to Web browsers.

Oracle *inter*Media supports application development by:

- Providing class libraries that allow access (insert, update, and retrieve) and manipulation (process) of multimedia data stored in the database. Class libraries provide access to multimedia data stored in the database in the following ways:
  - Using Oracle *inter*Media Java Classes. Using the Java database connectivity (JDBC) interface, you can quickly develop applications for use on any tier (client, application server, or database) to manipulate and modify audio, image, and video data, or heterogeneous media data stored in a database. Oracle *inter*Media Java Classes makes it possible for JDBC result sets to include both traditional relational data and *inter*Media columns of object type media data, to easily select and operate on the result set, to access object attributes, and to invoke object methods. See *Oracle interMedia Java Classes API Reference* for more information. See Section 1.9.1 in Chapter 1 for more general information, and Section 2.3 for information about how to develop media-rich Java client applications using these Java classes.
  - Using Oracle *inter*Media Java Classes for Servlets and JSP. These additional Java classes support Web technologies. See *Oracle interMedia Java Classes for Servlets and JSP API Reference* for more information. See Section 1.9.3 in Chapter 1 for more general information, and Section 2.4 for information about how to develop media-rich Java-based Web applications using these Java classes. See Section 3.2.1 in Chapter 3 for an example of a Java servlet application, and Section 3.2.2 in that chapter for an example of a JavaServer Pages (JSP) application.

  - Using the *inter*Media/Oracle Application Development Framework Business Components (ADF Business Components) integration package, which includes the *inter*Media domain classes and a set of utilities. These classes are for use with Oracle JDeveloper, the Java integrated development environment (IDE) tool that supports the application framework (ADF Business Components) that enables you to build multitier, component-based Internet applications. See Section 1.9.3 in Chapter 1 and *Oracle JDeveloper 10g* help for more information.
  - Using Oracle *inter*Media Custom DataSource and DataSink classes. These classes are an extension to JMF version 2.0/2.1 that allows a JMF application to upload and retrieve time-based media data stored in a database using *inter*Media OrdAudio and OrdVideo object types. See Section 1.9.4 in Chapter 1 for more information.
  - Using Java Advanced Imaging (JAI) classes. Oracle *inter*Media Java Classes describes three types of stream objects, which provide interfaces to BLOB and BFILE data, that can be used by JAI. These classes allow a JAI application to read and write image data stored in a database using *inter*Media OrdImage objects, or in BLOBs or BFILEs. See Section 1.9.5 in Chapter 1 for more information.
  - Using Oracle Application Server 10*g* Multimedia Tag Library for JSP. This tag library is an extension of Oracle *inter*Media Java Classes for Servlets and JSP. It provides JSP tags that simplify retrieving and uploading media data from and to Oracle Database in multimedia JSP Web applications. See *Oracle Application Server 10g Multimedia Tag Library for JSP User's Guide and Reference* in the Oracle Application Server 10*g* Online Documentation Library for more information.
  - Using C++ and traditional 3GLs through modern class library interfaces.

- Using the PL/SQL Gateway (mod_plsql) feature of the Oracle HTTP Server and the PL/SQL Web Toolkit features of Oracle Application Server and Oracle Database to listen for browser requests, to execute stored PL/SQL procedures in the database using Oracle Net and Oracle Call Interface (OCI), and to generate an HTML page containing data and code for the response returned to the Web browser for display. As a Web application developer, you can write PL/SQL servlets and PL/SQL server pages (PSP) that invoke PL/SQL procedures stored in the database through an Oracle Net connection and OCI. See Section 2.2 for more information.
- Integrating Oracle development tools with tightly integrated components to enable you to quickly and easily develop applications that provide access to (insert, update, and retrieve) and manipulation (process) of multimedia data stored in the database for delivery to Web browsers and client applications. These development tools include:
  - Oracle Application Server Portal -- a simple browser-based environment for building and deploying enterprise information portlets (EIPs). An enterprise portal provides access to **portlets**, which are summarized versions of applications and Web content situated in defined regions of the Web page. Oracle Application Server Portal portlets execute PL/SQL stored procedures residing in the database, which in turn generate an HTTP response in the form of a generated HTML page. Oracle Application Server Portal contains two predefined components: Forms and Reports, which both support rich media content being uploaded or downloaded between the database and the portal framework form or report. See Section 1.9.3 in Chapter 1 for more information.

  - Oracle JDeveloper -- written 100% in Java, is the IDE tool that supports the application framework (Oracle Application Development Framework Business Components). An *inter*Media/ADF Business Components integration package includes the *inter*Media domain classes and a set of utilities. The domain classes are wrappers of Oracle *inter*Media Java Classes and inherit all the underlying multimedia retrieval, upload, and manipulation methods. The domain classes support the ADF Business Components APIs and provide built-in integrated multimedia capabilities, while the utility classes support the retrieval, rendering, and uploading of multimedia content. See Section 1.9.3 in Chapter 1 for more information.
  - Oracle Designer -- a tool used to manage software configuration management for controlling the evolution of an application from identification of components, through initiation, evaluation, authorization, development, and implementation. Oracle Designer can generate C++ classes that enable applications running on the client, on Oracle Application Server, or on Oracle Database to call *inter*Media methods.
  - Oracle Content Management SDK -- lets you create custom file system applications using XML and Java that use the features and capabilities of the database, and a variety of Web-based interfaces, such as Java servlets and JSP or executing SQL or calling stored PL/SQL procedures for execution in the transaction context of the database.
- Integration with third-party streaming media servers to allow dynamic and direct delivery of multimedia data stored in the database to a media player client. These third-party streaming servers include:
  - Oracle *inter*Media Plug-in for RealNetworks Server. This component is a data source plug-in that enables a RealNetworks server to stream media data directly from Oracle Database to a media player client. The plug-in is installed with RealNetworks Server and configured and managed using the administration tool of the streaming server. The plug-in is format neutral; any format supported by the streaming server can be sourced by Oracle Database. See Section 1.9.2 in Chapter 1 for more information.
  - Oracle *inter*Media Plug-in for Microsoft Windows Media Services. This tool allows Microsoft Windows Media servers to stream multimedia content to a client directly from Oracle Database. This plug-in is installed on Windows 2003 Server and configured with Windows Media Services. See Section 1.9.2 in Chapter 1 for more information.

Section 2.2 describes how to use PL/SQL Gateway and PL/SQL Web Toolkit to develop PL/SQL Web applications. Section 2.3 describes how to use Java and JDBC to develop media-rich Java client applications based on Oracle *inter*Media Java Classes. Section 2.4 describes how to develop Java-based Web applications based on Oracle *inter*Media Java Classes and Oracle *inter*Media Java Classes for Servlets and JSP.

Chapter 3 describes a sample Web application, *inter*Media Photo Album, which is implemented using the following different technologies: PL/SQL, Java servlets and JavaServer Pages (JSP), and Microsoft Active Server Pages (ASP)/Visual Basic (VB). This sample application demonstrates how to apply the steps described in Section 2.2 and Section 2.4 in a real Web application to upload and retrieve media data stored in a database. Chapter 3 also describes an *inter*Media Code Wizard application that lets you create PL/SQL stored procedures for the PL/SQL Gateway to upload and retrieve media data stored in a database using *inter*Media object types.

Chapter 4 describes a sample Java application, IMExample, which is implemented using Java, JDBC, and Oracle *inter*Media Java Classes. This sample application demonstrates how to apply the steps described in Section 2.3 in a real Java application to upload and retrieve media data stored in a database.

2.1 Developing PL/SQL Client Applications Using the PL/SQL API

PL/SQL is a completely portable, high-performance transaction processing language that combines the data manipulation power of SQL with the data processing power of procedural languages.

This section briefly describes how to manipulate *inter*Media database objects with the PL/SQL Application Programming Interface (API). The following *inter*Media object types are available for storing media in the database:

- ORDAudio
- ORDDoc
- ORDImage
- ORDImageSignature
- ORDVideo

Section 2.1.1 describes how to set up the environment to use Oracle *inter*Media with PL/SQL. Section 2.1.2 describes how to use standard SQL queries with *inter*Media objects. Section 2.1.3 describes how to retrieve media data from *inter*Media objects in a PL/SQL application. Section 2.1.4 describes how to upload media data into *inter*Media database objects in a PL/SQL application. Section 2.1.5 describes how to handle exceptions in a PL/SQL application.

All the examples in this section use the sample schemas, which are installed by default when you install Oracle. Refer to *Oracle Database Sample Schemas* for information about how these schemas were created and how you can use them yourself.

See *Oracle interMedia Reference* for details about the *inter*Media object types and available methods in the PL/SQL API.

2.1.1 Setting Up Your Environment for PL/SQL

To access files with PL/SQL, you must create a directory object in the database that points to a directory that is accessible by the database server. For example, the following command creates the `MEDIA_DIR` directory in the sample schema:

```
CREATE DIRECTORY MEDIA_DIR AS
    'c:\oracle\product\10.2.0\db_1\demo\schema\product_media';
```

To retrieve media data from the database to a file, you must grant the write permission on the specified directory to the appropriate user. For example:

```
GRANT WRITE ON DIRECTORY MEDIA_DIR TO SCOTT;
```

To upload media data from a file to the database, you must grant the read permission on the specified directory to the appropriate user. For example:

```
GRANT READ ON DIRECTORY MEDIA_DIR TO SCOTT;
```

2.1.2 Media Query in PL/SQL

You can include media attributes (for example: height, width, and MIME type) in standard SQL queries by using accessor methods (for example: getHeight, getWidth, and getMimeType). Example 2–1, Example 2–2, and Example 2–3 show how to use these accessor methods to query one or more object attributes for image, audio, and video objects, respectively.

Example 2–1 Image Query (Height, Width, and MimeType Attributes)

```
SELECT t.product_id                 id,
       t.product_photo.getHeight()   height,
       t.product_photo.getWidth()    width,
       t.product_photo.getMimeType() mimetype
  FROM pm.online_media t;
```

Example 2–2 Audio Query (MimeType Attribute)

```
SELECT t.product_id                 id,
       t.product_audio.getMimeType() mimetype
  FROM pm.online_media t;
```

Example 2–3 Video Query (MimeType Attribute)

```
SELECT t.product_id                 id,
       t.product_video.getMimeType() mimetype
  FROM pm.online_media t;
```

2.1.3 Media Download in PL/SQL

To download media from the database into a file on the file system, call the export method of the *inter*Media object. The following code example exports the image in the row with product_id `3117` to a file named `3117.jpg` in the directory `MEDIA_DIR`. This code example highlights in bold the PL/SQL statements where this export operation takes place.

```
DECLARE
  img ORDImage;
  ctx RAW(64) := NULL;
BEGIN
  SELECT  product_photo
    INTO  img
    FROM  pm.online_media
    WHERE product_id = 3117;
  img.export(ctx, 'FILE', 'MEDIA_DIR', '3117.jpg');
END;
/
```

2.1.4 Media Upload in PL/SQL

Media upload means importing media data from the file system into the database tablespaces. The following series of steps is typical:

1. Insert a new row into the table, creating new objects by using the init method of the *inter*Media object type.
2. Call the import method of the *inter*Media object to bring the data from the file system into the database.
3. Call the setProperties method of the *inter*Media object to determine and populate the attributes of the object.
4. Update the table so that the *inter*Media object in the table contains the attribute values extracted in the previous step.

The PL/SQL code that implements these steps for inserting a new row in the `PM.ONLINE_MEDIA` table is shown in the following example:

```
DECLARE
  img ORDImage;
  aud ORDAudio;
  vid ORDVideo;
  ctx RAW(64) := NULL;
BEGIN
  -- Insert a new row into the pm.online_media table
  DELETE FROM pm.online_media WHERE product_id = 3003;
  INSERT INTO pm.online_media
         (product_id,
          product_photo,
          product_audio,
          product_video)
  VALUES (3003,
          ORDImage.init('FILE', 'MEDIA_DIR', 'laptop.jpg'),
          ORDAudio.init('FILE', 'MEDIA_DIR', 'laptop.mpa'),
          ORDVideo.init('FILE', 'MEDIA_DIR', 'laptop.rm'))
  RETURNING product_photo, product_audio, product_video
  INTO img, aud, vid;

  -- Bring the media into the database and populate the attributes
  img.import(ctx);
  -- ORDImage.import also calls ORDImage.setProperties;

  aud.import(ctx);
  aud.setProperties(ctx);

  vid.import(ctx);
  vid.setProperties(ctx);

  -- update the table with the properties we have extracted
  UPDATE pm.online_media
  SET    product_photo = img,
         product_audio = aud,
         product_video = vid
  WHERE  product_id = 3003;

  COMMIT;
END;
/
```

2.1.5 Handling *inter*Media Exceptions in PL/SQL

Possible errors that can occur during run time should always be handled in your application. This practice enables the program to continue its operation even when it encounters a run-time error. This practice also enables users to know what went wrong during program operation. Proper error handling practices ensure that, whenever possible, you will always be able to recover from an error while running an application. In addition, proper error handling provides you with the information you need so that you will always know what went wrong.

This section demonstrates proper error handling practices through the use of code examples. These examples show how to handle some common *inter*Media errors as well as other types of errors in PL/SQL programs. These examples are extracted from the sample applications described in Chapter 3. See Oracle interMedia Reference for more examples.

When handling exceptions, PL/SQL uses exception blocks. For example, in PL/SQL, the exception may appear as:

```
BEGIN
<some program logic>
EXCEPTION
     WHEN OTHERS THEN
     <some exception logic
END;
```

When you design, code, and debug your application, you are aware of the places in your program where processing might stop due to a failure to anticipate an error. Those are the places in your program where you must add exception handling blocks to handle the potential errors. For more information about handling PL/SQL exceptions, see *Oracle Database PL/SQL User's Guide and Reference*.

The following examples describe exception handling in the *inter*Media PL/SQL Web Toolkit Photo Album sample application.

2.1.5.1 Handling the Setting of Properties for Unknown Image Formats

If your program tries to set the properties of an uploaded image (it reads the image data to get the values of the object attributes so it can store them in the appropriate attribute fields) and the image format is not recognized, then the setProperties( ) method will fail. To catch this exception and work around this potential problem, the application uses the following exception block:

```
BEGIN
   new_image.setProperties();
EXCEPTION
   WHEN OTHERS THEN
         new_image.contentLength := upload_size;
         new_image.mimeType := upload_mime_type;
END;
```

In this example, this exception handler sets the MIME type and length of the image based on the values from the upload table described at the beginning of the `insert_new_photo` procedure. The browser sets a MIME type header when the file is uploaded. The application reads this header to set the ORDImage field.

2.1.5.2 Handling Image Processing for Unknown Image Formats

If your program tries to process an image in cases when the image format is unknown, then the processCopy( ) method will always fail. To work around this potential problem, the application uses the following exception block:

```
BEGIN
   new_image.processCopy( 'maxScale=50,50', new_thumb);
EXCEPTION
   WHEN OTHERS THEN
      new_thumb.deleteContent();
      new_thumb.contentLength := 0;
END;
```

In this example from the *inter*Media PL/SQL Web Toolkit Photo Album application, when the image format is unknown and a thumbnail image cannot be created, this exception handler deletes the content of the thumbnail image and sets its length to zero.

2.2 Developing PL/SQL Web Applications

SQL developers who are familiar with the database can develop Web applications that exclusively use Oracle Application Server and Oracle Database using the PL/SQL development environment. With the PL/SQL development environment, developers can come quickly up to speed to develop PL/SQL-based Web applications.

Developing Web applications using PL/SQL consists of developing one or more PL/SQL packages consisting of sets of stored procedures that interact with Web browsers through HTTP. Stored procedures can be executed in several ways:

- From a hypertext link that calls a stored procedure when it is selected
- By clicking **Submit** on an HTML form to denote the completion of a task such as filling out a form supplied on the HTML page
- By passing parameters to a stored procedure based on user choices from a list

Information in the stored procedure, such as tagged HTML text, is displayed in the Web browser as a Web page. These dynamic Web pages are generated by the database and are based on the database contents and the input parameters passed in to the stored procedure. Using PL/SQL stored procedures is especially efficient and powerful for generating dynamic Web page content.

There are two ways of generating HTML output from PL/SQL:

- Using function calls to generate each HTML tag for output using the PL/SQL Web Toolkit package that is part of Oracle Application Server and Oracle Database and whose `owa` packages are loaded into a common schema so that all users can access it
- Embedding PL/SQL code in Web pages (PL/SQL server pages)

Use *inter*Media when media data such as images, audio, video, or combinations of all three are to be uploaded into and retrieved from database tables using the *inter*Media object types and their respective sets of methods.

Media upload procedures first perform a SQL INSERT operation to insert a row of data in the media table, which also initializes instances of the respective *inter*Media object columns with an empty BLOB. Next, a SQL SELECT FOR UPDATE operation selects the object columns for update. Finally, a SQL UPDATE operation updates the media objects in their respective columns. *inter*Media methods are called to do the following:

- Initialize the object columns with an empty BLOB.
- Set attributes to indicate media data is stored internally in a BLOB.
- Get values of the object attributes and store them in the object attributes.
- When exceptions occur, determine the length of the BLOB content and its MIME type.

Media retrieval operations involve the following tasks:

- Retrieving the object from the database into a local object
- Checking the cache validity of the object based on its updated time versus that of the HTTP header time
- Determining where the media object is located: in the database, in a BFILE, or at a URL location; then, getting the media, and downloading it for display on an HTML page

*inter*Media methods are called to get the time that the media object was last updated, to determine if the media is stored locally in the database, in a BFILE, or at a URL location, to get the MIME type of the media object, and finally to retrieve the media data.

2.2.1 Using the PL/SQL Gateway and PL/SQL Web Toolkit

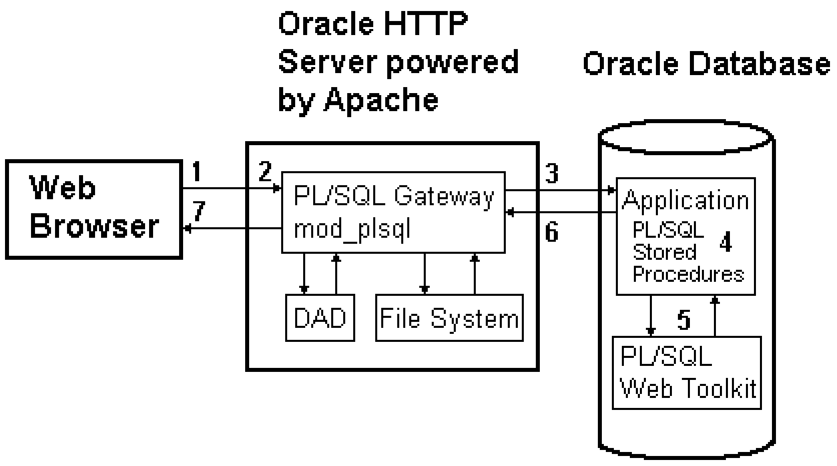
Oracle Application Server and Oracle Database install Oracle HTTP Server powered by the Apache HTTP server that contains the PL/SQL Gateway to communicate directly with a client Web browser.

Oracle HTTP Server serves mainly the static HTML files, images, and so forth, that a Web application uses, and is usually located in the file system where Oracle HTTP Server is installed. Oracle HTTP Server contains modules or plug-ins that extend its functions. One of these modules supplied by Oracle is the mod_plsql module, also known as the PL/SQL Gateway. The PL/SQL Gateway serves data dynamically from the database to Web browsers by calling PL/SQL stored procedures. The PL/SQL Gateway receives requests from a Web browser in the form of PL/SQL servlets or PL/SQL server pages that are mapped to PL/SQL stored procedure calls. PL/SQL stored procedures retrieve data from the database and generate an HTTP response containing the data and code from the PL/SQL Web Toolkit to display the generated Web page in a Web browser. The PL/SQL Web Toolkit contains a set of packages called `htp`, `htf`, and `owa` packages that can be used in the stored procedures to get information about the request, construct HTML tags, and return header information to the client Web browser.

Figure 2–1 shows these main components of the PL/SQL development environment, Oracle HTTP Server (a component of Oracle Application Server and Oracle Database), the Web browser, and the database. The following information describes how a client Web browser request is turned into a Web page response from the execution of the PL/SQL procedure:

1. A client Web browser sends a PL/SQL server page or servlet request to Oracle HTTP Server.
2. Oracle HTTP Server routes the request to the PL/SQL Gateway (mod_plsql).
3. The PL/SQL Gateway forwards the request to the database using configuration information stored in the database access descriptor (DAD) and connects to the database.
4. The PL/SQL Gateway prepares the call parameters and invokes the PL/SQL package and the PL/SQL stored procedure in the application.
5. The PL/SQL procedure generates an HTML page using data from the database and special packages in the PL/SQL Web Toolkit accessed from the database. The PL/SQL Web Toolkit contains a set of packages called `htp`, `htf`, and `owa` packages that are used in the stored procedures to get information about the request, construct HTML tags, and return header information back to the client Web browser as the response returned to the PL/SQL Gateway.
6. The PL/SQL Gateway sends the response to Oracle HTTP Server.
7. Oracle HTTP Server sends the response to the client Web browser for display as a formatted Web page.

Figure 2–1 Components of the PL/SQL Development Environment



Usually, the returned formatted Web page has one or more additional links, and each link, when selected, sends another request to the database through the PL/SQL Gateway to execute one or more stored procedures. The generated response displays data on the client Web page usually with additional links, which, when selected, execute more stored procedures that return the generated response for display as yet another formatted Web page, and so forth. This is how the PL/SQL application in the PL/SQL development environment is designed to work.

Web application developers who use the PL/SQL development environment, create a PL/SQL package specification and body that describe procedures and functions that comprise the application. The package specification defines the procedures and functions used by the application, and the package body is the implementation of each procedure and function. All packages are compiled and stored in the database to perform specific operations for accessing data in the database and formatting HTML output for Web page presentation. To invoke these stored PL/SQL procedures, Web application developers use the request/response PL/SQL servlets and PL/SQL server pages (PSP) to allow Web browser clients to send requests and get back responses using HTTP.

Oracle HTTP Server maps a URL entered in a browser to a specific PL/SQL procedure stored in the database. It does this by storing specific configuration information by means of a DAD for each stored procedure. Thus, each DAD contains the database connection information that is needed by the Web server to translate the URL entered into a database connection in order to call the stored procedure.

Oracle HTTP Server listens for a request, routes the request to the PL/SQL Gateway, which forwards it to the database. Configuration information values stored in a DAD determine the database alias to use, the connection string to use for remote access, the procedure to use for uploading or downloading documents, and the user name and password information to allow access to the database. From the Web browser, the user specifies the URL that invokes the PL/SQL Gateway. The URL has a defined format specifying all required and optional parameters needed, including the location of the DAD and the name of the PL/SQL stored procedure to run, as shown in Example 2–4.

Example 2–4 URL Format Required for Invoking mod_plsql in a Web Browser

```
protocol://hostname[:port number]/DAD-name/[[!][schema name.][package
name.]procedure_name[?query_string]]
```

For a detailed description of each parameter and options available, see *Oracle Application Server mod_plsql User's Guide*. However, to use the photo album application for *inter*Media and the PL/SQL Web Toolkit described in Section 3.1 in Chapter 3, the URL can be simplified to the format shown in Example 2–5.

Example 2–5 URL Format Required to Invoke mod_plsql in a Web Browser for the Photo Album Application

```
protocol://<hostname>[:<port-number>]/DAD-name/]procedure_name
```

When the URL is entered in the Web browser, it includes the protocol (HTTP or HTTPS), the name of the hosting Web server, and the port number to which it is listening to handle requests. Next, the specified virtual path includes `/pls/<DAD-name>` to indicate that the Web server is configured to invoke mod_plsql, and the location of the DAD on the Web server.

In Example 2–4, the last five parameters include the exclamation point (!) character, schema name, package name, procedure name, and query string. From the syntax, the exclamation point, schema name, package name, and query string parameters are optional; only the procedure name is required.

The exclamation point indicates that flexible parameter passing is being used. The schema name, if omitted, is resolved based on the user name. The package name, if omitted, means the procedure is standalone. The query string parameters are for the stored procedure and follow a special format. Of these five parameters, the procedure name must be specified in both the DAD and the URL. The other four parameters are specified in either the DAD or the URL, or not at all, depending on the application.

The URL displays the home page for the specified DAD. When the URL is entered in the address field of the Web browser page, it invokes either the specified DAD location only, or the specified DAD location along with the procedure name, or the specified DAD location along with the `schema.package.procedure` name. The response is returned as an HTML page. The HTML page contains the requested data and any other specified code for display in the client's Web browser. The Code Wizard described in Section 3.3.1 in Chapter 3 illustrates how this works. For example, to invoke the Code Wizard administration URL, enter the following URL shown in Step 3 in Section 3.3.2 in that chapter:

```
http://<hostname>:<port-number>/pls/ordcwadmin
```

The virtual path includes `pls` to indicate that the Web server is configured to invoke mod_plsql, followed by the name of the DAD used for the Code Wizard administrator, `ordcwadmin`.

When the HTML page is displayed, it resolves to the following URL for the Code Wizard administrator:

```
http://<hostname>:<port-number>/pls/ordcwadmin/ORDCWPKG.menu
```

`ORDCWPKG.menu` represents the `package.procedure` name, which is specified as the default home page in the `ordcwadmin` DAD.

When the PL/SQL Gateway is invoked, it uses the stateless model and does not allow a transaction to span across multiple HTTP requests. In this stateless model, applications typically can create a session to maintain state by using one of the following techniques: HTTP cookies, a hidden HTML field as an HTML form element of the HTML Form package, or storage of vital information in database tables for query. For more information, see *Oracle Database Application Developer's Guide - Fundamentals*.

2.3 Developing Java Client Applications Using JDBC

Developers who are familiar with Java and Java database connectivity (JDBC) can write media-rich Java applications using Oracle *inter*Media Java Classes. The classes in Oracle *inter*Media Java Classes are the Java proxy classes for *inter*Media database objects. These Java classes provide access to *inter*Media database objects through JDBC in a Java application.

The Java classes in Oracle *inter*Media Java Classes are included in the `oracle.ord.im.*` package. The Java classes are named similarly to the *inter*Media database objects, and in compliance with the standard Java naming convention:

- OrdAudio
- OrdDoc
- OrdImage
- OrdImageSignature
- OrdVideo

Section 2.3.1 describes how to set up the environment to use Oracle *inter*Media Java Classes. Section 2.3.2 describes how to retrieve media data from *inter*Media objects in a Java application. Section 2.3.3 describes how to upload media data into *inter*Media database objects in a Java application. Section 2.3.4 describes how to handle exceptions in a Java application.

All the examples in this section use the sample schemas, which are installed by default when you install Oracle. Refer to *Oracle Database Sample Schemas* for information about how these schemas were created and how you can use them yourself.

See *Oracle interMedia Java Classes API Reference* for details about the available methods in these classes.

2.3.1 Setting Up Your Environment for Java

Before you can begin using *inter*Media Java Classes, you must set up your environment with the appropriate Java libraries and import the necessary Java classes. Follow these steps:

1. Ensure that the following items are in your CLASSPATH environment variable:

   - Oracle JDBC drivers:

     `<ORACLE_HOME>/jdbc/lib/ojdbc14.jar` (preferred)

     `<ORACLE_HOME>/jdbc/lib/classes12.jar` (deprecated)

   - SQLJ run-time library:

     `<ORACLE_HOME>/sqlj/lib/runtime12.jar`

   - XDB Java library:

     `<ORACLE_HOME>/rdbms/jlib/xdb.jar`

   - Oracle *inter*Media Java Client library:

     `<ORACLE_HOME>/ord/jlib/ordim.jar`

2. Add one or more of the following import statements to the Java program:

   Along with the standard JDBC classes included in the `java.sql` package, you must also import the Oracle JDBC extension class `oracle.jdbc.OracleResultSet`, as follows:

```
import oracle.jdbc.OracleResultSet;
```

Based on the type of media to be handled in the Java application, you might also need to add one or more of following import statements:

```
import oracle.ord.im.OrdAudio;
import oracle.ord.im.OrdDoc;
import oracle.ord.im.OrdImage;
import oracle.ord.im.OrdVideo;
```

2.3.2 Media Retrieval in Java

*inter*Media objects can be retrieved into Java applications as Java proxy objects to the *inter*Media database objects with the same names: OrdAudio, OrdDoc, OrdImage, and OrdVideo. After the JDBC connection is established, follow these steps to retrieve *inter*Media Java objects:

1. Create the JDBC statement to select *inter*Media objects from the database:

```
String query = "select product_photo, product_audio,"+
  " product_video, product_testimonials from" +
  " pm.online_media where product_id=3117";
PreparedStatement pstmt = conn.prepareStatement(query);
```

2. Execute the query and obtain the result set:

```
OracleResultSet rset = (OracleResultSet)pstmt.executeQuery();
```

3. Retrieve the *inter*Media Java object from the result set:

```
if ( rset.next() )
{

  OrdImage imgProxy = (OrdImage)rset.getORAData(
          "product_photo", OrdImage.getORADataFactory());
  OrdAudio audProxy = (OrdAudio)rset.getORAData(
          "product_audio", OrdAudio.getORADataFactory());
  OrdVideo vidProxy = (OrdVideo)rset.getORAData(
          "product_video", OrdVideo.getORADataFactory());
  OrdDoc docProxy = (OrdDoc)rset.getORAData(
          "product_testimonials",
          OrdDoc.getORADataFactory());
}
```

Note: In Oracle *inter*Media release 8*i* and release 9*i*, the getCustomDatum method is used to retrieve the *inter*Media Java objects. In Oracle JDBC release 10*g*, the getCustomDatum method was deprecated and replaced by the getORAData method.

In your Java program environment, be sure to use the same version for both the Oracle *inter*Media Java Client library (`ordim.jar`) and the Oracle JDBC library.

4. Retrieve the media attributes. Media attributes can be retrieved directly from *inter*Media Java objects. For example:

```
int height = imgProxy.getHeight();
int width = imgProxy.getWidth();
String audFormat = audProxy.getFormat();
String vidMimetype = vidProxy.getMimeType();
```

2.3.3 Media Upload in Java

Follow these steps to upload media data into *inter*Media database objects in a Java application:

1. Enter the following statement to enable the JDBC connection object to set the autocommit flag to `false`:

   ```
   conn.setAutoCommit(false);
   ```

2. Retrieve *inter*Media Java objects from the database for updating. You can load media data into existing *inter*Media objects in a table or into nonexisting *inter*Media objects by creating a new row in a table.

   The following example includes a query you can use to load media data into existing *inter*Media objects in a table.

   ```
   //"for update" is required in the query string
   //since we will update the row later.
   String query1 = "select product_photo," +
   " product_audio, product_video," +
   " product_testimonials from" +
   " pm.online_media where product_id=3106" +
   " for update";

   PreparedStatement pstmt = conn.prepareStatement(query1);

   OracleResultSet rset = (OracleResultSet)pstmt.executeQuery();

   if ( rset.next() )
   {

     OrdImage imgProxy = (OrdImage)rset.getORAData(
             "product_photo", OrdImage.getORADataFactory());
     OrdAudio audProxy = (OrdAudio)rset.getORAData(
             "product_audio", OrdAudio.getORADataFactory());
     OrdVideo vidProxy = (OrdVideo)rset.getORAData(
             "product_video", OrdVideo.getORADataFactory());
     OrdDoc docProxy = (OrdDoc)rset.getORAData(
             "product_testimonials",
             OrdDoc.getORADataFactory());
   }

   rset.close();
   pstmt.close();
   ```

   The following example includes a query you can use to load media data into nonexisting *inter*Media objects by creating a new row.

   Note: This code segment assumes that there is no row with `product_id=3106` in the `pm.online_media` table.

   ```
   String query2 =
     "begin insert into pm.online_media " +
     " (product_id, product_photo, product_audio," +
     " product_video, product_testimonials) values" +
     " (3106, ordimage.init()," +
     " ordaudio.init(), ordvideo.init()," +
     " orddoc.init()) returning product_photo," +
     " product_audio, product_video," +
   ```

```
  " product_testimonials into ?, ?, ?, ?;end;";

OracleCallableStatement cstmt =
 (OracleCallableStatement) conn.prepareCall(query2);
cstmt.registerOutParameter(1, OrdImage._SQL_TYPECODE,
                              OrdImage._SQL_NAME);
cstmt.registerOutParameter(2, OrdAudio._SQL_TYPECODE,
                              OrdAudio._SQL_NAME);
cstmt.registerOutParameter(3, OrdVideo._SQL_TYPECODE,
                              OrdVideo._SQL_NAME);
cstmt.registerOutParameter(4, OrdDoc._SQL_TYPECODE,
                              OrdDoc._SQL_NAME);

cstmt.execute();

OrdImage imgProxy = (OrdImage)cstmt.getORAData(1,
                    OrdImage.getORADataFactory());
OrdAudio audProxy = (OrdAudio)cstmt.getORAData(2,
                    OrdAudio.getORADataFactory());
OrdVideo vidProxy = (OrdVideo)cstmt.getORAData(3,
                    OrdVideo.getORADataFactory());
OrdDoc docProxy = (OrdDoc)cstmt.getORAData(4,
                    OrdDoc.getORADataFactory());

cstmt.close();
```

3. Load the media data from a file to the *inter*Media Java objects by calling the loadDataFromFile method:

```
String imageFileName = "laptop.jpg";
String audioFileName = "laptop.mpa";
String videoFileName = "laptop.rm";
String docFileName = "laptop.jpg";
imgProxy.loadDataFromFile(imageFileName);
audProxy.loadDataFromFile(audioFileName);
vidProxy.loadDataFromFile(videoFileName);
docProxy.loadDataFromFile(docFileName);
```

4. Set the properties of the *inter*Media objects by populating the Java object fields with media attributes (optional):

```
imgProxy.setProperties();
audProxy.setProperties(new byte[1][64]);
vidProxy.setProperties(new byte[1][64]);
docProxy.setProperties(new byte[1][64], true);
```

Note: The setProperties method will try to recognize the format of the media and populate the objects field with media information such as image height, image width, format, MIME type, and so on. If the media format is not recognized, the java.sql.SQLException error will be thrown.

5. Update the database table with *inter*Media Java objects that have data already loaded:

```
String query3 = "update pm.online_media set" +
 " product_photo=?, product_audio=?," +
 " product_video=?, product_testimonials=?" +
 " where product_id=3106";
```

```
   OraclePreparedStatement pstmt =
(OraclePreparedStatement)conn.prepareStatement(query3);
   pstmt.setORAData(1, imgProxy);
   pstmt.setORAData(2, audProxy);
   pstmt.setORAData(3, vidProxy);
   pstmt.setORAData(4, docProxy);

   pstmt.execute();
   pstmt.close();
```

6. Commit the transaction:

```
conn.commit();
```

2.3.4 Handling *inter*Media Exceptions in Java

Possible errors that can occur during run time should always be handled in your application. This practice enables the program to continue its operation even when it encounters a run-time error. This practice also enables users to know what went wrong during program operation. Proper error handling practices ensure that, whenever possible, you will always be able to recover from an error while running an application. In addition, proper error handling provides you with the information you need so that you will always know what went wrong.

This section demonstrates proper error handling practices through the use of code examples. These examples show how to handle some common *inter*Media errors as well as other types of errors in Java programs. These examples are extracted from the sample applications described in Chapter 3 and Chapter 4. See Oracle interMedia Reference for more examples.

When handling exceptions, Java uses the try/catch block. For example, in Java, the exception may appear as:

```
try {
    //<some program logic>)
}
catch (exceptionName a) {
//Exception logic
}
finally {
//Execute logic if try block is executed even if an exception is caught
}
```

When you design, code, and debug your application, you are aware of the places in your program where processing might stop due to a failure to anticipate an error. Those are the places in your program where you must add exception handling blocks to handle the potential errors. For more information about handling Java exceptions, see *Oracle Database Java Developer's Guide* and *Oracle Database JDBC Developer's Guide and Reference*.

The following examples describe exception handling using the try/catch block. These examples are in either the *inter*Media IMExample application or are in the *inter*Media Java Servlet Photo Album application, the *inter*Media JavaServer Pages Photo Album application, or both of these applications.

2.3.4.1 Handling the Setting of Properties for Unknown Image Formats

The `IMUtil` class of the *inter*Media Java sample application called IMExample, contains utility methods for common image functions. One of these methods is the setProperties( ) method. The static method takes an OrdImage object as an input parameter and calls the setProperties( ) method on the object.

```
static boolean setProperties(OrdImage img)
  {
    try
    {
      img.setProperties();
      return true;
    }
    catch (SQLException e)
    {
      return false;
    }
  }
```

If an exception is thrown, the setProperties( ) method returns false to indicate failure; otherwise it returns true.

See Chapter 4 for a full description of the IMExample application and for more information about using the setProperties( ) method in a Java application.

2.3.4.2 Handling Image Processing for Unknown Image Formats

In the insertNewPhoto( ) method in both the `PhotoAlbumServlet` class of the *inter*Media Java Servlet Photo Album application and in the `PhotoAlbumBean` class of the *inter*Media JavaServer Pages Photo Album application, a new photograph is inserted into the photo album, creating a thumbnail image at the same time. If the application tries to process an image in cases when the image format is unknown, then when the application calls the processCopy( ) method, the application will always fail. To work around this potential problem, the application uses the following `try` block and `catch` block to catch any SQL exceptions:

```
try
{
    image.processCopy( "maxScale=50,50", thumb );
}
catch ( SQLException e )
{
    thumb.deleteContent();
    thumb.setContentLength( 0 );
}
```

In this example, when the image format is unknown and a thumbnail image cannot be created, the application catches the SQL exception and calls the deleteContent( ) method to delete the content of the thumbnail image, and then calls the setContentLength( ) method to set its length to zero.

2.4 Developing Java-Based Web Applications

On the Java platform, a Web application is a dynamic extension of a Web server. A Java-based Web application is composed of Java servlets, JavaServer Pages (JSP), or both. Java servlets are Java classes that dynamically process HTTP requests and construct HTTP responses. JavaServer Pages are text-based documents that execute as servlets but that allow a more natural approach to creating static content.

Oracle *inter*Media Java Classes for Servlets and JSP is based on Oracle *inter*Media Java Classes. The classes in Oracle *inter*Media Java Classes for Servlets and JSP facilitate the retrieval and uploading of media data from and to Oracle Database in a Java-based Web application.

Like the Java classes in Oracle *inter*Media Java Classes, these Java classes are included in the `oracle.ord.im.*` package. The classes are as follows:

- OrdHttpResponseHandler
- OrdHttpJspResponseHandler
- OrdHttpUploadFormData
- OrdHttpUploadFile
- OrdMultipartFilter
- OrdMultipartWrapper

The OrdHttpResponseHandler class facilitates the retrieval of the media data from Oracle Database and its delivery to an HTTP client from a Java servlet. The OrdHttpJspResponseHandler class provides the same features for JSP pages. The OrdHttpUploadFormData, OrdHttpUploadFile, OrdMultipartFilter, and OrdMultipartWrapper classes facilitate the uploading of media data from a Web client to Oracle Database.

Section 2.4.1 describes how to retrieve media data from *inter*Media objects in a Java-based Web application. Section 2.4.2 describes how to upload media data into database *inter*Media objects in a Java-based Web application.

Before you can begin using *inter*Media Java Classes for Servlets and JSP, you must set up your environment with the appropriate Java libraries, as described in Step 1, Section 2.3.1. In addition to the items in that list, you must include the Oracle *inter*Media Java Web library `<`*`ORACLE_HOME`*`>/ord/jlib/ordhttp.jar` in your CLASSPATH environment variable.

See *Oracle interMedia Java Classes for Servlets and JSP API Reference* for details about the available methods in these classes.

2.4.1 Media Retrieval in Java-Based Web Applications

In general, displaying a Web page that contains images in a Web browser requires two HTTP round trips.

In the first trip, the Web browser makes an HTTP request to the URL of the Web page that contains the images. The Web server responds with the Web page text content and the URLs for the media content. The URL is the `src` attribute of the `<img>` tag in the Web page.

In the second trip, the Web browser makes another HTTP request to the URL in the `<img>` tag to get the image binary data, and then displays the image in the browser.

In a Java-based Web application, sending media data from the database to an HTTP client (Web browser) requires the proper media URL (generated in the first HTTP response); and the proper media delivery component (a servlet or JSP for the second HTTP response).

2.4.1.1 Media URL

When media data is stored as static files on the Web server, the media URL is the relative or absolute path to the media files on the file system. When media data is stored in a database, the media URL is generally composed of a media delivery component (a servlet or JSP) and the parameters for the media delivery component. The media delivery component is the target for the second HTTP request to retrieve the media data. The parameters for the media delivery component are used by the media delivery component to query and locate the media data in the database. For example:

```
<img src="OrdGetMedia.jsp?id=1"/>
```

where `OrdGetMedia.jsp` in the media URL `"OrdGetMedia.jsp?id=1"` is the media delivery component, and `id=1` is the parameter to the media delivery component.

2.4.1.2 Media Delivery Component

Because media data is stored in the database as *inter*Media objects, the media delivery component must dynamically retrieve the media data as Java objects (see Section 2.3.2), based on certain query conditions. Then, you can use either the OrdHttpResponseHandler or the OrdHttpJspResponsehandler class in Oracle *inter*Media Java Classes for Servlets and JSP to deliver the data to the HTTP client (Web browser).

The following example demonstrates the use of a Java servlet as the media delivery component, and highlights in bold the SQL statements and significant areas in the code where this operation takes place.

```
import oracle.ord.im.OrdHttpResponseHandler;

protected void doGet(HttpServletRequest request,
 HttpServletResponse response)
  throws ServletException, java.io.IOException
{
// obtain oracle.ord.im.OrdImage object
// imgProxy follows the Section "Media Retrieval in Java"
 . . .

// deliver the image data to the browser
OrdHttpResponseHandler handler =
new OrdHttpResponseHandler( request, response);
handler.sendImage(imgProxy);

 . . .
 }
```

The following example demonstrates the use of a JSP page as the media delivery component, and highlights in bold the SQL statements and significant areas in the code where this operation takes place.

```
<%@ page
import="oracle.ord.im.OrdHttpJspResponseHandler"
%>

<jsp:useBean id = "handler" scope="page"
     class = "oracle.ord.im.OrdHttpJspResponseHandler"
/>

<%
// obtain oracle.ord.im.OrdImage object
// imgProxy follows the Section "Media Retrieval in Java"
. . .

// deliver the image data to the browser
   handler.setPageContext( pageContext );
   handler.sendImage(imgProxy);
   return;
%>
```

2.4.2 Media Upload in Java-Based Web Applications

The HTML form allows you to input and upload data from a Web browser to a Web server for processing. The following HTML code segment is an example of the HTML form that uploads a file. This code example highlights in bold the SQL statements and areas in the code where this operation takes place.

```
<form action="uploadAction.jsp" method="post"
enctype="multipart/form-data">
id: <input type="text" name="id"/>
description: <input type="text" name="description"/>
Photo: <input type="file" name="photo"/>
</form>
```

Referring to the preceding code example, setting the value of the `enctype` attribute in the `<form>` tag to "`multipart/form-data`" specifies multipart/form-data format encoding of the uploaded data. The value of the `action` attribute in the `<form>` tag represents the name of the JSP that will handle the uploaded data.

To handle the uploaded data in a JSP or servlet, follow these steps:

1. Decode the uploaded file. Because this file is encoded in multipart/form-data format, the data must be decoded before further processing can proceed. You can use the OrdHttpUploadFormData class to decode the encoded HTTP request data and obtain the uploaded file as an instance of the OrdHttpUploadFile object. You can use this class explicitly or implicitly to get the decoded uploaded file.

   The following example demonstrates how to use the OrdHttpUploadFormData class *explicitly* to get the uploaded file, and highlights in bold the SQL statements and significant areas in the code where this operation takes place. Use this method within the servlet or JSP that handles the upload HTTP request.

   ```
   //
   // Import OrdHttpUploadFormData and OrdHttpUploadFile class:
   // In a servlet:
   // import oracle.ord.im.OrdHttpUploadFormData;
   // import oracle.ord.im.OrdHttpUploadFile;
   // In a JSP:
   // <%@ page import="oracle.ord.im.OrdHttpUploadFormData" %>
   // <%@ page import="oracle.ord.im.OrdHttpUploadFile" %>
   //

   //
   // Following code snippets should be within <% %> if in a JSP.
   //

   // Create an OrdHttpUploadFormData object and use it to parse
   // the multipart/form-data message.
   //
   OrdHttpUploadFormData formData = new OrdHttpUploadFormData(
    request );
   formData.parseFormData();

   //
   // Get the description, location, and photo.
   //
   String id = formData.getParameter( "id" );
   String description = formData.getParameter( "description" );
   ```

```
OrdHttpUploadFile photo = formData.getFileParameter( "photo" );

//
// Process the uploaded file
//
 ...

//
// Release the resources
//
formData.release();
```

To avoid instantiating and releasing the OrdHttpUploadFormData class explicitly in each JSP or servlet that handles the uploaded data, you can use the OrdHttpUploadFormData class implicitly by configuring the Web application with the OrdMultipartFilter class. Using the OrdMultipartFilter class ensures that any HTTP request that is encoded in multipart/form-data format will be decoded and passed along to the JSP or servlet that further processes the request.

The following substeps and accompanying examples describe how to use the OrdHttpUploadFormData class *implicitly* to get the uploaded file. These code examples highlight in bold the SQL statements and significant areas in the code where this operation takes place.

a. Configure the filter by adding the following code to the `web.xml` file in your Web application:

```
<filter>
    <filter-name>OrdMultipartFilter</filter-name>
    <filter-class>
oracle.ord.im.OrdMultipartFilter
    </filter-class>
</filter>
<filter-mapping>
    <filter-name>OrdMultipartFilter</filter-name>
    <servlet-name>*.jsp</servlet-name>
</filter-mapping>
```

b. Obtain the form data and the uploaded file in the JSP or servlet after the filter is configured:

```
//
// Get the id, description, and photo.
//
String id = request.getParameter( "id" );
String description = request.getParameter( "description" );
oracle.ord.im.OrdHttpUploadFile photoFile =
 request.getFileParameter("photo");
```

where `request` is the HttpServletRequest object passed to the JSP or servlet.

2. Save the uploaded file to the database. After the OrdHttpUploadFile object is obtained by explicitly or implicitly using the OrdHttpUploadFormData class, the uploaded file is ready to be loaded into an *inter*Media object in the database, using the following statement:

```
photoFile.loadImage(imgProxy);
```

where `photoFile` is the OrdHttpUploadFile object and`imgProxy` is an OrdImage object obtained in Step 1 in Section 2.3.3.

The loadImage method implicitly calls the setProperties method to populate the object fields.

After the data is loaded into the *inter*Media Java object, you can update the corresponding *inter*Media object in the database table by following Steps 4 and 5 in Section 2.3.3.

3 Media Upload and Retrieval Web Sample Applications

This chapter describes the development of several types of media upload and retrieval applications using Oracle *inter*Media ("*inter*Media") object types.

Section 3.1 describes the development of the *inter*Media PL/SQL photo album sample Web application that uses the PL/SQL Gateway and PL/SQL Web Toolkit for Oracle Application Server and Oracle Database.

Section 3.2 describes the development of the following *inter*Media photo album sample Web applications that use the *inter*Media image object type:

- Java servlet application that uses Oracle *inter*Media Java Classes for Servlets and JSP (see Section 3.2.1)
- JavaServer Pages (JSP) application that uses Oracle *inter*Media Java Classes for Servlets and JSP (see Section 3.2.2)
- Active Server Pages (ASP)/Visual Basic (VB) application for the Microsoft Internet Information Server (IIS) Web Server (see Section 3.2.3)

> **Note:** The sample applications described in Section 3.2 differ from the PL/SQL photo album sample application described in Section 3.1.

Section 3.3 describes the *inter*Media Code Wizard application for the PL/SQL Gateway that uses the *inter*Media image, audio, video, and heterogeneous media object types.

This chapter assumes the following:

- You are familiar with:
  - Developing PL/SQL applications using the PL/SQL Gateway and PL/SQL Web Toolkit
  - Developing Java-based Web applications using JDBC, creating Java source code, compiling it into byte code (`.class`) files, and deploying class files into respective servlet containers required by Oracle HTTP Server for Oracle Application Server and Oracle Database
  - Developing ASP/VB scripts for the Microsoft IIS Web Server
- You have already installed and configured the following sample applications:
  - Oracle *inter*Media PL/SQL Web Toolkit Photo Album application
  - Oracle *inter*Media Java Servlet Photo Album application
  - Oracle *inter*Media JSP Photo Album application

- Oracle *inter*Media ASP/VBScript Photo Album application
- Oracle *inter*Media Code Wizard for the PL/SQL Gateway application

See the `README.txt` file for each respective sample application for installation and configuration information.

3.1 Oracle *inter*Media PL/SQL Photo Album Sample Application

The *inter*Media PL/SQL Web Toolkit Photo Album sample application demonstrates how to perform the following operations:

- Use the *inter*Media image object type to upload, retrieve, and process media data stored in Oracle Database.
- Combine the image metadata methods of *inter*Media with the XML document management capabilities of Oracle XML DB and the full-text indexing and search features of Oracle Text to create a solution that can extract, store, and search metadata that is embedded in binary image files.
- Collect new metadata from a user, format the metadata into an XML document, and store the document in the binary image.

When installed, the photo album application creates a number of schema objects that are important to the following discussion. These objects include the `photos` table, which is defined by the following CREATE TABLE statement:

```
CREATE TABLE photos( id           NUMBER PRIMARY KEY,
                     description  VARCHAR2(40) NOT NULL,
                     metaORDImage XMLTYPE,
                     metaEXIF     XMLTYPE,
                     metaIPTC     XMLTYPE,
                     metaXMP      XMLTYPE,
                     image        ORDSYS.ORDIMAGE,
                     thumb        ORDSYS.ORDIMAGE )
--
-- storage images with 32K chunk
--
LOB(image.source.localdata)  STORE AS (chunk 32k)
--
-- but the thumbnails with only 16k
--
LOB(thumb.source.localdata)  STORE AS (chunk 16k)
--
-- and bind the XMLType columns to the interMedia metadata schemas
XMLType COLUMN metaORDImage
 XMLSCHEMA "http://xmlns.oracle.com/ord/meta/ordimage"
 ELEMENT "ordImageAttributes"
XMLType COLUMN metaEXIF
 XMLSCHEMA "http://xmlns.oracle.com/ord/meta/exif"
 ELEMENT "exifMetadata"
XMLType COLUMN metaIPTC
 XMLSCHEMA "http://xmlns.oracle.com/ord/meta/iptc"
 ELEMENT "iptcMetadata"
XMLType COLUMN metaXMP
 XMLSCHEMA "http://xmlns.oracle.com/ord/meta/xmp"
 ELEMENT "xmpMetadata";
```

The data types for the `image` and `thumb` columns are defined as *inter*Media image object types. These columns are used to store the full-size images and the generated thumbnail images, respectively. The LOB storage clauses indicate that storage for the full-size images is to be allocated in 32-kilobyte chunks, thus enabling the fastest reading and writing of the image data. Similarly, storage for the thumbnail images is allocated in 16-kilobyte chunks, enabling fast access and efficient storage. In addition, using a smaller chunk size reduces the allocation of empty space.

The table also defines four columns of type `XMLType` to store XML documents that contain four different kinds of image metadata. Each column is bound to a specific *inter*Media metadata schema. Each metadata schema defines precisely the data model of the metadata document. These schemas are registered with Oracle XML DB when the database is created. The column definitions specify that the database uses structured storage to manage the XML metadata documents. Some advantages of using structured storage to manage XML include optimized memory management, reduced storage requirements, B-tree indexing, and in-place updates. For more information about XML DB, see *Oracle XML DB Developer's Guide*.

When installed, the photo album application also creates other schema objects. These schema objects include two types of indexes that accelerate metadata searches: a `CONTEXT` text index and a `CTXXPATH` text index.

The `CONTEXT` type is a text index over all columns that contain descriptive information about the image. These columns include `PHOTOS.DESCRIPTION`, which is a VARCHAR2 data type, and the following four `XMLType` columns: `PHOTOS.METAIPTC`, `PHOTOS.METAEXIF`, `PHOTOS.METAXMP`, and `PHOTOS.METAORDIMAGE`. The `CONTEXT` text index is used to accelerate metadata searches by implementing the photo album search feature that allows users to search for photographs by keyword or phrase.

The `CONTEXT` text index is created by the following statements. (This example assumes that the photo album application has been installed in the SCOTT schema.)

```
-- create preference PA_CTXIDX
ctx_ddl.create_preference('SCOTT.PA_CTXIDX', 'MULTI_COLUMN_DATASTORE');

-- create a multi-column datastore
ctxcols := 'description, '                  ||
           'SCOTT.photo_album.getClob(METAIPTC), ' ||
           'SCOTT.photo_album.getClob(METAEXIF), ' ||
           'SCOTT.photo_album.getClob(METAXMP), '  ||
           'SCOTT.photo_album.getClob(METAORDIMAGE)';
ctx_ddl.set_attribute( ctxpref, 'COLUMNS', ctxcols );


-- create the CONTEXT text index
create  index pa_ctx_idx on photos(description)
indextype is ctxsys.context
parameters ( 'DATASTORE SCOTT.PA_CTXIDX' );
```

For more information about creating and using text indexing, see *Oracle Text Application Developer's Guide*.

The `CTXXPATH` type text index is used to accelerate metadata searches by allowing users to search only certain types of image metadata as well as limit the search to specific portions of an XML document. For example, the following statements create three text indexes of type `CTXXPATH` to speed up existsNode( ) queries on columns of `XMLType`:

```
create index pa_path_iptc_idx  on photos( metaIptc )
 indextype is ctxsys.ctxxpath;

create index pa_path_exif_idx  on photos( metaExif )
 indextype is ctxsys.ctxxpath;
```

```
create index pa_path_xmp_idx  on photos( metaXMP )
 indextype is ctxsys.ctxxpath;
```

For more information about creating and using `CTXXPATH` indexes, see *Oracle Text Application Developer's Guide*.

During the installation, as prescribed by the PL/SQL Gateway, a document upload table is defined by the following CREATE TABLE statement:

```
CREATE TABLE PHOTOS_UPLOAD(name           VARCHAR2(256) UNIQUE NOT NULL,
                           mime_type      VARCHAR2(128),
                           doc_size       NUMBER,
                           dad_charset    VARCHAR2(128),
                           last_updated   DATE,
                           content_type   VARCHAR2(128),
                           blob_content   BLOB );
```

Each image uploaded using the PL/SQL Gateway is stored in the `PHOTOS_UPLOAD` table. An upload procedure (`insert_new_photo`) automatically moves the uploaded image from the specified `PHOTOS_UPLOAD` table to the photo album applications table called `photos`.

3.1.1 Running the PL/SQL Photo Album Application

After you have completed the setup tasks and have built the photo album application, including creating a database access descriptor (DAD) entry as described in the `README.txt` file, you can run the photo album application by entering the following URL in the address field of your Web browser:

```
<protocol><hostname:port-number>/photoalbum
```

The *`<protocol>`* field is `http://` and the *`<hostname:port-number>`* field is the host name and port number of the system where your HTTP server is running.

When first invoked, the photo album application displays any images that are currently stored in the album. By default, the photo album is empty when first installed. To upload a new photograph, select **Upload photo**. Enter a description of the photograph and the name of the image file, or browse to its directory location. Then, click **Upload photo**.

The contents of the photo album are displayed, along with a picture of the new photograph. Click the thumbnail image to view the full-size version of the photograph. When the photo album application displays the text **view image** instead of its thumbnail image, the image format that was uploaded was not recognized by *inter*Media. Click **view image** to display the full-size image.

You can now begin to load your photo album application with your favorite photographs.

3.1.2 Description of the PL/SQL Photo Album Application

The user interface for the photo album application consists of a set of Web pages. You can use these Web pages to perform the tasks shown in Table 3–1. The tasks and the Web pages are introduced in this section and described in further detail in the following sections.

Table 3–1 PL/SQL Photo Album Sample Application Overview

User Task	Web Page	PL/SQL Procedures

Browsing the photo album
Section 3.1.2.1
	View album
	Figure 3–1
		`view_album`
		Example 3–1
		
		`print_album`
		Example 3–2
		
		`print_image_link`
		Example 3–3
		
		`deliver_media`
		Example 3–4

Adding images to the photo album
Section 3.1.2.2
	Upload photo
	Figure 3–2
		`view_upload_form`
		
		`print_upload_form`
		Example 3–5
		
		`insert_new_photo`
		Example 3–6

Searching for images by keyword or phrase
Section 3.1.2.3
	Search album
	Figure 3–3
		`view_album`
		Example 3–1
		
		`print_album`
		Example 3–2

Viewing full-size images
Section 3.1.2.4
	View entry
	Figure 3–4
		`view_entry`
		Example 3–7
		
		`print_image_link`
		Example 3–3
		
		`deliver_media`
		Example 3–4

Examining image metadata
Section 3.1.2.5
	View metadata
	Figure 3–5
		`view_metadata`
		Example 3–8
		
		`print_metadata`
		Example 3–9

Writing new XMP metadata to images Section 3.1.2.6	**Write XMP metadata** Figure 3–6	`write_metadata` Example 3–10
Searching for images that contain specific metadata attributes Section 3.1.2.7	**Search metadata** Figure 3–7	`search_metadata` Example 3–11

You can explore the photo album application using the navigation bar near the top of each Web task page. The leftmost entry of the navigation bar displays the name of the current Web page. On the right, there are links to other Web pages you can access from the current page. Each Web task page contains a link to the **View album** page, which is the home page for the application.

The photo album application is implemented as a set of PL/SQL procedures and functions organized in a single PL/SQL package. These procedures combine several database features to create the application. Oracle *inter*Media is used to store and process image data. It is also used to extract metadata from images and embed new metadata into images. The XMLType feature is used to store and process the XML metadata documents. Oracle Text indexes are used to accelerate two kinds of metadata searches. Finally, the PL/SQL Web Toolkit is used to create HTML pages and deliver media content.

For detailed information about these database features, see *Oracle XML DB Developer's Guide*, *Oracle Text Application Developer's Guide*, and *Oracle Application Server 10g PL/SQL Web Toolkit Reference* in the Oracle Application Server 10*g* Online Documentation Library.

Browsing the Photo Album Using the View album Page The **View album** page displays thumbnail-size versions of all the images in the photo album as well as a description link positioned under each thumbnail image. When you select a thumbnail image, the full-size image is displayed. When you select the description link for an image, all the metadata for that image is displayed. The **View album** page is the home page for the application.

Adding Images to the Photo Album Using the Upload photo Page The **Upload photo** page displays a simple form to collect a description for a new image and the directory path to the location of the image on the local computer. When you click the **Upload photo** button, the browser sends the image to the Web server and the image is stored in the database.

Searching for Images by Keyword or Phrase Using the Search album Page The **Search album** page displays a search album form to collect keywords or phrases to initiate full text searches through all image metadata. The application queries the database for all images with metadata that contains the specified keywords or phrases. The search results are displayed as a set of thumbnail images. The search album form is also available from the **View album** page.

Viewing Full-Size Images Using the View entry Page The **View entry** page displays the full-size image of a specified photograph, including any description text that was entered for that image when it was uploaded.

Examining Image Metadata Using the View metadata Page The **View metadata** page displays all the metadata that was extracted from the image when it was uploaded. Up to four types of metadata can be displayed.

Writing New XMP Metadata to Images Using the Write XMP metadata Page The **Write XMP metadata** page displays a form to collect input for five metadata attributes. These attributes are formatted into an XML document that is embedded within the binary image. The new XMP metadata overwrites any existing XMP metadata.

Searching for Images That Contain Specific Metadata Attributes Using the Search metadata Page The **Search metadata** page collects input for advanced metadata searches. You can specify the type of metadata to be searched. Optionally, you can also limit the search to a specific XML tag within the specified document. The search results are displayed as a set of thumbnail images.

3.1.2.1 Browsing the Photo Album

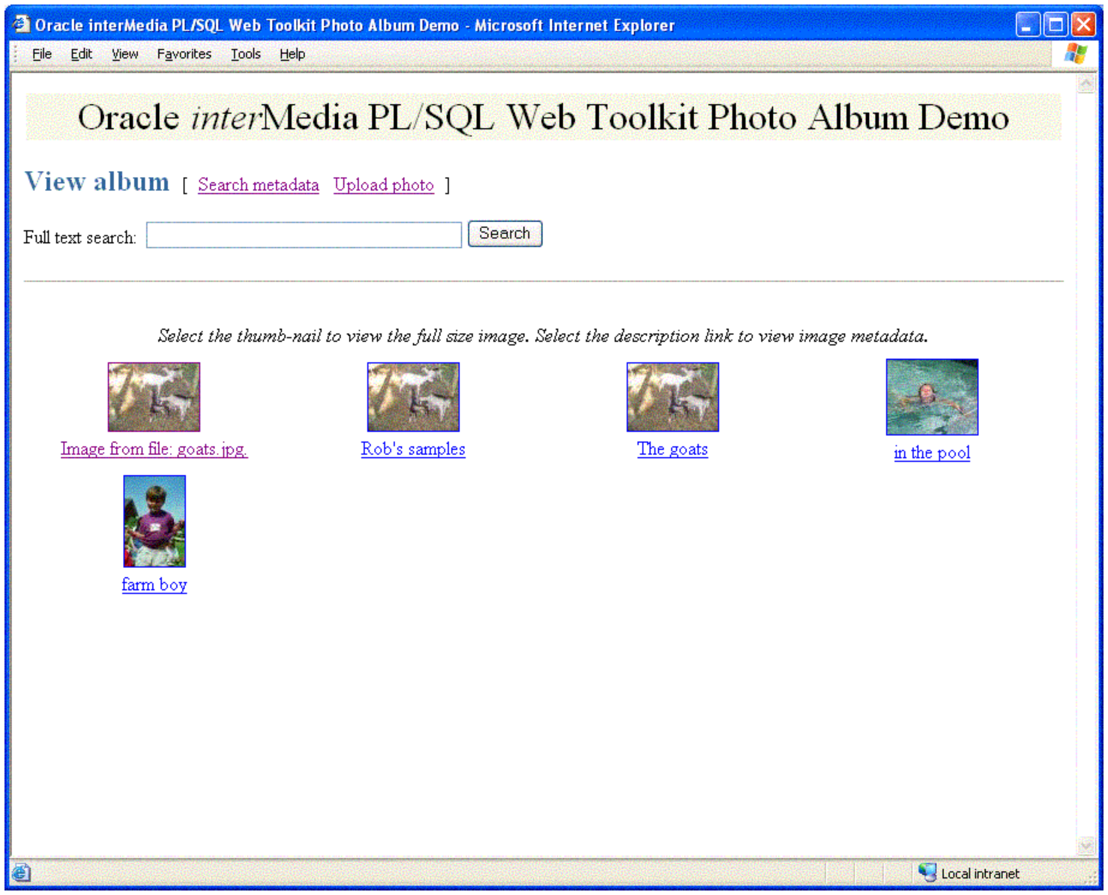
The home page for the photo album application, **View album**, displays the contents of the photo album as thumbnail images in four-column format. Each thumbnail image is also a link to the **View entry** page. When you click a thumbnail image link, the application displays the full-size image on a View entry page. Included under each thumbnail image on the **View album** page is the image description that was entered when the image was uploaded to the album. The description is also a link to the **View metadata** page where all the metadata for this photograph can be examined.

Near the top of the **View album** page, there is a text entry field (in the shape of a rectangular box) that accepts user input for a full text search through all the photo album metadata. The **Search** button to the right of the text field initiates the search. The search results are displayed on the **Search album** page, which is discussed in Section 3.1.2.3.

At the top of the **View album** page, there is a navigation bar, which includes links to other photo album pages. From the **View album** page, you can navigate to the **Search metadata** page or the **Upload photo** page. These pages are described in Section 3.1.2.7 and Section 3.1.2.2, respectively.

Figure 3–1 shows the **View album** page for an album that contains five images.

Figure 3–1 View album Page with Five Uploaded Images


Oracle interMedia PL/SQL Web Toolkit Photo Album Demo - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Oracle *inter*Media PL/SQL Web Toolkit Photo Album Demo
View album [Search metadata Upload photo]
Full text search:
Search
Select the thumb-nail to view the full size image. Select the description link to view image metadata.
Image from file: goats.jpg.
Rob's samples
The goats
in the pool
farm boy
Local intranet

The PL/SQL procedures `view_album`, `print_album`, `print_image_link`, and `deliver_media` are the primary application components that implement the **View album** page. The `view_album` procedure is a public procedure that takes a single optional argument. By default, the argument has a `NULL` value. Or, it can have the value of the string entered in the text entry field on the **Search album** page. When the search argument is `NULL`, the SELECT statement retrieves the `id`, `description`, and `thumb` columns for all entries in the `photos` table. When the search string is not `NULL`, the SELECT statement uses the CONTAINS operator to restrict the result set to only images with metadata that matches the search string. (Section 3.1 describes how the application creates a multicolumn text index over the four XMLType columns `PHOTOS.METAIPTC`, `PHOTOS.METAEXIF`, `PHOTOS.METAXMP`, and `PHOTOS.METAORDIMAGE` as well as the `PHOTOS.DESCRIPTION` column.)

Example 3–1 contains some relevant lines of code in the `view_album` procedure.

Example 3–1 Procedure view_album

```
--
-- no search criteria so fetch all entries
--
IF search IS NULL THEN
  OPEN album_cur FOR
    SELECT id, description, thumb
    FROM photos
    ORDER BY id;
  print_album( album_cur, 'The photo album is empty.' );
  CLOSE album_cur;
ELSE
--    -- use the full-text index to select entries matching the search criteria
--
  OPEN album_cur FOR
    SELECT id, description, thumb
    FROM photos
    WHERE CONTAINS( description, trim(search) ) > 0
    ORDER BY id;
  print_album( album_cur, 'No photos were found.' );
  CLOSE album_cur;
END IF;
```

The SELECT statement is bound to the cursor variable `album_cur` and passed to the procedure `print_album`, which creates the HTML output.

The `print_album` procedure uses the HTP and HTF packages from the PL/SQL Web Toolkit to create the HTML tags that format the output into a four-column table. Each cell in the table contains two links or anchor tags. The first link is to the **View entry** page, which displays the full-size version of the image. This anchor is implemented by PHOTO_ALBUM.VIEW_ENTRY, and passes `entry_id` as a query string input argument. If the thumbnail image has a nonzero length, then procedure `print_image_link` is called to create an HTML `<img>` tag that is the content (the thumbnail image) of the anchor link. The string `thumb` and the `entry_id` are passed to procedure `print_image_link`, along with the image description, and the height and width of the thumbnail image. These values are used to create the `<img>` tag.

If an image is in a format that *inter*Media does not support, the application will not be able to create a thumbnail version of the image. In this case, the content of the anchor link is the text **view image**.

Example 3–2 contains some relevant lines of code in the `print_album` procedure.

Example 3–2 Procedure print_album

```
    -- escape the description text
    sc_description := htf.escape_sc( entry.description );

    --
    -- Display the thumb-nail image as an anchor tag which can be used
    -- to display the full-size image. If the image format isn't
    -- supported by interMedia, then a thumb-nail wouldn't have been
    -- produced when the image was uploaded, so use the text '[view
    -- image]' instead of the thumb-nail.
    --

    htp.print( '<td headers="c' || colIdx || '" align="center" >
                <a href="PHOTO_ALBUM.VIEW_ENTRY?entry_id=' ||
                entry.id || '">' );
    IF entry.thumb.contentLength > 0
    THEN
        print_image_link( 'thumb', entry.id, sc_description,
                          entry.thumb.height, entry.thumb.width );
    ELSE
        htp.prn( '[view image]' );
    END IF;
    htp.print( '</a>' );

    -- Create link to the metadata
    htp.prn('<br>');
    htp.anchor( curl=>'PHOTO_ALBUM.VIEW_METADATA?entry_id=' || entry.id,
                ctext=>sc_description );
    htp.prn('</td>');
```

The procedure `print_image_link` uses the `height` and `width` arguments to populate the `height` and `width` attributes of the `<img>` tag. The `description` argument is used to create text for the `alt` attribute. If the `description` argument is empty, a default string is constructed. Finally, the `src` attribute is set to the URL PHOTO_ALBUM.DELIVER_MEDIA with two query string arguments, `media` and `entry_id`. The `media` argument controls whether the thumbnail or full-size version of the image is delivered. The `entry_id` argument identifies the image to be delivered.

Example 3–3 contains some relevant lines of code in the `print_image_link` procedure.

Example 3–3 Procedure print_image_link

```
-- add height and width to tag if non zero
IF height > 0 AND width > 0 THEN
  attributes := attributes || ' height=' || height || ' width=' || width;
END IF;

-- create an alt text if none given
IF alt IS NULL THEN
  IF type = 'thumb' THEN
    alt2 := 'thumb-nail image ';
  ELSE
    alt2 := 'full-size image ';
  END IF;
  alt2 := alt2 || 'for album entry ' || entry_id;
ELSE
  alt2 := alt;
END IF;

htp.img( curl=>'PHOTO_ALBUM.DELIVER_MEDIA?media=' || type ||
                 ampersand || 'entry_id=' || entry_id,
           calt=>alt2, cattributes=>attributes );
```

The procedure `deliver_media` fetches the image content from the database. The `If-Modified-Since` HTTP request header is compared to the last modification time of the image. If the image has not been modified, a response is sent that the browser can display the image from its cache. Otherwise, the image MIME type and last modified time are sent to the Web server, along with the image content.

Example 3–4 contains some relevant lines of code in the `deliver_media` procedure.

Example 3–4   Procedure deliver_media

```
--
-- Fetch the thumb-nail or full-size image from the database.
--
IF media = 'thumb'
THEN
    SELECT thumb INTO local_image FROM photos WHERE id = entry_id;
ELSE
    SELECT image INTO local_image FROM photos WHERE id = entry_id;
END IF;

--
-- Check update time if browser sent If-Modified-Since header
--
IF ordplsgwyutil.cache_is_valid( local_image.getUpdateTime() )
THEN
  owa_util.status_line( ordplsgwyutil.http_status_not_modified );
  RETURN;
END IF;

--
-- Set the MIME type and deliver the image to the browser.
--
owa_util.mime_header( local_image.mimeType, FALSE );
ordplsgwyutil.set_last_modified( local_image.getUpdateTime() );
owa_util.http_header_close();

IF owa_util.get_cgi_env( 'REQUEST_METHOD' ) <> 'HEAD' THEN
  wpg_docload.download_file( local_image.source.localData );
END IF;
```

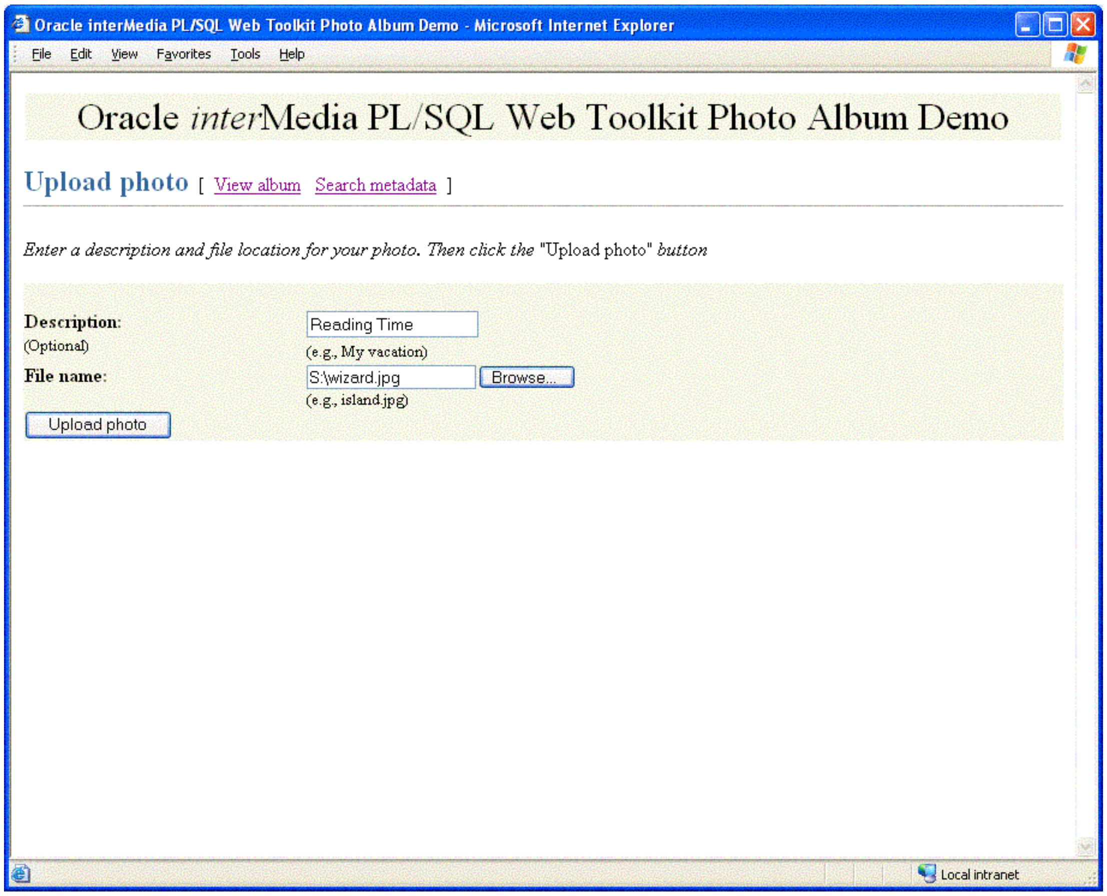
3.1.2.2 Adding Images to the Photo Album

The **Upload photo** page is used to add new images to the photo album. The page displays a form with two text entry fields. In the **Description:** field, you can optionally enter a word or short phrase that describes the image. In the **File name:** field, enter the name of the image file or click **Browse...** to locate the image file to be uploaded. The **Upload photo** button under the **File name:** field starts the upload operation. When the image is successfully uploaded, the **View album** page appears. From that page, you can display the contents of the photo album, as described in Section 3.1.2.1.

At the top of the **Upload photo** page, there is a navigation bar, which includes links to other photo album pages. From the **Upload photo** page, you can return to the **View album** page or select the **Search metadata** page. These pages are described in Section 3.1.2.1 and Section 3.1.2.7, respectively.

Figure 3–2 shows an **Upload photo** page with all the entry fields completed.

Figure 3–2 Completed Upload photo Page


Oracle interMedia PL/SQL Web Toolkit Photo Album Demo - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Browse...
Upload photo
Local intranet

Oracle *inter*Media PL/SQL Web Toolkit Photo Album Demo

Upload photo [View album Search metadata]

Enter a description and file location for your photo. Then click the "Upload photo" *button*

Description: (Optional) Reading Time (e.g., My vacation)

File name: S:\wizard.jpg (e.g., island.jpg)

The PL/SQL procedures `view_upload_form`, `print_upload_form`, and `insert_new_photo` are the primary application components that implement the **Upload photo** page. Together, view_upload_form and print_upload_form create the HTML page that is displayed. The page contains a form tag, a portion of which is shown in Example 3–5. The target of the form is PHOTO_ALBUM.INSERT_NEW_PHOTO.

Example 3–5 contains some relevant lines of code in the `print_upload_form` procedure.

Example 3–5 Procedure print_upload_form

```
<form action="PHOTO_ALBUM.INSERT_NEW_PHOTO"
method="post"
enctype="multipart/form-data">
database.
```

Procedure `insert_new_photo` receives the form, processes the inputs, and stores the new image in the database.

First, the `insert_new_photo` procedure checks that a file name was entered into the upload form. The image size, MIME type, and BLOB locator for the image content are selected from the document upload table, and the size is checked to ensure that the image is not of zero length. If the `description` field is blank, a description is created using the file name.

Next, the ORDSYS.ORDIMAGE.INIT( ) function is called to initialize the `thumb` and `image` ORDImage object type columns with an empty BLOB for the new row to be stored in the `photos` table. A SQL SELECT FOR UPDATE statement fetches the newly initialized thumbnail image and full-size image object type columns for updating. A DBMS_LOB.COPY operation loads the image from the upload table into the `image` ORDImage object type column.

The ORDImage object method setProperties( ) reads the image and sets the image object attributes. Because some browsers cannot display some image formats inline, in this sample application, BMP formatted images are converted to a JPEG image format (for images with more than 8 bits of color), or a GIFF image format (for images with less than 9 bits of color) by calling the `get_preferred_format` function. A processCopy( ) operation is performed on the full-size image to create the thumbnail image.

The ORDImage object getMetadata( ) method is called to extract all supported types of image metadata. The root element of each XML document in the return vector is examined to discover the metadata type so that the documents can be stored in the correct columns.

Then, a SQL UPDATE statement stores the full-size image, the thumbnail image, and the image metadata documents in the database. Procedure `sync_indexes` is called to force an update of the text indexes. Finally, the form data input is deleted from the document upload table. A success message is returned to the browser, and the browser is redirected to the **View album** page.

Example 3–6 contains some relevant lines of code in the `insert_new_photo` procedure.

Example 3–6 Procedure insert_new_photo

```
--
-- Make sure a file name has been provided. If not, display an error
-- message, then re-display the form.
--
IF new_photo IS NULL OR LENGTH( new_photo ) = 0
THEN
    print_page_header;
    print_error( 'Please supply a file name.' );
    print_upload_form;
    print_page_trailer( TRUE );
    return;
END IF;

--
-- Get the length, MIME type and the BLOB of the new photo from the
-- upload table.
--
SELECT doc_size,
       mime_type,
       blob_content
INTO   upload_size,
       upload_mime_type,
       upload_blob
FROM photos_upload
WHERE name = new_photo;

--
-- Make sure we have a valid file.
--
IF upload_size = 0
THEN
```

```
    print_page_header;
    print_heading( 'Error message' );
    htp.print( '<hr size="-1"><p>Please supply a valid image file.</p>' );
    print_upload_form;
    print_page_trailer( TRUE );
    return;
END IF;

--
-- If the description is blank, then use the file name.
--
IF c_description IS NULL
THEN
    c_description := new_photo;
    pos := INSTR( c_description, '/', -1 );
    IF pos > 0
    THEN
        c_description := SUBSTR( c_description, pos + 1 );
    END IF;
    c_description := SUBSTR( 'Image from file: ' ||
                     c_description || '.', 1, 40 );
END IF;
--
-- Insert a new row into the table, returning the newly allocated sequence
-- number.
INSERT INTO photos ( id, description, metaExif, metaIPTC, metaXMP,
                     image, thumb )
VALUES ( photos_sequence.nextval, c_description, NULL, NULL, NULL,
             ORDSYS.ORDIMAGE.INIT(), ORDSYS.ORDIMAGE.INIT() )
RETURN id
INTO new_id;

--
-- Fetch the newly initialized full-size and thumb-nail image objects.
--
SELECT image,
       thumb
INTO new_image,
     new_thumb
FROM photos
WHERE id = new_id
FOR UPDATE;

--
-- Load the photo from the upload table into the image object.
--
DBMS_LOB.COPY( new_image.source.localData, upload_blob, upload_size );
new_image.setLocal();
--
-- Set the properties. If the image format is not recognized, then
-- the exception handler will set the MIME type and length from the
-- upload table.
--
BEGIN
    new_image.setProperties();
EXCEPTION
    WHEN OTHERS THEN
         new_image.contentLength := upload_size;
         new_image.mimeType := upload_mime_type;
END;
```

```
--
-- Some image formats are supported by interMedia but may not be able
-- to be displayed in-line by a browser. The BMP format is one example.
-- Convert the image to a GIF or JPEG based on number of colors in the
-- image.
--
IF new_image.contentFormat IS NOT NULL AND
   ( new_image.mimeType = 'image/bmp' OR
     new_image.mimeType = 'image/x-bmp' )
THEN
    BEGIN
        new_image.process(
                     'fileFormat=' ||
                     get_preferred_format( new_image.contentFormat ) );
    EXCEPTION
        WHEN OTHERS THEN
            NULL;
    END;
END IF;

--
-- Try to copy the full-size image and process it to create the thumb-nail.
-- This may not be possible if the image format is not recognized.
--
BEGIN
    new_image.processCopy( thumb_scale, new_thumb );
EXCEPTION
    WHEN OTHERS THEN
        new_thumb.deleteContent();
        new_thumb.contentLength := 0;
END;
--
-- fetch the metadata and sort the results
--
BEGIN
  metav := new_image.getMetadata( 'ALL' );
  FOR i IN 1..metav.count() LOOP
    meta_root := metav(i).getRootElement();
    CASE meta_root
      WHEN 'ordImageAttributes' THEN xmlORD := metav(i);
      WHEN 'xmpMetadata'  THEN xmlXMP  := metav(i);
      WHEN 'iptcMetadata' THEN xmlIPTC := metav(i);
      WHEN 'exifMetadata' THEN xmlEXIF := metav(i);
      ELSE NULL;
    END CASE;
  END LOOP;
EXCEPTION
  WHEN OTHERS THEN
    NULL;
END;

--
-- Update the full-size and thumb-nail images in the database.
-- Update metadata columns
--
UPDATE photos
SET image = new_image,
    thumb = new_thumb,
    metaORDImage = xmlORD,
    metaEXIF = xmlEXIF,
    metaIPTC = xmlIPTC,
    metaXMP = xmlXMP
WHERE id = new_id;

--      -- update the text indexes
--      sync_indexes;

--
-- Delete the row from the upload table.
--
DELETE FROM photos_upload WHERE name = new_photo;
COMMIT;

--
-- Redirect browser to display full album.
--      print_page_header(
    '<meta http-equiv="refresh" content="2;url=PHOTO_ALBUM.VIEW_ALBUM">' );
print_heading( 'Photo successfully uploaded into photo album' );
```

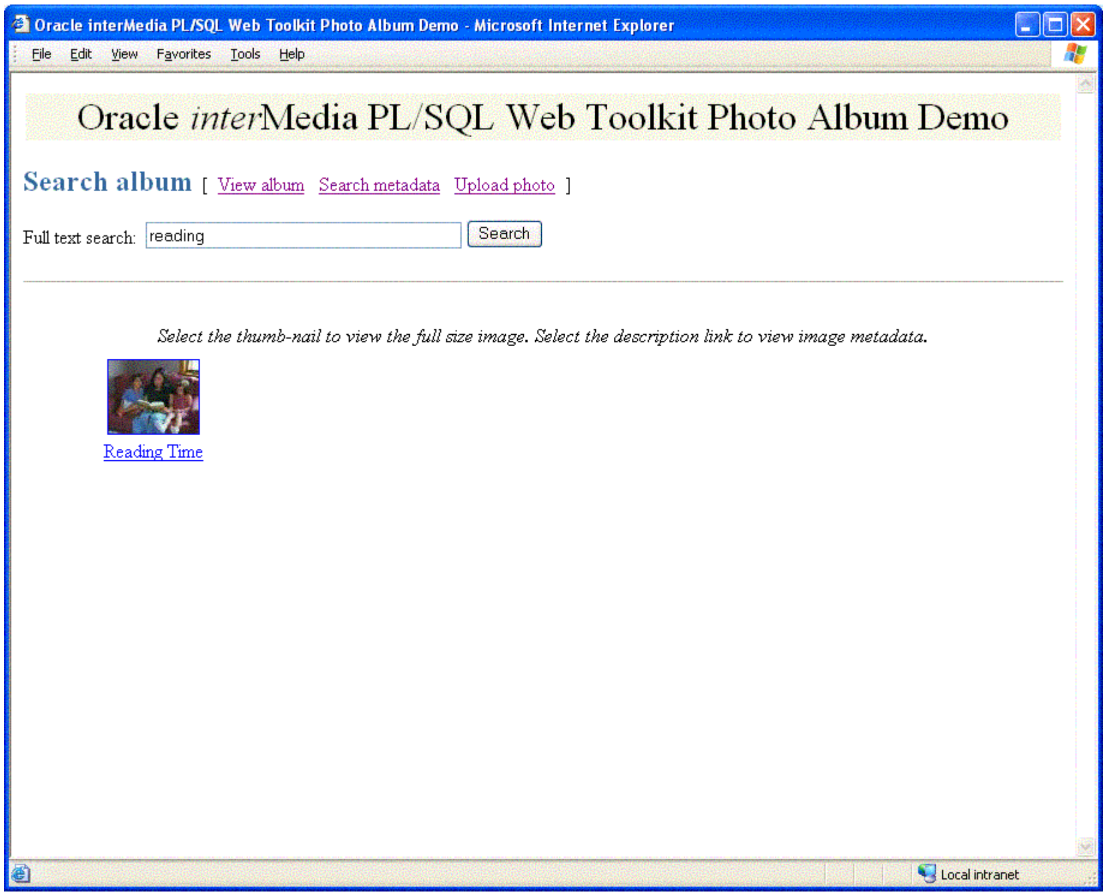
3.1.2.3 Searching for Images by Keyword or Phrase

You can use the **View album** and **Search album** pages to perform a keyword or phrase search of the metadata stored in the photo album. On either of these pages, enter the keyword or phrase in the **Full text search:** text entry field and click **Search**. The photo album application uses the `CONTEXT` text index to locate images that have metadata containing the text you entered. If the search is successful, the thumbnail versions of the matching images are displayed in a four-column table. Select the thumbnail image to view the full-size version, or select the description link below the thumbnail image to view the metadata for the image. If the search fails, the message "No photos were found" is displayed.

At the top of the **Search album** page, there is a navigation bar, which includes links to other photo album pages. From the **Search album** page, you can return to the **View album** page or select the **Search metadata** or **Upload photo** pages. These pages are described in Section 3.1.2.1, Section 3.1.2.7, and Section 3.1.2.2, respectively.

Figure 3–3 shows a **Search album** page that contains the results of a successful search operation.

Figure 3–3 Search album Page Showing Results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Search album [View album Search metadata Upload photo]

Full text search: reading

Select the thumb-nail to view the full size image. Select the description link to view image metadata.

Full text searching of the photo album is implemented by the `view_album` and `print_album` procedures. See Section 3.1.2.1 for a discussion of these procedures.

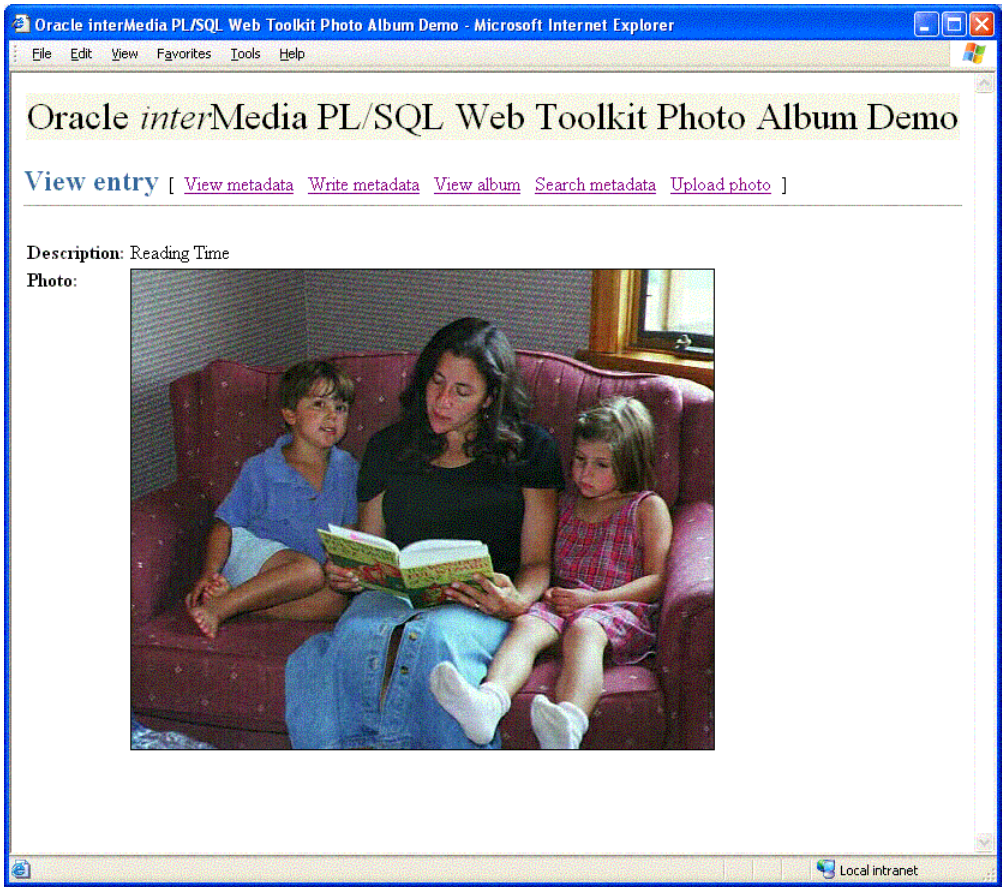
3.1.2.4 Viewing Full-Size Images

When you select a thumbnail image, the application directs you to the **View entry** page. This page displays the description of the image and the full-size version of the image.

At the top of the **View entry** page, there is a navigation bar, which includes links to other photo album pages. From the **View entry** page, you can return to the **View album** page, or select any of the **View metadata**, **Write metadata**, **Search metadata**, or **Upload photo** pages. These pages are described in Section 3.1.2.1, Section 3.1.2.5, Section 3.1.2.6, Section 3.1.2.7, and Section 3.1.2.2, respectively.

Figure 3–4 shows a **View entry** page that contains the description and the full-size version of an image.

Figure 3–4 View entry Page with a Full-Size Image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Oracle *inter*Media PL/SQL Web Toolkit Photo Album Demo

View entry [View metadata Write metadata View album Search metadata Upload photo]

Description: Reading Time

Photo:

The PL/SQL procedures `view_entry`, `print_image_link`, and `deliver_media` are the primary application components that implement the **View entry** page. The procedure `view_entry` takes a single parameter, `entry_id`, which uniquely locates the image in the `photos` table. The description and image object are fetched from the `photos` table. The procedure `print_image_link` creates the HTML `<img>` tag, and then calls procedure `deliver_media` to fetch the image content. See Section 3.1.2.1 for more information about the `print_image_link` and `deliver_media` procedures.

Example 3–7 contains some relevant lines of code in the `view_entry` procedure.

Example 3–7 Procedure view_entry

```
--
-- Fetch the row.
--
BEGIN
  SELECT htf.escape_sc(description), image
  INTO sc_description, photo
  FROM photos
  WHERE id = entry_id;
  EXCEPTION
  WHEN no_data_found THEN
    print_error( 'Image <b>' || htf.escape_sc(entry_id) ||
                 '</b> was not found.</p>' );
    print_page_trailer( TRUE );
    return;
    END;

    print_image_link( 'image', entry_id, sc_description,
photo.height, photo.width );
```

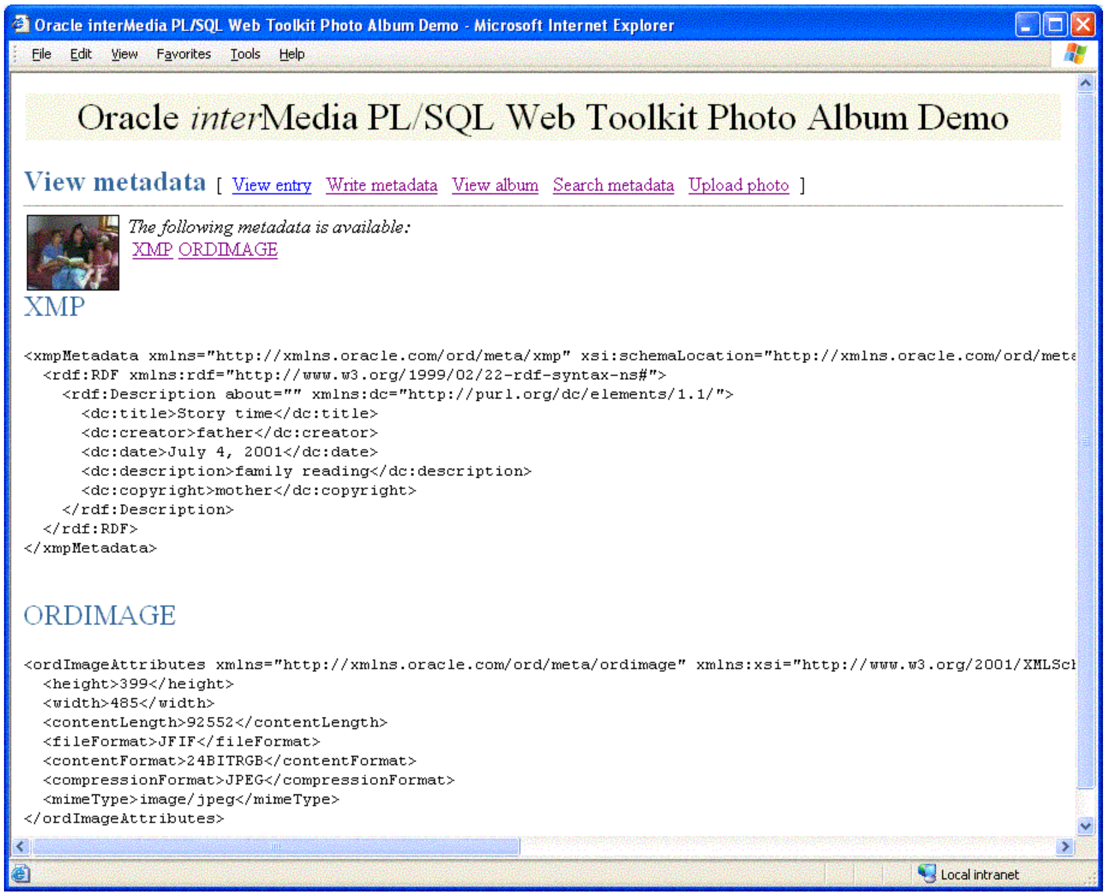
3.1.2.5 Examining Image Metadata

You can use the **View metadata** page to examine all the metadata for a specific image. Typically, you access this page from the **View album** page by selecting the description link below a thumbnail image. You can also access this page by selecting the **View metadata** link from the navigation bar. The **View metadata** page displays the thumbnail version of the image. To the right of the thumbnail image, there is a list of the metadata documents for this image. Each entry in the list is a link that takes you to the metadata document on the **View metadata** page.

At the top of the **View metadata** page, there is a navigation bar, which includes links to other photo album pages. From the **View metadata** page, you can return to the **View album** page, or select any of the **View entry**, **Write metadata**, **Search metadata**, or **Upload photo** pages. These pages are described in Section 3.1.2.1, Section 3.1.2.4, Section 3.1.2.6, Section 3.1.2.7, and Section 3.1.2.2, respectively.

Figure 3–5 shows a **View metadata** page that contains two types of metadata (XMP and ORDIMAGE) for an image.

Figure 3–5 View metadata Page with Metadata for an Uploaded Image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The following metadata is available:
XMP ORDIMAGE

XMP

```
<xmpMetadata xmlns="http://xmlns.oracle.com/ord/meta/xmp" xsi:schemaLocation="http://xmlns.oracle.com/ord/meta
  <rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#">
    <rdf:Description about="" xmlns:dc="http://purl.org/dc/elements/1.1/">
      <dc:title>Story time</dc:title>
      <dc:creator>father</dc:creator>
      <dc:date>July 4, 2001</dc:date>
      <dc:description>family reading</dc:description>
      <dc:copyright>mother</dc:copyright>
    </rdf:Description>
  </rdf:RDF>
</xmpMetadata>
```

ORDIMAGE

```
<ordImageAttributes xmlns="http://xmlns.oracle.com/ord/meta/ordimage" xmlns:xsi="http://www.w3.org/2001/XMLSch
  <height>399</height>
  <width>485</width>
  <contentLength>92552</contentLength>
  <fileFormat>JFIF</fileFormat>
  <contentFormat>24BITRGB</contentFormat>
  <compressionFormat>JPEG</compressionFormat>
  <mimeType>image/jpeg</mimeType>
</ordImageAttributes>
```

The PL/SQL procedures `view_metadata` and `print_metadata` are the primary application components that implement the **View metadata** page. The procedure view_metadata is passed the argument entry_id, which uniquely identifies the image in the photos table. A SELECT statement retrieves all the XMLtype metadata columns for the specified entry. If the metadata column is not NULL, procedure print_metadata is called to display the XML document inside an HTML <pre> tag.

Example 3–8 contains some relevant lines of code in the view_metadata procedure.

Example 3–8 Procedure view_metadata

```
--
-- Fetch the row.
--
SELECT metaOrdImage, metaEXIF, metaIPTC, metaXMP
INTO   metaO, metaE, metaI, metaX
FROM   photos
WHERE  id = entry_id;

-- display the EXIF metadata
IF metaE IS NOT NULL THEN
  htp.print( '<span class="bigBlue" id="exifMetadata">EXIF</span>' );
  htp.print( '<br><pre>' );
  print_metadata( metaE );      htp.print( '</pre>' );
END IF;
```

The print_metadata procedure accepts an XMLType document as an argument. It uses the getClobVal( ) method to access the document as a CLOB. The content of the CLOB is read in a loop and formatted in the HTML page using the htp.prints procedure. The htp.prints procedure escapes the '<' and '>' characters so that they are rendered properly by the Web browser.

Example 3–9 contains some relevant lines of code in the print_metadata procedure.

Example 3–9 Procedure print_metadata

```
metaClob := meta.getClobVal();
len := dbms_lob.getLength( metaClob );
IF bufSize > len THEN
  bufSize := len;
END IF;
WHILE len > 0 LOOP
  dbms_lob.read( metaClob, bufSize, pos, buf );
  htp.prints( buf );
  pos := pos + bufSize;
  len := len - bufSize;
END LOOP;
```

3.1.2.6 Writing New XMP Metadata to Images

You can use the **Write XMP metadata** page to write new or replace existing XMP metadata in an image. *inter*Media provides support for writing XMP metadata only. You can access the **Write XMP metadata** page by selecting the **Write metadata** link in the navigation bar from either the **View entry** page or the **View metadata** page.

The **Write XMP metadata** page displays the thumbnail version of the image to be modified. The page also displays an input form to collect metadata attributes in these five text entry fields:

- **Title:** Specify a title for the photograph.
- **Creator:** Enter the name of the person who took the photograph. This field is optional.

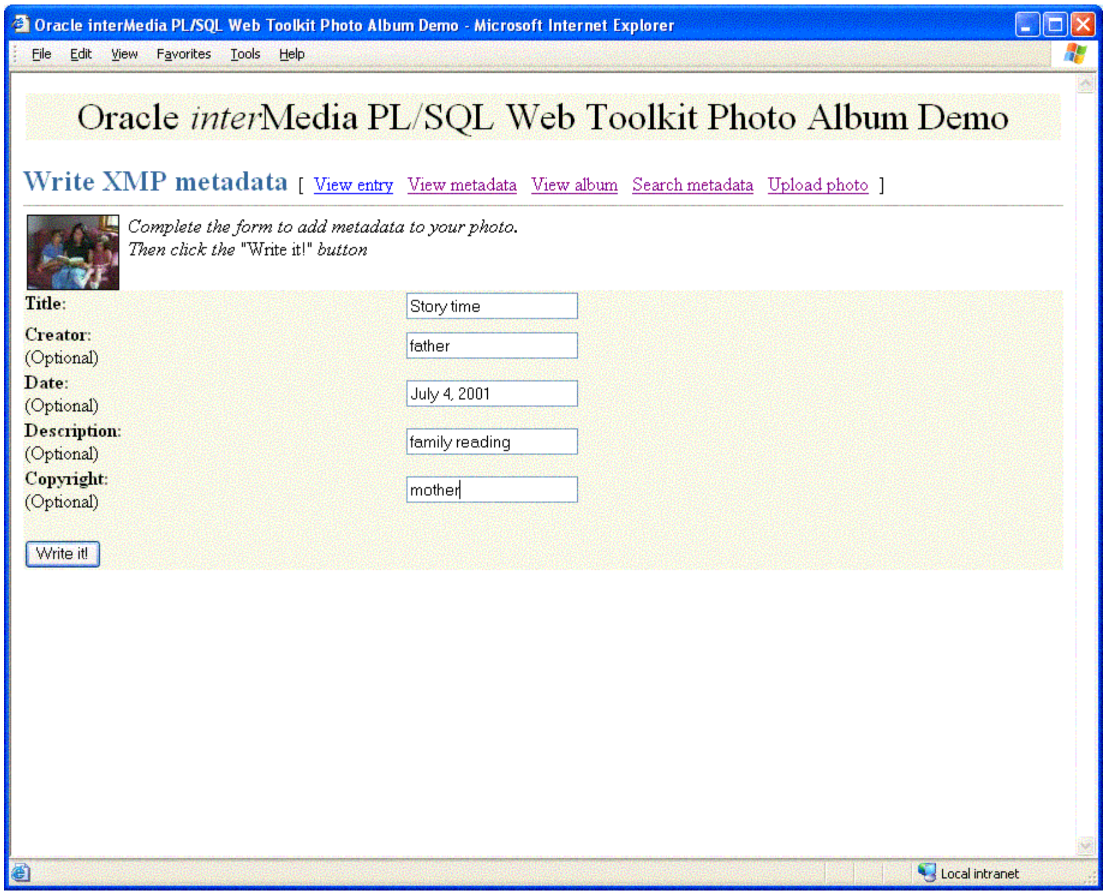
- **Date:** Enter the date the photograph was taken. This field is optional.
- **Description:** Enter a description, such as the subject of the photograph. This field is optional.
- **Copyright:** Enter the month and year when the photograph was taken. This field is optional.

Click **Write it!** to send the form to the application and embed the metadata in XMP format in the image.

At the top of the **Write XMP metadata** page, there is a navigation bar, which includes links to other photo album pages. From the **Write XMP metadata** page, you can return to the **View album** page, or select any of the **View entry**, **View metadata**, **Search metadata**, or **Upload photo** pages. These pages are described in Section 3.1.2.1, Section 3.1.2.4, Section 3.1.2.5, Section 3.1.2.7, and Section 3.1.2.2, respectively.

Figure 3–6 shows a **Write XMP metadata** page with completed entries for an image.

Figure 3–6 Completed Write XMP metadata Page with XMP Metadata for an Uploaded Image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Write XMP metadata [View entry View metadata View album Search metadata Upload photo]

Complete the form to add metadata to your photo.
Then click the "Write it!" *button*

Title:	Story time
Creator: (Optional)	father
Date: (Optional)	July 4, 2001
Description: (Optional)	family reading
Copyright: (Optional)	mother

Write it!

The PL/SQL procedure `write_metadata` receives the form input fields from the browser. The procedure creates an XML document (as a string buffer) that is valid to the *inter*Media XMP schema `http://xmlns.oracle.com/ord/meta/xmp`. The string buffer is used to create an XMLType object.

A SELECT FOR UPDATE statement retrieves the image to be modified. The *inter*Media method putMetadata( ) is called to embed the XML document into the image. The modified image is stored back to the photos table. Finally, procedure `sync_indexes` is called to update the text indexes.

Example 3–10 contains some relevant lines of code in the `write_metadata` procedure.

Example 3–10 Procedure write_metadata

```
-- Create the XMP packet it must be schema valid
-- to "http://xmlns.oracle.com/ord/meta/xmp"
-- and contain an <RDF> element. This example uses
-- the Dublin Core schema as implemented by Adobe XMP
buf := '<xmpMetadata xmlns="http://xmlns.oracle.com/ord/meta/xmp"
         xsi:schemaLocation="http://xmlns.oracle.com/ord/meta/xmp
         http://xmlns.oracle.com/ord/meta/xmp"
         xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" >
  <rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#">
  <rdf:Description about="" xmlns:dc="http://purl.org/dc/elements/1.1/">
  <dc:title>' || htf.escape_sc(title) || '</dc:title>';

IF c_creator IS NOT NULL THEN
  buf := buf || '<dc:creator>' || htf.escape_sc(c_creator)
             || '</dc:creator>';
END IF;
IF c_date IS NOT NULL THEN
  buf := buf || '<dc:date>' || htf.escape_sc(c_date)
             || '</dc:date>';
END IF;
IF c_description IS NOT NULL THEN
  buf := buf || '<dc:description>' || htf.escape_sc(c_description)
             || '</dc:description>';
END IF;
IF c_copyright IS NOT NULL THEN
  buf := buf || '<dc:copyright>' || htf.escape_sc(c_copyright)
             || '</dc:copyright>';
END IF;
buf := buf || '
  </rdf:Description>
  </rdf:RDF>
  </xmpMetadata>';

xmp := XMLType.createXML(buf, 'http://xmlns.oracle.com/ord/meta/xmp');

--    -- select image for update
-- description is selected to force update of CTX index
--
SELECT image, description
INTO img, des
FROM photos
WHERE id = entry_id
FOR UPDATE;

--
-- write the metadata
--
img.putMetadata( xmp, 'XMP' );

--
-- save updated image and new metadata to table
-- description updated to force update of CTX index
--
```

```
UPDATE photos
SET image = img,
    metaXMP = xmp,
    description = des
WHERE id = entry_id;

-- update the text indexes
sync_indexes;
```

The input data shown in Example 3–10 would result in the storage of the following metadata in the image:

```
<xmpMetadata xmlns="http://xmlns.oracle.com/ord/meta/xmp"
            xsi:schemaLocation="http://xmlns.oracle.com/ord/meta/xmp
            http://xmlns.oracle.com/ord/meta/xmp"
            xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
 <rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#">
   <rdf:Description about="" xmlns:dc="http://purl.org/dc/elements/1.1/">
     <dc:title>Story time</dc:title>
     <dc:creator>father</dc:creator>
     <dc:date>July 4, 2001</dc:date>
     <dc:description>family reading</dc:description>
     <dc:copyright>mother</dc:copyright>
   </rdf:Description>
 </rdf:RDF>
</xmpMetadata>
```

3.1.2.7 Searching for Images That Contain Specific Metadata Attributes

You can use the **Search metadata** page to search a specific metadata type as well as to limit your search to a specific tag within a metadata document. You can access the **Search metadata** page by selecting the **Search metadata** link in the navigation bar of any photo album application Web page.

The **Search metadata** page displays a form with four fields to define how the search is to be performed. Use the pull-down menu in the **Search in metadata:** field to select the type of metadata (**EXIF**, **IPTC**, or **XMP**) to be searched. When this field is changed, the fields **Search in tag:** and **Search method:** are initialized with values that are appropriate to the type of metadata search.

Use the drop-down list in the **Search in tag:** field to limit the search to a specific XML element within a metadata document. The list is populated with element names that are appropriate for the selected metadata type. When the value **--Any tag--** is showing, the search will look at all elements within the document type. When the **XMP** metadata type is selected, searches are limited to Description elements within the parent RDF element. If the metadata document is properly constructed, selecting **RDF/Description** in this field should search all relevant metadata within XMP documents.

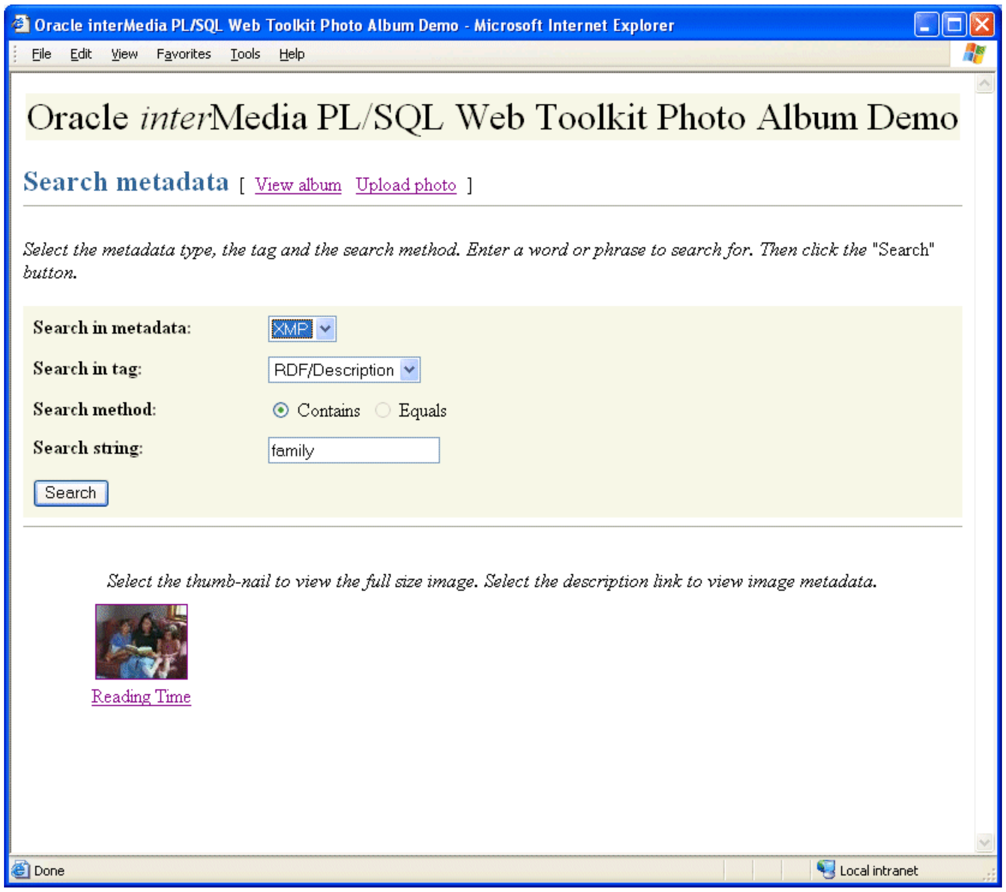
In the **Search method:** field, select the radio button **Contains** to specify a search where an element contains the search string. Select the radio button **Equals** to specify a search where element values are matched exactly to the search string. For searches in XMP metadata, only the **Contains** search method is available.

Finally, enter a keyword or phrase in the **Search string:** field and click **Search**. If the search is successful, the thumbnail versions of the matching images are displayed in a four-column table. Select the thumbnail image to view the full-size version of an image. Or, select the description link below the thumbnail image to view the metadata for the image. If the search fails, the message "No photos matched the search criteria." is displayed.

At the top of the **Search metadata** page, there is a navigation bar, which includes links to other photo album pages. From the **Search metadata** page, you can return to the **View album** page or select the **Upload photo** page. These pages are described in Section 3.1.2.1 and Section 3.1.2.2, respectively.

Figure 3–7 shows a **Search metadata** page that contains sample search criteria and results from a successful search operation.

Figure 3–7 Completed Search metadata Page for an Uploaded Image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File Edit View Favorites Tools Help
Search
Done
Local intranet

Oracle *inter*Media PL/SQL Web Toolkit Photo Album Demo

Search metadata [View album Upload photo]

Select the metadata type, the tag and the search method. Enter a word or phrase to search for. Then click the "Search" button.

Search in metadata:	XMP
Search in tag:	RDF/Description
Search method:	[✓ Contains] Equals
Search string:	family

Select the thumb-nail to view the full size image. Select the description link to view image metadata.

Reading Time

The PL/SQL procedure `search_metadata` receives the form input fields from the Web browser. The search parameters are used to build a query to find images that contain the desired metadata. The search is accomplished using the SQL EXISTSNODE operator. The EXISTSNODE operator is used to search an XML document for content that matches the given search predicate. The operator returns `1` if the document matched the search, and `0` otherwise. The operator takes three arguments. The first argument is the name of the XMLType column. In this application, the column to search is determined by the metadata type selected in the pull-down menu for the **Search in metadata:** field. The second argument is an XPATH expression that specifies the content to be searched and how the matching is evaluated. The **Search in tag:** and **Search method:** fields are used to build the XPATH expression. The third argument is a string to define the XML namespaces to be used to process the document and the XPATH expression.

For example, assume that the `search_metadata` procedure receives input that specifies to search the `caption` tag in IPTC metadata for an exact match of the word "farm". The query to accomplish this search is as follows:

```
SELECT id, description, thumb
FROM photos
WHERE EXISTSNODE( metaIptc,
                 '/iptcMetadata//caption="farm"',
                 'xmlns:ora="http://xmlns.oracle.com/xdb" ' ||
                 'xmlns="http://xmlns.oracle.com/ord/meta/iptc"' ) = 1;
```

The second argument to the EXISTSNODE operator, `'/iptcMetadata//caption="farm"`, specifies a search for all `<caption>` elements under the root element `<iptcMetadata>` where the `<caption>` content is equal to `"farm"`.

For more information about the EXISTSNODE operator, see *Oracle XML DB Developer's Guide*. For more information about the contains( ) text search operator, see *Oracle Text Application Developer's Guide*.

Example 3–11 contains some relevant lines of code in the `search_metadata` procedure.

Example 3–11 Procedure search_metadata

```
-- set up search variables for EXIF documents
IF mtype = 'exif' THEN
  IF op = 'equals' THEN
    xpath  := '/exifMetadata//' || tag || '="' || c_search || '"';
  ELSE  -- default to contains
    xpath  := '/exifMetadata//' || tag ||
              '[ora:contains(text(), "' || c_search || '")>0]';
  END IF;

  nspace := 'xmlns:ora="http://xmlns.oracle.com/xdb" ' ||
            'xmlns="http://xmlns.oracle.com/ord/meta/exif"';

  OPEN album_cur FOR
    SELECT id, description, thumb
    FROM photos
    WHERE existsnode( metaExif, xpath, nspace ) = 1;

-- set up search variables for IPTC documents
ELSIF mtype = 'iptc' THEN
  IF op = 'equals' THEN
    xpath  := '/iptcMetadata//' || tag || '="' || c_search || '"';
  ELSE  -- default to contains
    xpath  := '/iptcMetadata//' || tag ||
              '[ora:contains(text(), "' || c_search || '")>0]';
  END IF;

  nspace := 'xmlns:ora="http://xmlns.oracle.com/xdb" ' ||
            'xmlns="http://xmlns.oracle.com/ord/meta/iptc"';

  OPEN album_cur FOR
    SELECT id, description, thumb
    FROM photos
    WHERE existsnode( metaIptc, xpath, nspace ) = 1;

-- set up search variables for XMP documents
ELSIF mtype = 'xmp' THEN
  -- default to contains
 xpath  := '/xmpMetadata/rdf:RDF/rdf:Description/*[ora:contains(text(), "'
           || c_search || '")>0]';
```

```
      -- add rdf namespace prefix
      nspace := 'xmlns:ora="http://xmlns.oracle.com/xdb" ' ||
                'xmlns="http://xmlns.oracle.com/ord/meta/xmp" ' ||
                'xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"';

      OPEN album_cur FOR
        SELECT id, description, thumb
        FROM photos
        WHERE existsnode( metaXMP, xpath, nspace ) = 1;

    ELSE
      errorMsg := 'Search domain is invalid: ' || htf.escape_sc(mtype);
    END IF;

   print_search_form( mtype, tag, op, c_search );
    htp.print('<hr size="-1">');
    print_album( album_cur, 'No photos matched the search criteria.' );
```

3.2 Other Photo Album Sample Applications

This set of *inter*Media photo album sample applications demonstrates the use of the *inter*Media image object type to upload and retrieve media data stored in Oracle Database.

Each of these photo album applications, when installed, creates a table named `photos` and a sequence named `photos_sequence`.

The `photos` table is described by the following CREATE TABLE statement:

```
CREATE TABLE photos(id          NUMBER PRIMARY KEY,
                    description VARCHAR2(40) NOT NULL,
                    location    VARCHAR2(40),
                    image       ORDSYS.ORDIMAGE,
                    thumb       ORDSYS.ORDIMAGE);
```

Note that the data type for the `image` and `thumb` columns are defined as *inter*Media image object types to store the full-size images and the generated thumbnail images.

The `photos_sequence` sequence is defined by the following CREATE SEQUENCE statement:

```
CREATE SEQUENCE photos_sequence;
```

3.2.1 Oracle *inter*Media Java Servlet Photo Album Sample Application

The *inter*Media Java Servlet Photo Album sample application demonstrates the use of Oracle *inter*Media Java Classes for Servlets and JSP to upload and retrieve multimedia data to and from the database. Users access the servlet application to view the contents of the photo album, including thumbnail versions of each photograph, to view the full-size version of any photograph, and to upload new photographs into the album.

3.2.1.1 Running the Java Servlet Photo Album Application

After you have completed the setup tasks and have built the Java servlet photo album application, you can run the application by entering the following URL in the address field of your Web browser:

- Default installation of Oracle Application Server or Oracle Database

  `<protocol><hostname:port-number>``/servlet/PhotoAlbumServlet`

- Default installation of Tomcat 3.2 on Windows

  ```
  <protocol><hostname:port-number>/examples/servlet/PhotoAlbumServlet
  ```

  The *<protocol>* field is `http://`, and the *<hostname:port-number>* field is the host name and port number of the system where your HTTP server is running.

When first invoked, the photo album application displays any images that are currently stored in the album. By default, the photo album is empty when first installed. To upload a new photograph, select **Upload new photo**. Enter a description of the photograph, the location where the photograph was taken, and the name of the image file (or browse to its directory location), then click **Upload photo**. The contents of the photo album are displayed along with a picture of the new photograph. Click the thumbnail image to view the full-size version of the photograph.

When the photo album application displays the text **view image** instead of its thumbnail image, the image format that was uploaded was not recognized by *inter*Media. Click **view image** to display the full-size image.

You can now begin to load your photo album application with your favorite photographs.

3.2.1.2 Description of the *inter*Media Java Servlet Photo Album Application

The *inter*Media Java Servlet Photo Album application combines both business logic and the presentation into a single servlet, which when compiled, creates two class files, `PhotoAlbumServlet.class` and `PhotoAlbumRequest.class`.

To follow along with the description of tasks, users should refer to a copy of the `PhotoAlbumServlet.java` file, which can be found in:

<ORACLE_HOME>`/ord/http/demo/servlet` (on UNIX)

<ORACLE_HOME>`\ord\http\demo\servlet` (on Windows)

PhotoAlbumServlet Class

The `PhotoAlbumServlet` class performs the following tasks:

- Extends the HttpServlet and contains the user-entered connection information.

  ```
  public class PhotoAlbumServlet extends HttpServlet
  ```

- Accepts connection information by allowing you to select the connection method, supply the necessary connection information, and optionally change the user name and password to connect to a schema other than `scott/tiger`.

  ```
  private final static String JDBC_CONNECT_STRING =
  //  "jdbc:oracle:oci:@<SQL*Net TNS name>";   // 9i JDBC OCI driver
  //  "jdbc:oracle:oci8:@<SQL*Net TNS name>";   // 8i JDBC OCI driver
      "jdbc:oracle:thin:@<host>:<port>:<sid>";  // JDBC Thin driver

  private final static String JDBC_USER_NAME = "scott";
  private final static String JDBC_PASSWORD  = "tiger";
  ```

- Instantiates a Java stack used to implement a simple connection-pooling mechanism.

  ```
  private static Stack connStack = new Stack();
  ```

- Defines a flag to indicate whether or not the JDBC Thin driver has been loaded.

  ```
  private static boolean driverLoaded = false;
  ```

- Defines a servlet initialization method.

```
public void init( ServletConfig config ) throws ServletException
{
    super.init(config);
}
```

- Defines a doGet( ) method to process an HTTP GET request containing an HttpServletRequest object and HttpServletResponse object, and instantiates a PhotoAlbumRequest object to process the request to deliver either a full-size or thumbnail image to the browser, or to display an upload form or the contents of the photo album as thumbnail images.

```
public void doGet( HttpServletRequest request,
                   HttpServletResponse response )
    throws ServletException, IOException
{
    Connection conn = null;

    //
    // Use a try-block to ensure that JDBC connections are always returned
    // to the pool.
    //
    try
    {
        //
        // Get a JDBC connection from the pool.
        //
        conn = getConnection();

        //
        // Instantiate a PhotoAlbumRequest object to process the request.
        //
        PhotoAlbumRequest albumRequest =
            new PhotoAlbumRequest( conn, request, response );

        //
        // Figure out what to do based on query string parameters.
        //
        String view_media = request.getParameter( "view_media" );
        if ( view_media != null )
        {
            //
            // Deliver a full-sized or thumbnail image to the browser.
            //
            albumRequest.viewMedia( view_media );
            return;
        }
        else if ( request.getParameter( "view_form" ) != null )
        {
            //
            // Display the HTML upload form.
            //
            albumRequest.viewUploadForm();
        }
        else if ( request.getParameter( "view_entry" ) != null )
        {
            //
            // Display full-sized photo image.
            //
            albumRequest.viewPhoto();
        }
        else
        {
            //
            // Display album contents with thumbnail images by default.
            //
            albumRequest.viewAlbum();
        }
    }
    catch ( SQLException e )
    {
        //
        // Log what went wrong.
        //
        e.printStackTrace( System.out );

        //
        // Turn SQL exceptions into ServletExceptions.
        //
        throw new ServletException( e.toString() );
    }
    finally
    {
        //
        // If we have a JDBC connection, then return it to the pool.
        //
        freeConnection( conn );
    }
}
```

- Defines a doPost( ) method to process an HTTP POST request used to upload a new photograph into the album by instantiating a PhotoAlbumRequest object to process the request and then calling the insertNewPhoto( ) method.

```
public void doPost( HttpServletRequest request,
                    HttpServletResponse response )
    throws ServletException, IOException
{
    Connection conn = null;

    //
    // Use a try-block to ensure that JDBC connections are always returned
    // to the pool.
    //
    try
    {
        //
        // Get a JDBC connection from the pool.
        //
        conn = getConnection();

        //
        // Instantiate a PhotoAlbumRequest object to process the request.
        //
        PhotoAlbumRequest albumRequest =
            new PhotoAlbumRequest( conn, request, response );

        //
        // Insert the photo into the album.
        //
```

```
            albumRequest.insertNewPhoto();
        }
        catch ( SQLException e )
        {
            //
            // Log what went wrong.
            //
            e.printStackTrace( System.out );

            //
            // Turn SQL exceptions into ServletExceptions.
            //
            throw new ServletException( e.toString() );
        }
        finally
        {
            //
            // If we have a JDBC connection, then return it to the pool.
            //
            freeConnection( conn );
        }
    }
```

- Defines a getConnection( ) method.

```
private Connection getConnection()
    throws SQLException
{
    OracleConnection conn = null;

    //
    // Synchronize on the stack object. Load the JDBC driver if not yet
    // done. If there's a free connection on the stack, then pop it off
    // the stack and return it to the caller. Otherwise, create a new
    // connection object and call the version compatibility initialization
    // method.
    //
    synchronized( connStack )
    {
        if ( !driverLoaded )
        {
            DriverManager.registerDriver(
                                    new oracle.jdbc.driver.OracleDriver() );
            driverLoaded = true;
        }
        if ( connStack.empty() )
        {
            conn = (OracleConnection)DriverManager.getConnection
                ( JDBC_CONNECT_STRING, JDBC_USER_NAME, JDBC_PASSWORD );
        }
        else
        {
            conn = (OracleConnection)connStack.pop();
        }
    }

    //
    // Enable auto-commit by default.
    //
    conn.setAutoCommit( true );
```

```
        return conn;
    }
```

- Defines a freeConnection( ) method.

```
    private void freeConnection( Connection conn )
    {
        //
        // Synchronize on the stack object, then push the connection onto the
        // stack.
        //
        if ( conn != null )
        {
            synchronized( connStack )
            {
                connStack.push( conn );
            }
        }
    }
```

In summary, the `PhotoAlbumServlet` class responds to the HTTP GET and POST requests by allocating a JDBC connection from a connection pool. Each HTTP GET or POST request is assigned its own JDBC connection from the pool to ensure that multiple requests can be serviced concurrently. An HTTP GET request is used to retrieve image data from the photo album and an HTTP POST request is used to upload image data into the photo album. Then, an instance of the `PhotoAlbumRequest` class is created to execute the request, executes the request, then releases the JDBC connection back to the pool at the end of the request.

PhotoAlbumRequest Class

The `PhotoAlbumRequest` class does the actual processing of an HTTP GET or POST request, and defines the getPreferredFormat( ) function and the following methods:

viewAlbum( )
viewPhoto( )
viewMedia( )
viewUploadForm( )
insertNewPhoto( )
printPageHeader( )
printPageTrailer( )
printMessage( )
printHeading( )
printLink( )

In the viewMedia( ) and insertNewPhoto( ) methods, three objects, OrdHttpResponseHandler, OrdHttpUploadFormData, and OrdHttpUploadFile, are instantiated. These objects are used to call the methods of the respective `OrdHttpResponseHandler`, `OrdHttpUploadFormData`, `OrdHttpUploadFile` classes of the Oracle *inter*Media Java Classes for Servlets and JSP. For example, in the viewMedia( ) method, the OrdHttpResponseHandler object is instantiated and used to call the sendImage( ) method as shown in the following code:

```
OrdHttpResponseHandler handler =
    new OrdHttpResponseHandler( request, response );
handler.sendImage( img );
```

The viewAlbum( ), viewPhoto( ), viewMedia( ), and insertNewPhoto( ) methods use the ORAData (formerly getCustomDatum) and ORADataFactory (formerly getFactory) interfaces supplied by Oracle to get the image or thumbnail OrdImage object from the result set to obtain height and width information, to retrieve an image from an OrdImage Java object and deliver it to the browser, and to upload an image in an OrdImage Java object and to also update it in the `photos` table. For example, the following code excerpt is from the viewAlbum( ) method:

```
OrdImage img =
    (OrdImage)rset.getORAData( 4, OrdImage.getORADataFactory() );
.
.
.
out.print( "<td headers=\"image\"><a href=\"" + servletUri +
           "?view_entry=yes&id=" + id + "\">" );
if ( img.getContentLength() > 0 )
{
    if (img.getMimeType().startsWith("image/"))
    {
out.print( "<img src=\"" + servletUri +
                           "?view_media=thumb&id=" + id + "\"" +
                           " height=" + img.getHeight() +
                           " width=" + img.getWidth() +
                           " alt=\"" + description + "\"" +
         " border=1>" );
    }
}
else
{
    out.print( "[view image]" );
}
out.println( "</a></td>" );
out.println( "</tr>" );
```

What follows is a more detailed description of each method and what it does:

- The viewAlbum( ) method does the following:
  - Initializes the row count to zero.
  - Writes a common page header on the HTML page using the function printPageHeader( ).
  - Executes a SELECT statement to fetch all the thumbnail images in the photo album, order them by description, and display the description and location information for each along with the thumbnail image if it exists, and returns the results in a result set.
  - Displays the thumbnail images in an HTML table with column headers labeled `Description`, `Location`, and `Image`.
  - Within a `while` block, reads the contents of the result set by reading the first row's contents beginning with the `id` value, displays the description and location values, then gets the thumbnail OrdImage object and builds the height and width attributes for each thumbnail image.
  - Displays the thumbnail image using an HTML anchor tag that can be used to display the full-size image. When a user clicks the thumbnail image or **view image**, the full-size image is displayed.
  - Displays the contents of the photo album within an HTML anchor tag using the tag `<IMG SRC="<servlet-path>?view_media=thumb&id=...">` to display the thumbnail images, where `<servlet-path>` is the value of `servletUri`. If the thumbnail image was not created because the image

format was not supported by *inter*Media, the text **view image** is displayed instead.

- Increments the row count to see if the photo album is empty; if so, it displays the message "The photo album is empty".
- Displays an HTML anchor tag near the bottom of the HTML page using the printLink( ) function with the text **Upload new photo**.
- Writes a common trailer at the bottom of the HTML page by calling the printPageHeader( ) function, however, in this case, sets the Boolean argument to false to not display the common page trailer.
- Closes the result set and the statement.

- The viewPhoto( ) method displays the full-size version of a photograph and does the following:
  - Writes a common page header on the HTML page using the function printPageHeader( ).
  - Gets the value of the `id` column for the entry being viewed.
  - Executes a SQL SELECT statement to fetch the entry's description, location, and full-size image where the value of `id` in the `where` clause is a parameter marker and returns the results in a result set.
  - Gets the image OrdImage object from the result set in order to later build the image height and width attributes within the `<IMG SRC=...>` image tag.
  - Displays the full-size image in an HTML table beginning with the column names `Description` and `Location`, and displays the entry's values for these two columns.
  - Builds the URL to fetch a full-size image for this entry by using an image tag `<IMG SRC="<servlet-path>?view_media=image&id=...">` to display an image in the column labeled `Photo`, where `<servlet-path>` is the value of `servletUri`.
  - Displays the full-size images height and width by calling the getHeight( ) and getWidth( ) *inter*Media object methods. If the image format is not recognized by *inter*Media, height and width values will be zero and will not be displayed.
  - Writes a common page trailer at the bottom of the HTML page by calling the printPageHeader( ) function and setting its Boolean argument to true to display the common page trailer.
  - Closes the result set and the statement.
- The viewMedia( ) method is invoked by both thumbnail and full-size image URLs to retrieve a thumbnail or full-size image from the `photos` table and deliver it to the browser using the `OrdHttpResponseHandler` class. This method does the following:
  - Executes a SQL SELECT statement to fetch either the thumbnail or full-size image where the value of `id` in the `where` clause is a parameter marker and returns the results in a result set. The SQL SELECT statement is built dynamically with the string `media` equating to either the thumbnail image column or the full-size image column.
  - Fetches a row from the result set.
  - Gets the OrdImage object from the result set.

  - Uses the `OrdHttpResponseHandler` class to create an OrdHttpResponseHandler object to retrieve the image from the OrdImage object and deliver it to the browser using the sendImage( ) method. The sendImage( ) method supports browser content caching by supporting the If-Modified-Since and Last-Modified headers.
  - Closes the result set and the statement.
- The viewUploadForm( ) method displays an HTML form that allows users to upload new photographs and does the following:
  - Calls the printPageHeader( ) function to produce the common page header.
  - Defines the form action as a multipart/form-data POST request.
  - Calls the `upload_form_fields` static string containing the contents of the upload form. The upload form is defined as a table with rows labeled `Description` and `Location`, with an input type of text and named description and location respectively, followed by a row labeled `File name:`, with an input type of `file` and named `photo`, and finally a row with no label, an input type of `submit`, and a value of `Upload photo`.
  - Calls the printPageTrailer( ) function to produce the common page trailer.
- The insertNewPhoto( ) method does the following:
  - Uses the `OrdHttpUploadFormData` class to parse a multipart/form-data POST request containing an uploaded photograph.
  - Uses the `OrdHttpUploadFile` class to upload the new photograph into the database.
  - Executes a SQL SELECT photos_sequence.nextval statement to get the next value of the `id` column for the new row to be inserted into the `photos` table.
  - Executes a SQL INSERT statement to insert a new row in the `photos` table.
  - Executes a SQL SELECT...FOR UPDATE statement to fetch the initialized full-size and thumbnail image objects from the `photos` table.
  - Calls the loadImage( ) method in the `OrdHttpUploadFile` class to populate an OrdImage object named `image` with the full-size image and sets the properties or attribute values of the image object based on the image contents.
  - Checks to see what the image format is and if it is an image format that may not be displayed inline by a browser, such as a BMP image format, then calls the getPreferredFormat( ) method to convert a BMP image format and return the preferred image format.
  - Calls the ProcessCopy( ) method in the `OrdImage` class to process the full-size image, create a thumbnail image, and populate an OrdImage object named `thumb`.
  - Executes a SQL UPDATE statement to update the full-size and thumbnail images in the database.
  - Displays a photo upload success message and then directs the browser to refresh the page.
- A getPreferredFormat( ) private function, in this sample application, converts a BMP image format and returns the preferred image file format based on the number of colors in the image; returns a MONOCHROME image format if there are no colors, or a JPEG if there are more than 8 colors, or a GIF if there are greater than 0 and fewer than 8 colors.

- A printPageHeader( ) private function displays an HTML header that is common to all HTML responses.
- A printPageTrailer( ) private function displays an HTML trailer that is common to all HTML responses.
- A printMessage( ) private function prints a message on the HTML page.
- A printHeading( ) private function prints a header on the HTML page.
- A printLink( ) function produces an HTML anchor tag in a standard format.

3.2.2 Oracle *inter*Media JavaServer Pages (JSP) Photo Album Sample Application

The *inter*Media JavaServer Pages (JSP) Photo Album sample application is a JSP application that demonstrates the use of Oracle *inter*Media Java Classes for Servlets and JSP to upload and retrieve multimedia data to and from a database. Users access the JSP files that constitute the application to view the contents of the photo album, including thumbnail versions of each photograph, to view the full-size version of any photograph, and to upload new photographs into the album.

3.2.2.1 Running the JSP Photo Album Application

After you have completed the setup tasks and have built the JSP photo album application, you can run the JSP photo album application by entering the following URL in the address field of your Web browser:

- Default installation of Oracle Application Server or Oracle Database

  ```
  <protocol><hostname:port-number>/demo/PhotoAlbum.jsp
  ```

- Default installation of Tomcat 3.2 on Windows

  ```
  <protocol><hostname:port-number>/examples/jsp/PhotoAlbum.jsp
  ```

  The *`<protocol>`* field is `http://`, and the *`<hostname:port-number>`* field is the host name and port number of the system where your HTTP server is running.

When first invoked, the photo album application displays any images that are currently stored in the album. By default, the photo album is empty when first installed. To upload a new photograph, select **Upload new photo**. Enter a description of the photograph, the location where the photograph was taken, and the name of the image file or browse to its directory location, then click **Upload photo**. The contents of the photo album are displayed along with a picture of the new photograph. Click the thumbnail image to view the full-size version of the photograph.

When the photo album application displays the text **view image** instead of its thumbnail image, the image format that was uploaded was not recognized by *inter*Media. Click **view image** to display the full-size image.

You can now begin to load your photo album application with your favorite photographs.

3.2.2.2 Description of the *inter*Media JSP Photo Album Application

The JSP photo album application separates the business logic from the presentation by having a JavaBean containing methods that are accessed from each of five JSP files. When compiled, the application creates the `PhotoAlbumBean.class` file, which contains the user-entered connection information and defines the functions: getId( ), getDescription( ), getLocation( ), and getPreferredFormat( ) and the following methods:

selectTable( )
selectRowById( )
fetch( )
insertNewPhoto( )
release( )
getConnection( )
freeConnection( )
setId( )
setDescription( )
setLocation( )
getImage( )
getThumb( )

To follow along with the description of tasks, users should refer to a copy of each JSP file, which can be found in:

<ORACLE_HOME>`/ord/http/demo/jsp` (on UNIX)

<ORACLE_HOME>`\ord\http\demo\jsp` (on Windows)

In the `PhotoAlbumEntryViewer`, `PhotoAlbumMediaViewer`, `PhotoAlbum`, and `PhotoAlbumInsertPhoto` JSP files, the `jsp:useBean` action tag is used to establish an ID and association with the `PhotoAlbumBean` class and the `OrdHttpJspResponseHandler` and `OrdHttpUploadFormData` classes of Oracle *inter*Media Java Classes for Servlets and JSP. For example, the following code appears in the `PhotoAlbumInsertPhoto` JSP file:

```
<jsp:useBean id="album" scope="page" class="PhotoAlbumBean"/>
<jsp:useBean id="handler" scope="page"
             class="oracle.ord.im.OrdHttpJspResponseHandler"/>
<jsp:useBean id="formData" scope="page"
             class="oracle.ord.im.OrdHttpUploadFormData"/>
```

This `jsp:useBean` action tag is used so these objects can be referenced by their respective ID values (`album`, `handler`, and `formData`) to call the methods of these classes.

The `OrdHttpUploadFile` class of Oracle *inter*Media Java Classes for Servlets and JSP is defined as an object with the name `uploadPhoto` in the insertNewPhoto( ) method in the `PhotoAlbumBean.java` file and then used to call its loadImage( ) method to load the photograph into the `photos` table as shown in the following code excerpts:

```
public void insertNewPhoto( OrdHttpUploadFile uploadPhoto )
        throws SQLException, ServletException, IOException
.
.
.
uploadPhoto.loadImage( image );
.
.
.
```

The insertNewPhoto( ) method defined in the `PhotoAlbumBean.java` file, uses the ORAData (formerly getCustomDatum) and ORADataFactory (formerly getFactory) interfaces supplied by Oracle to upload an image and a thumbnail image in an OrdImage Java object. First, the method executes a SQL SELECT...FOR UPDATE statement to select the row for update, and then, executes a SQL UPDATE statement to update the `image` and `thumb` columns for that row in the `photos` table as shown in the following code excerpts:

```
stmt = (OraclePreparedStatement)conn.prepareStatement(
            "select image,thumb from photos where id = ? for update" );
stmt.setString( 1, id );
rset = (OracleResultSet)stmt.executeQuery();
if ( !rset.next() )
{
    throw new ServletException( "new row not found in table" );
}
image = (OrdImage)rset.getORAData( 1, OrdImage.getORADataFactory());
thumb = (OrdImage)rset.getORAData( 2, OrdImage.getORADataFactory());

rset.close();
stmt.close();
.
.
.
    //
    // Prepare and execute a SQL statement to update the full-sized and
    // thumbnail images in the database.
    //
    stmt = (OraclePreparedStatement)conn.prepareStatement(
               "update photos set image = ?, thumb = ? where id = ?" );
    stmt.setORAData( 1, image );
    stmt.setORAData( 2, thumb );
    stmt.setString( 3, id );
    stmt.execute();
    stmt.close();

    //
    // Commit the changes.
    //
    conn.commit();
}
```

The fetch( ) method defined in the `PhotoAlbumBean.java` file or the PhotoAlbumBean JavaBean, fetches the next row from the result set using the ORAData and ORADataFactory interfaces to retrieve the image and the thumbnail image from an OrdImage Java object, and delivers each to the browser, as shown in the following example:

```
public boolean fetch()
    throws SQLException
{
    if ( rset.next() )
    {
        id = rset.getString( 1 );
        description = rset.getString( 2 );
        location = rset.getString( 3 );
        image = (OrdImage)rset.getORAData( 4, OrdImage.getORADataFactory() );
        thumb = (OrdImage)rset.getORAData( 5, OrdImage.getORADataFactory() );
        return true;
    }
    else
    {
        rset.close();
        stmt.close();
        return false;
    }
}
```

What follows is a more detailed description of each JSP file.

PhotoAlbum.jsp

This JSP file is the entry point to the JSP photo album application and does the following:

- Uses the PhotoAlbumBean JavaBean to access the contents of the `photos` table.
- Uses the `OrdHttpJspResponseHandler` class to facilitate the retrieval of image data from the `photos` table and its delivery to a browser or other HTTP client from a Java servlet.
- Displays the title of the page in the HTML header and in the common page header.
- Displays the thumbnail images in a table using column headers labeled, `Description`, `Location`, and `Image`.
- Uses a `try/catch` block to ensure the JDBC connection is released.
- Calls the selectTable( ) method to select all the rows in the `photos` table.
- Initializes the row count to zero.
- Displays an entry in the photo album by calling the getDescription( ) method, then the getLocation( ) method, and then printing the values in the appropriate columns. If the location information is blank, print a space in the `Location` column.
- Displays the contents of the photo album as thumbnail images using an HTML anchor tag to call the `PhotoAlbumEntryViewer.jsp` file to get the ID value by calling the getID( ) function.
- Calls the getThumb( ) method to get the thumbnail image and calls the getContentLength( ) method to determine the image length.
- Tests to see if the value returned for the image length is greater than 0, and if so uses an image tag of the form `<IMG SRC="PhotoAlbumMediaViewer.jsp?media=thumb&...>` to display the thumbnail image; otherwise, prints the link **view image** in the column header labeled `Image`, which, when clicked, retrieves the full-size image.
- Displays a message "The photo album is empty" if the photo album is empty. If the photo album is not empty, the following message is displayed "Select the thumbnail to view the full-sized image".
- Ends the `try/catch` block with a `finally` clause and releases the JDBC connection by calling the release( ) method.
- Displays a link to the upload form with the text **Upload new photo** at the bottom of the page that calls the `PhotoAlbumUploadForm.jsp` file.

PhotoAlbumEntryViewer.jsp

This JSP file is called by the `PhotoAlbum.jsp` file that displays one full-size version of a photograph in the album. This JSP file does the following:

- Uses the PhotoAlbumBean JavaBean to access the contents of the `photos` table.
- Uses the `OrdHttpJspResponseHandler` class to facilitate the retrieval of image data from the `photos` table and its delivery to a browser or other HTTP client from a Java servlet.
- Displays the title of the page in the HTML header and in the common page header.

- Defines a string named `id` that calls the getParameter( ) method to get the `id` value.
- Displays a message "Malformed URL, no id parameter" in the event the value of the `id` string is null.
- Uses a `try/catch` block to ensure the JDBC connection is released.
- Calls the selectRowById( ) method with the value of `id` to select the entry to be displayed. If the next row to be fetched for that `id` value is not found, display a message "Entry not found: <id value>".
- Displays the entry in the album by calling the getDescription( ) method and displaying its value under the header `Description`, calling the getLocation( ) method and displaying its value under the `Location` header.
- Displays one full-size version of a photograph in the album using an image tag in the form `<IMG SRC="PhotoAlbumMediaViewer.jsp?media=image&...">` under the `Photo` header.
- Displays the full-size images height and width by calling the getHeight( ) and getWidth( ) methods. If the image format is not recognized by *inter*Media, height and width values will be zero and will not be displayed.
- Displays a link at the bottom of the page **Return to photo album** that calls the `PhotoAlbum.jsp` file.
- Ends the `try/catch` block, and with a `finally` clause, releases the JDBC connection by calling the release( ) method.

PhotoAlbumMediaViewer.jsp

This JSP file is called by the `PhotoAlbum.jsp` and `PhotoAlbumEntryViewer.jsp` files and retrieves a single thumbnail or full-size image from the `photos` table using the PhotoAlbumBean JavaBean and delivers it to the browser using the `OrdHttpResponseHandler` class. This JSP file does the following:

- Uses the PhotoAlbumBean JavaBean to access the contents of the `photos` table.
- Uses the `OrdHttpJspResponseHandler` class to facilitate the retrieval of image data from the `photos` table and its delivery to a browser or other HTTP client from a Java servlet.
- Defines a string named `id` that calls the getParameter( ) method to get the `id` value.
- Defines a string named `media` that calls the getParameter( ) method to get the `media` value.
- Sets a condition to proceed as long as the value of the string `id` and the value of the string `media` is not null.
- Uses a `try/catch` block to ensure the JDBC connection is released.
- Calls the selectRowById( ) method to select a specific row from the `photos` table for the value of `id`.
- Delivers the full-size or thumbnail image by first calling the setPageContext( ) method of the `OrdHttpJspResponseHandler` class to specify the page context object; then, calling the getImage( ) method to return the image to the OrdImage object; then, calling the sendImage( ) method of the `OrdHttpResponseHandler` class to retrieve the image from the OrdImage object and deliver it to the browser. If the value of media is `image`, an image is delivered to the browser; if the value of media is `thumb`, a thumbnail image is delivered to the browser. The sendImage( )

method supports browser content caching by supporting the If-Modified-Since and Last-Modified headers.

- Ends the `try/catch` block with a `finally` clause and releases the JDBC connection by calling the release( ) method.
- Displays the following message in the event the request is not understood "PhotoAlbumMediaViewer.jsp - malformed URL".

PhotoAlbumUploadForm.jsp

This JSP file is called by the `PhotoAlbum.jsp` file that displays an HTML form to allow users to upload new photographs into the album. This JSP file does the following:

- Displays the title of the page in the HTML header and in its common page header.
- Displays any error message under the header "Error message" from a previous attempt to upload an image to determine whether or not the value of a string is not null after calling the getParameter( ) method with an argument of `error`.
- Displays a header with the text **Upload a new photo**.
- Defines the form action specifying the `PhotoAlbumInsertPhoto.jsp` file to process the upload request as a multipart/form-data POST request.
- Displays the upload form with rows labeled `Description`, `Location`, and `File name:`.
- Displays the contents of the upload form defined as a table with rows labeled `Description` and `Location`, both with an input type of text and named description and location respectively, followed by a row labeled `File name:` with an input type of `file` and named `photo`, and finally followed by a row with no label and an input type of `submit` and a value of `Upload photo`.
- Displays a link at the bottom of the page **Return to photo album** that calls the `PhotoAlbum.jsp` file.

PhotoAlbumInsertPhoto.jsp

This JSP file is called by the `PhotoAlbumUploadForm.jsp` file that uses the `OrdHttpUploadFormData` class to parse the POST data in a POST request containing the uploaded photograph. This JSP file does the following:

- Uses the PhotoAlbumBean JavaBean to access the contents of the `photos` table.
- Uses the `OrdHttpJspResponseHandler` class to facilitate the retrieval of image data from the `photos` table and its delivery to a browser or other HTTP client from a JSP file.
- Uses the `OrdHttpUploadFormData` class to facilitate the processing of POST requests by parsing the POST data containing the multipart/form-data encoding, and making the contents of regular form fields and uploaded files readily accessible to a JSP file.
- Sets the value of the strings `description` and `location` to `null` and the OrdHttpUploadFile object uploadPhoto to `null`.
- Uses a `try/catch` block to ensure the JDBC connection is released.
- Passes an OrdHttpUploadFile object to the `PhotoAlbumBean` class to store the photograph in the database.
- Calls the setServletRequest( ) method of the `OrdHttpUploadFormData` class to specify the ServletRequest object for the request.

- Tests to see if the request is encoded using the multipart/form-data encoding by calling the isUploadRequest( ) method of the `OrdHttpUploadFormData` class.
- Forwards the request to the `PhotoAlbumUploadForm.jsp` file if the call to the isUploadRequest( ) method returns a Boolean expression of not false.
- Parses the form data by calling the parseFormData( ) method of the `OrdHttpUploadFormData` class.
- Gets the form field values for description and location by calling the getParameter( ) method of the `OrdHttpUploadFormData` class, and also gets the name of the file to be uploaded by calling the getFileParameter( ) method of the same class.
- Tests to make sure the file name is not null from the getFileParameter( ) method call of the `OrdHttpUploadFormData` class, then calls the getOriginalFileName( ) method of the `OrdHttpUploadFile` class to ensure that the original file name as provided by the browser is not null, or that the content length of the file is empty by calling the getContentLength( ) method of the `OrdHttpUploadFile` class.
- Forwards the request to the `PhotoAlbumUploadForm.jsp` file if there is a valid image file.
- If the description is null or empty, uses the file name as the description by calling the getSimpleFileName( ) method of the `OrdHttpUploadFile` class.
- Inserts the new entry into the `photos` table by calling the setDescription( ), setLocation( ), and insertNewPhoto( ) methods in the `PhotoAlbumBean.java` JavaBean.
- Ends the `try/catch` block with a `finally` clause and releases the JDBC connection by calling the release( ) method and releases all resources held by the OrdHttpUploadFormData object by calling its release( ) method.
- Displays the updated photo album by displaying the title of the page in the HTML header and in its common page header, directing the browser to the main page by calling the `PhotoAlbum.jsp` file, then displays the header "Photo successfully uploaded into photo album" and the instruction, "Please click on link below or wait for the browser to refresh the page".
- Displays a link at the bottom of the main page **Return to photo album** that calls the `PhotoAlbum.jsp` file.

PhotoAlbumBean.java

This is a JavaBean used by the JSP files to access the database.

The first call to the JavaBean for a request causes it to allocate a JDBC connection from a connection pool. Subsequent calls by the same request reuse the same connection. At the end of a request, each JSP file is responsible for calling the JavaBean to release the JDBC connection back to the pool. Each HTTP GET or POST request is assigned its own JDBC connection from the pool to ensure that multiple requests can be serviced concurrently.

The following methods are defined:

- The selectTable( ) method selects all the rows in the `photos` table, orders them by location, and returns the results in a result set.
- The selectRowById( ) method selects a specific row from the `photos` table where the value of `id` in the `where` clause is a parameter marker and returns the results in a result set.
- The fetch( ) method fetches the next row from the result set.

- The insertNewPhoto( ) method does the following:
  - Uses the `OrdHttpUploadFile` class to upload the new photograph into the database.
  - Disables auto-commit by calling the setAutoCommit( ) method with an argument of false.
  - Executes a SQL SELECT photos_sequence.nextval statement to get the next value for the value of the `id` column for the new row to be inserted into the `photos` table.
  - Executes a SQL INSERT statement to insert a new row in the `photos` table.
  - Executes a SQL SELECT...FOR UPDATE statement to fetch the initialized full-size and thumbnail image objects from the `photos` table.
  - Loads the image by calling the loadImage( ) method in the `OrdHttpUploadFile` class to populate an OrdImage object named `image` with the full-size image, and sets the properties or attribute values of the image object based on the image contents.
  - Gets the image file format by calling the getContentFormat( ) method and if it is not null, and if the MIME type is BMP, then tries to process the image by calling the process( ) method and calling the getPreferredFormat( ) method to convert it to a MONOCHROME, GIF, or JPEG image format, based on the number of colors in the image.
  - Tries to copy the full-size image and process it to create the thumbnail image by calling the processCopy( ) method in the `OrdImage` class and populate the OrdImage object named `thumb`.
  - Executes a SQL UPDATE statement to update the full-size and thumbnail images in the database.
  - Commits the changes.
- A release( ) method to release the result set and statement objects, and places the JDBC connection back on the free list or stack.
- Get methods (getId( ), getDescription( ), getLocation( ), getImage( ), and getThumb( )) and the set methods (setId( ), setDescription( ), and setLocation( )) are used to get or set attributes for all attributes or columns.
- A getConnection( ) private function implements a simple JDBC connection pool.
- A freeConnection( ) private function releases the JDBC connection back to the pool at the end of the request.
- A getPreferredFormat( ) private function returns the preferred image file format based on the number of bits of color in the BMP image; returns a MONOCHROME image if there are no bits of color, returns JPEG if there are more than 8 bits of color, or returns GIF if there are between 1 and 8 bits of color.

3.2.3 Oracle *inter*Media ASP/VBScript Photo Album Sample Application

The *inter*Media ASP/VBScript Photo Album sample application is an ASP/VBScript application that demonstrates how to upload, retrieve, and process multimedia data stored using the *inter*Media ORDImage type and Oracle Objects for OLE. Users access the application to view the contents of the photo album, including thumbnail versions of each photograph, to view the full-size version of any photograph, and to upload new photographs into the album.

3.2.3.1 Running the ASP/VBScript Photo Album Application

After you have installed and configured this photo album application in Microsoft IIS and configured the application connection parameters, you are ready to run the photo album application.

To use it, enter the photo album URL into the location bar of your Web browser, for example:

```
http://<hostname:port>/photoAlbum
```

When first invoked, the application displays any images that are currently stored in the album. By default, the photo album is empty when first installed. To upload a new photograph, click **Upload new photo**. Enter a description of the photograph, the location where the photograph was taken, and the name of the image file or browse to its directory location, then click **Upload new photo**. The contents of the photo album are then displayed along with a picture of the new photograph. Click the thumbnail image to view the full-size version of the photograph.

When the photo album application displays the text **view image** instead of its thumbnail image, the image format that was uploaded was not recognized by *inter*Media. Click **view image** to display the full-size image.

You can now begin to load your photo album application with your favorite photographs.

3.2.3.2 Description of the ASP/VBScript Photo Album Application

The top-level files that implement the photo album application are: `viewAlbum.asp`, `viewEntry.asp`, and `uploadPhoto.asp`. In addition, the `getPhoto.asp` file retrieves the images from the database and the `insertPhoto.asp` file inserts a new image into the database.

viewAlbum.asp

The **viewAlbum** page displays the contents of the photo album in a tabular format with columns labeled `Description`, `Location`, and `Image`.

Thumbnail images are ordered by description in the SQL SELECT statement and displayed with an anchor tag that is used to display the full-size image, using the tag `<img src="getPhoto.asp?entry_id=...">` as follows:

```
<A href="viewEntry.asp?entry_id=<%=strId%>">
       <% If objThumb.contentlength > 0 Then %>
         <IMG border = 1
              height="<%=objThumb.height%>"
              width="<%=objThumb.width%>"
              alt="<%=strDescription%>"
              src="getPhoto.asp?media=thumb&entry_id=<%=strId%>"
         >
```

If *inter*Media does not support the image format, then a thumbnail image would not have been created and stored in the database. In this case, the text **view image** is displayed instead of the thumbnail image in the `Image` column header of the table.

Text is displayed on the page stating **Select the thumbnail to view the full-size image**. A link appearing at the bottom of the page **Upload new photo**, calls the `uploadPhoto.asp` file to present an upload form (`uploadForm.inc`) to assist in uploading a new photograph into the database.

viewEntry.asp

The **viewEntry** page, which displays the full-size version of a photograph, also uses the tag `<img src="getPhoto.asp?entry_id...">` to display an image, as follows:

```
<TD vAlign=top scope="col"><B>Photo:</B></TD>
    <TD scope="col">
       <IMG border=1
            alt="<%=strDescription%>"
            src="getPhoto.asp?media=image&entry_id=<%=strId%>"
       <% If objImage.height > 0 And objImage.width > 0 Then %>
            height="<%=objImage.height%>"
            width="<%=objImage.width%>"
       <% End If %>
       >
    </TD>
```

Both URLs will retrieve an image from the database and deliver it to the browser using Oracle Objects for OLE to communicate with the database.

A link appears at the bottom of the page **Return to photo album** that calls the `viewAlbum.asp` file to present the photo album table and its set of thumbnail images to view.

uploadPhoto.asp

The **uploadPhoto** page displays an HTML form (`uploadForm.inc`) that allows a user to upload a new photograph into the database by entering description and location information for the new photograph, and its image file name. The form invokes the **insertPhoto** page as follows:

```
<FORM action="insertPhoto.asp" method="post" encType="multipart/form-data">
```

insertPhoto.asp

The **insertPhoto** page performs the work of loading the image into the `photos` table and automatically generating a thumbnail version of the image.

Clicking **Upload photo** near the bottom of the **uploadPhoto** page executes the submit input type form action, as follows:

```
<TD colSpan=2><INPUT type=submit value="Upload photo"></TD>
```

getPhoto.asp

The **getPhoto** page retrieves the image, either a thumbnail or full-size image, based on its photo column indicator value (`thumb` or `image`), from the database and returns it to the browser. If the image requested is in the browser cache and the cache is valid, then it retrieves the image from cache; otherwise, it sets the MIME type of the image based on its attribute value in the database, then gets the image from the database and delivers it to the browser, as follows:

```
If CacheIsValid( setPhotos(1).value ) Then
  Response.Status = HTTP_STATUS_NOT_MODIFIED
Else
  ' Set the mime type header and deliver the image to the browser.
  SetLastModified( setPhotos(1).value )
  Response.ContentType = objMedia.mimetype
  ReadBlob objMedia.source.localData
End If
```

3.3 Oracle *inter*Media Code Wizard Sample Application

The *inter*Media Code Wizard sample application lets you create PL/SQL stored procedures for the PL/SQL Gateway to upload and retrieve media data (images, audio, video, and general media) stored in a database using *inter*Media object types, ORDImage, ORDAudio, ORDVideo, and ORDDoc, and their respective methods. The Code Wizard guides you through a series of self-explanatory steps to create either a media retrieval or a media upload procedure. You can either create and compile standalone media access procedures, or you can create the source of media access procedures for inclusion in a PL/SQL package. This is similar to how the photo album application (see Section 3.1) uses the `insert_new_photo` procedure as the image upload procedure and the `deliver_media` procedure as the image retrieval procedure in the `photo_album` PL/SQL package. Finally, once created, you can customize the media access procedures as necessary to meet specific application requirements.

3.3.1 Using the Code Wizard

The *inter*Media Code Wizard sample application can be installed from the Companion CD of Oracle Database. The application is installed in the following directory:

```
<ORACLE_HOME>/ord/http/demo/plsgwycw
```

The `README.txt` file in this directory contains complete instructions on installing and configuring the Code Wizard sample application. The following discussion assumes that the Code Wizard has been installed into the ORDSYS schema.

To use the Code Wizard to create and test media upload and retrieval procedures, you must do the following steps:

1. Create a new DAD or choose an existing DAD for use with the Code Wizard.
2. Authorize use of the DAD using the Code Wizard's administration function.
3. Create and test media upload and retrieval procedures.

This section describes each of these topics in more detail as the following topics:

- Creating a New DAD or Choosing an Existing DAD
- Authorizing a DAD
- Creating and Testing Media Upload and Retrieval Procedures
- Using the PL/SQL Gateway Document Table
- How Time Zone Information Is Used to Support Browser Caching

3.3.1.1 Creating a New DAD or Choosing an Existing DAD

To create media upload or retrieval procedures, you must select one or more DADs for use with the Code Wizard. To prevent the unauthorized browsing of schema tables and to prevent the unauthorized creation of media access procedures, you must authorize each DAD using the Code Wizard's administration function. Depending on your database and application security requirements, you may choose to create and authorize one or more new DADs specifically for use with the Code Wizard, or you may choose to authorize the use of one or more existing DADs.

Oracle recommends that any DAD authorized for use with the Code Wizard should use some form of user authentication mechanism. The simplest approach is to create or use a DAD that uses database authentication. To use this approach, select **Basic Authentication Mode** and omit the Password in the DAD specification. Alternatively, you may choose to use a DAD that specifies an existing application-specific authentication mechanism. For more information about configuring DADs, see *Oracle HTTP Server Administrator's Guide* in the Oracle Application Server 10*g* Online Documentation Library.

The following example describes how to create a DAD to create and test media upload and retrieval procedures in the `SCOTT` schema.

Note: To test media upload procedures, the name of a document table must be specified in the DAD. When testing an upload procedure, you may choose the DAD you use to create the procedure, or you may use the DAD used to access the application. You may choose a document table name when you create a DAD, edit a DAD to specify the document table name at a later time, or use an existing DAD that already specifies a document table name. This example illustrates specifying the document table name when you create the DAD.

1. Set your Web browser to the Oracle HTTP Server Home page. Select "PL/SQL Properties" in the "Administration" page. This opens the `mod_plsql` Services page.
2. On the `mod_plsql` Services page, scroll to the DAD Status section. Click **Create**. This opens the DAD Type page.
3. Select the DAD type to be "General". Click **Next**. This opens the Database Connection page.
4. Enter "/scottw" in the DAD Name field. Enter SCOTT for the database account, and leave the password blank. Enter the connection information in the Database Connectivity Information section. In the Default page field, enter ORDCWPKG.MENU. Leave the other fields blank. Click **Next**. This opens the Document, Alias, and Session page.
5. On the Document, Alias, and Session page, enter MEDIA_UPLOAD_TABLE for the Document Table. Click **Apply.**
6. Restart Oracle HTTP Server for the changes to take effect.

3.3.1.2 Authorizing a DAD

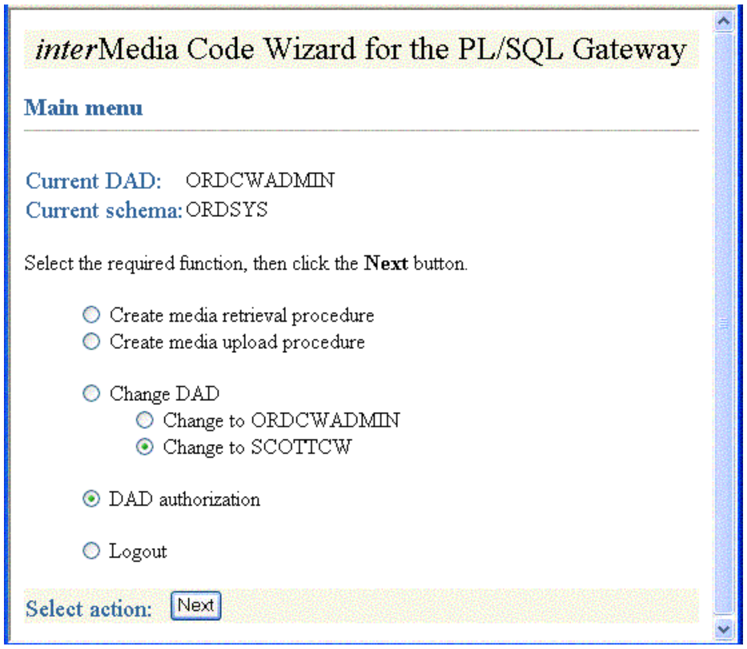
To authorize a DAD for use with the Code Wizard, do the following steps:

1. Enter the Code Wizard's administration URL into your browser's location bar, for example:

   ```
   http://<host-name>:<port-number>/ordcwadmin
   ```

2. Enter the ORDSYS user name and password when prompted by the browser.
3. Select **DAD authorization** from the **Main menu** as shown in Figure 3–8, then click **Next**.

Figure 3–8 Main Menu for the interMedia Code Wizard for the PL/SQL Gateway


*inter*Media Code Wizard for the PL/SQL Gateway

Main menu

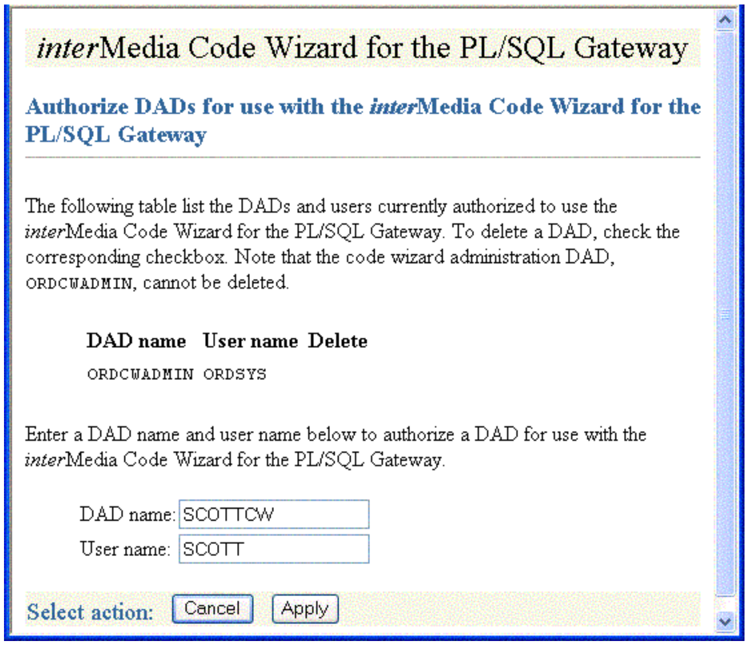
Current DAD: ORDCWADMIN
Current schema: ORDSYS

Select the required function, then click the **Next** button.

- ○ Create media retrieval procedure
- ○ Create media upload procedure
- ○ Change DAD
  - ○ Change to ORDCWADMIN
  - [✓ Change to SCOTTCW]
- [✓ DAD authorization]
- ○ Logout

4. Enter the name of the DAD you wish to authorize together with the user name, as shown in Figure 3–9, then click **Apply**.

Figure 3–9 Authorizing the SCOTTCW DAD


*inter*Media Code Wizard for the PL/SQL Gateway

Authorize DADs for use with the *inter*Media Code Wizard for the PL/SQL Gateway

The following table list the DADs and users currently authorized to use the *inter*Media Code Wizard for the PL/SQL Gateway. To delete a DAD, check the corresponding checkbox. Note that the code wizard administration DAD, ORDCWADMIN, cannot be deleted.

DAD name	User name	Delete
ORDCWADMIN	ORDSYS	

Enter a DAD name and user name below to authorize a DAD for use with the *inter*Media Code Wizard for the PL/SQL Gateway.

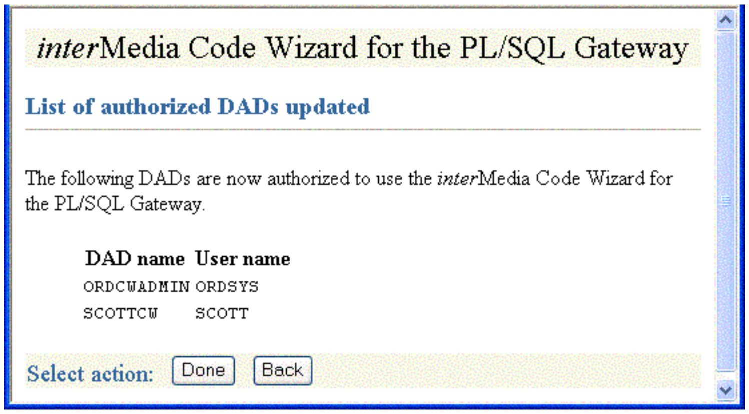
DAD name:	SCOTTCW
User name:	SCOTT

Note: Duplicate DADs are not allowed, and each authorized DAD must indicate which database schema the user is authorized to access with the Code Wizard, using the DAD. Use this same page to delete the authorization for any existing DADs that no longer need to use the Code Wizard.

---

5. Review the updated list of DADs that are authorized to use the *inter*Media Code Wizard, as shown in Figure 3–10, then click **Next**.

Figure 3–10 List of Authorized DADs



*inter*Media Code Wizard for the PL/SQL Gateway

List of authorized DADs updated

The following DADs are now authorized to use the *inter*Media Code Wizard for the PL/SQL Gateway.

DAD name	User name
ORDCWADMIN	ORDSYS
SCOTTCW	SCOTT

6. To log out (clear HTTP authentication information), select **Logout** from the **Main menu**, then click **Next**. The log out operation redirects the request to the PL/SQL Gateway's built-in `logmeoff` function. For more information, see *Oracle Application Server mod_plsql User's Guide*.

3.3.1.3 Creating and Testing Media Upload and Retrieval Procedures

To start the Code Wizard, enter the appropriate URL into your browser's location bar, for example:

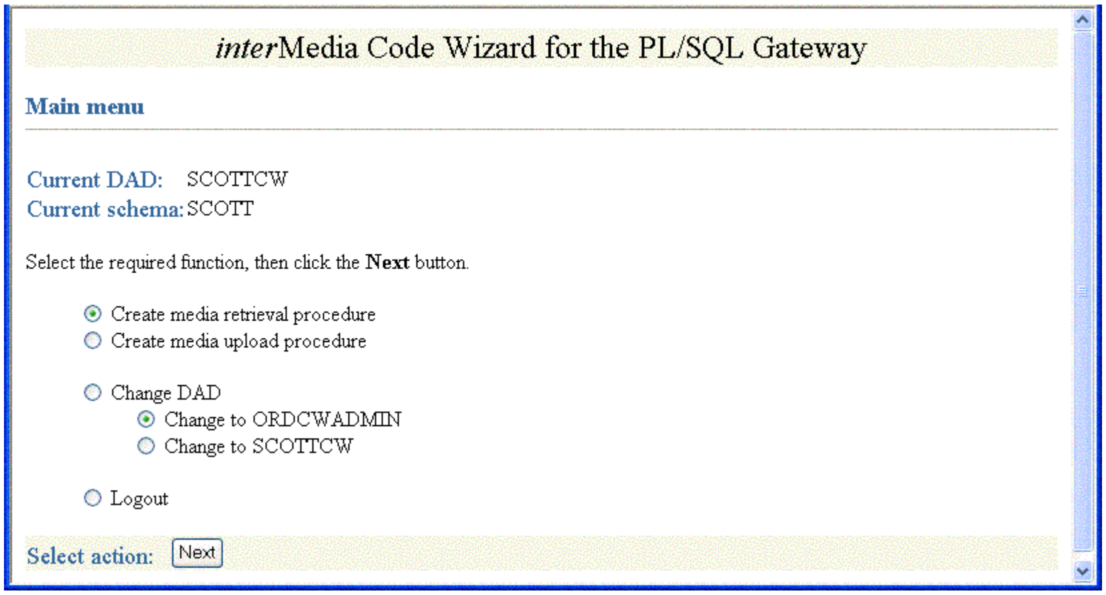
```
http://<hostname>:<port-number>/scottcw
```

or

```
http://<hostname>:<port-number>/mediadad/ordcwpkg.menu
```

Then, enter the user name and password when prompted by the browser. The **Main menu** page of the *inter*Media Code Wizard for the PL/SQL Gateway is displayed as shown in Figure 3–11.

Figure 3–11 Using the SCOTTCW DAD


*inter*Media Code Wizard for the PL/SQL Gateway

Main menu

Current DAD: SCOTTCW
Current schema: SCOTT

Select the required function, then click the **Next** button.

[✓ Create media retrieval procedure]
Create media upload procedure

Change DAD
[✓ Change to ORDCWADMIN]
Change to SCOTTCW

Logout

Select action: Next

If the DAD is configured specifically for use with the Code Wizard, simply enter the DAD name. Alternatively, to use another DAD, enter the DAD name together with the Code Wizard package name and **Main menu** procedure name, `ORDCWPKG.MENU` after the DAD name.

Once you have logged in, you can log out (clear HTTP authentication information) at any time by selecting **Logout** from the **Main menu**, then clicking **Next**. The logout operation redirects the request to the PL/SQL Gateway's built-in `logmeoff` function. For more information, see *Oracle Application Server mod_plsql User's Guide*.

To create a media upload procedure (see Section 3.3.1.4) or a media retrieval procedure (see Section 3.3.1.5), select the appropriate option from the **Main menu**, then click **Next**. The Code Wizard then guides you through a series of self-explanatory steps to create the procedure.

If you create a standalone media upload or retrieval procedure, you will have the opportunity to view the contents of the procedure as well as to test it.

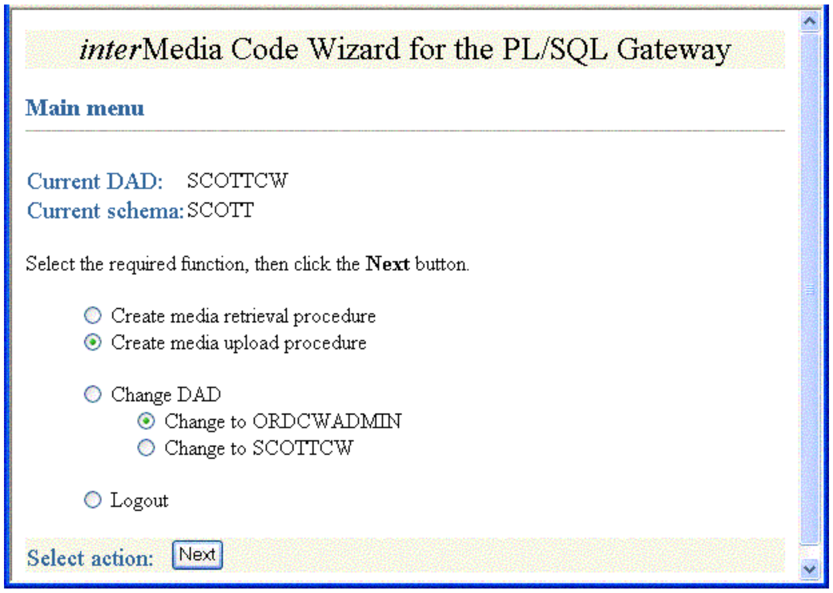
The image and multimedia sample sessions described in Section 3.3.2 and Section 3.3.3 respectively, illustrate how to create and test a media upload procedure and a media retrieval procedure.

3.3.1.4 Creating a Media Upload Procedure

To create a media upload procedure using the *inter*Media Code Wizard for the PL/SQL Gateway, do the following steps:

1. At the **Main menu**, select **Create media upload procedure** as shown in Figure 3–12. Click **Next**.

Figure 3–12 Create a Media Upload Procedure



*inter*Media Code Wizard for the PL/SQL Gateway

Main menu

Current DAD: SCOTTCW
Current schema: SCOTT

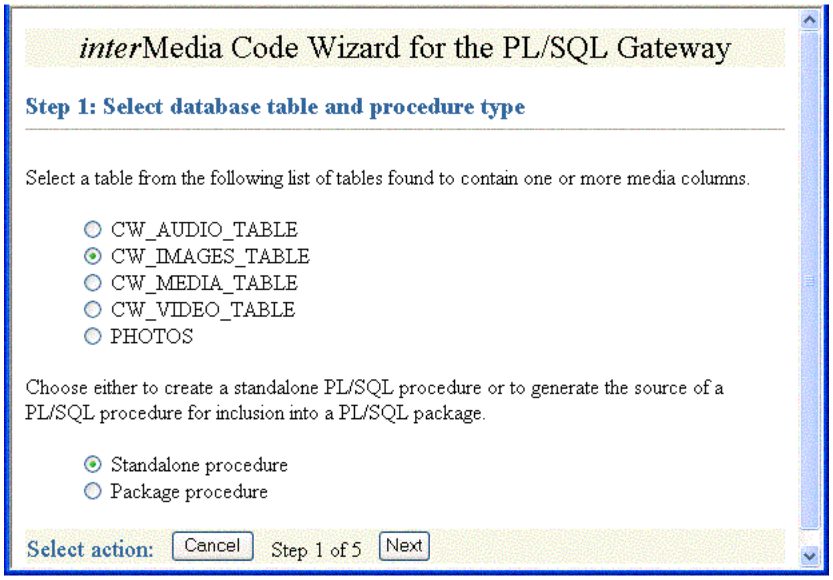
Select the required function, then click the **Next** button.

- ○ Create media retrieval procedure
- [✓ Create media upload procedure]
- ○ Change DAD
  - [✓ Change to ORDCWADMIN]
  - ○ Change to SCOTTCW
- ○ Logout

Select action: Next

2. At **Step 1: Select database table and procedure type**, select **CW_IMAGES_TABLE** and **Standalone procedure** as shown in Figure 3–13. Click **Next**.

Figure 3–13 Step 1: Select Database Table and Procedure Type



*inter*Media Code Wizard for the PL/SQL Gateway

Step 1: Select database table and procedure type

Select a table from the following list of tables found to contain one or more media columns.

- ○ CW_AUDIO_TABLE
- [✓ CW_IMAGES_TABLE]
- ○ CW_MEDIA_TABLE
- ○ CW_VIDEO_TABLE
- ○ PHOTOS

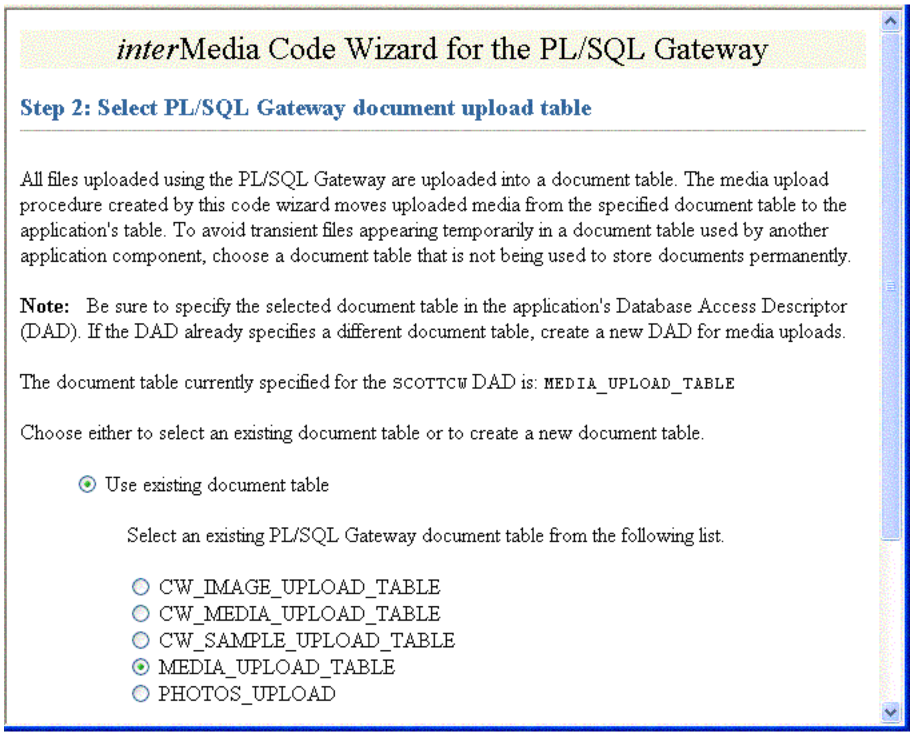
Choose either to create a standalone PL/SQL procedure or to generate the source of a PL/SQL procedure for inclusion into a PL/SQL package.

- [✓ Standalone procedure]
- ○ Package procedure

Select action: Cancel Step 1 of 5 Next

3. At **Step 2: Select PL/SQL Gateway document upload table**, select **Use existing document table** and select **MEDIA_UPLOAD_TABLE** because the `SCOTTCW` DAD is configured to use this document table as shown in Figure 3–14 and Figure 3–15. Click **Next**.

Figure 3–14 Step 2: Select PL/SQL Gateway Document Upload Table (Part 1)



*inter*Media Code Wizard for the PL/SQL Gateway

Step 2: Select PL/SQL Gateway document upload table

All files uploaded using the PL/SQL Gateway are uploaded into a document table. The media upload procedure created by this code wizard moves uploaded media from the specified document table to the application's table. To avoid transient files appearing temporarily in a document table used by another application component, choose a document table that is not being used to store documents permanently.

Note: Be sure to specify the selected document table in the application's Database Access Descriptor (DAD). If the DAD already specifies a different document table, create a new DAD for media uploads.

The document table currently specified for the SCOTTCW DAD is: MEDIA_UPLOAD_TABLE

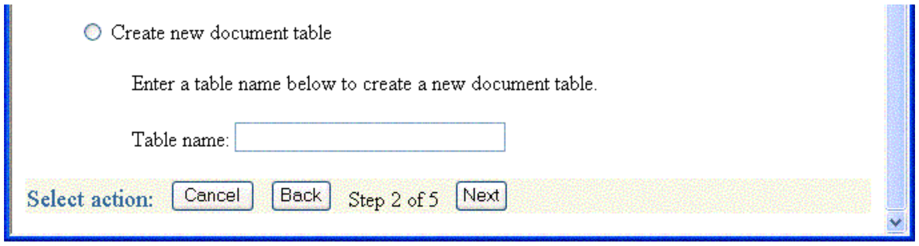
Choose either to select an existing document table or to create a new document table.

[✓ Use existing document table]

Select an existing PL/SQL Gateway document table from the following list.

- CW_IMAGE_UPLOAD_TABLE
- CW_MEDIA_UPLOAD_TABLE
- CW_SAMPLE_UPLOAD_TABLE
- [✓ MEDIA_UPLOAD_TABLE]
- PHOTOS_UPLOAD

Figure 3–15 Step 2: Select PL/SQL Gateway Document Upload Table (Part 2)



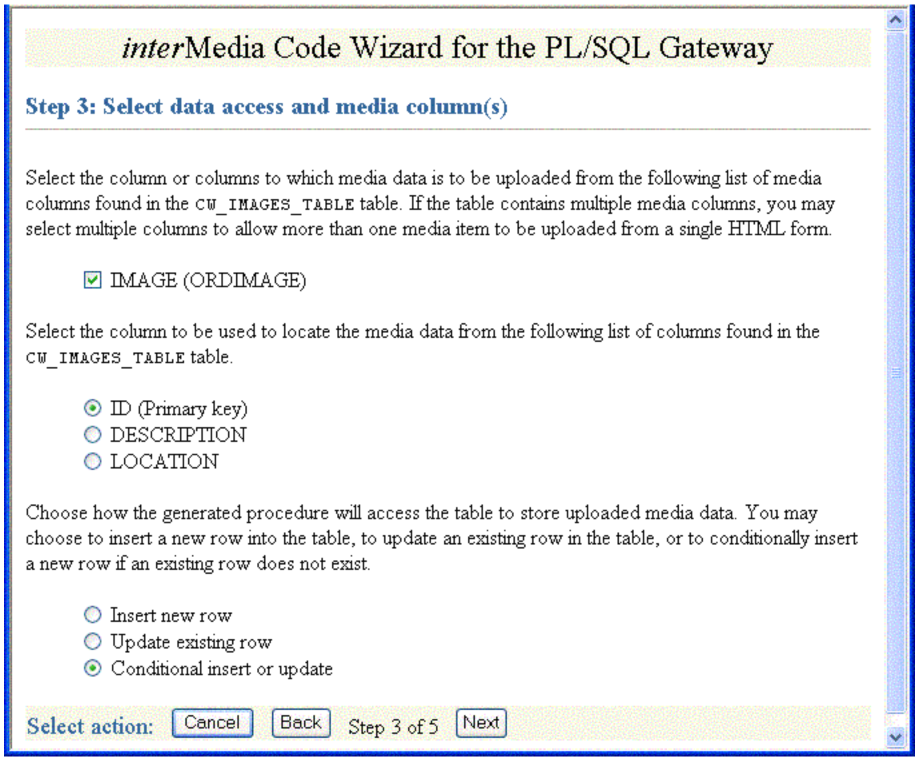
Create new document table

Enter a table name below to create a new document table.

Table name:

4. At **Step 3: Select data access and media column(s)**, ensure **IMAGE (ORDIMAGE)** is checkmarked, that **ID (Primary key)** is selected, and select **Conditional insert or update** as shown in Figure 3–16. Click **Next**.

Figure 3–16 Step 3: Select Data Access and Media Column(s)



*inter*Media Code Wizard for the PL/SQL Gateway

Step 3: Select data access and media column(s)

Select the column or columns to which media data is to be uploaded from the following list of media columns found in the `CW_IMAGES_TABLE` table. If the table contains multiple media columns, you may select multiple columns to allow more than one media item to be uploaded from a single HTML form.

☑ IMAGE (ORDIMAGE)

Select the column to be used to locate the media data from the following list of columns found in the `CW_IMAGES_TABLE` table.

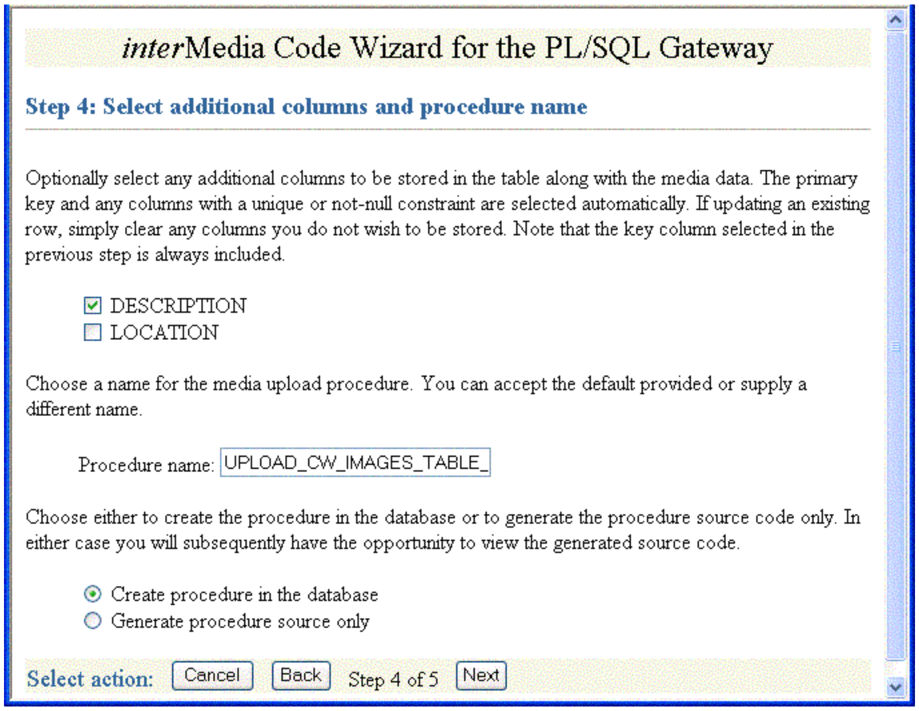
[✓ ID (Primary key)]
DESCRIPTION
LOCATION

Choose how the generated procedure will access the table to store uploaded media data. You may choose to insert a new row into the table, to update an existing row in the table, or to conditionally insert a new row if an existing row does not exist.

Insert new row
Update existing row
[✓ Conditional insert or update]

5. At **Step 4: Select additional columns and procedure name**, ensure **DESCRIPTION** is checkmarked, accept the default procedure name, **UPLOAD_CW_IMAGES_TABLE_IMAGE**, and select **Create procedure in the database** as shown in Figure 3–17. Click **Next**.

Figure 3–17 Step 4: Select Additional Columns and Procedure Name



*inter*Media Code Wizard for the PL/SQL Gateway

Step 4: Select additional columns and procedure name

Optionally select any additional columns to be stored in the table along with the media data. The primary key and any columns with a unique or not-null constraint are selected automatically. If updating an existing row, simply clear any columns you do not wish to be stored. Note that the key column selected in the previous step is always included.

☑ DESCRIPTION
☐ LOCATION

Choose a name for the media upload procedure. You can accept the default provided or supply a different name.

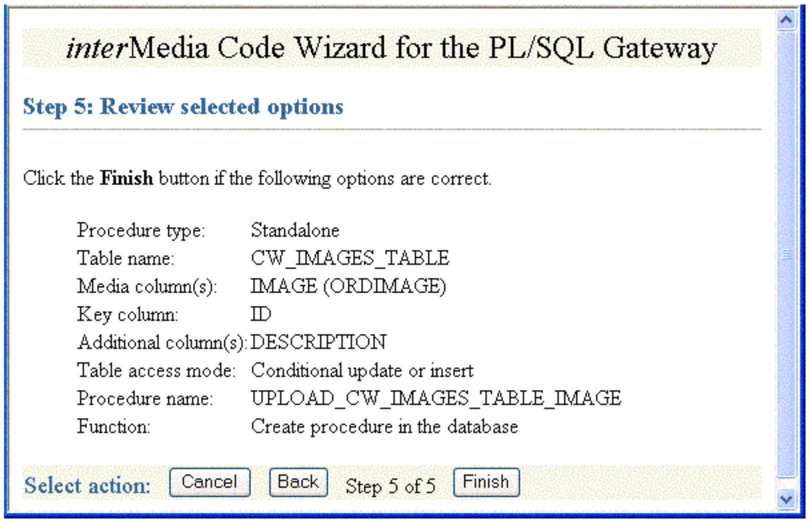
Procedure name: UPLOAD_CW_IMAGES_TABLE_

Choose either to create the procedure in the database or to generate the procedure source code only. In either case you will subsequently have the opportunity to view the generated source code.

[✓ Create procedure in the database]
Generate procedure source only

6. At **Step 5: Review selected options**, review the options you have selected as shown in Figure 3–18. If the options selected are correct, click **Finish**.

Figure 3–18 Step 5: Review Selected Options



*inter*Media Code Wizard for the PL/SQL Gateway

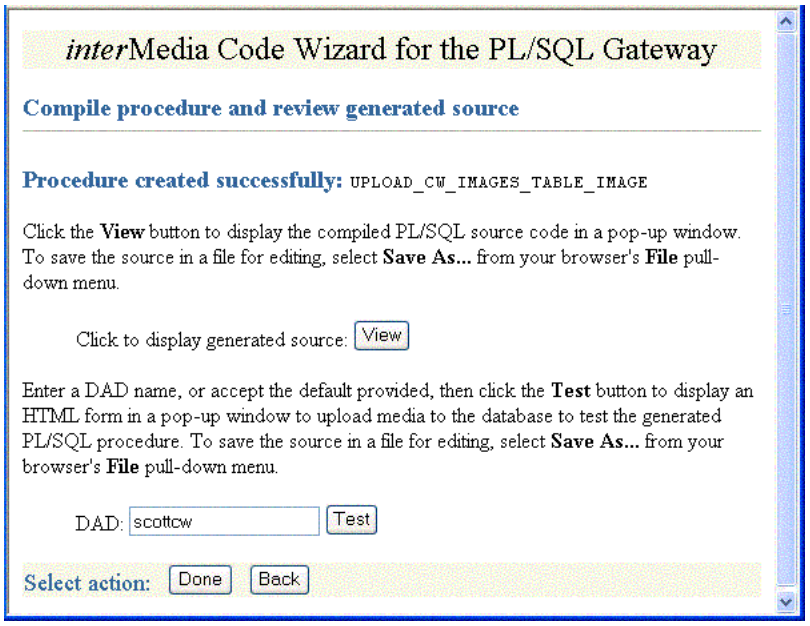
Step 5: Review selected options

Click the **Finish** button if the following options are correct.

Procedure type:	Standalone
Table name:	CW_IMAGES_TABLE
Media column(s):	IMAGE (ORDIMAGE)
Key column:	ID
Additional column(s):	DESCRIPTION
Table access mode:	Conditional update or insert
Procedure name:	UPLOAD_CW_IMAGES_TABLE_IMAGE
Function:	Create procedure in the database

7. At the **Compile procedure and review generated source** window note the message, `Procedure created successfully: UPLOAD_CW_IMAGES_TABLE_IMAGE` as shown in Figure 3–19. To review the compiled PL/SQL source code in another window, click **View** (see Step 5, substep 6g in Section 3.3.2 for a copy of the generated upload procedure). Assuming you have configured the `SCOTTCW` DAD and specified `MEDIA_UPLOAD_TABLE` as the document table, in the **DAD:** field, the DAD name `scottcw` is displayed by default. To test the PL/SQL procedure created, click **Test**.

Figure 3–19 Compile Procedure and Review Generated Source



*inter*Media Code Wizard for the PL/SQL Gateway

Compile procedure and review generated source

Procedure created successfully: UPLOAD_CW_IMAGES_TABLE_IMAGE

Click the **View** button to display the compiled PL/SQL source code in a pop-up window. To save the source in a file for editing, select **Save As...** from your browser's **File** pull-down menu.

Click to display generated source: View

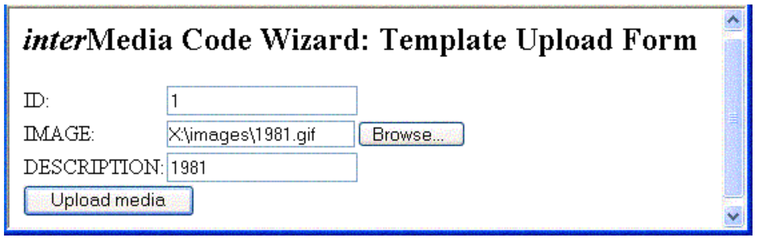
Enter a DAD name, or accept the default provided, then click the **Test** button to display an HTML form in a pop-up window to upload media to the database to test the generated PL/SQL procedure. To save the source in a file for editing, select **Save As...** from your browser's **File** pull-down menu.

DAD: scottcw

8. At the ***inter*****Media Code Wizard: Template Upload Form** window, enter the value `1` in the **ID** field, browse for and select the image you want to upload in the

IMAGE field, and enter a brief description of the image to be uploaded in the **DESCRIPTION** field as shown in Figure 3–20. Click **Upload media**.

Figure 3–20 Template Upload Form

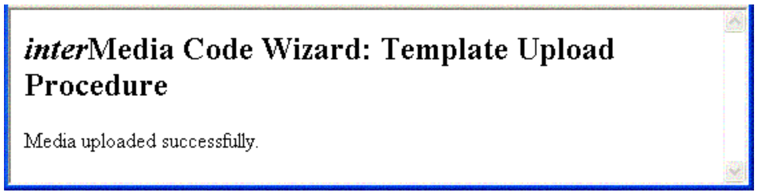


***inter*Media Code Wizard: Template Upload Form**

ID:	1
IMAGE:	X:\images\1981.gif
DESCRIPTION:	1981

9. The image is uploaded into the table row and a message is displayed, as shown in Figure 3–21.

Figure 3–21 Template Upload Procedure -- Media Uploaded Successfully Message



***inter*Media Code Wizard: Template Upload Procedure**

Media uploaded successfully.

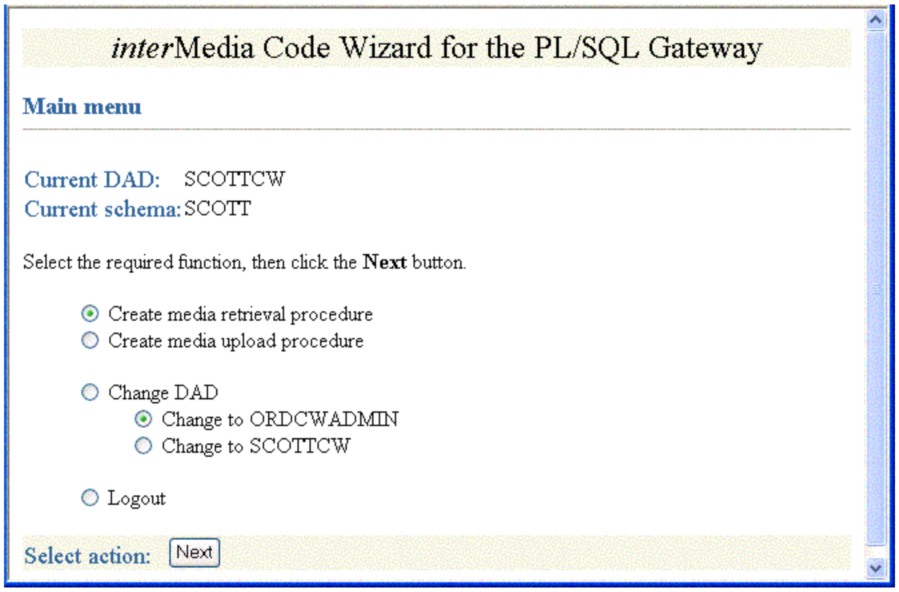
10. Return to the **Compile procedure and review generated source** window. If you are finished testing, click **Done** to return to the **Main menu**.

3.3.1.5 Creating a Media Retrieval Procedure

To create a media retrieval procedure using the *inter*Media Code Wizard for the PL/SQL Gateway, do the following steps:

1. At the **Main menu**, select **Create media retrieval procedure** as shown in Figure 3–22. Click **Next**.

Figure 3–22 Create a Media Retrieval Procedure



*inter*Media Code Wizard for the PL/SQL Gateway

Main menu

Current DAD: SCOTTCW
Current schema: SCOTT

Select the required function, then click the **Next** button.

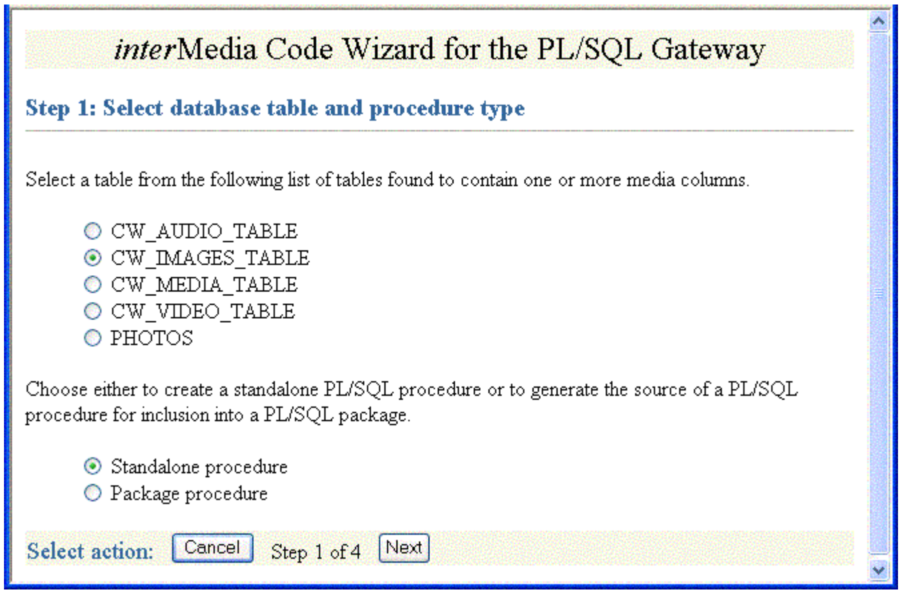
[✓ Create media retrieval procedure]
Create media upload procedure

Change DAD
[✓ Change to ORDCWADMIN]
Change to SCOTTCW

Logout

2. At **Step 1: Select database table and procedure type**, select **CW_IMAGES_TABLE** and select **Standalone procedure** as shown in Figure 3–23. Click **Next**.

Figure 3–23 Step 1: Select Database Table and Procedure Type



*inter*Media Code Wizard for the PL/SQL Gateway

Step 1: Select database table and procedure type

Select a table from the following list of tables found to contain one or more media columns.

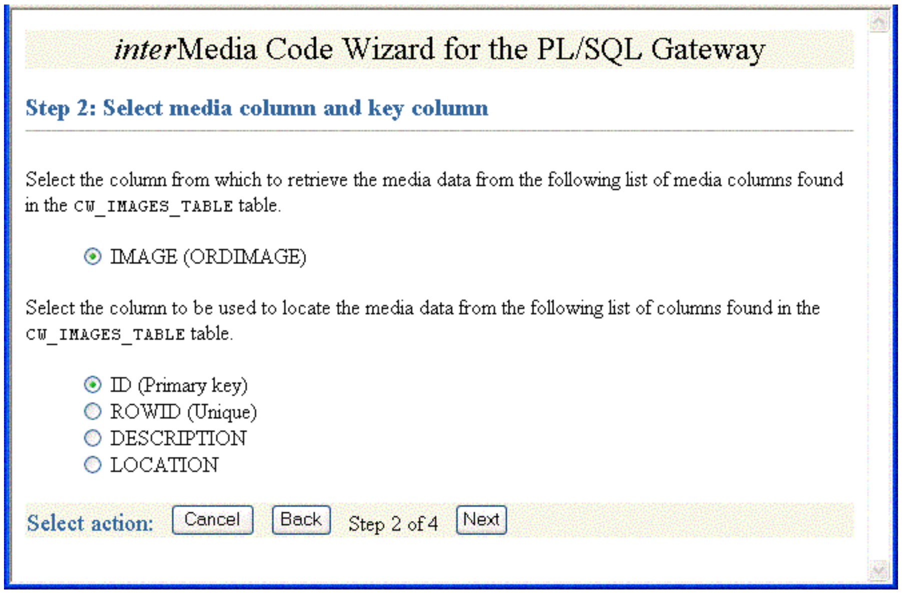
- ○ CW_AUDIO_TABLE
- [✓ CW_IMAGES_TABLE]
- ○ CW_MEDIA_TABLE
- ○ CW_VIDEO_TABLE
- ○ PHOTOS

Choose either to create a standalone PL/SQL procedure or to generate the source of a PL/SQL procedure for inclusion into a PL/SQL package.

- [✓ Standalone procedure]
- ○ Package procedure

3. At **Step 2: Select media column and key column**, ensure **IMAGE (ORDIMAGE)** and **ID (Primary key)** are selected as shown in Figure 3–24. Click **Next**.

Figure 3–24 Step 2: Select Media Column and Key Column



*inter*Media Code Wizard for the PL/SQL Gateway

Step 2: Select media column and key column

Select the column from which to retrieve the media data from the following list of media columns found in the `CW_IMAGES_TABLE` table.

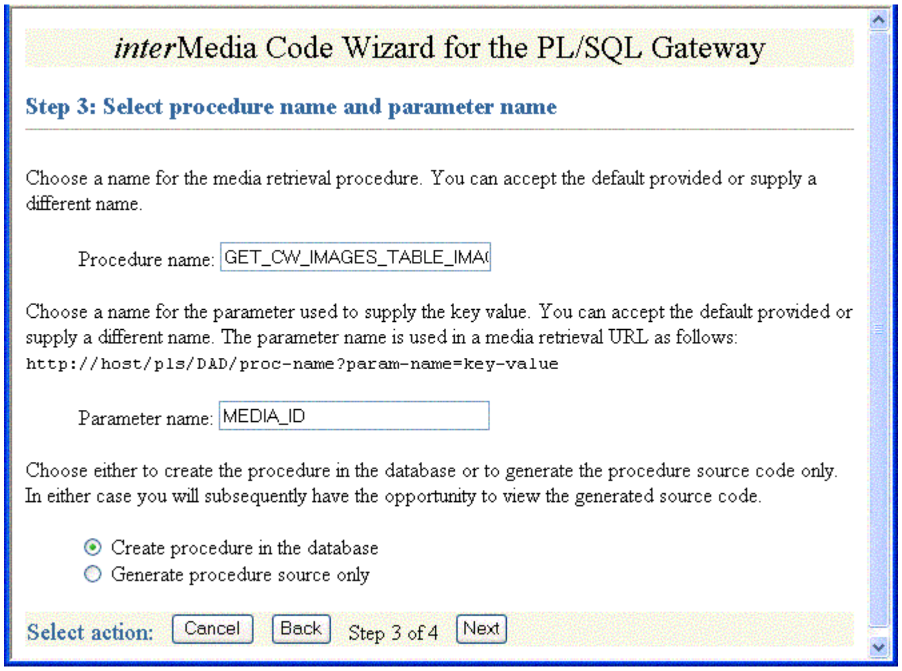
- [✓ IMAGE (ORDIMAGE)]

Select the column to be used to locate the media data from the following list of columns found in the `CW_IMAGES_TABLE` table.

- [✓ ID (Primary key)]
- ○ ROWID (Unique)
- ○ DESCRIPTION
- ○ LOCATION

4. At **Step 3: Select procedure name and parameter name**, accept the default procedure name, `GET_CW_IMAGES_TABLE_IMAGES`, accept the default parameter name, `MEDIA_ID`, and accept **Create procedure in the database** as shown in Figure 3–25. Click **Next**.

Figure 3–25 Step 3: Select Procedure Name and Parameter Name



*inter*Media Code Wizard for the PL/SQL Gateway

Step 3: Select procedure name and parameter name

Choose a name for the media retrieval procedure. You can accept the default provided or supply a different name.

Procedure name: GET_CW_IMAGES_TABLE_IMA(

Choose a name for the parameter used to supply the key value. You can accept the default provided or supply a different name. The parameter name is used in a media retrieval URL as follows:
`http://host/pls/DAD/proc-name?param-name=key-value`

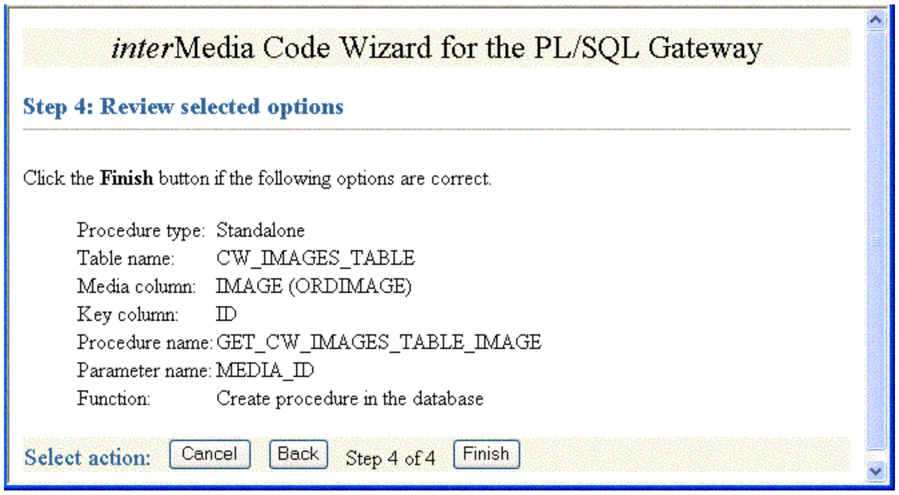
Parameter name: MEDIA_ID

Choose either to create the procedure in the database or to generate the procedure source code only. In either case you will subsequently have the opportunity to view the generated source code.

[✓ Create procedure in the database]
Generate procedure source only

5. At **Step 4: Review Selected Options**, review the options you have selected as shown in Figure 3–26. If the options selected are correct, click **Finish**.

Figure 3–26 Step 4: Review Selected Options



*inter*Media Code Wizard for the PL/SQL Gateway

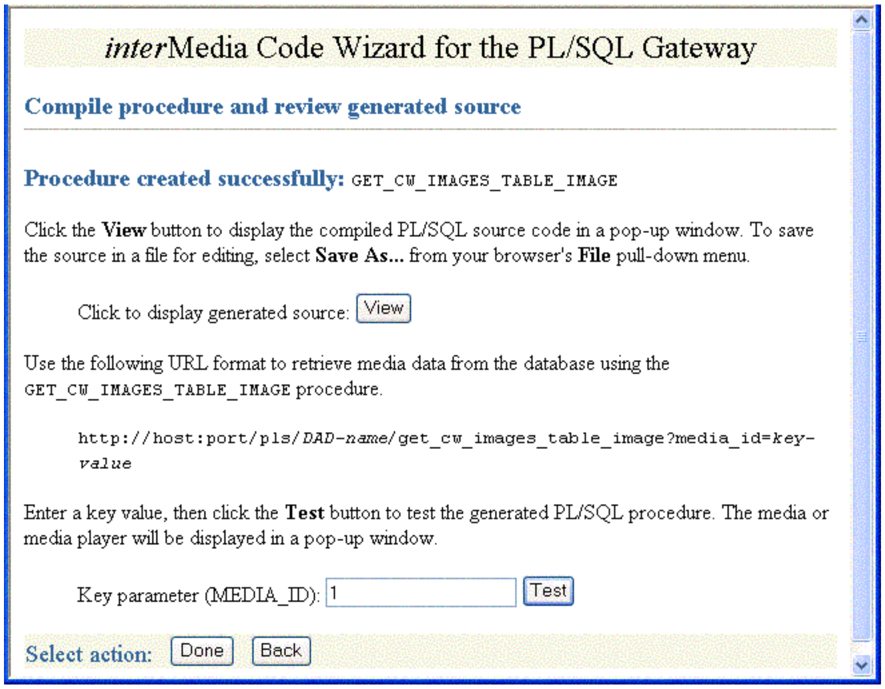
Step 4: Review selected options

Click the **Finish** button if the following options are correct.

Procedure type:	Standalone
Table name:	CW_IMAGES_TABLE
Media column:	IMAGE (ORDIMAGE)
Key column:	ID
Procedure name:	GET_CW_IMAGES_TABLE_IMAGE
Parameter name:	MEDIA_ID
Function:	Create procedure in the database

6. At the **Compile procedure and review generated source** window note the message, `Procedure created successfully: GET_CW_IMAGES_TABLE_IMAGE` as shown in Figure 3–27. To review the compiled PL/SQL source code in another window, click **View** (see Step 6, substep 5e in Section 3.3.2 for a copy of the generated retrieval procedure). To test the PL/SQL procedure created, assuming you have an image already loaded in the database with an ID value of `1`, enter the value `1` for the Key parameter (`MEDIA_ID`), then click **Test**. The image is retrieved from the table row and is displayed as shown in Figure 3–28. Click **Done** to return to the **Main menu**.

Figure 3–27 Compile Procedure and Review Generated Source



*inter*Media Code Wizard for the PL/SQL Gateway

Compile procedure and review generated source

Procedure created successfully: `GET_CW_IMAGES_TABLE_IMAGE`

Click the **View** button to display the compiled PL/SQL source code in a pop-up window. To save the source in a file for editing, select **Save As...** from your browser's **File** pull-down menu.

Click to display generated source: View

Use the following URL format to retrieve media data from the database using the `GET_CW_IMAGES_TABLE_IMAGE` procedure.

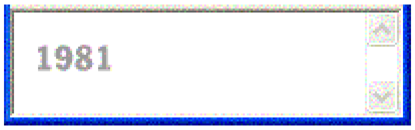
```
http://host:port/pls/DAD-name/get_cw_images_table_image?media_id=key-
value
```

Enter a key value, then click the **Test** button to test the generated PL/SQL procedure. The media or media player will be displayed in a pop-up window.

Key parameter (MEDIA_ID): 1 Test

Select action: Done Back

Figure 3–28 Displayed Image 1981



3.3.1.6 Using the PL/SQL Gateway Document Table

All files uploaded using the PL/SQL Gateway are stored in a document table. Media upload procedures created by the Code Wizard automatically move uploaded media from the specified document table to the application's table. To avoid transient files from appearing temporarily in a document table used by another application component, use a document table that is not being used to store documents permanently.

Be sure to specify the selected document table in the application's database access descriptor (DAD). If the DAD already specifies a different document table, create a new DAD for media upload procedures. If you choose to create a new document table, the Code Wizard will create a table with the following format:

```
CREATE TABLE document-table-name
  ( name          VARCHAR2(256) UNIQUE NOT NULL,
    mime_type     VARCHAR2(128),
    doc_size      NUMBER,
    dad_charset   VARCHAR2(128),
    last_updated  DATE,
    content_type  VARCHAR2(128),
    blob_content  BLOB );
```

For more information about file upload and document tables, see *Oracle Application Server mod_plsql User's Guide*.

3.3.1.7 How Time Zone Information Is Used to Support Browser Caching

User response times are improved and network traffic is reduced if a browser can cache resources received from a Web server and subsequently use those cached resources to satisfy future requests. This section describes at a very high level, how the browser caching mechanism works and how the Code Wizard utility package is used to support that mechanism. When reading this discussion, note that all HTTP date and time stamps are expressed in Coordinated Universal Time (UTC).

All HTTP responses include a Date header, which indicates the date and time when the response was generated. When a Web server sends a resource in response to a request from a browser, it can also include the Last-Modified HTTP response header, which indicates the date and time when the requested resource was last modified. It is important to note that the Last-Modified header must not be later than the Date header.

After receiving and caching a resource, if a browser needs to retrieve the same resource again, it sends a request to the Web server with the If-Modified-Since request header specified as the value of the Last-Modified date, which was returned by the application server when the resource was previously retrieved and cached. When the Web server receives the request, it compares the date in the If-Modified-Since request header with the last update time of the resource. Assuming the resource still exists, if the resource has not changed since it was cached by the browser, the Web server responds with an HTTP `304 Not Modified` status with no response body, which indicates that the browser can use the resource currently stored in its cache. Assuming once again the resource still exists, if the request does not include an If-Modified-Since header or if the resource has been updated since it was cached by the browser, the Web server responds with an HTTP `200 OK` status and sends the resource to the browser. See the HTTP specification (`http://www.w3.org/Protocols/`) for more information.

The ORDImage, ORDAudio, ORDVideo, and ORDDoc objects all possess an updateTime attribute stored as a DATE in the embedded ORDSource object. Although the DATE data type has no support for time zones or daylight savings time, the Oracle9*i* and later database versions do support time zones and also provide functions for converting a DATE value stored in a database to UTC. See *Oracle Database Administrator's Guide* for more information about how to set a time zone for a database. See *Oracle Database SQL Reference* for more information about date and time functions.

When a response is first returned to a browser, a media retrieval procedure sets the Last-Modified HTTP response header based on the updateTime attribute. If a request for media data includes an If-Modified-Since header, the media retrieval procedure compares the value with the updateTime attribute and returns an appropriate response. If the resource in the browser's cache is still valid, an HTTP `304 Not Modified` status is returned with no response body. If the resource has been updated since it was cached by the browser, then an HTTP `200 OK` status is returned with the media resource as the response body.

Media retrieval procedures created by the Code Wizard call the utility package to convert a DATE value stored in the database to UTC. The utility package uses the time zone information stored with an Oracle9*i* or later database and the date and time functions to convert database date and time stamps to UTC. To ensure the resulting date conforms to the rule for the Last-Modified date described previously, the time zone information must be specified correctly. See *Oracle Database Administrator's Guide* for more information about how to set a time zone for a database.

3.3.2 Sample Session Using Images

The following sample session uses the SCOTT schema to illustrate the creation of image media upload and retrieval procedures. Substitute a different schema name if you want to use a different schema.

This sample session assumes the *inter*Media Code Wizard has been installed in the ORDSYS schema.

Perform the following steps:

Step 1 Create a table to store images for the application by starting SQL*Plus and connecting to the SCOTT schema in the database.

For example:

```
sqlplus SCOTT/TIGER[@<connect_identifer>]

SQL> CREATE TABLE cw_images_table(id NUMBER PRIMARY KEY,
                                  description VARCHAR2(30) NOT NULL,
                                  location VARCHAR2(30),
                                  image ORDSYS.ORDIMAGE );
```

Step 2 Create the SCOTTCW DAD to be used to create the procedures.

1. Set your Web browser to the Oracle HTTP Server Home page. Select "PL/SQL Properties" in the "Administration" page. This opens the mod_plsql Services page.
2. On the mod_plsql Services page, scroll to the DAD Status section. Click **Create**. This opens the DAD Type page.
3. Select the DAD type to be "General". Click **Next**. This opens the Database Connection page.
4. Enter "/scottw" in the DAD Name field. Enter SCOTT for the database account, and leave the password blank. Enter the connection information in the Database Connectivity Information section. In the Default page field, enter ORDCWPKG.MENU. Leave the other fields blank. Click **Next**. This opens the Document, Alias, and Session page.
5. On the Document, Alias, and Session page, enter MEDIA_UPLOAD_TABLE for the Document Table. Click **Apply.**
6. Restart Oracle HTTP Server for the changes to take effect.

Step 3 Authorize the use of the SCOTTCW DAD and SCOTT schema with the Code Wizard.

1. Enter the Code Wizard's administration URL into your browser's location bar, then enter the ORDSYS user name and password when prompted by the browser, for example:

   ```
   http://<hostname>:<port-number>/ordcwadmin
   ```

2. Select the DAD authorization function from the Code Wizard's **Main menu** and click **Next**. Enter the name of the demonstration DAD, SCOTTCW, and the user name SCOTT, then click **Apply**. Click **Done** when the confirmation window is displayed.

Step 4 Change DADs to the SCOTTCW DAD.

1. Click **Change DAD** from the Code Wizard's **Main menu**.

2. Click Change to SCOTTCW, if it is not already selected, then click **Next**.
3. Enter the user name `SCOTT` and password `TIGER` when prompted for user name and password, then click **OK**.

   The **Main menu** now displays the current DAD as `SCOTTCW` and the current schema as `SCOTT`.

Step 5 Create and test the media upload procedure.

Click **Create media upload procedure** from the **Main menu**, then click **Next**.

1. Select the database table and procedure type.
   a. Click the **CW_IMAGES_TABLE** database table.
   b. Click **Standalone procedure**.
   c. Click **Next**.
2. Select the PL/SQL document upload table.

   If there are no document tables in the `SCOTT` schema, the Code Wizard displays a message indicating this situation. In this case, accept the default table name provided, `CW_SAMPLE_UPLOAD_TABLE`, then click **Next**.

   If there are existing document tables, but the `CW_SAMPLE_UPLOAD_TABLE` is not among them, click **Create new document table**, accept the default table name provided, `CW_SAMPLE_UPLOAD_TABLE`, then click **Next**.

   If the `CW_SAMPLE_UPLOAD_TABLE` document table already exists, ensure that the **Use existing document table** and the **CW_SAMPLE_UPLOAD_TABLE** options are selected. Click **Next**.
3. Select the data access and media columns.
   a. Click **IMAGE (ORDIMAGE)**.
   b. Click **ID (Primary key)**.
   c. Click **Conditional insert or update**.
   d. Click **Next**.
4. Select additional columns and procedure names.
   a. Ensure that **DESCRIPTION** checkmarked because this column has a `NOT NULL` constraint. (The **LOCATION** column is not checkmarked by default as there are no constraints on this column.)
   b. Accept the procedure name provided, `UPLOAD_CW_IMAGES_TABLE_IMAGE`.
   c. Click **Create procedure in the database**.
   d. Click **Next**.
5. Review the following selected procedure creation options that are displayed:

```
Procedure type:        Standalone
Table name:            CW_IMAGES_TABLE
Media column(s):       IMAGE (ORDIMAGE)
Key column:            ID
Additional column(s):  DESCRIPTION
Table access mode:     Conditional update or insert
Procedure name:        UPLOAD_CW_IMAGES_TABLE_IMAGE
Function:              Create procedure in the database
```

   Click **Finish**.

6. Compile the procedure and review the generated source information.

   The Code Wizard displays the following message: "`Procedure created successfully: UPLOAD_CW_IMAGES_TABLE_IMAGE`".

   a. At the option **Click to display generated source:**, click **View** to view the generated source in another window. A copy of the generated source is shown at the end of Step 5, substep 6g.

   b. Close the window after looking at the generated source.

   c. Accept the **DAD:** name provided, `SCOTTCW`, then click **Test** to produce another window that displays a template file upload form that you can use to test the generated procedure.

   d. To customize the template file upload form, select **Save As...** from your browser's **File** pull-down menu to save the HTML source for editing.

   e. To test the template upload form, enter the following information:

      – For the **ID:** column, enter the number `1` as the row's primary key.

      – For the **IMAGE** column, click **Browse...** and choose an image file to upload to the database.

      – For the **DESCRIPTION** column, enter a brief description of the image.

      – Click **Upload media**.

      The Code Wizard displays a template completion window with the heading ***inter*Media Code Wizard: Template Upload Procedure**, and, if the procedure is successful, the message: `Media uploaded successfully`.

   f. Close the window.

   g. Click **Done** on the **Compile procedure and review generated source** window to return to the **Main menu** of the Code Wizard.

   A copy of the generated image upload procedure is as follows:

```
CREATE OR REPLACE PROCEDURE UPLOAD_CW_IMAGES_TABLE_IMAGE
  ( in_ID IN VARCHAR2,
    in_IMAGE IN VARCHAR2 DEFAULT NULL,
    in_DESCRIPTION IN VARCHAR2 DEFAULT NULL )
AS
  local_IMAGE ORDSYS.ORDIMAGE := ORDSYS.ORDIMAGE.init();
  local_ID CW_IMAGES_TABLE.ID%TYPE := NULL;
  upload_size     INTEGER;
  upload_mimetype VARCHAR2( 128 );
  upload_blob     BLOB;
BEGIN
  --
  -- Update the existing row.
  --
  UPDATE CW_IMAGES_TABLE mtbl
    SET mtbl.IMAGE = local_IMAGE,
        mtbl.DESCRIPTION = in_DESCRIPTION
    WHERE mtbl.ID = in_ID
    RETURN mtbl.ID INTO local_ID;
  --
  -- Conditionally insert a new row if no existing row is updated.
  --
  IF local_ID IS NULL
  THEN
    --
    -- Insert the new row into the table.
    --
    INSERT INTO CW_IMAGES_TABLE ( ID, IMAGE, DESCRIPTION )
      VALUES ( in_ID, local_IMAGE, in_DESCRIPTION );
  END IF;
  --
  -- Select interMedia object(s) for update.
  --
  SELECT mtbl.IMAGE INTO local_IMAGE
    FROM CW_IMAGES_TABLE mtbl WHERE mtbl.ID = in_ID FOR UPDATE;
  --
  -- Store media data for the column in_IMAGE.
  --
  IF in_IMAGE IS NOT NULL
  THEN
    SELECT dtbl.doc_size, dtbl.mime_type, dtbl.blob_content INTO
           upload_size, upload_mimetype, upload_blob
      FROM CW_IMAGE_UPLOAD_TABLE dtbl WHERE dtbl.name = in_IMAGE;
    IF upload_size &gt; 0
    THEN
      dbms_lob.copy( local_IMAGE.source.localData,
                     upload_blob,
                     upload_size );
      local_IMAGE.setLocal();
      BEGIN
        local_IMAGE.setProperties();
      EXCEPTION
        WHEN OTHERS THEN
          local_IMAGE.contentLength := upload_size;
          local_IMAGE.mimeType := upload_mimetype;
      END;
    END IF;
    DELETE FROM CW_IMAGE_UPLOAD_TABLE dtbl WHERE dtbl.name = in_IMAGE;
  END IF;
  --
  -- Update interMedia objects in the table.
  --
  UPDATE CW_IMAGES_TABLE mtbl
    SET mtbl.IMAGE = local_IMAGE
    WHERE mtbl.ID = in_ID;
  --
  -- Display the template completion message.
  --
  htp.print( '&lt;html&gt;' );
  htp.print( '&lt;title&gt;interMedia Code Wizard: Template Upload
Procedure&lt;/title&gt;' );
  htp.print( '&lt;body&gt;' );
  htp.print( '&lt;h2&gt;&lt;i&gt;inter&lt;/i&gt;Media Code Wizard:
Template Upload Procedure&lt;/h2&gt;' );
  htp.print( 'Media uploaded successfully.' );
  htp.print( '&lt;/body&gt;' );
  htp.print( '&lt;/html&gt;' );
END UPLOAD_CW_IMAGES_TABLE_IMAGE;
```

This sample image upload procedure declares the following input parameters and variables:

1. In the declaration section, the procedure declares three input parameters: `in_ID`, `in_IMAGE`, and `in_DESCRIPTION`, then initializes the latter two to `NULL`.
2. In the subprogram section, the following variables are declared:

– The variable `local_IMAGE` is assigned the data type ORDSYS.ORDIMAGE and initialized with an empty BLOB using the ORDIMAGE.init( ) method.

– The variable `local_ID` takes the same data type as the `ID` column in the table `CW_IMAGES_TABLE` and is initialized to `NULL`.

– Three additional variables are declared `upload_size`, `upload_mimetype`, and `upload_blob`, which are later given values from comparable column names `doc_size`, `mime_type`, and `blob_content` from the document table `CW_IMAGE_UPLOAD_TABLE`, using a SELECT statement in preparation for copying the content of the image BLOB data to the ORDSYS.ORDIMAGE.source.localData attribute.

Within the outer BEGIN...END executable statement section, the following operations are executed:

1. Update the existing row in the table `CW_IMAGES_TABLE` for the `IMAGE` and `DESCRIPTION` columns and return the value of `local_ID` where the value of the `ID` column is the value of the `in_ID` input parameter.
2. If the value returned of `local_ID` is `NULL`, conditionally insert a new row into the table `CW_IMAGES_TABLE` and initialize the instance of the ORDImage object type in the `image` column with an empty BLOB.
3. Select the ORDImage object column `IMAGE` in the table `CW_IMAGES_TABLE` for update where the value of the `ID` column is the value of the `in_ID` input parameter.
4. Select a row for the `doc_size`, `mime_type`, and `blob_content` columns from the document table and pass the values to the `upload_size`, `upload_mimetype`, and `upload_blob` variables where the value of the document table `Name` column is the value of the `in_IMAGE` input parameter.
5. Perform a DBMS_LOB copy of the BLOB data from the table `CW_IMAGE_UPLOAD_TABLE` into the ORDSYS.ORDIMAGE.source.localData attribute, then call the setLocal( ) method to indicate that the image data is stored locally in the BLOB, and ORDImage methods should look for corresponding data in the source.localData attribute.
6. In the inner executable block, call the ORDImage setProperties( ) method to read the image data to get the values of the object attributes and store them in the image object attributes for the ORDImage object.
7. If the setProperties( ) call fails, catch the exception and call the contentLength( ) method to get the size of the image and call the mimeType( ) method to get the MIME type of the image.
8. Delete the row of data from the document table `CW_IMAGE_UPLOAD_TABLE` that was copied to the row in the table `CW_IMAGES_TABLE` where the value of the `Name` column is the value of the `in_IMAGE` input parameter.
9. Update the ORDImage object `IMAGE` column in the table `CW_IMAGES_TABLE` with the content of the variable `local_IMAGE` where the value of the `ID` column is the value of the `in_ID` input parameter.
10. Display a completion message on the HTML page to indicate that the media uploaded successfully using the `htp.print` function from the PL/SQL Web Toolkit.

Step 6 Create and test a media retrieval.

Select **Create media retrieval procedure** from the **Main menu**, then click **Next**.

1. Select the database table and procedure type.
   a. Click **CW_IMAGES_TABLE**.
   b. Click **Standalone procedure**.
   c. Click **Next**.
2. Select the media column and key column.
   a. Click **IMAGE (ORDIMAGE)**.
   b. Click **ID (Primary key)**.
   c. Click **Next**.
3. Select the procedure name and parameter name.
   a. Accept the procedure name provided, `GET_CW_IMAGES_TABLE_IMAGE`.
   b. Accept the parameter name provided, `MEDIA_ID`.
   c. Click **Create procedure in the database**.
   d. Click **Next**.
4. Review the following selected procedure creation options:

```
Procedure type:        Standalone
Table name:            CW_IMAGES_TABLE
Media column(s):       IMAGE (ORDIMAGE)
Key column:            ID
Procedure name:        GET_CW_IMAGES_TABLE_IMAGE
Parameter Name:        MEDIA_ID
Function:              Create procedure in the database
```

   Click **Next**.

5. Compile the procedure and review the generated source.

   The Code Wizard displays the following message: `Procedure created successfully: GET_CW_IMAGES_TABLE_IMAGE`

   a. Click **View** to view the generated source in another window. Close the window after looking at the generated source. A copy of the generated source is shown at the end of Step 6, substep 5e.
   b. Review the URL format used to retrieve images using the `GET_CW_IMAGES_TABLE_IMAGE` procedure.
   c. Enter the number `1` as the Key parameter, then click **Test** to test the procedure by retrieving the image uploaded previously.

      The retrieved image is displayed in another window.
   d. Close the window.
   e. Click **Done** to return to the **Main menu**.

   A copy of the generated image retrieval procedure is as follows:

```
CREATE OR REPLACE PROCEDURE GET_CW_IMAGES_TABLE_IMAGE (
 MEDIA_ID IN VARCHAR2 )
AS
  localObject ORDSYS.ORDIMAGE;
  localBlob  BLOB;
```

```
    localBfile BFILE;
    httpStatus NUMBER;
    lastModDate VARCHAR2(256);
  BEGIN
    --
    -- Retrieve the object from the database into a local object.
    --
    BEGIN
      SELECT mtbl.IMAGE INTO localObject FROM CW_IMAGES_TABLE mtbl
        WHERE mtbl.ID = MEDIA_ID;
    EXCEPTION
      WHEN NO_DATA_FOUND THEN
        ordplsgwyutil.resource_not_found( 'MEDIA_ID', MEDIA_ID );
        RETURN;
    END;

    --
    -- Check the update time if the browser sent an If-Modified-Since header.
    --
    IF ordplsgwyutil.cache_is_valid( localObject.getUpdateTime() )
    THEN
      owa_util.status_line( ordplsgwyutil.http_status_not_modified );
      RETURN;
    END IF;

    --
    -- Figure out where the image is.
    --
    IF localObject.isLocal() THEN
      --
      -- Data is stored locally in the localData BLOB attribute.
      --
      localBlob := localObject.getContent();
      owa_util.mime_header( localObject.getMimeType(), FALSE );
      ordplsgwyutil.set_last_modified( localObject.getUpdateTime() );
      owa_util.http_header_close();
      IF owa_util.get_cgi_env( 'REQUEST_METHOD' ) &lt;&gt; 'HEAD' THEN
        wpg_docload.download_file( localBlob );
      END IF;
    ELSIF UPPER( localObject.getSourceType() ) = 'FILE' THEN

      --
      -- Data is stored as a file from which ORDSource creates
      -- a BFILE.
      --
      localBfile  := localObject.getBFILE();
      owa_util.mime_header( localObject.getMimeType(), FALSE );
      ordplsgwyutil.set_last_modified( localObject.getUpdateTime() );
      owa_util.http_header_close();
      IF owa_util.get_cgi_env( 'REQUEST_METHOD' ) &lt;&gt; 'HEAD' THEN
        wpg_docload.download_file( localBfile );
      END IF;

    ELSIF UPPER( localObject.getSourceType() ) = 'HTTP' THEN
      --
      -- The image is referenced as an HTTP entity, so we have to
      -- redirect the client to the URL that ORDSource provides.
      --
      owa_util.redirect_url( localObject.getSource() );
    ELSE
      --
      -- The image is stored in an application-specific data
      -- source type for which no default action is available.
      --
      NULL;
    END IF;
  END GET_CW_IMAGES_TABLE_IMAGE;
```

This sample image retrieval procedure declares the following input parameters and variables:

1. In the declaration section, the procedure declares one input parameter: `MEDIA_ID`.
2. In the subprogram section, the following variables are declared:
   - The variable `localObject` is assigned the data type ORDSYS.ORDIMAGE.
   - The variable `localBlob` is a BLOB data type, the variable `localBfile` is a BFILE data type, `httpStatus` is a NUMBER, and `lastModDate` is a VARCHAR2 with a maximum size of 256 characters.

Within the outer BEGIN...END executable statement section, the following operations are executed:

1. Select the ORDImage object column `IMAGE` in the table `CW_IMAGES_TABLE` where the value of the `ID` column is the value of the `MEDIA_ID` input parameter.
2. In the inner executable block, when no data is found, raise an exception and call the `resource_not_found` function of the PL/SQL Gateway and get the value of the `MEDIA_ID` input parameter.
3. Check the update time if the browser sent an If-Modified-Since header by calling the getUpdateTime( ) method passed into the `cache_is_valid` function of the PL/SQL Gateway.
4. If the cache is valid, send an HTTP status code to the client using the PL/SQL Web Toolkit `owa_util` package `status_line` procedure passing in the call to the `http_status_not_modified` function.
5. Determine where the image data is stored; call the ORDImage isLocal( ) method, which returns a Boolean expression of true if the image data is stored locally in the BLOB, then get the handle to the local BLOB.
   - If the value is true, assign the variable `localBlob` the ORDImage getContent( ) method to get the handle of the local BLOB containing the image data.
   - Call the ORDImage getMimeType( ) method to determine the image's MIME type and pass this to the `owa_util.mime_header` procedure and keep the HTTP header open.
   - Call the ORDImage getUpdateTime( ) method to get the time the image was last modified and pass this to the `ordplsgwyutil.set_last_modified` procedure.
   - Close the HTTP header by calling the `owa_util.http_header_close( )` procedure.
   - Call the `owa_util.get_cgi_env` procedure and if the value of the request method is not `HEAD`, then use the `wpg_docload.download_`

file procedure to pass in the value of localBlob that contains the LOB locator of the BLOB containing the image data to download the image from the database.

6. If the ORDImage isLocal( ) method returns false, call the ORDImage getSourceType( ) method to determine if the value is FILE; if so, then the image data is stored as an external file on the local file system. Then, get the LOB locator of the BFILE containing the image data.
   - Assign the variable localBfile the ORDImage getBfile( ) method to get the LOB locator of the BFILE containing the image data.
   - Call the ORDImage getMimeType( ) method to determine the image's MIME type and pass this to the owa_util.mime_header procedure and keep the HTTP header open.
   - Call the ORDImage getUpdateTime( ) method to get the time the image was last modified and pass this to the ordplsgwyutil.set_last_modified procedure.
   - Close the HTTP header by calling the owa_util.http_header_close() procedure.
   - Call the owa_util.get_cgi_env procedure and if the value of the request method is not HEAD, then use the wpg_docload.download_file procedure to pass in the value of localBfile that contains the LOB locator of the BFILE containing the image data to download the image from the file.
7. If the ORDImage isLocal( ) method returns false, call the ORDImage getSourceType( ) method to determine if the value is HTTP; if so, then the image data is stored at an HTTP URL location, which then redirects the client to the URL that ORDSource provides using the owa_util.redirect_url procedure.
8. If the ORDImage isLocal( ) method returns false, call the ORDImage getSourceType( ) method to determine if the value is FILE or HTTP; if it is neither, then the image is stored in an application-specific data source type that is not recognized or supported by *inter*Media.

3.3.3 Sample Session Using Multiple Object Columns

The following sample session uses the SCOTT schema to illustrate the creation of a multimedia upload (multiple *inter*Media object columns) and single media retrieval procedures. Substitute a different schema name if you want to use a different schema.

This sample session assumes the *inter*Media Code Wizard has been installed.

Perform the following steps:

Step 1 Create a table to store audio for the application by starting SQL*Plus and connecting to the SCOTT schema in the database.

For example:

```
sqlplus SCOTT/TIGER[@<connect_identifer>]

SQL> CREATE TABLE cw_media_table(id NUMBER PRIMARY KEY,
                                 description VARCHAR2(30) NOT NULL,
                                 location VARCHAR2(30),
                                 image ORDSYS.ORDIMAGE,
                                 thumb ORDSYS.ORDIMAGE,
audio ORDSYS.ORDAUDIO,
video ORDSYS.ORDVIDEO,
media ORDSYS.ORDDOC);
```

Step 2 Use the `SCOTTW` DAD you created in Step 2, and then, authorized the use of it in Step 3, of Section 3.3.2.

If you have not created the `SCOTTW` DAD and authorized the use of this DAD, perform Steps 2 and 3 in Section 3.3.2, then continue to next step that follows in this section, Step 3.

Step 3 Change DADs to the `SCOTTCW` DAD.

1. Enter the Code Wizard's administration URL into your browser's location bar, then enter the `ORDSYS` user name and password when prompted by the browser, for example:

   `http://`*`<hostname>`*`:`*`<port-number>`*`/ordcwadmin`

2. Click **Change DAD** from the Code Wizard's **Main menu**.
3. Click Change to SCOTTCW, if it is not already selected, then click **Next**.
4. Enter the user name `SCOTT` and password `TIGER` when prompted for user name and password, then press **OK**.

   The **Main menu** now displays the current DAD as `SCOTTCW` and the current schema as `SCOTT`.

Step 4 Create and test the media upload procedure.

Click **Create media upload procedure** from the **Main menu**, then click **Next**.

1. Select the database table and procedure Type.
   a. Click **CW_MEDIA_TABLE**.
   b. Click **Standalone procedure**.
   c. Click **Next**.
2. Select the PL/SQL document upload table.

   If there are no document tables in the `SCOTT` schema, the Code Wizard displays a message indicating this situation. In this case, accept the default table name provided, `CW_MEDIA_UPLOAD_TABLE`, then click **Next**.

   If there are existing document tables, but the table `CW_MEDIA_UPLOAD_TABLE` is not among them, click **Create new document table**, accept the default table name provided, `CW_MEDIA_UPLOAD_TABLE`, then click **Next**.

   If the `CW_MEDIA_UPLOAD_TABLE` document table already exists, select **Use existing document table** and **CW_MEDIA_UPLOAD_TABLE**, then click **Next**.
3. Select the data access and media columns.
   a. Ensure that **IMAGE (ORDIMAGE)**, **THUMB (ORDIMAGE)** , **AUDIO (ORDAUDIO)**, **VIDEO (ORDVIDEO)**, and **MEDIA (ORDDOC)** are all checkmarked.
   b. Click **ID (Primary key)**.
   c. Click **Conditional insert or update**.
   d. Click **Next**.

4. Select additional columns and procedure names.

   a. Ensure that **DESCRIPTION** is checkmarked because this column has a `NOT NULL` constraint. (The **LOCATION** column is not checkmarked by default as there are no constraints on this column.)

   b. Accept the procedure name provided, `UPLOAD_CW_MEDIA_TABLE_IMAGE`.

   c. Click **Create procedure in the database**.

   d. Click **Next**.

5. Review the following selected procedure creation options that are displayed:

```
Procedure type:        Standalone
Table name:            CW_MEDIA_TABLE
Media column(s):       IMAGE (ORDIMAGE)
                       THUMB (ORDIMAGE)
                       AUDIO (ORDAUDIO)
                       VIDEO (ORDVIDEO)
                       MEDIA (ORDDOC)
Key column:            ID
Additional column(s):  DESCRIPTION
Table access mode:     Conditional update or insert
Procedure name:        UPLOAD_CW_MEDIA_TABLE_IMAGE
Function:              Create procedure in the database
```

   Click **Finish**.

6. Compile the procedure and review the generated source information.

   The Code Wizard displays the following message: "`Procedure created successfully: UPLOAD_CW_MEDIA_TABLE_IMAGE`".

   a. At the option **Click to display generated source:**, click **View** to view the generated source in another window. A copy of the generated source is shown at the end of Step 4, substep 6g.

   b. Close the window after looking at the generated source.

   c. Accept the **DAD:** name provided, `SCOTTCW`, then click **Test** to display in another window a template file upload form that you can use to test the generated procedure.

   d. To customize the template file upload form, select **Save As...** from your browser's **File** pull-down menu to save the HTML source for editing.

   e. To test the template upload form, enter the following information:

      – For the **ID:** column, enter the number `1` as the row's primary key.

      – For each *inter*Media object column, click **Browse...** and choose the appropriate media to upload to each column of the table. You can choose one or more or all columns to test.

      – For the **DESCRIPTION** column, enter a brief description of the media.

      – Click **Upload media**.

      The Code Wizard displays a template completion window with the heading ***inter*Media Code Wizard: Template Upload Procedure**, and, if the procedure is successful, the message: `Media uploaded successfully`.

   f. Close the window.

g. Click **Done** on the **Compile procedure and review generated source** window to return to the **Main menu** of the Code Wizard.

A copy of the generated multimedia upload procedure is as follows:

```
CREATE OR REPLACE PROCEDURE UPLOAD_CW_MEDIA_TABLE_IMAGE
  ( in_ID IN VARCHAR2,
    in_IMAGE IN VARCHAR2 DEFAULT NULL,
    in_THUMB IN VARCHAR2 DEFAULT NULL,
    in_AUDIO IN VARCHAR2 DEFAULT NULL,
    in_VIDEO IN VARCHAR2 DEFAULT NULL,
    in_MEDIA IN VARCHAR2 DEFAULT NULL,
    in_DESCRIPTION IN VARCHAR2 DEFAULT NULL )
AS
  local_IMAGE ORDSYS.ORDIMAGE := ORDSYS.ORDIMAGE.init();
  local_THUMB ORDSYS.ORDIMAGE := ORDSYS.ORDIMAGE.init();
  local_AUDIO ORDSYS.ORDAUDIO := ORDSYS.ORDAUDIO.init();
  local_AUDIO_ctx RAW( 64 );
  local_VIDEO ORDSYS.ORDVIDEO := ORDSYS.ORDVIDEO.init();
  local_VIDEO_ctx RAW( 64 );
  local_MEDIA ORDSYS.ORDDOC := ORDSYS.ORDDOC.init();
  local_MEDIA_ctx RAW( 64 );
  local_ID CW_MEDIA_TABLE.ID%TYPE := NULL;
  upload_size     INTEGER;
  upload_mimetype VARCHAR2( 128 );
  upload_blob     BLOB;
BEGIN
  --
  -- Update the existing row.
  --
  UPDATE CW_MEDIA_TABLE mtbl
    SET mtbl.IMAGE = local_IMAGE,
        mtbl.THUMB = local_THUMB,
        mtbl.AUDIO = local_AUDIO,
        mtbl.VIDEO = local_VIDEO,
        mtbl.MEDIA = local_MEDIA,
        mtbl.DESCRIPTION = in_DESCRIPTION
    WHERE mtbl.ID = in_ID
    RETURN mtbl.ID INTO local_ID;
  --
  -- Conditionally insert a new row if no existing row is updated.
  --
  IF local_ID IS NULL
  THEN
    --
    -- Insert a new row into the table.
    --
    INSERT INTO CW_MEDIA_TABLE ( ID, IMAGE, THUMB, AUDIO, VIDEO, MEDIA,
 DESCRIPTION )
      VALUES ( in_ID, local_IMAGE, local_THUMB, local_AUDIO,
               local_VIDEO, local_MEDIA, in_DESCRIPTION );
  END IF;
  --
  -- Select interMedia object(s) for update.
  --
  SELECT mtbl.IMAGE, mtbl.THUMB, mtbl.AUDIO, mtbl.VIDEO, mtbl.MEDIA INTO
 local_IMAGE, local_THUMB, local_AUDIO, local_VIDEO, local_MEDIA
    FROM CW_MEDIA_TABLE mtbl WHERE mtbl.ID = in_ID FOR UPDATE;
  --
  -- Store media data for the column in_IMAGE.
  --
```

```
IF in_IMAGE IS NOT NULL
THEN
  SELECT dtbl.doc_size, dtbl.mime_type, dtbl.blob_content INTO
         upload_size, upload_mimetype, upload_blob
    FROM MEDIA_UPLOAD_TABLE dtbl WHERE dtbl.name = in_IMAGE;
  IF upload_size &gt; 0
  THEN
    dbms_lob.copy( local_IMAGE.source.localData,
                   upload_blob,
                   upload_size );
    local_IMAGE.setLocal();
    BEGIN
      local_IMAGE.setProperties();
    EXCEPTION
      WHEN OTHERS THEN
        local_IMAGE.contentLength := upload_size;
        local_IMAGE.mimeType := upload_mimetype;
    END;
  END IF;
  DELETE FROM MEDIA_UPLOAD_TABLE dtbl WHERE dtbl.name = in_IMAGE;
END IF;
--
-- Store media data for the column in_THUMB.
--
IF in_THUMB IS NOT NULL
THEN
  SELECT dtbl.doc_size, dtbl.mime_type, dtbl.blob_content INTO
         upload_size, upload_mimetype, upload_blob
    FROM MEDIA_UPLOAD_TABLE dtbl WHERE dtbl.name = in_THUMB;
  IF upload_size &gt; 0
  THEN
    dbms_lob.copy( local_THUMB.source.localData,
                   upload_blob,
                   upload_size );
    local_THUMB.setLocal();
    BEGIN
      local_THUMB.setProperties();
    EXCEPTION
      WHEN OTHERS THEN
        local_THUMB.contentLength := upload_size;
        local_THUMB.mimeType := upload_mimetype;
    END;
  END IF;
  DELETE FROM MEDIA_UPLOAD_TABLE dtbl WHERE dtbl.name = in_THUMB;
END IF;
--
-- Store media data for the column in_AUDIO.
--
IF in_AUDIO IS NOT NULL
THEN
  SELECT dtbl.doc_size, dtbl.mime_type, dtbl.blob_content INTO
         upload_size, upload_mimetype, upload_blob
    FROM MEDIA_UPLOAD_TABLE dtbl WHERE dtbl.name = in_AUDIO;
  IF upload_size &gt; 0
  THEN
    dbms_lob.copy( local_AUDIO.source.localData,
                   upload_blob,
                   upload_size );
    local_AUDIO.setLocal();
    BEGIN
```

```
        local_AUDIO.setProperties(local_AUDIO_ctx);
      EXCEPTION
        WHEN OTHERS THEN
          local_AUDIO.mimeType := upload_mimetype;
      END;
    END IF;
    DELETE FROM MEDIA_UPLOAD_TABLE dtbl WHERE dtbl.name = in_AUDIO;
  END IF;
  --
  -- Store media data for the column in_VIDEO.
  --
  IF in_VIDEO IS NOT NULL
  THEN
    SELECT dtbl.doc_size, dtbl.mime_type, dtbl.blob_content INTO
           upload_size, upload_mimetype, upload_blob
      FROM MEDIA_UPLOAD_TABLE dtbl WHERE dtbl.name = in_VIDEO;
    IF upload_size &gt; 0
    THEN
      dbms_lob.copy( local_VIDEO.source.localData,
                     upload_blob,
                     upload_size );
      local_VIDEO.setLocal();
      BEGIN
        local_VIDEO.setProperties(local_VIDEO_ctx);
      EXCEPTION
        WHEN OTHERS THEN
          local_VIDEO.mimeType := upload_mimetype;
      END;
    END IF;
    DELETE FROM MEDIA_UPLOAD_TABLE dtbl WHERE dtbl.name = in_VIDEO;
  END IF;
  --
  -- Store media data for the column in_MEDIA.
  --
  IF in_MEDIA IS NOT NULL
  THEN
    SELECT dtbl.doc_size, dtbl.mime_type, dtbl.blob_content INTO
           upload_size, upload_mimetype, upload_blob
      FROM MEDIA_UPLOAD_TABLE dtbl WHERE dtbl.name = in_MEDIA;
    IF upload_size &gt; 0
    THEN
      dbms_lob.copy( local_MEDIA.source.localData,
                     upload_blob,
                     upload_size );
      local_MEDIA.setLocal();
      BEGIN
        local_MEDIA.setProperties(local_MEDIA_ctx, FALSE);
      EXCEPTION
        WHEN OTHERS THEN
          local_MEDIA.contentLength := upload_size;
          local_MEDIA.mimeType := upload_mimetype;
      END;
    END IF;
    DELETE FROM MEDIA_UPLOAD_TABLE dtbl WHERE dtbl.name = in_MEDIA;
  END IF;
  --
  -- Update interMedia objects in the table.
  --
  UPDATE CW_MEDIA_TABLE mtbl
    SET mtbl.IMAGE = local_IMAGE,
        mtbl.THUMB = local_THUMB,
        mtbl.AUDIO = local_AUDIO,
        mtbl.VIDEO = local_VIDEO,
        mtbl.MEDIA = local_MEDIA
    WHERE mtbl.ID = in_ID;
  --
  -- Display the template completion message.
  --
  htp.print( '&lt;html&gt;' );
  htp.print( '&lt;title&gt;interMedia Code Wizard: Template Upload
 Procedure&lt;/title&gt;' );
  htp.print( '&lt;body&gt;' );
  htp.print( '&lt;h2&gt;&lt;i&gt;inter&lt;/i&gt;Media Code Wizard:
 Template Upload Procedure&lt;/h2&gt;' );
  htp.print( 'Media uploaded successfully.' );
  htp.print( '&lt;/body&gt;' );
  htp.print( '&lt;/html&gt;' );

END UPLOAD_CW_MEDIA_TABLE_IMAGE;
```

This sample multimedia upload procedure declares the following input parameters and variables:

1. In the declaration section, the procedure declares seven input parameters: `in_ID`, `in_IMAGE`, `in_THUMB`, `in_AUDIO`, `in_VIDEO`, `in_MEDIA`, and `in_DESCRIPTION`, then initializes the last six to `NULL`.
2. In the subprogram section, the following variables are declared:
   – The variables `local_IMAGE` and `local_THUMB` are assigned the data type ORDSYS.ORDIMAGE and initialized with an empty BLOB using the ORDIMAGE.init( ) method.
   – The variable `local_AUDIO` is assigned the data type ORDSYS.ORDAUDIO and initialized with an empty BLOB using the ORDAUDIO.init( ) method. Also a context variable `local_AUDIO_ctx` is assigned the data type RAW(64).
   – The variable `local_VIDEO` is assigned the data type ORDSYS.ORDVIDEO and initialized with an empty BLOB using the ORDVIDEO.init( ) method. Also, a context variable `local_VIDEO_ctx` is assigned the data type RAW(64).
   – The variable `local_MEDIA` is assigned the data type ORDSYS.ORDDOC and initialized with an empty BLOB using the ORDDOC.init( ) method. Also, a context variable `local_MEDIA_ctx` is assigned the data type RAW(64).
   – The variable `local_ID` takes the same data type as the `ID` column in the table `CW_MEDIA_TABLE` and is initialized to `NULL`.
   – Three additional variables are declared `upload_size`, `upload_mimetype`, and `upload_blob`, which are later given values from comparable column names `doc_size`, `mime_type`, and `blob_content` from the document table `MEDIA_UPLOAD_TABLE` using a SELECT statement. This is all in preparation for copying the content of the image, thumb, audio, video, and media BLOB data to the respective ORDSYS.ORDIMAGE.source.localData, ORDSYS.ORDIMAGE.source.localData, ORDSYS.ORDAUDIO.source.localData,

ORDSYS.ORDVIDEO.source.localData, and ORDSYS.ORDDOC.source.localData attributes.

Within the outer BEGIN...END executable statement section, the following operations are executed:

1. Update the existing row in the table `CW_MEDIA_TABLE` for the `IMAGE` , `THUMB`, `AUDIO`, `VIDEO`, `MEDIA`, and `DESCRIPTION` columns and return the value of `local_ID` where the value of the `ID` column is the value of the `in_ID` input parameter.
2. If the value returned of `local_ID` is `NULL`, conditionally insert a new row into the table `CW_MEDIA_TABLE` and initialize the instance of the ORDImage object type in the `IMAGE` column with an empty BLOB, the instance of the ORDImage object type in the `THUMB` column with an empty BLOB, the instance of the ORDAudio object type in the `AUDIO` column with an empty BLOB, the instance of the ORDVideo object type in the `VIDEO` column with an empty BLOB, and the instance of the ORDDoc object type in the `MEDIA` column with an empty BLOB.
3. Select the ORDImage object column `IMAGE`, ORDImage object column `THUMB`, ORDAudio object column `AUDIO`, ORDVideo object column `VIDEO`, and ORDDoc object column `MEDIA` in the table `CW_MEDIA_TABLE` for update where the value of the `ID` column is the value of the `in_ID` input parameter.
4. Select a row for the `doc_size`, `mime_type`, and `blob_content` columns from the document table and pass the values to the `upload_size`, `upload_mimetype`, and `upload_blob` variables where the value of the `Name` column is the value of one of the following input parameters `in_IMAGE`; `in_THUMB`; `in_AUDIO`; `in_VIDEO`; or `in_MEDIA`.
5. Perform a DBMS LOB copy of the BLOB data from the table `MEDIA_UPLOAD_TABLE` into the ORDSYS.ORDIMAGE.source.localData, ORDSYS.ORDIMAGE.source.localData, ORDSYS.ORDAUDIO.source.localData, ORDSYS.ORDVIDEO.source.localData, and ORDSYS.ORDDoc.source.localData attribute, then call the setLocal( ) method to indicate that the image, audio, and video data are stored locally in the BLOB, and ORDImage, ORDAudio, ORDVideo, and ORDDoc methods should look for corresponding data in the source.localData attribute.
6. In the inner executable block, call the respective ORDImage, ORDAudio, ORDVideo, and ORDDoc setProperties( ) method to read the image, audio, and video data to get the values of the object attributes and store them in the image, audio, video, and media object attributes for the ORDImage, ORDAudio, ORDVideo, and ORDDoc objects.
7. If the setProperties( ) call fails, catch the exception and call the contentLength( ) method to get the size of the media data and call the mimeType( ) method to get the MIME type of the media data.
8. Delete the row of data from the document table `MEDIA_UPLOAD_TABLE` hat was copied to the row in the table `CW_MEDIA_TABLE` where the value of the `Name` column is the value of the respective `in_IMAGE`, `in_THUMB`, `in_AUDIO`, `in_VIDEO`, and `in_MEDIA` input parameter.
9. Update the ORDImage object `IMAGE` column, the ORDImage object `THUMB` column, the ORDAudio object `AUDIO` column, the ORDVideo object `VIDEO` column, and the ORDDoc object `MEDIA` column in the table `CW_MEDIA_TABLE` with the content of the variables `local_IMAGE`, `local_THUMB`,

`local_AUDIO`, `local_VIDEO`, and `local_MEDIA` respectively, where the value of the `ID` column is the value of the `in_ID` input parameter.

10. Display a completion message on the HTML page to indicate that the media uploaded successfully using the `htp.print` function from the PL/SQL Web Toolkit.

Step 5 Create and test a media retrieval.

Select **Create media retrieval procedure** from the **Main menu**, then click **Next**.

1. Select the database table and procedure type.
   a. Click **CW_MEDIA_TABLE**.
   b. Click **Standalone procedure**.
   c. Click **Next**.
2. Select the media column and key column.
   a. Ensure that one the following object columns is checkmarked. For example, if you loaded media data into the media column in Step 4, substep 6e, then select the **MEDIA (ORDDOC)** column.
   b. Click **ID (Primary key)**.
   c. Click **Next**.
3. Select the procedure name and parameter name.
   a. Accept the procedure name provided, `GET_CW_MEDIA_TABLE_IMAGE`.
   b. Accept the parameter name provided, `MEDIA_ID`.
   c. Click **Create procedure in the database**.
   d. Click **Next**.
4. Review the following selected procedure creation options:

```
Procedure type:        Standalone
Table name:            CW_MEDIA_TABLE
Key column:            ID
Media column:          IMAGE (ORDDOC)
Procedure name:        GET_CW_MEDIA_TABLE_IMAGE
Parameter name:        MEDIA_ID
Function:              Create procedure in the database
```

   Click **Finish**.
5. Compile the procedure and review the generated source.

   The Code Wizard displays the following message: `Procedure created successfully: GET_CW_MEDIA_TABLE_IMAGE`.
   a. Click **View** to view the generated source in another window. Close the window after looking at the generated source. A copy of the generated source is shown at the end of this step.
   b. Review the URL format used to retrieve images using the `GET_CW_MEDIA_TABLE_IMAGE` procedure.
   c. Enter the number `1` as the Key parameter, then click **Test** to test the procedure by retrieving the image uploaded previously.
   d. The retrieved image is displayed in another window.

e. Close the window.

f. Click **Done** to return to the **Main menu**.

Note: A generated media retrieval script, unlike the multiple media upload script shown at the end of Step 4, handles only the type of media data designed for that *inter*Media object type. To retrieve media data stored in other *inter*Media object types, generate a retrieval script for each desired media data type and add it to your PL/SQL package.

A copy of the generated media retrieval procedure is as follows:

```
CREATE OR REPLACE PROCEDURE GET_CW_MEDIA_TABLE_MEDIA ( MEDIA_ID
 IN VARCHAR2 )
AS
  localObject ORDSYS.ORDDOC;
  localBlob  BLOB;
  localBfile BFILE;
  httpStatus NUMBER;
  lastModDate VARCHAR2(256);

BEGIN
  --
  -- Retrieve the object from the database into a local object.
  --
  BEGIN
    SELECT mtbl.MEDIA INTO localObject FROM CW_MEDIA_TABLE mtbl
      WHERE mtbl.ID = MEDIA_ID;
  EXCEPTION
    WHEN NO_DATA_FOUND THEN
      ordplsgwyutil.resource_not_found( 'MEDIA_ID', MEDIA_ID );
      RETURN;
  END;
  --
  -- Check the update time if the browser sent an If-Modified-Since header.
  --
  IF ordplsgwyutil.cache_is_valid( localObject.getUpdateTime() )
  THEN
    owa_util.status_line( ordplsgwyutil.http_status_not_modified );
    RETURN;
  END IF;
  --
  -- Figure out where the image is.
  --
  IF localObject.isLocal() THEN
    --
    -- Data is stored locally in the localData BLOB attribute.
    --
    localBlob := localObject.getContent();
    owa_util.mime_header( localObject.getMimeType(), FALSE );
    ordplsgwyutil.set_last_modified( localObject.getUpdateTime() );
    owa_util.http_header_close();
    IF owa_util.get_cgi_env( 'REQUEST_METHOD' ) &lt;&gt; 'HEAD' THEN
      wpg_docload.download_file( localBlob );
    END IF;

  ELSIF UPPER( localObject.getSourceType() ) = 'FILE' THEN
    --
    -- Data is stored as a file from which ORDSource creates
    -- a BFILE.
    --
    localBfile  := localObject.getBFILE();
    owa_util.mime_header( localObject.getMimeType(), FALSE );
    ordplsgwyutil.set_last_modified( localObject.getUpdateTime() );
    owa_util.http_header_close();
    IF owa_util.get_cgi_env( 'REQUEST_METHOD' ) &lt;&gt; 'HEAD' THEN
      wpg_docload.download_file( localBfile );
    END IF;

  ELSIF UPPER( localObject.getSourceType() ) = 'HTTP' THEN
    --
    -- The image is referenced as an HTTP entity, so we have to
    -- redirect the client to the URL that ORDSource provides.
    --
    owa_util.redirect_url( localObject.getSource() );
  ELSE
    --
    -- The image is stored in an application-specific data
    -- source type for which no default action is available.
    --
    NULL;
  END IF;
END GET_CW_MEDIA_TABLE_MEDIA;
```

See the description at the end of the generated image retrieval procedure in Section 3.3.2, Step 6 "Create and test a media retrieval", after substep 5e. The only difference between these two retrieval procedures is the type of object being retrieved, an ORDImage object type versus an ORDDoc object type.

3.3.4 Known Restrictions of the Oracle *inter*Media Code Wizard

The following restrictions are known for the *inter*Media Code Wizard:

- Tables with composite primary keys are not supported.

  To use a table with a composite primary key, create an upload or download procedure, then edit the generated source to support all the primary key columns. For example, for a media retrieval procedure, this might involve adding an additional parameter, then specifying that parameter in the `where` clause of the SELECT statement.

- User object types containing embedded *inter*Media object types are not recognized by the *inter*Media Code Wizard.

4 IMExample Java Sample Application

This chapter describes the IMExample Java sample application. This chapter assumes you have already installed, compiled, and can run this sample application. See the `README.txt` file in your `<ORACLE_HOME>/ord/im/demo/java` directory for requirements and instructions on how to install, compile, and run this sample application. This chapter describes how Oracle *inter*Media Java Classes ("*inter*Media Java Classes") is used in creating this sample application.

4.1 Overview of the IMExample Application

This sample application lets you retrieve multimedia data from the Oracle Database sample schemas, save to a file, play, and delete from the sample schema image, audio, video, and testimonial data using the respective Oracle *inter*Media ("*inter*Media") object types, OrdImage, OrdAudio, OrdVideo, and OrdDoc by product ID for rows in the `PM.ONLINE_MEDIA` table. Section 4.2 describes the class files and shows code examples that illustrate how *inter*Media object types and methods and other Oracle objects are used.

4.2 Description of the IMExample Application

The IMExample sample application, when compiled, creates the following class files:

- `IMExample` -- creates the sample application frame and maintains the only connection to the database. This class is the entry point of this sample application.
- `IMExampleFrame` -- extends the `JFrame` class and displays the main frame.
- `IMLoginDialog` -- extends the `JDialog` class, displays the login dialog box, and creates the connection to the database.
- `IMExampleQuery` -- performs the SQL SELECT statement to retrieve rows of the `OE.PRODUCT_INFORMATION` table and displays the content of the table by product ID.
- `IMProductDialog` -- extends the `JDialog` class, shows a dialog box to display detailed information for a particular product, including the product ID, product name, and product description. The IMProductDialog class also retrieves and displays the product photo, audio, video, and testimonial data within the appropriate panel. It supports retrieving, saving, deleting, and playing the media data. And, it allows for applying changes or rolling back changes to the media objects.
- `IMImagePanel` -- extends the `IMMediaPanel` class, displays the product photo and its attributes: MIME type, image height, image width, and content length, and

if it applies, generates and displays the thumbnail image and displays lists for reading and writing metadata.

- IMAudioPanel -- extends the IMMediaPanel class and displays the product audio and its attributes: MIME type, duration of the audio, and content length.
- IMVideoPanel -- extends the IMMediaPanel class and displays the product video and its attributes: MIME type, frame height, frame width, duration of the video, and content length.
- IMDocPanel -- extends the IMMediaPanel class and displays the product testimonials and its attributes: MIME type and content length.
- IMLoadFile -- loads a media stream (photo, video, audio, and testimonials), from a file to the PM.ONLINE_MEDIA table in the database, and if necessary, inserts a row and initializes the media objects, then updates the media data, sets the media attributes, and generates and updates the thumbnail image if loading a photo.
- IMSaveFile -- saves a media stream from the database to a target file.
- IMMediaPanel -- extends the JPanel class, lays out the common components for the photo, audio, video, and doc panel with load, save, delete, and play check boxes, initializes the MIME configuration file for each operating system that lists plug-in players and media and their associated MIME types, plays the data stream associated with the MIME type of the media, and allows users to specify their own player to play the media data stream.

The major flow among these class files is: IMExample to IMExampleFrame to IMLoginDialog (login) to IMExampleFrame.showDefaultTable( ) to IMExampleQuery to IMProductDialog to one group of classes (IMImagePanel, IMAudioPanel, IMVideoPanel, IMDocPanel), and finally to the last group of classes (IMLoadFile, IMSaveFile, IMMediaPanel).

The remaining class files in this sample application include:

- IMUtil -- includes common utilities such as a method to generate and update thumbnail images, wrapper methods for each setProperties( ) method of each media object type to separate the exceptions caused by unrecognizable formats, and cleanup methods to close the following: resultSet, Statement, input stream and its reader, and output stream and its writer.
- IMMIME -- loads and stores the mapping between plug-in players and the MIME type.
- IMResultSetTableModel -- extends the AbstractTableModel class and controls the display of the OE.PRODUCT_INFORMATION table.
- IMMessage -- displays various messages for the sample application and classifies the message level as error, warning, or suggestion.
- IMMessageResource -- extends the java.util.ListResourceBundle class and contains the actual message text for all messages.
- IMJOptionPane -- extends and puts into subclasses the JOptionPane class in order to add an accessible description message to the displayed dialog box.
- IMGetMetadataDialog -- extends the JDialog class, and retrieves the metadata from an image into an XML document and then displays the XML document in a JTree form.
- IMPutMetadataDialog -- extends the JDialog class, and constructs an XMP packet to write into an image from user inputs.

- `XMLTreeNode` -- extends the `DefaultMutableTreeNode` class, and creates a tree representation of an XML node.
- `XMLTreeView` -- extends the `JPanel` class, and displays an XML document as a tree.
- `IMFileChooser` -- extends the `JFileChooser` class, and inherits from the `JFileChooser` class in order to add the button mnemonic and accessible description.
- `IMConstants` -- describes the IMConstants interface, which contains all the constants for column names, media types, message types, and message dialog titles.
- `IMAttrTableModel` -- extends and puts into subclasses the `DefaultTableModel` class in order to provide the table model for displaying media attributes, and overwrites the isCellEditable( ) method to make the cells uneditable.
- `FocusedJTextField` -- extends and puts into subclasses the `JTextField` class and overwrites the isFocusTraversable( ) method to allow it to gain focus when it is set to uneditable.
- `FocusedJTextArea` -- extends and puts into subclasses the `JTextArea` class and overwrites the isFocusTraversable( ) method to allow it to gain focus when it is set to uneditable; also overrides the isManagingFocus( ) method to force the `JTextArea` class not to handle a TAB key operation.
- `FocusedJPanel` -- extends and puts into subclasses the `JPanel` class and overwrites the isFocusTraversable( ) method to allow it to gain focus.
- `FocusedJLabel` -- extends and puts into subclasses the `JLabel` class, overwrites the isFocusTraversable( ) method, and adds a focus listener to allow it to gain focus.
- `BooleanRenderer` -- extends the `JCheckBox` class and renders Boolean objects as JCheckBox (a checkbox) in a JTable (two-dimensional table format). This class also sets the AccessibleName and AccessibleDescription properties by setting the tooltip to support accessibility.
- `IMStreamAbsorber` -- extends the `Thread` class and runs as a separate thread to consume an input stream. This is useful when a plug-in application is loaded and it writes something out to, for example, a standard error, without consuming the application's output, the application may be unable to continue.
- `IMTable` -- extends and puts into subclasses the `JTable` class and overwrites the isManagingFocus( ) method to avoid letting the table handle a TAB key operation.
- `IMTableRenderer` -- extends the `DefaultTableCellRenderer` class and renders the `PRODUCT_ID`, `PRODUCT_NAME`, and `PRODUCT_DESCRIPTION` columns to add accessibility information, and sets the customized display.
- `IMUIUtil` -- includes common GUI utilities.

4.2.1 IMProductDialog Class

This class defines the following methods followed by a description of what each method does:

- The loadMedia( ) method to retrieve the media objects from the database. This method performs a SQL SELECT...FOR UPDATE statement on the `PM.ONLINE_MEDIA` table where the `PRODUCT_ID` column is a parameter marker; then this class uses the getORAData and getORADataFactory interfaces to get the media data objects from the result set.

- The displayMedia( ) method to display the media data, which in turn calls the corresponding media display methods displayImage( ), displayAudio( ), displayVideo( ), and displayDoc ( ).
- The displayImage( ) method calls the IMImagePanel.display( ) method to display the image data attributes, display the thumbnail image, and display the full sized image using a media player that supports this MIME type.
- The displayAudio( ) method calls the IMAudioPanel.display( ) method to display the audio data attributes and play the audio stream using a media player that supports this MIME type.
- The displayVideo( ) method calls the IMVideoPanel.display( ) method to display the video data attributes and play the video stream using a media player that supports this MIME type.
- The displayDoc( ) method calls the IMDocPanel.display( ) method to display the testimonial data attributes and play the testimonial data using a media player that supports this MIME type.

The following code example shows the loadMedia( ), displayMedia( ), displayImage( ), displayAudio( ), displayVideo( ), and displayDoc( ) methods, and highlights in bold the SQL query statements and areas in the code where *inter*Media and other Oracle object types and methods are used.

```
private void loadMedia() throws SQLException, IOException
{
  String sQuery =
    "select product_photo, product_thumbnail, product_audio, product_video, " +
    "product_testimonials from pm.online_media where product_id = ? for update";

  OracleConnection conn = null;
  OracleResultSet rs = null;
  OraclePreparedStatement pstmt = null;
  boolean isInsertNeeded = false;
  byte[] ctx[] = new byte[1][64];

  try
  {
    conn = IMExample.getDBConnection();

    pstmt = (OraclePreparedStatement)conn.prepareStatement(sQuery);
    pstmt.setInt(1, m_iProdId);
    rs = (OracleResultSet)pstmt.executeQuery();
    if (rs.next() == true)
    {
      m_img = (OrdImage)rs.getORAData(1, OrdImage.getORADataFactory());
      m_imgThumb = (OrdImage)rs.getORAData(2, OrdImage.getORADataFactory());
      m_aud = (OrdAudio)rs.getORAData(3, OrdAudio.getORADataFactory());
      m_vid = (OrdVideo)rs.getORAData(4, OrdVideo.getORADataFactory());
      m_doc = (OrdDoc)rs.getORAData(5, OrdDoc.getORADataFactory());
    }

    displayMedia();

    rs.close();
    pstmt.close();
  }
  finally
  {
    IMUtil.cleanup(rs, pstmt);
  }
}

private void displayMedia() throws SQLException, IOException
{
  displayImage();
  displayAudio();
  displayVideo();
  displayDoc();
}

/**
 * Add the product photo panel.
 */
private void displayImage() throws SQLException, IOException
{
  m_jImgPanel = new IMImagePanel(this,
      m_img, m_imgThumb, m_iProdId, m_colorFieldBg);
  m_jImgPanel.display();
  m_jImgPanel.getAccessibleContext().setAccessibleName
    ("Product photo panel");
  m_jImgPanel.getAccessibleContext().setAccessibleDescription
    ("Product photo panel with an image icon on the left, " +
     "image attribute panel in the middle and image control" +
      "panel on the right.");

  m_jMediaPanel.add(m_jImgPanel);

  Component jImgFocus = m_jImgPanel.getFirstFocusComponent();
}

/**
 * Add the product audio panel.
 */
private void displayAudio() throws SQLException, IOException
{
  m_jAudPanel = new IMAudioPanel(this, m_aud, m_iProdId, m_colorFieldBg);
  m_jAudPanel.display();
  m_jAudPanel.getAccessibleContext().setAccessibleName
    ("Product audio panel");
  m_jAudPanel.getAccessibleContext().setAccessibleDescription(
      "Product audio panel with an audio icon at the left, " +
      "audio attribute panel in the middle and audio control" +
      "panel at the right.");
  m_jMediaPanel.add(m_jAudPanel);
}

/**
 * Add the product video panel.
 */
private void displayVideo() throws SQLException, IOException
{
  m_jVidPanel = new IMVideoPanel(this, m_vid, m_iProdId, m_colorFieldBg);
  m_jVidPanel.display();
  m_jVidPanel.getAccessibleContext().setAccessibleName
    ("Product audio panel");
  m_jVidPanel.getAccessibleContext().setAccessibleDescription(
      "Product audio panel with an video icon at the left, " +
      "video attribute panel in the middle and video control" +
      "panel at the right.");
  m_jMediaPanel.add(m_jVidPanel);
}

/**
 * Add the product testimonials panel.
 */
private void displayDoc() throws SQLException, IOException
{
  m_jDocPanel = new IMDocPanel(this, m _doc, m_iProdId, m_colorFieldBg);
  m_jDocPanel.display();
  m_jDocPanel.getAccessibleContext().setAccessibleName
    ("Product testimonials panel");
  m_jDocPanel.getAccessibleContext().setAccessibleDescription(
      "Product testimonials panel with an document icon at the left, " +
      "testimonials attribute panel in the middle and testimonials control" +
      "panel at the right.");
  m_jMediaPanel.add(m_jDocPanel);
}
```

See IMImagePanel Class, IMAudioPanel Class, IMVideoPanel Class, and IMDocPanel Class for code examples of the corresponding m_j*Xxx*Panel.display( ) methods, where *Xxx* represents the particular media data type, Img, Aud, Vid, or Doc.

4.2.2 IMImagePanel Class

This class displays the image panel, the product photo and its attributes, and the thumbnail image, and lists for reading and writing metadata. What follows is a more detailed description of each of the methods that are defined and what each method does:

- The display( ) method, which first calls the insertProperty( ) method, which calls the *inter*Media image object type methods getMimeType( ), getHeight( ), getWidth( ), and getContentlength( ) to get the attributes of the image to display in a table, and lays out the user interface components for reading and writing image metadata.
- For supported formats, the class displays the product photo thumbnail image, which is generated by calling the IMUtil.generateThumbnail( )method to create the thumbnail image from the product photo.
- The addThumbnail( ) method to show the new thumbnail image.
- The changeThumbnail( ) method to change the thumbnail image.
- The saveToFile( ) method to save the photo to a file.
- The deleteMedia( ) method to delete the product photo image and its thumbnail image from the database by setting the image object type columns to empty using the OrdImage.init( ) method.
- The play( ) media method to show the image using a media player.
- The setMedia( ) method to set the photo and thumbnail object.
- The notExist( ) method checks to see if the image data exists and returns true if the BLOB is empty or is not associated with an existing BFILE; otherwise, it returns false.

- The getDataInByteArray( ) method retrieves image data into a byte array by calling the *inter*Media importData( ) method first for the BFILE and returns the results of calling the *inter*Media getDataInByteArray( ) method.
- The refreshPanel( ) method refreshes the display when updating the photo image, attributes, and thumbnail image.
- The getFirstFocusComponent( ) method enforces the correct focus order.
- The emptyPanel( ) method clears the icon and attribute panel.
- The showMetadata( ) method to pop up a window for displaying metadata for the selected type.
- The writeMetadata( ) method to display the write metadata dialog.

The following code example includes the display( ), insertProperty( ), notExist( ), getDataInByteArray( ), and refreshPanel( ) methods, and highlights in bold any SQL query statements and areas in the code where *inter*Media and other Oracle object types and methods are used:

```
void display() throws IOException, SQLException
{
  addControlPane();

  if (notExist(m_img))
  {
    // The image does not exist.
    m_hasMedia = false;
    layoutEmpty(s_sNotExist);
  }
  else
  {
    m_hasMedia = true;
    // If image exists, try to show the attributes.
    if (insertProperty())
    {
      // Show the thumbnail image.
      // If the thumbnail image does not exist, generate it first.
      if (m_imgThumb != null)
      {
        String sFormat = m_imgThumb.getFormat();

        if (notExist(m_imgThumb) ||
            ( !("JFIF".equalsIgnoreCase(sFormat)) &&
              !("GIFF".equalsIgnoreCase(sFormat))
            ))
        {
          m_imgThumb = IMUtil.generateThumbnail(m_iProdId, m_img, m_imgThumb);
        }

        byte[] thumbnail = getDataInByteArray(m_imgThumb);
        addThumbnail(thumbnail);
      }
      else
      {
        m_imgThumb = IMUtil.generateThumbnail(m_iProdId, m_img, m_imgThumb);
        byte[] thumbnail = getDataInByteArray(m_imgThumb);
        addThumbnail(thumbnail);
      }
    }
    }
  }
.
.
.
  boolean insertProperty() throws SQLException
  {
    boolean isFormatSupported = false;
    String sMimeType = m_img.getMimeType();

    if (sMimeType == null)
      isFormatSupported = IMUtil.setProperties(m_img);
    else
      isFormatSupported = true;

    if (!isFormatSupported)
    {
      layoutEmpty(s_sNotSupported);
    }
    else
    {
      Object[][] data =
      {
        {"MIME Type",  m_img.getMimeType()},
        {"Height", new Integer(m_img.getHeight()).toString()},
        {"Width",  new Integer(m_img.getWidth()).toString()},
        {"Content Length", new Integer(m_img.getContentLength()).toString()}
      };

      .
      .
      .
    }

    return isFormatSupported;
  }
.
.
.
  static boolean notExist(OrdImage img) throws SQLException, IOException
  {
    if (img == null)
      return true;
    else
    {
      if (img.isLocal() && (img.getDataInByteArray() == null))
        return true;
      else if (!img.isLocal() && (":///".equals(img.getSource())))
        return true;
      else
      {
        if (!img.isLocal())
        {
          BFILE bfile = img.getBFILE();
          if (!bfile.fileExists())
            return true;
          else
            return false;
        }
        else
        return false;
      }
    }
  }
.
.
.
  static byte[] getDataInByteArray(OrdImage img) throws SQLException, IOException
  {
    if (notExist(img))
      return null;
    else
    {
      if (!img.isLocal())
      {
        byte[] ctx[] = new byte[1][4000];
        try
        {
          img.importData(ctx);
        }
        catch (SQLException e)
        {
          new IMMessage(IMConstants.ERROR, "MEDIA_SOURCE_ERR", e);
          return null;
        }
      }
      return img.getDataInByteArray();
    }
  }
.
.
.
  void refreshPanel(boolean isFormatSupported) throws SQLException, IOException
  {
    m_hasMedia = true;
    if (isFormatSupported)
    {
      if (m_jAttrTbl == null)
      {
        m_jAttrPane.remove(m_jEmpty);
        m_jIconPane.remove(m_jIcon);

        byte[] thumbnail = getDataInByteArray(m_imgThumb);
        addThumbnail(thumbnail);

        insertProperty();
      }
      else
      {
        byte[] thumbnail = getDataInByteArray(m_imgThumb);
        changThumbnail(thumbnail);

        m_jAttrTbl.setValueAt(m_img.getMimeType(), 0, 1);
        m_jAttrTbl.setValueAt(new Integer(m_img.getHeight()).toString(), 1, 1);
        m_jAttrTbl.setValueAt(new Integer(m_img.getWidth()).toString(), 2, 1);
        m_jAttrTbl.setValueAt(new Integer(m_img.getContentLength()).toString(),3, 1);
      }
    }
   .
   .
  .
}
```

4.2.3 IMGetMetadataDialog Class

This class shows a dialog to display detailed information for metadata in a product photograph. This class also defines the displayMetadata( ) method and describes what it does.

The displayMetadata( ) method retrieves metadata from the image by using the *inter*Media OrdImage getMetadata( ) method, and then displays the metadata.

The following code example includes the displayMetadata( ) method, and highlights in bold any SQL query statements and areas in the code where *inter*Media and other Oracle object types and methods are used:

```
private void displayMetadata(String sMetaType)
{
  XMLDocument doc = null;
  try
  {
    //
    // Retrieves the metadata into an XMLType array
    //
    XMLType xmlList[] = m_img.getMetadata(sMetaType);

    if (xmlList.length == 1)
    {
      DOMParser parser = new DOMParser();
      parser.setValidationMode(XMLConstants.NONVALIDATING);
      parser.setPreserveWhitespace(false);
      parser.parse(new StringReader(XMLType.createXML(xmlList[0]).getStringVal()));
      doc = parser.getDocument();
    }
  }
  .
  .
  .
}
```

4.2.4 IMPutMetadataDialog Class

This class shows a dialog to write metadata into a product photograph. This class also defines the writeMetadata( ) method and describes what it does.

The writeMetadata( ) method writes XMP metadata into the image metadata by using the *inter*Media OrdImage putMetadata( ) method.

The following code example includes the writeMetadata( ) method, and highlights in bold any SQL query statements and areas in the code where *inter*Media and other Oracle object types and methods are used:

```
void writeMetadata()
{
  try
  {
    //
    // Let the StringBuffer to hold the XMP packet
    //
```

```
      StringBuffer sb = new StringBuffer(
          "<xmpMetadata xmlns=\"http://xmlns.oracle.com/ord/meta/xmp\" "
          + " xsi:schemaLocation=\"http://xmlns.oracle.com/ord/meta/xmp "
          + " http://xmlns.oracle.com/ord/meta/xmp\" "
          + " xmlns:xsi=\"http://www.w3.org/2001/XMLSchema-instance\" > "
          + " <rdf:RDF xmlns:rdf=\"http://www.w3.org/1999/02/22-rdf-syntax-ns#\"> "
          + " <rdf:Description about=\"\" xmlns:dc=\"http://purl.org/dc/elements/1.1/\"> "
          );

      String str = null;
      if ( (str=m_jTitleField.getText()) != null)
        sb.append("<dc:title>" + str + "</dc:title>");
      if ( (str=m_jCreatorField.getText()) !=null)
        sb.append("<dc:creator>" + str + "</dc:creator>");
      if ( (str=m_jDateField.getText()) !=null)
        sb.append("<dc:date>" + str + "</dc:date>");
      if ( (str=m_jDescriptionField.getText()) !=null)
        sb.append("<dc:description>" + str + "</dc:description>");
      if ( (str=m_jCopyrightField.getText()) !=null)
        sb.append("<dc:rights>" + str + "</dc:rights>");

      sb.append("</rdf:Description></rdf:RDF></xmpMetadata>");

      XMLType xmp = XMLType.createXML(IMExample.getDBConnection(), sb.toString(),
                "http://xmlns.oracle.com/ord/meta/xmp", true, true);

      //
      // Make sure the image data is local
      //
      if (!m_img.isLocal())
      {
        byte[] ctx[] = new byte[1][4000];
        m_img.importData(ctx);
      }

      //
      // Call Ordimage.putMetadata
      //
      m_img.putMetadata(xmp, "XMP", "utf-8");

      this.dispose();
    }
    .
    .
    .
  }
```

4.2.5 IMVideoPanel Class

This class displays the video panel, the product video, and its attributes. This class is identical in structure and functions similarly to the `IMImagePanel` class. See IMImagePanel Class for descriptions of methods.

The following code example includes the display( ), insertProperty( ), notExist( ), getDataInByteArray( ), and refreshPanel( ) methods, and highlights in bold any SQL query statements and areas in the code where *inter*Media and other Oracle object types and methods are used:

```
  void display() throws IOException, SQLException
  {
    addControlPane();

    // Set the video icon.
    m_jIcon = new JLabel(new ImageIcon(IMExampleFrame.class.getResource("OrdVideo.gif")));
    m_jIcon.setLabelFor(m_jAttrPane);

      m_jIconPane.add(m_jIcon, BorderLayout.CENTER);

    if (notExist())
    {
      // The video does not exist.
      m_hasMedia = false;
      layoutEmpty(s_sNotExist);
    }
    else
    {
      m_hasMedia = true;
      // If the video exists, try to show the attributes.
      insertProperty();
    }
  }
.
.
.
  boolean insertProperty() throws SQLException
  {
    boolean isFormatSupported = false;
    String sMimeType = m_vid.getMimeType();

    if (sMimeType == null)
      isFormatSupported = IMUtil.setProperties(m_vid);
    else
      isFormatSupported = true;

    if (!isFormatSupported)
    {
      layoutEmpty(s_sNotSupported);
    }
    else
    {
      Object[][] data =
      {
        {"MIME Type",  m_vid.getMimeType()},
        {"Height", new Integer(m_vid.getHeight()).toString()},
        {"Width",  new Integer(m_vid.getWidth()).toString()},
        {"Duration", new Integer(m_vid.getVideoDuration()).toString()},
        {"Content Length", new Integer(m_vid.getContentLength()).toString()}
      };
      .
      .
      .
    }

    return isFormatSupported;
  }
.
.
.
  boolean notExist() throws SQLException, IOException
  {
    if (m_vid == null)
      return true;
    else
    {
      if (m_vid.isLocal() && (m_vid.getDataInByteArray() == null))
        return true;
      else if (!m_vid.isLocal() && (":///".equals(m_vid.getSource())))
        return true;
      else
      {
        if (!m_vid.isLocal())
        {
          BFILE bfile = m_vid.getBFILE();
          if (!bfile.fileExists())
            return true;
          else
            return false;
        }
        else
          return false;
      }
    }
  }
.
.
.
  byte[] getDataInByteArray(OrdVideo vid) throws SQLException, IOException
  {
    if (!m_hasMedia)
      return null;
    else
    {
      if (!vid.isLocal())
      {
        byte[] ctx[] = new byte[1][4000];
        try
        {
          vid.importData(ctx);
        }
        catch (SQLException e)
        {
          new IMMessage(IMConstants.ERROR, "MEDIA_SOURCE_ERR", e);
          return null;
        }
      }
      return vid.getDataInByteArray();
    }
  }
.
.
.
  void refreshPanel(boolean isFormatSupported) throws SQLException, IOException
  {
    m_hasMedia = true;

    if (isFormatSupported)
    {
      if (m_jAttrTbl == null)
      {
        m_jAttrPane.remove(m_jEmpty);
        insertProperty();
      }
      else
      {
        m_jAttrTbl.setValueAt(m_vid.getMimeType(), 0, 1);
        m_jAttrTbl.setValueAt(new Integer(m_vid.getHeight()).toString(), 1, 1);
        m_jAttrTbl.setValueAt(new Integer(m_vid.getWidth()).toString(), 2, 1);
        m_jAttrTbl.setValueAt(new Integer(m_vid.getVideoDuration()).toString(), 3, 1);
        m_jAttrTbl.setValueAt(new Integer(m_vid.getContentLength()).toString(), 4, 1);
      }
    }
        .
        .
        .
  }
```

4.2.6 IMAudioPanel Class

This class displays the audio panel, the product audio, and its attributes. This class is identical in structure and functions similarly to the `IMImagePanel` class. See IMImagePanel Class for descriptions of methods.

The following code example includes the display( ), insertProperty( ), notExist( ), getDataInByteArray( ), and refreshPanel( ) methods, and highlights in bold any SQL query statements and areas in the code where *inter*Media and other Oracle object types and methods are used:

```
  void display() throws IOException, SQLException
  {
    addControlPane();

    // Set the audio icon.
    m_jIcon = new JLabel(new ImageIcon(IMExampleFrame.class.getResource("OrdAudio.gif")));
    m_jIcon.setLabelFor(m_jAttrPane);

      m_jIconPane.add(m_jIcon, BorderLayout.CENTER);

    if (notExist())
    {
      // The audio does not exist.
      m_hasMedia = false;
      layoutEmpty(s_sNotExist);
    }
    else
    {
      m_hasMedia = true;

      // If the audio exists, try to show the attributes.
      insertProperty();
    }
  }
.
.
.
  boolean insertProperty() throws SQLException
  {
    boolean isFormatSupported = false;
    String sMimeType = m_aud.getMimeType();
    if (sMimeType == null)
      isFormatSupported = IMUtil.setProperties(m_aud);
    else
      isFormatSupported = true;

    if (!isFormatSupported)
    {
      layoutEmpty(s_sNotSupported);
    }
    else
    {
      Object[][] data =
      {
        {"MIME Type",  m_aud.getMimeType()},
        {"Duration", new Integer(m_aud.getAudioDuration()).toString()},
        {"Content Length", new Integer(m_aud.getContentLength()).toString()}
      };

      .
      .
      .
    }

    return isFormatSupported;
  }
.
.
.
  boolean notExist() throws SQLException, IOException
  {
    if (m_aud == null)
      return true;
    else
    {
      if (m_aud.isLocal() && (m_aud.getDataInByteArray() == null))
        return true;
      else if (!m_aud.isLocal() && (":///".equals(m_aud.getSource())))
        return true;
      else
      {
        if (!m_aud.isLocal())
        {
          BFILE bfile = m_aud.getBFILE();
          if (!bfile.fileExists())
            return true;
          else
            return false;
        }
        else
          return false;
      }
    }
  }
.
.
.
  byte[] getDataInByteArray(OrdAudio aud) throws SQLException, IOException
  {
    if (!m_hasMedia)
```

```
      return null;
    else
    {
      if (!aud.isLocal())
      {
        byte[] ctx[] = new byte[1][4000];
        try
        {
          aud.importData(ctx);
        }
        catch (SQLException e)
        {
          new IMMessage(IMConstants.ERROR, "MEDIA_SOURCE_ERR", e);
          return null;
        }
      }
      return aud.getDataInByteArray();
    }
  }
.
.
.
  void refreshPanel(boolean isFormatSupported) throws SQLException, IOException
  {
    m_hasMedia = true;
    if (isFormatSupported)
    {
      if (m_jAttrTbl == null)
      {
        m_jAttrPane.remove(m_jEmpty);
        insertProperty();
      }
      else
      {
        m_jAttrTbl.setValueAt(m_aud.getMimeType(), 0, 1);
        m_jAttrTbl.setValueAt(new Integer(m_aud.getAudioDuration()).toString(), 1, 1);
        m_jAttrTbl.setValueAt(new Integer(m_aud.getContentLength()).toString(), 2, 1);
      }
    }
    .
    .
    .
  }
```

4.2.7 IMDocPanel Class

This class displays the doc panel, the product testimonials, and its attributes. This class is identical in structure and functions similarly to the `IMImagePanel` class. See IMImagePanel Class for descriptions of methods.

The following code example includes the display( ), insertProperty( ), notExist( ), getDataInByteArray( ), and refreshPanel( ) methods, and highlights in bold any SQL query statements and areas in the code where *inter*Media and other Oracle object types and methods are used:

```
  void display() throws IOException, SQLException
  {
    addControlPane();
    // Set the icon.
    m_jIcon = new JLabel(new ImageIcon(
          IMExampleFrame.class.getResource("OrdDoc.gif")
          ));
    m_jIcon.setLabelFor(m_jAttrPane);
      m_jIconPane.add(m_jIcon, BorderLayout.CENTER);

    if (notExist())
    {
      // The doc does not exist.
      m_hasMedia = false;
      layoutEmpty(s_sNotExist);
    }
    else
    {
      // If the doc exists, show the attribute table.
      m_hasMedia = true;
      insertProperty();
    }
  }
.
.
.
  boolean insertProperty() throws SQLException
  {
    boolean isFormatSupported = false;
    String sMimeType = m_doc.getMimeType();

    if (sMimeType == null)
      isFormatSupported = IMUtil.setProperties(m_doc);
    else
      isFormatSupported = true;

    if (!isFormatSupported)
    {
      layoutEmpty(s_sNotSupported);
    }
    else
    {
      Object[][] data =
      {
        {"MIME Type",  m_doc.getMimeType()},
        {"Content Length", new Integer(m_doc.getContentLength()).toString()}
      };

     .
     .
     .
    }

    return isFormatSupported;
  }
.
.
.
  boolean notExist() throws SQLException, IOException
  {
    if (m_doc == null)
      return true;
    else
    {
      if (m_doc.isLocal() && (m_doc.getDataInByteArray() == null))
        return true;
      else if (!m_doc.isLocal() && (":///".equals(m_doc.getSource())))
        return true;
      else
      {
        if (!m_doc.isLocal())
        {
          BFILE bfile = m_doc.getBFILE();
          if (!bfile.fileExists())
            return true;
          else
            return false;
        }
        else
          return false;
      }
    }
  }
.
.
.
  byte[] getDataInByteArray(OrdDoc doc) throws SQLException, IOException
  {
    if (!m_hasMedia)
      return null;
    else
    {
      if (!doc.isLocal())
      {
        byte[] ctx[] = new byte[1][4000];
        try
        {
          doc.importData(ctx, false);
        }
        catch (SQLException e)
        {
          new IMMessage(IMConstants.ERROR, "MEDIA_SOURCE_ERR", e);
          return null;
        }
      }
      return doc.getDataInByteArray();
    }
  }
.
.
.
  void refreshPanel(boolean isFormatSupported) throws SQLException, IOException
  {
    m_hasMedia = true;
    if (isFormatSupported)
    {
      if (m_jAttrTbl == null)
      {
        m_jAttrPane.remove(m_jEmpty);
        insertProperty();
      }
      else
      {
        m_jAttrTbl.setValueAt(m_doc.getMimeType(), 0, 1);
        m_jAttrTbl.setValueAt(new Integer(m_doc.getContentLength()).toString(), 1, 1);
      }
    }
.
.
.
  }
```

4.2.8 IMLoadFile Class

This class loads a media stream from a file to a database for each of the media object types. First, it checks to see if this `PRODUCT_ID` column exists in the `PM.ONLINE_MEDIA` table and if not, it inserts a new row into the table. Then, it creates and initializes a new media object for each media object type, updates the media data, that is, loads it into the database if it is not already stored there, and finally, sets the media attributes for each media data object.

In this class, the IMFileLoad( ) method calls the initFileChooser( ) method, then the initFileChooser( ) method calls the loadNewMedia( ) method, which does the row insertion and initializing of the media object type columns, and then calls the updateMedia( ) method to update the media and to set the media attributes.

The following code example includes the loadNewMedia( ) and UpdateMedia( ) methods, and highlights in bold any SQL query statements and areas in the code where *inter*Media and other Oracle object types and methods are used as previously described:

```
  private void loadNewMedia()
    throws SQLException, FileNotFoundException, SecurityException, IOException
  {
    boolean isInsertNeeded = false;
    String sQuery = null;
    OracleConnection conn = null;
    OracleResultSet rs = null;
    OraclePreparedStatement pstmt = null;

    try
    {
      conn = IMExample.getDBConnection();

      if (m_obj == null)
      {
        // First, check whether or not this product exists in the
        // pm.online_media table. If it exists, isInsertNeeded is set to false;
        // or else, isInsertNeeded is set to true.
        sQuery = new String(
            "select product_id from pm.online_media where product_id = ?");
        pstmt = (OraclePreparedStatement) conn.prepareStatement(sQuery);
        pstmt.setInt(1, m_iProdId);
        rs = (OracleResultSet)pstmt.executeQuery();
        if (rs.next() == false)
          isInsertNeeded = true;
        else
          isInsertNeeded = false;
        rs.close();
        pstmt.close();

        if (isInsertNeeded)
        {
          // If this product is not in the pm.online_media table,
          // insert a row in pm.online_media for this product,
          // and initialize the media object at the same time.
          sQuery = new String(
              "insert into pm.online_media (product_id, product_photo, " +
              "product_photo_signature, product_thumbnail, product_video, " +
              "product_audio, product_text, product_testimonials) values (" +
              "?, ORDSYS.ORDImage.init(), ORDSYS.ORDImageSignature.init(), " +
              "ORDSYS.ORDImage.init(),  ORDSYS.ORDVideo.init(), " +
              "ORDSYS.ORDAudio.init(), null, ORDSYS.ORDDoc.init())");

          pstmt = (OraclePreparedStatement) conn.prepareCall(sQuery);
          pstmt.setInt(1, m_iProdId);
          pstmt.execute();
          pstmt.close();
        }
      }

    if (!isInsertNeeded)
    {
      // Create a new media object.
      switch (m_iTypeIdentifier)
      {
        case IMG_TYPE:
          sQuery = new String(
              "update pm.online_media set " + m_sColName +
              " = ORDSYS.ORDImage.init() where product_id = ?");
          break;
        case AUD_TYPE:
          sQuery = new String(
              "update pm.online_media set " + m_sColName +
              " = ORDSYS.ORDAudio.init() where product_id = ?");
          break;
        case VID_TYPE:
          sQuery = new String(
              "update pm.online_media set " + m_sColName +
              " = ORDSYS.ORDVideo.init() where product_id = ?");
          break;
        case DOC_TYPE:
          sQuery = new String(
              "update pm.online_media set " + m_sColName +
              " = ORDSYS.ORDDoc.init() where product_id = ?");
          break;
        default:
          new IMMessage(IMConstants.ERROR, "UNKNOWN_TYPE");
          break;
      }

      pstmt = (OraclePreparedStatement) conn.prepareCall(sQuery);
      pstmt.setInt(1, m_iProdId);
      pstmt.execute();
      pstmt.close();
    }

      // At this point, there is a row in the online_media table
      // for this product and the desired media object is initialized.
      // In the following, we update the media object pointer and
      // acquire the right to modify it by selecting again from the
      // database.
      //
      sQuery = new String(
          "select " + m_sColName +
          " from pm.online_media where product_id = ? for update");
      pstmt = (OraclePreparedStatement) conn.prepareStatement(sQuery);
      pstmt.setInt(1, m_iProdId);
      rs = (OracleResultSet)pstmt.executeQuery();
      if (rs.next() == false)
        throw new SQLException();
      else
      {
        switch (m_iTypeIdentifier)
        {
          case IMG_TYPE:
            m_img = (OrdImage)rs.getORAData(1, OrdImage.getORADataFactory());
            break;
          case AUD_TYPE:
            m_aud = (OrdAudio)rs.getORAData(1, OrdAudio.getORADataFactory());
            break;
          case VID_TYPE:
            m_vid = (OrdVideo)rs.getORAData(1, OrdVideo.getORADataFactory());
            break;
          case DOC_TYPE:
            m_doc = (OrdDoc)rs.getORAData(1, OrdDoc.getORADataFactory());
            break;
          default:
            new IMMessage(IMConstants.ERROR, "UNKNOWN_TYPE");
            break;
        }

        // Update the media object.
        updateMedia();
      }

      rs.close();
      pstmt.close();
    }
    finally
    {
      IMUtil.cleanup(rs, pstmt);
    }
  }

  /**
   * Update the media and also set the media properties.
   */
  private void updateMedia()
    throws SQLException, FileNotFoundException, SecurityException, IOException
  {
    String sQuery = null;
    OracleConnection conn = null;
    byte[] ctx[] = new byte[1][64];
    OraclePreparedStatement pstmt = null;

    boolean isFormatSupported = false;

    try
    {
      conn = IMExample.getDBConnection();
      sQuery = new String(
          "update pm.online_media set " + m_sColName +
          " = ? where product_id = ?");
      pstmt = (OraclePreparedStatement) conn.prepareCall(sQuery);
      pstmt.setInt(2, m_iProdId);

      switch (m_iTypeIdentifier)
      {
        case IMG_TYPE:
          m_img.loadDataFromFile(m_jFileChooser.getText());
          isFormatSupported = IMUtil.setProperties(m_img);
          m_img.setLocal();
          pstmt.setORAData(1, m_img);
          break;
        case AUD_TYPE:
          m_aud.loadDataFromFile(m_jFileChooser.getText());
          isFormatSupported = IMUtil.setProperties(m_aud);
          m_aud.setLocal();
          pstmt.setORAData(1, m_aud);

          // We need to update the media pointer for display,
          // because the input media pointer may be null.
          ((IMAudioPanel)m_parent).setMedia(m_aud);
          ((IMAudioPanel)m_parent).refreshPanel(isFormatSupported);
          break;
        case VID_TYPE:
          m_vid.loadDataFromFile(m_jFileChooser.getText());
          isFormatSupported = IMUtil.setProperties(m_vid);
          m_vid.setLocal();
          pstmt.setORAData(1, m_vid);

          ((IMVideoPanel)m_parent).setMedia(m_vid);
          ((IMVideoPanel)m_parent).refreshPanel(isFormatSupported);
          break;
        case DOC_TYPE:
          m_doc.loadDataFromFile(m_jFileChooser.getText());
          isFormatSupported = IMUtil.setProperties(m_doc);
          m_doc.setLocal();
          pstmt.setORAData(1, m_doc);

          ((IMDocPanel)m_parent).setMedia(m_doc);
          ((IMDocPanel)m_parent).refreshPanel(isFormatSupported);
          break;
        default:
          new IMMessage(IMConstants.ERROR, "UNKNOWN_TYPE");
          break;
      }

      pstmt.execute();
      pstmt.close();

      // Update the thumbnail image.
      if (m_iTypeIdentifier == IMG_TYPE)
      {
        if (isFormatSupported)
          m_imgThumb = IMUtil.generateThumbnail(m_iProdId, m_img, m_imgThumb);

        ((IMImagePanel)m_parent).setMedia(m_img, m_imgThumb);
        ((IMImagePanel)m_parent).refreshPanel(isFormatSupported);
      }
    }
```

```
    finally
    {
      IMUtil.cleanup(pstmt);
    }
  }
```

4.2.9 IMUtil Class

This class contains common utilities, such as a generateThumbnail( ) static method, wrapper methods for the setProperties( ) methods for each media object type to separate the exceptions caused by unrecognizable formats, and finally, a number of cleanup methods.

The following code example includes the generateThumbnail( ) method, and highlights in bold any SQL query statements and areas in the code where *inter*Media and other Oracle object types and methods are used:

```
static OrdImage generateThumbnail(int iProdId, OrdImage img, OrdImage imgThumb)
  throws SQLException
  {
    String sQuery = null;
    OracleConnection conn = null;
    OracleResultSet rs = null;
    OraclePreparedStatement pstmt = null;

    try
    {
      conn = IMExample.getDBConnection();

      if (imgThumb == null)
      {
        // The thumbnail media pointer is not initialized.
        // Initialize it first.
        sQuery = new String(
            "update pm.online_media set product_thumbnail = " +
            "ORDSYS.ORDImage.init() where product_id = ?");
        pstmt = (OraclePreparedStatement) conn.prepareCall(sQuery);
        pstmt.setInt(1, iProdId);
        pstmt.execute();
        pstmt.close();

        // Acquire the new pointer and the permission to update.
        sQuery = new String("select product_thumbnail from pm.online_media " +
            "where product_id = ? for update");
        pstmt = (OraclePreparedStatement) conn.prepareStatement(sQuery);
        pstmt.setInt(1, iProdId);
        rs = (OracleResultSet)pstmt.executeQuery();
        if (rs.next() == false)
          throw new SQLException();
        else
          imgThumb = (OrdImage)rs.getORAData(1, OrdImage.getORADataFactory());

        rs.close();
        pstmt.close();
      }

      // Generate the thumbnail image.
      img.processCopy("maxScale=64 64, fileFormat=GIFF", imgThumb);
      // Update the thumbnail image in the database.
      sQuery = new String(
          "update pm.online_media set product_thumbnail = ? where product_id = ?");
      pstmt = (OraclePreparedStatement) conn.prepareCall(sQuery);
      pstmt.setORAData(1, imgThumb);
      pstmt.setInt(2, iProdId);
      pstmt.execute();
      pstmt.close();

      return imgThumb;
    }
    finally
    {
      IMUtil.cleanup(rs, pstmt);
    }
  }
```

5 Working with Metadata in Images

Image files can contain information about the content of the images, the image rasters, and image metadata. In general, data about data is referred to as **metadata**. In this case, metadata refers to additional information about the actual images, which is stored in the image files along with the images.

5.1 Metadata Concepts

Several types of metadata can be stored in an image file, and each type can serve a different purpose. One type, **technical metadata**, is used to describe an image in a technical sense. For example, technical metadata can include attributes about an image, such as its height and width, in pixels, or the type of compression used to store it. Another type, **content metadata**, can further describe the content of an image, the name of the photographer, and the date and time when a photograph was taken.

Metadata is stored in image files using a variety of mechanisms. Digital cameras and scanners automatically insert metadata into the images they create. Digital photograph processing applications like Adobe Photoshop allow users to add or edit metadata to be stored with the image. Annotating digital images with additional metadata is a common practice in photographic and news gathering applications and for image archiving usages, as well as at the consumer level.

Storing metadata together with image data in the same containing file provides encapsulation. With encapsulation, both types of data can be shared and exchanged reliably as one unit. Metadata that is stored in the image file format is referred to as **embedded metadata**.

5.2 Oracle *inter*Media Image Metadata Concepts

For a large number of image file formats, Oracle *inter*Media ("*inter*Media") can extract and manage a limited set of metadata attributes. These attributes include: height, width, contentLength, fileFormat, contentFormat, compressionFormat, and mimeType. For a limited number of image file formats, *inter*Media can extract a rich set of metadata attributes. This metadata is represented in schema-based XML documents. These XML documents can be stored in a database, indexed, searched, updated, and made available to applications using the standard mechanisms of Oracle Database.

*inter*Media can also write or embed metadata supplied by users into a limited number of image file formats. The application provides the metadata as a schema-based XML document. *inter*Media processes the XML document and writes the metadata into the image file.

5.3 Image File Formats

*inter*Media supports metadata extraction and metadata embedding for the GIF, TIFF, and JPEG file formats. See *Oracle interMedia Reference* for information about the image file formats supported by *inter*Media.

5.4 Image Metadata Formats

The term **image metadata format** refers to the standard protocols and techniques used to store image metadata within an image file. The following subsections describe the embedded image metadata formats supported by *inter*Media:

- EXIF
- IPTC-IIM
- XMP

5.4.1 EXIF

The Exchangeable Image File Format (EXIF) is the standard for image file storage for digital still cameras. It was developed by the Japan Electronic Industry Development Association (JEIDA) as a standard way of storing images created by digital cameras as well as metadata about the images. EXIF image metadata can be stored in TIFF and JPEG format images. *inter*Media supports the extraction of EXIF metadata from TIFF and JPEG file formats.

5.4.2 IPTC–IIM

The International Press Telecommunications Council-Information Interchange Model (IPTC-IIM) Version 4 is a standard developed jointly by the International Press Telecommunications Council and the Newspaper Association of America. This metadata standard is designed to capture information that is important to the activities of news gathering, reporting, and publishing. These information records are commonly referred to as IPTC tags.

The use of embedded IPTC tags in image file formats became widespread with the use of the Adobe Photoshop tool for image editing. IPTC metadata can be stored in TIFF and JPEG format images. *inter*Media supports the extraction of IPTC metadata from TIFF and JPEG file formats.

5.4.3 XMP

The Extensible Metadata Platform (XMP) is a standard metadata format, developed by Adobe, for the creation, processing, and interchange of metadata in a variety of applications. XMP uses Resource Description Framework (RDF) technology for data modeling. XMP also defines how the data model is serialized (converted to a byte stream), and embedded within an image file. *inter*Media supports the extraction of XMP metadata from GIF, TIFF, and JPEG file formats. *inter*Media also supports writing XMP data packets into GIF, TIFF, and JPEG file formats.

For more information about XMP, see the Adobe Systems Incorporated Web site at

`http://www.adobe.com/`

For more information about RDF, see the Resource Description Framework Web page on the World Wide Web Consortium Web site at

`http://www.w3.org/RDF/`

5.5 Representing Metadata Outside Images

Once metadata has been extracted from the binary image file, the next step is to represent the metadata in a form that can be easily stored, indexed, queried, updated, and presented. *inter*Media returns image metadata in XML documents. These documents are based on XML schemas that *inter*Media registers with the database. Each type of image metadata has a separate XML schema. These XML schemas are used by the metadata methods of the ORDImage object type. See *Oracle interMedia Reference* for complete definitions of the XML schemas supported by *inter*Media.

The XML documents can be stored in XMLType columns within the database. These documents are easily searched and processed using the wide range of standards-based XML technologies provided by Oracle XML DB. (See *Oracle XML DB Developer's Guide* for more information.)

5.6 Oracle *inter*Media Image Metadata Examples

The following examples of metadata extraction and embedding make use of the `photos` table. The `photos` table is defined by the Photo Album sample application. The implementation of the Photo Album sample application is defined in the PL/SQL package named `PHOTO_ALBUM`. See Chapter 3 for a complete description of the *inter*Media PL/SQL Web Toolkit Photo Album sample application.

The `photos` table stores two instances of an image: the full-size photograph and a thumbnail image. This table can also store up to four different image metadata documents. These documents are stored in the columns named `metaORDImage`, `metaEXIF`, `metaIPTC`, and `metaXMP`, and represent image metadata from the ORDImage, EXIF, IPTC, and XMP metadata formats, respectively. The metadata columns are of type `XMLType`, and they are bound to the corresponding metadata XML schemas that *inter*Media provides.

5.6.1 Creating a Table for Metadata Storage

Before you can extract or embed metadata, you must create the table and columns where the metadata will be stored. The following PL/SQL code segment creates the `photos` table with four XMLTYPE columns (`metaORDImage`, `metaEXIF`, `metaIPTC`, and `metaXMP`) to store each type of image metadata, and two ORDIMAGE columns (`image` and `thumb`) for the original image and the thumbnail image, respectively. Each metadata column is bound to its corresponding metadata schema. For example, the `metaEXIF` column is bound to the XML schema stored at `http://xmlns.oracle.com/ord/meta/exif`, and is defined as the XML element `exifMetadata`.

For ease of reference, the code statements where the image metadata columns are defined and bound to XML schemas are highlighted in bold.

```
--
-- Create the PHOTOS table
--
CREATE TABLE photos( id           NUMBER PRIMARY KEY,
                     description  VARCHAR2(40) NOT NULL,
                     metaORDImage XMLTYPE,
                     metaEXIF     XMLTYPE,
                     metaIPTC     XMLTYPE,
                     metaXMP      XMLTYPE,
                     image        ORDSYS.ORDIMAGE,
                     thumb        ORDSYS.ORDIMAGE )
LOB(image.source.localdata)  -- storage images with 32K chunk
```

```
  STORE AS (chunk 32k)
LOB(thumb.source.localdata)  -- but the thumbnails with only 16k
  STORE AS (chunk 16k)
-- and bind the XMLType columns to the interMedia metadata schemas
XMLType COLUMN metaORDImage
  XMLSCHEMA "http://xmlns.oracle.com/ord/meta/ordimage"
  ELEMENT "ordImageAttributes"
XMLType COLUMN metaEXIF
  XMLSCHEMA "http://xmlns.oracle.com/ord/meta/exif"
  ELEMENT "exifMetadata"
XMLType COLUMN metaIPTC
  XMLSCHEMA "http://xmlns.oracle.com/ord/meta/iptc"
  ELEMENT "iptcMetadata"
XMLType COLUMN metaXMP
  XMLSCHEMA "http://xmlns.oracle.com/ord/meta/xmp"
  ELEMENT "xmpMetadata";
```

5.6.2 Extracting Image Metadata

The following PL/SQL procedure extracts metadata from an image and stores it in the specified columns in the `photos` table you created. This procedure demonstrates the getMetadata( ) method, which returns an array of XML documents. The root element of each document is examined to determine the metadata type. The UPDATE statement stores the documents in the corresponding columns in the `photos` table.

For ease of reference, the code statement where the getMetadata( ) method is called is highlighted in bold.

```
--
-- fetch the metadata and sort the results
--
PROCEDURE extractMetadata(inID IN INTEGER)
IS
  img ORDSYS.ORDIMAGE;
  metav XMLSequenceType;
  meta_root VARCHAR2(40);
  xmlORD XMLType;
  xmlXMP XMLType;
  xmlEXIF XMLType;
  xmlIPTC XMLType;

BEGIN

-- select the image
SELECT image
INTO img
FROM PHOTOS
WHERE id = inID;

-- extract all the metadata
metav := image.getMetadata( 'ALL' );

-- process the result array to discover what types of metadata were
returned
FOR i IN 1..metav.count() LOOP
  meta_root := metav(i).getRootElement();
  CASE meta_root
    WHEN 'ordImageAttributes' THEN xmlORD := metav(i);
    WHEN 'xmpMetadata' THEN xmlXMP := metav(i);
    WHEN 'iptcMetadata' THEN xmlIPTC := metav(i);
    WHEN 'exifMetadata' THEN xmlEXIF := metav(i);
    ELSE NULL;
  END CASE;
END LOOP;

-- Update metadata columns
--
UPDATE photos
SET metaORDImage = xmlORD,
    metaEXIF = xmlEXIF,
    metaIPTC = xmlIPTC,
    metaXMP = xmlXMP
WHERE id = inID;

END extractMetadata;
```

5.6.3 Embedding Image Metadata

The following PL/SQL procedure demonstrates the putMetadata( ) method. This procedure accepts six arguments. The `entry_id` argument identifies the image in the `photos` table to be updated. The remaining arguments (`title`, `creator`, `date`, `description`, and `copyright`) are strings that will be formatted into an XMP packet and embedded within the target image.

This example creates an XML document instance based on the *inter*Media XML schema for XMP metadata. (This schema is preregistered with Oracle XML DB. See *Oracle XML DB Developer's Guide* for more information.) The schema for XMP metadata defines a single, global element `<xmpMetadata>`. The <xmpMetadata> element contains a single, well-formed RDF document. The RDF document contains a single `<RDF>` element, which is derived from the `rdf` namespace. This RDF document is constructed using elements defined by the Dublin Core Schema.

The call to the putMetadata( ) method embeds the metadata document into the image file. The UPDATE statement stores the new image and the new metadata back in the `photos` table.

For ease of reference, the code statement where the putMetadata( ) method is called is highlighted in bold.

```
--
-- write the metadata to the image
--
PROCEDURE write_metadata( entry_id IN VARCHAR2,
                          title IN VARCHAR2,
                          creator IN VARCHAR2,
                          date IN VARCHAR2,
                          description IN VARCHAR2,
                          copyright IN VARCHAR2 )
IS
  img ORDSYS.ORDImage;
  xmp XMLType;
  buf VARCHAR2(5000);
BEGIN
-- select the image
SELECT image
INTO img
FROM PHOTOS
WHERE id = entry_id FOR UPDATE;

-- Create the XMP packet it must be schema valid
-- to "http://xmlns.oracle.com/ord/meta/xmp"
-- and contain an <RDF> element. This example uses
-- the Dublin Core schema.

/* An example XML instance document

<xmpMetadata xmlns="http://xmlns.oracle.com/ord/meta/xmp"
              xsi:schemaLocation="http://xmlns.oracle.com/ord/meta/xmp
              http://xmlns.oracle.com/ord/meta/xmp"
              xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">

  <rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#">
    <rdf:Description about="" xmlns:dc="http://purl.org/dc/elements/1.1/">
      <dc:title>A Winter Day<dc:title>
      <dc:creator>Frosty S. Man</dc:creator>
      <dc:date>21-Dec-2004</dc:date>
      <dc:description>a sleigh ride</dc:description>
      <dc:copyright>North Pole Inc.</dc:copyright>
    </rdf:Description>
  </rdf:RDF>
</xmpMetadata>

*/

buf := '<xmpMetadata xmlns="http://xmlns.oracle.com/ord/meta/xmp"
         xsi:schemaLocation="http://xmlns.oracle.com/ord/meta/xmp
         http://xmlns.oracle.com/ord/meta/xmp"
         xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" >
  <rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#">
  <rdf:Description about="" xmlns:dc="http://purl.org/dc/elements/1.1/">';

IF title IS NOT NULL THEN
  buf := buf || '<dc:title>' || htf.escape_sc(title) || '</dc:title>';
END IF;

IF creator IS NOT NULL THEN
  buf := buf || '<dc:creator>' || htf.escape_sc(creator)
             || '</dc:creator>';
END IF;
IF date IS NOT NULL THEN
  buf := buf || '<dc:date>' || htf.escape_sc(date)
             || '</dc:date>';
END IF;
IF description IS NOT NULL THEN
  buf := buf || '<dc:description>' || htf.escape_sc(description)
             || '</dc:description>';
END IF;
IF copyright IS NOT NULL THEN
  buf := buf || '<dc:copyright>' || htf.escape_sc(copyright)
             || '</dc:copyright>';
END IF;

buf := buf || '
  </rdf:Description>
  </rdf:RDF>
  </xmpMetadata>';

-- create the XML document
xmp := XMLType.createXML(buf, 'http://xmlns.oracle.com/ord/meta/xmp');
```

```
-- write the metadata
img.putMetadata( xmp, 'XMP' );

-- update the image
UPDATE photos
SET image = img,
    metaXMP = xmp
WHERE id = entry_id;

END write_Metadata;
```

5.7 Metadata References

The following Web sites provide information about standards and technologies related to working with metadata in images.

- Dublin Core, a standard schema for Dublin core elements

  http://purl.org/dc/elements/1.1/

- Extensible Metadata Platform

  http://www.adobe.com/

- Resource Description Framework (See *RDF Primer)*

  http://www.w3.org/RDF/

5.8 Extracting and Mapping DICOM Metadata Attributes in Images

The Digital Imaging and Communications in Medicine (DICOM) feature allows *inter*Media to recognize standalone DICOM objects and extract the set of attributes related to patient, study, series, and equipment. Recognizing a DICOM object means that *inter*Media can determine whether given binary data represents a standalone DICOM object. If it does, *inter*Media can extract DICOM metadata from that DICOM object. The data can be stored as the content of an ORDImage object, or directly in a BLOB or a BFILE.

DICOM objects are objects that can store different types of data. Examples include patient administration information, waveforms, images, slices of 3-D volumes, video segments, and time-variant 3-D volumes. A standalone DICOM object must have a file header that conforms to the DICOM standard.

The DICOM standard was initiated by the American College of Radiology (ACR) to enhance the connectivity of radiological devices. Before DICOM become a widely adopted standard, each manufacturer had its own proprietary image format and communication protocol, making it almost impossible to produce third-party software to manage or study medical data. Nor was it possible to connect devices from different manufacturers. In 1985, the American College of Radiology and the National Electrical Manufacturers Association (NEMA) jointly published a medical imaging and communication standard, named the ACR-NEMA standard, to address this problem. In 1993 the standard was revised and renamed as DICOM (Version 3.0). Since then, the DICOM standard has become the dominant standard for radiology imaging and communication. All major manufacturers conform to this standard. Today, any software component can take DICOM data from any manufacturer and manage the data with a uniform interface.

See *Oracle interMedia Reference* for details about the DICOM methods, encoding rules, image format, and exceptions supported by *inter*Media.

5.9 DICOM Image File Format

*inter*Media supports metadata extraction for the DICM image file format. DICM is the *inter*Media designation for the Digital Imaging and Communications in Medicine format. See *Oracle interMedia Reference* for more information about the image file formats supported by *inter*Media.

5.10 Oracle *inter*Media DICOM Image Metadata Example

The following example of DICOM metadata extraction makes use of the `medicalImages` table, which is defined in the sample PL/SQL code segments described in the following subsections.

The `medicalImages` table stores two instances of an image: the full-size photograph and a thumbnail image. This table can also store one image metadata document. This document is stored in the column named `metadata`, and represents DICOM image metadata from the DICM metadata format. The metadata column is of type `XMLType`, and it is bound to the corresponding metadata XML schema that *inter*Media provides.

5.10.1 Creating a Table for DICOM Metadata Storage

Before you can extract DICOM metadata, you must create the table and column where the metadata will be stored. The following PL/SQL code segment creates the `medicalImages` table with one XMLTYPE column (`metadata`) to store the DICOM image metadata, and two ORDIMAGE columns (`image` and `thumb`) for the original image and the thumbnail image, respectively. The metadata column is bound to the XML schema stored at `http://xmlns.oracle.com/ord/meta/dicomImage`, and is defined as the XML element `DICOM_IMAGE`.

For ease of reference, the code statements where the image metadata column is defined and bound to the XML schema are highlighted in bold.

```
create table medicalImages(id number primary key,
                           description VARCHAR2(40),
                           metadata XMLType,
                           image ORDSYS.ORDIMAGE,
                           thumb ORDSYS.ORDIMAGE)
LOB (image.source.localdata) -- store images with 32K chunk
  STORE AS (chunk 32K)
LOB (thumb.source.localdata) -- but the thumbnails with only 16K
  STORE AS (chunk 16K)
-- and bind the XMLType columns to the interMedia metadata columns
XMLType column metadata
  XMLSCHEMA "http://xmlns.oracle.com/ord/meta/dicomImage"
  ELEMENT "DICOM_IMAGE";
```

5.10.2 Extracting DICOM Image Metadata

The following PL/SQL procedure extracts DICOM metadata from an image and stores it in the specified column in the `medicalImages` table you created. This procedure demonstrates the getDicomMetadata( ) method, which returns an XML document. The UPDATE statement stores the document in the corresponding column in the `medicalImages` table.

For ease of reference, the code statement where the getDicomMetadata( ) method is called is highlighted in bold.

```
--
PROCEDURE extractDicomMetadata(inID INTEGER)
```

```
IS
   local_image ORDSYS.ORDIMAGE;
   local_id INTEGER;
   dicom_metadata XMLType := NULL;
BEGIN
   SELECT image INTO local_image FROM medicalImages WHERE id = inID;
   -- extract DICOM metadata
   dicom_metadata := local_image.getDicomMetadata('imageGeneral');
   IF (dicom_metadata IS NULL) THEN
      DBMS_OUTPUT.PUT_LINE('metadata is NULL');
   ELSE
      UPDATE medicalImages SET metadata = dicom_metadata where id = inID;
   END IF;
   -- let us print the namespace of the XML document containing the
   -- dicom metadata that we just extracted
   DBMS_OUTPUT.PUT_LINE('namespace: ' || dicom_metadata.getNamespace());

END extractDicomMetadata;
--
```

5.11 DICOM References

The following Web sites provide information about medical imaging standards and issues related to DICOM.

- Digital Imaging and Communications in Medicine

  http://medical.nema.org/

- NEMA standard: Digital Imaging and Communications in Medicine (DICOM) PS3-1 to PS3-16. NEMA, 2003

  http://medical.nema.org/dicom/2003.html

- Integrating the Healthcare Enterprise

  http://www.rsna.org/IHE/index.shtml

6 Content-Based Retrieval Concepts

This chapter explains, at a high level, why and how to use content-based retrieval. It covers the following topics:

- Overview and benefits of content-based retrieval (see Section 6.1)
- How content-based retrieval works, including definitions and explanations of the visual attributes (color, texture, shape, location) and why you might emphasize specific attributes in certain situations (see Section 6.2)
- Image matching using a specified comparison image, including comparing how the weights of visual attributes determine the degree of similarity between images (see Section 6.3)
- Use of indexing to improve search and retrieval performance (see Section 6.4)
- Image preparation or selection to maximize the usefulness of comparisons (see Section 6.5)

6.1 Overview and Benefits of Content-Based Retrieval

Inexpensive image-capture and storage technologies have allowed massive collections of digital images to be created. However, as an image database grows, the difficulty of finding relevant images increases. Two general approaches to this problem have been developed. Both use metadata for image retrieval.

- Using information manually entered or included in the table design, such as titles, descriptive keywords from a limited vocabulary, and predetermined classification schemes
- Using automated image feature extraction and object recognition to classify image content -- that is, using capabilities unique to content-based retrieval

With Oracle *inter*Media ("*inter*Media"), you can combine both approaches in designing a table to accommodate images: use traditional text columns to describe the semantic significance of the image (for example, that the pictured automobile won a particular award, or that its engine has six or eight cylinders), and use the ORDImageSignature type to permit content-based queries based on intrinsic attributes of the image (for example, how closely its color and shape match a picture of a specific automobile).

As an alternative to defining image-related attributes in columns separate from the image, a database designer could create a specialized composite data type that combines an ORDImage object and the appropriate text, numeric, and date attributes.

The primary benefit of using content-based retrieval is reduced time and effort required to obtain image-based information. With frequent adding and updating of images in massive databases, it is often not practical to require manual entry of all attributes that might be needed for queries, and content-based retrieval provides increased flexibility and practical value. It is also useful in providing the ability to query on attributes such as texture or shape that are difficult to represent using keywords.

Examples of database applications where content-based retrieval is useful -- where the query is semantically of the form, "find objects that look like this one" -- include:

- Trademarks, copyrights, and logos
- Art galleries and museums
- Retailing
- Fashion and fabric design
- Interior design or decorating

For example, a Web-based interface to a retail clothing catalog might allow users to search by traditional categories (such as style or price range) and also by image properties (such as color or texture). Thus, a user might ask for formal shirts in a particular price range that are off-white with pin stripes. Similarly, fashion designers could use a database with images of fabric swatches, designs, concept sketches, and finished garments to facilitate their creative processes.

6.2 How Content-Based Retrieval Works

A content-based retrieval system processes the information contained in image data and creates an abstraction of its content in terms of visual attributes. Any query operations deal solely with this abstraction rather than with the image itself. Thus, every image inserted into the database is analyzed, and a compact representation of its content is stored in a feature vector, or **signature**.

The signature for the image in Figure 6–1 is extracted by segmenting the image into regions based on color as shown in Figure 6–2. Each region has associated with it color, texture, and shape information. The signature contains this region-based information along with global color, texture, and shape information to represent these attributes for the entire image. In Figure 6–2, there are a total of 55 shapes (patches of connected pixels with similar color) in this segmented image. In addition, there is also a "background" shape, which consists of small disjoint dark patches. These tiny patches (usually having distinct colors) do not belong to any of their adjacent shapes and are all classified into a single "background" shape. This background shape is also taken into consideration for image retrieval.

Figure 6–1 Unsegmented Image

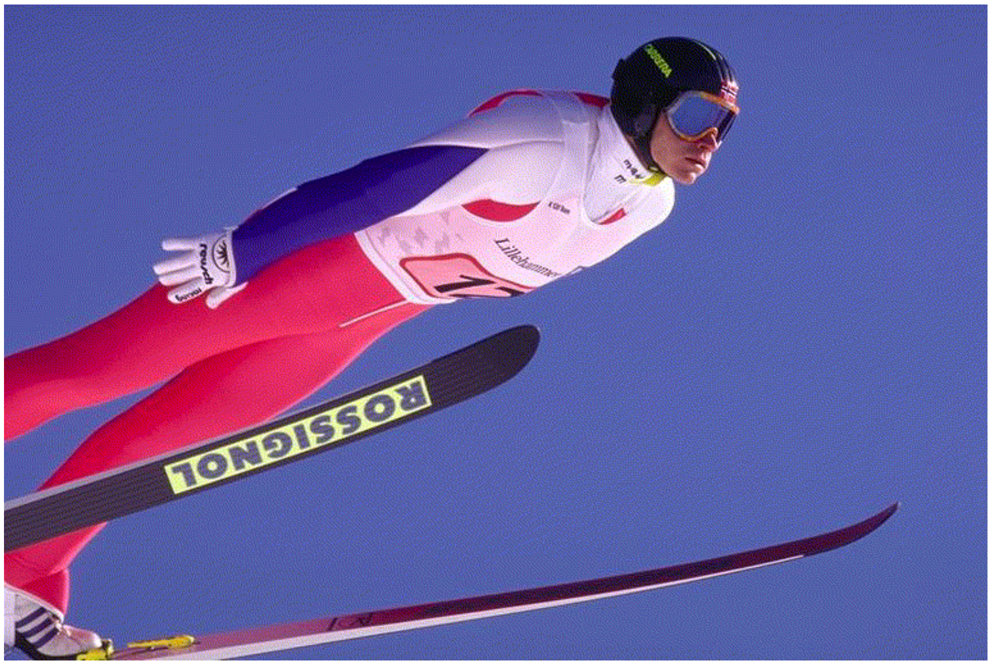
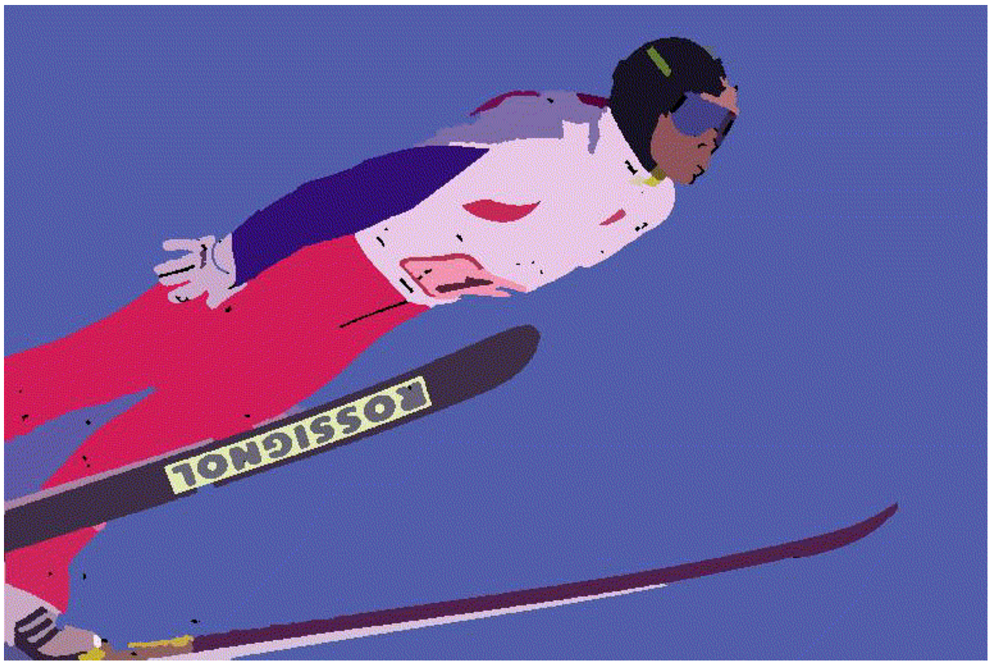


Figure 6–2 Segmented Image



Images are matched based on the color, texture, and shape attributes. The positions of these visual attributes in the image are represented by location. Location by itself is not a meaningful search parameter, but in conjunction with one of the three visual attributes represents a search where the visual attribute and the location of that visual attribute are both important.

The signature contains information about the following visual attributes:

- **Color** represents the distribution of colors within the entire image. This distribution includes the amounts of each color.
- **Texture** represents the low-level patterns and textures within the image, such as graininess or smoothness. Unlike shape, texture is very sensitive to features that appear with great frequency in the image.
- **Shape** represents the shapes that appear in the image, as determined by color-based segmentation techniques. A shape is characterized by a region of uniform color.
- **Location** represents the positions of the shape components, color, and texture components. For example, the color blue could be located in the top half of the image. A certain texture could be located in the bottom right corner of the image.

Feature data for all these visual attributes is stored in the signature, whose size typically ranges from 3000 to 4000 bytes. For better performance with large image databases, you can create an index based on the signatures of your images. See Section 6.4 for more information about indexing.

Images in the database can be retrieved by matching them with a comparison image. The comparison image can be any image inside or outside the current database, a sketch, an algorithmically generated image, and so forth.

The matching process requires that signatures be generated for the comparison image and each image to be compared with it. Images are seldom identical, and therefore matching is based on a similarity-measuring function for the visual attributes and a set of weights for each attribute. The **score** is the relative distance between two images being compared. The score for each attribute is used to determine the degree of similarity when images are compared, with a smaller distance reflecting a closer match, as explained in Section 6.3.3.

6.2.1 Color

Color reflects the distribution of colors within the entire image.

Color and location specified together reflect the color distributions *and* where they occur in the image. To illustrate the relationship between color and location, consider Figure 6–3.

Figure 6–3 Image Comparison: Color and Location

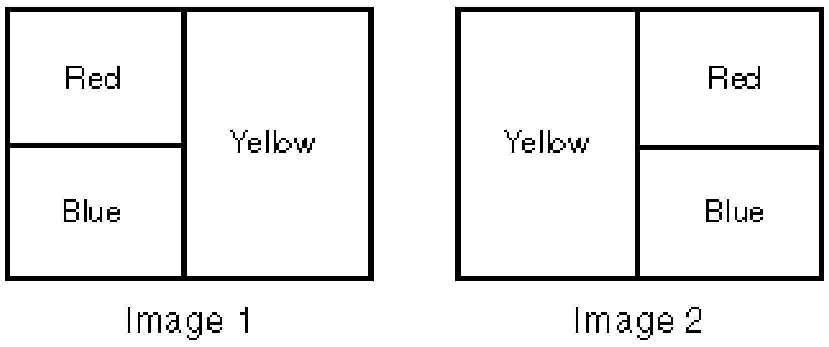


Image 1 on the left and Image 2 on the right are the same size and are filled with solid colors. In Image 1, the top left quarter (25%) is red, the bottom left quarter (25%) is blue, and the right half (50%) is yellow. In Image 2, the top right quarter (25%) is red, the bottom right quarter (25%) is blue, and the left half (50%) is yellow.

If the two images are compared first solely on color and then color and location, the following are the similarity results:

- Color: complete similarity (score = 0.0), because each color (red, blue, yellow) occupies the same percentage of the total image in each one
- Color and location: no similarity (score = 100), because there is no overlap in the placement of any of the colors between the two images

Thus, if you need to select images based on the dominant color or colors (for example, to find apartments with blue interiors), give greater relative weight to color. If you need to find images with common colors in common locations (for example, red dominant in the upper portion to find sunsets), give greater relative weight to location and color together.

Figure 6–4 shows two images very close in color. Figure 6–5 shows two images very close in both color and location.

Figure 6–4 Images Very Similar in Color

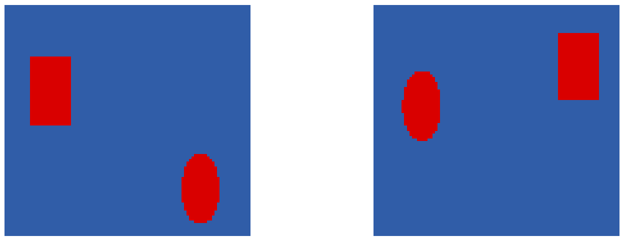
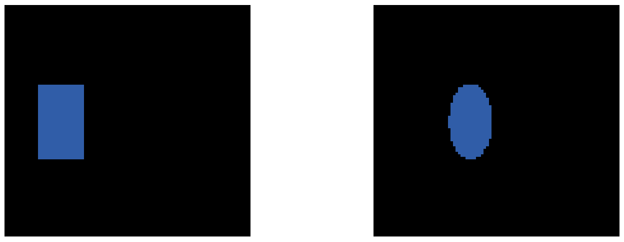


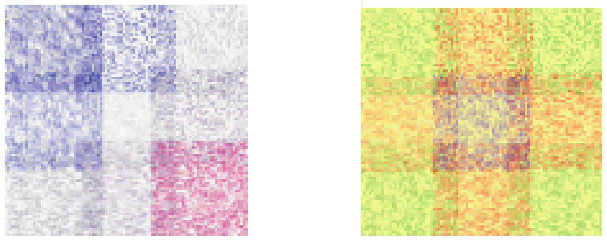
Figure 6–5 Images Very Similar in Color and Location



6.2.2 Texture

Texture reflects the texture of the entire image. Texture is most useful for full images of textures, such as catalogs of wood grains, marble, sand, or stones. These images are generally hard to categorize using keywords alone because our vocabulary for textures is limited. Texture can be used effectively alone (without color) for pure textures, but also with a little bit of color for some kinds of textures, like wood or fabrics. Figure 6–6 shows two similar fabric samples.

Figure 6–6 Fabric Images with Similar Texture



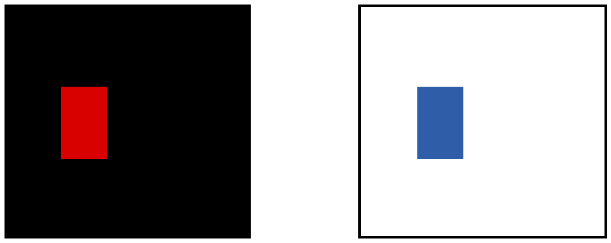
Texture and location specified together compare texture and location of the textured regions in the image.

6.2.3 Shape

Shape represents the shapes that appear in the image. Shapes are determined by identifying regions of uniform color.

Shape is useful to capture objects such as horizon lines in landscapes, rectangular shapes in buildings, and organic shapes such as trees. Shape is very useful for querying on simple shapes (like circles, polygons, or diagonal lines) especially when the query image is drawn by hand. Figure 6–7 shows two images very close in shape.

Figure 6–7   Images with Very Similar Shape



Shape and location specified together compare shapes and location of the shapes in the images.

6.3 How Matching Works

When you match images, you assign an importance measure, or weight, to each of the visual attributes, and *inter*Media calculates a similarity measure for each visual attribute.

6.3.1 Weight

Each **weight** value reflects how sensitive the matching process for a given attribute should be to the degree of similarity or dissimilarity between two images. For example, if you want color to be completely ignored in matching, assign a weight of 0.0 to color; in this case, any similarity or difference between the color of the two images is totally irrelevant in matching. On the other hand, if color is extremely important, assign it a weight greater than any of the other attributes; this will cause any similarity or dissimilarity between the two images with respect to color to contribute greatly to whether or not the two images match.

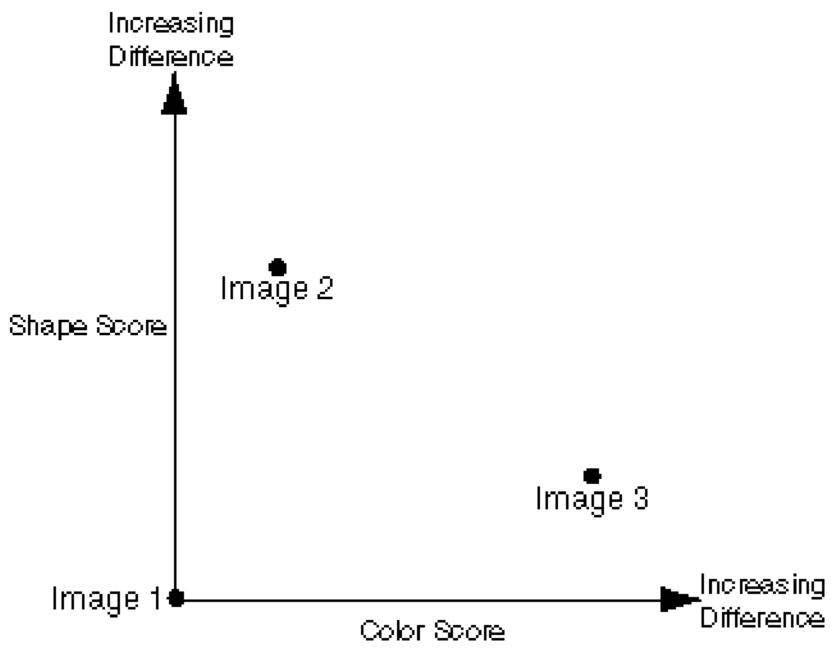
Weight values can be between 0.0 and 1.0. During processing, the values are normalized such that they total 1.0. The weight of at least one of the color, texture, or shape attributes must be set to greater than zero. See Section 6.3.3 for details of the calculation.

6.3.2 Score

The similarity measure for each visual attribute is calculated as the **score** or **distance** between the two images with respect to that attribute. The score can range from 0.00 (no difference) to 100.0 (maximum possible difference). Thus, the more similar two images are with respect to a visual attribute, the *smaller* the score will be for that attribute.

As an example of how distance is determined, assume that the dots in Figure 6–8 represent scores for three images with respect to two visual attributes, such as color and shape, plotted along the x-axis and y-axis of a graph.

Figure 6–8 Score and Distance Relationship



For matching, assume Image 1 is the comparison image, and Image 2 and Image 3 are each being compared with Image 1. With respect to the color attribute plotted on the x-axis, the distance between Image 1 and Image 2 is relatively small (for example, 15), whereas the distance between Image 1 and Image 3 is much greater (for example, 75). If the color attribute is given more weight, then the fact that the two distance values differ by a great deal will probably be very important in determining whether or not Image 2 and Image 3 match Image 1. However, if color is minimized and the shape attribute is emphasized instead, then Image 3 will match Image 1 better than Image 2 matches Image 1.

6.3.3 Similarity Calculation

In Section 6.3.2, Figure 6–8 showed a graph of only two of the attributes that *inter*Media can consider. In reality, when images are matched, the degree of similarity depends on a weighted sum reflecting the weight and distance of all three of the visual attributes in conjunction with location of the comparison image and the test image.

For example, assume that for the comparison image (Image 1) and one of the images being tested for matching (Image 2), Table 6–1 lists the relative distances between the two images for each attribute. Note that you would never see these individual numbers unless you computed three separate scores, each time highlighting one attribute and setting the others to zero. For simplicity, the three attributes are not considered in conjunction with location in this example.

Table 6–1 Distances for Visual Attributes Between Image1 and Image2

Visual Attribute	Distance
Color	15

Table 6–1 (Cont.) Distances for Visual Attributes Between Image1 and Image2

Visual Attribute	Distance
Texture	5
Shape	50

In this example, the two images are most similar with respect to texture (distance = 5) and most different with respect to shape (distance = 50), as shown in Table 6–1.

Assume that for the matching process, the following weights have been assigned to each visual attribute:

- Color = 0.7
- Texture = 0.2
- Shape = 0.1

The weights are supplied in the range of 0.0 to 1.0. Within this range, a weight of 1 indicates the strongest emphasis, and a weight of 0 means the attribute should be ignored. The values you supply are automatically normalized such that the weights total 1.0, still maintaining the ratios you have supplied. In this example, the weights were specified such that normalization was not necessary.

The following formula is used to calculate the weighted sum of the distances, which is used to determine the degree of similarity between two images:

```
weighted_sum = color_weight    * color_distance +
               texture_weight  * texture_distance +
               shape_weight    * shape_distance+
```

The degree of similarity between two images in this case is computed as:

0.7*c_distance + 0.2*tex_distance + 0.1*shape_distance

Using the supplied values, this becomes:

(0.7*15 + 0.2*5 + 0.1*50) = (10.5 + 1.0 + 5.0) = 16.5

To illustrate the effect of different weights in this case, assume that the weights for color and shape were reversed. In this case, the degree of similarity between two images is computed as:

0.1*c_distance +0.2*tex_distance + 0.7*shape_distance

That is:

(0.1*15 + 0.2*5 + 0.7*50) = (1.5 + 1.0 + 35.0) = 37.5

In this second case, the images are considered to be less similar than in the first case, because the overall score (37.5) is greater than in the first case (16.5). Whether or not the two images are considered matching depends on the threshold value (explained in Section 6.3.4). If the weighted sum is less than or equal to the threshold, the images match; if the weighted sum is greater than the threshold, the images do not match.

In these two cases, the *correct* weight assignments depend on what you are looking for in the images. If color is extremely important, then the first set of weights is a better choice than the second set of weights, because the first set of weights grants greater significance to the disparity between these two specific images with respect to color. The two images differ greatly in shape (50) but that difference contributes less to the final score because the weight assigned to the attribute shape is low. With the second set of weights, the images have a higher score when shape is assigned a higher weight and the images are less similar with respect to shape than with respect to color.

6.3.4 Threshold Value

When you match images, you assign a **threshold** value. If the weighted sum of the distances for the visual attributes is less than or equal to the threshold, the images match; if the weighted sum is greater than the threshold, the images do not match.

Using the examples in Section 6.3.3, if you assign a threshold of 20, the images do not match when the weighted sum is 37.5, but they do match when the weighted sum is 16.5. If the threshold is 10, the images do not match in either case; and if the threshold is 37.5 or greater, the images match in both cases.

The following example shows a cursor (getphotos) that selects the `product_id` and `product_photo` columns from the `online_media` table where the threshold value is 20 for comparing photographs with a comparison image:

```
CURSOR getphotos IS
 SELECT product_id, product_photo FROM online_media WHERE
   ORDSYS.IMGSimilar(photo_sig, comparison_sig, 'color="0.4",
   texture="0.10", shape="0.3", location="0.2"', 20)=1;
```

Before the cursor executes, the generateSignature( ) method must be called to compute the signature of the comparison image (comparison_sig), and to compute signatures for each image in the table. See *Oracle interMedia Reference* for a description of all the operators, including IMGSimilar and IMGScore.

The number of matches returned generally increases as the threshold increases. Setting the threshold to 100 would return all images as matches. Such a result, of course, defeats the purpose of content-based retrieval. If your images are all very similar, you may find that even a threshold of 50 returns too many (or all) images as matches. Through trial and error, adjust the threshold to an appropriate value for your application.

You will probably want to experiment with different weights for the visual attributes and different threshold values, to see which combinations retrieve the kinds and approximate number of matches you want.

6.4 Using an Index to Compare Signatures

A domain index, or extensible index, is an approach for supporting complex data objects. Oracle Database and *inter*Media cooperate to define, build, and maintain an index for image data. This index is of type ORDImageIndex. Once it is created, the index automatically updates itself every time an image is inserted, updated, or removed from the database table. The index is created, managed, and accessed by the index type routines.

For better performance with large image databases, you should always create and use an index for searching through the image signatures. The default search model compares the signature of the query image to the signatures of all images stored in the database. This works well for simple queries against a few images such as, "Does this picture of an automobile match the image stored with the client's insurance records?" However, if you want to compare that image with thousands or millions of images to determine if the images match, then a linear search through the database would be impractical. In this case, an index based on the image signatures would greatly improve performance.

Assume you are using the `online_media` table from the `Product Media` schema.

Process each image using the generateSignature( ) method to generate the signatures.

```
DECLARE
```

```
 t_image   ORDSYS.ORDImage;
 image_sig ORDSYS.ORDImageSignature;
BEGIN
 SELECT p.product_photo, p.product_photo_signature INTO t_image, image_sig
  FROM pm.online_media p
  WHERE p.product_id = 1910 FOR UPDATE;
 -- Generate a signature:
 image_sig.generateSignature(t_image);
 UPDATE pm.online_media p SET p.product_photo_signature = image_sig
 WHERE    product_id = 1910;
 COMMIT;
END;
/
```

Note: Performance is greatly improved by loading the data tables prior to creating the index.

Once the signatures are created, the following command creates an index on this table, based on the data in the `product_photo_signature` column:

```
CREATE INDEX idx1 ON online_media(product_photo_signature) INDEXTYPE IS ORDSYS.ORDIMAGEINDEX
    PARAMETERS ('ORDImage_Filter_Tablespace = <name>,ORDImage_Index_Tablespace = <name>');
```

The index name is limited to 24 or fewer characters. As with any Oracle table, do not use pound signs (#) or dollar signs ($) in the name. Also as usual, the tablespaces must be created before creating the index.

Note: The standard Oracle restriction is 30 characters for table or index names. However, *inter*Media requires an extra 6 characters for internal processing of the domain index.

The index data resides in two tablespaces, which must be created first. The first contains the actual index data, and the second is an internal index created on that data.

The following recommendations are good starting points for further index tuning:

- ORDIMAGE_FILTER_TABLESPACE -- Each signature requires approximately 350 bytes in this tablespace. The tablespace should be at least 350 times the number of signatures in the table.
- ORDIMAGE_INDEX_TABLESPACE -- The size of the tablespace should be 100 times the size of the initial and final extents specified. For example, if an extent is 10 KB, the tablespace size should be 1 MB. The initial and final extents should be equal to each other. The size of the tablespace should also be approximately equal to the size of ORDIMAGE_FILTER_TABLESPACE.
- Typically, it will be much faster if you create the index after the images are loaded into the database and signatures have been generated for them.
- When importing a large number of images, you should postpone index creation until after the import operation completes. Do this by specifying the following parameters to the IMPORT statement: INDEXES=N and INDEXNAME=<filename>. See *Oracle Database Utilities* for details.
- Rollback segments of an appropriate size are required. The size depends on the size of your transactions, such as, how many signatures are indexed at one time.

- Analyze the new index.

As with other Oracle indexes, you should analyze the new index as follows:

```
ANALYZE INDEX idx1 COMPUTE STATISTICS;
```

Two operators, IMGSimilar and IMGScore, support queries using the index. The operators automatically use the index if it is present. See *Oracle interMedia Reference* for syntax information and examples.

Queries for indexed and nonindexed comparisons are identical. The Oracle optimizer uses the domain index if it determines that the first argument passed to the IMGSimilar operator is a domain-indexed column. Otherwise, the optimizer invokes a functional implementation of the operator that compares the query signature with the stored signatures, one row at a time.

See *Oracle interMedia Reference* for examples of retrieving similar images. As in the example, be sure to specify the query signature as the second parameter.

6.5 Preparing or Selecting Images for Useful Matching

The human mind is infinitely smarter than a computer in matching images. If we are near a street and want to identify all red automobiles, we can easily do so because our minds rapidly adjust for the following factors:

- Whether the automobile is stopped or moving
- The distinction among red automobiles, red motorcycles, and red trailers
- The absolute size of the automobile, as well as its relative size in our field of vision (because of its distance from us)
- The location of the automobile in our field of vision (center, left, right, top, bottom)
- The direction in which the automobile is pointing or traveling (left or right, toward us, or away from us)

However, for a computer to find red automobiles (retrieving all red automobiles and no or very few images that are not red or not automobiles), it is helpful if all the automobile images have the automobile occupy almost the entire image, have no extraneous elements (people, plants, decorations, and so on), and have the automobiles pointing in the same direction. In this case, a match emphasizing color and shape would produce useful results. However, if the pictures show automobiles in different locations, with different relative sizes in the image, pointing in different directions, and with different backgrounds, it will be difficult to perform content-based retrieval with these images.

The following are some suggestions for selecting images or preparing images for comparison. The list is not exhaustive, but the basic principle to keep in mind is this: Know what you are looking for, and use common sense. If possible, crop and edit images in accordance with the following suggestions before performing content-based retrieval:

- Have what you expect to be looking for occupy almost all the image space, or at least occupy the same size and position on each image. For example, if you want to find all the red automobiles, each automobile image should show only the automobile and should have the automobile in approximately the same position within the overall image.
- Minimize any extraneous elements that might prevent desired matches or cause unwanted matches. For example, if you want to match red automobiles and if each

automobile has a person standing in front of it, the color, shape, and position of the person (skin and clothing) will cause color and shape similarities to be detected, and might reduce the importance of color and shape similarities between automobiles (because part of the automobile is behind the person and thus not visible). If you know that your images vary in this way, experiment with different thresholds and different weights for the various visual attributes until you find a combination that provides the best result set for your needs.

- During signature generation, images are temporarily scaled to a common size such that the resulting signatures are based on a common frame of reference. If you crop a section of an image, and then compare that piece back to the original, *inter*Media will likely find that the images are less similar than you would expect.

> **Note:** *inter*Media has a fuzzy search engine, and is not designed to recognize objects. For example, *inter*Media cannot find a specific automobile in a parking lot. However, if you crop an individual automobile from a picture of a parking lot, you can then compare the automobile to known automobile images.

- When there are several objects in the image, *inter*Media matches them best when:
  - The colors in the image are distinct from each other. For example, an image of green and red as opposed to an image of dark green and light green.
  - The color in adjacent objects in the image contrast with each other.
  - The image consists of a few, simple shapes.

6.5.1 Image Matching Example 1

The photographs in Figure 6–9 illustrate roads. The human mind would focus on the similarities in these images and consider them a match. Specifically, the human mind recognizes that the object in both images is a road. Because the road is roughly in the center of both images, it is the focal point in both photographs. *inter*Media, however, focuses on the entire image in each photograph without recognizing the objects in these images. Thus, *inter*Media concludes that these images do not match in color, texture, or shape.

Figure 6–9 Images of Roads with Different Backgrounds

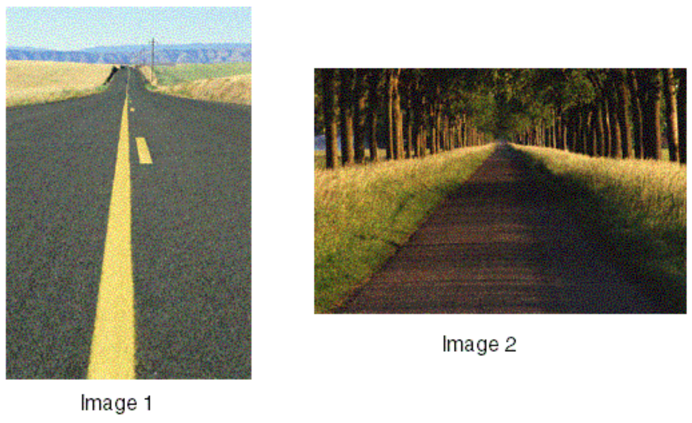


Image 1 appears far away; the road is long and narrow with a barren-looking countryside in the background and an open view of the sky. Image 2 appears closer; the road is short and wide with hedges and a thick forest in the background with the sky barely visible between the trees on the left.

*inter*Media image matching involves making comparisons based on the visual attributes of color, texture, and shape. Because image matching is based on these attributes rather than on object recognition, *inter*Media cannot recognize the fact that both of these images contain a road. Thus, *inter*Media image matching does not work well for these two images.

First, the color of the roads in these images is different. In Image 1, the road is gray because the open sky illuminates the road in full daylight. In Image 2, however, the road is brown because the sky is obscured by the thick forest, allowing very little daylight to shine on the road. The remaining colors in these images are also different. For example, *inter*Media identifies the following colors in Image 1: a large percentage of gray (the road), some blue (the sky), and some golden brown (the barren sides of the road). The colors in Image 2, however, include grayish brown (the road), some green (the grass on the side of the road and the leaves of the trees), and brown (the tree trunks). Clearly, the colors in these two images do not match.

Second, the shape of the roads in these images is different. In Image 1, the road occupies a large area, and is square (or rectangular) in shape. The road in Image 2 occupies a small area, and is triangular in shape. Thus two of the criteria used for shape matching, the area and the geometric shape, do not match.

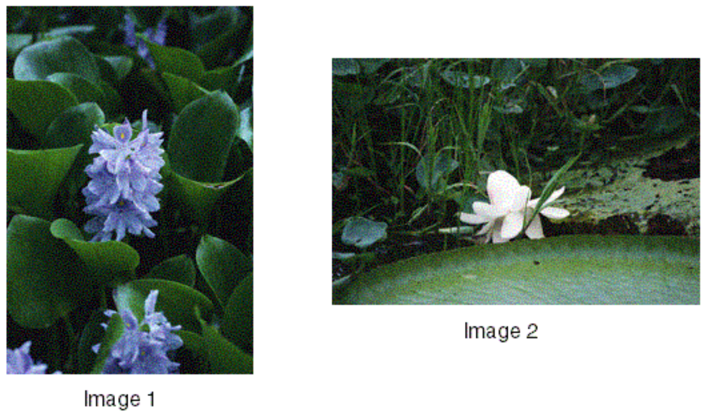
Finally, the texture of the roads in these images is similar, which results in a slightly better match. However, other objects contained in these images, such as the sky and the leaves, have a different texture. Thus, these images do not match in texture.

In summary, the comparisons based on the visual attributes of color, texture, shape are insufficient to match these two images.

6.5.2 Image Matching Example 2

The photographs in Figure 6–10 illustrate two kinds of flowers. These images are a better match than the images in Section 6.5.1.

Figure 6–10 Images of Flowers with Different Colors and Backgrounds



In both Image 1 and Image 2, the flowers are approximately in the center of the image, surrounded by a leafy green background. In Image 2, the foreground also includes part of a bird bath or a small fountain.

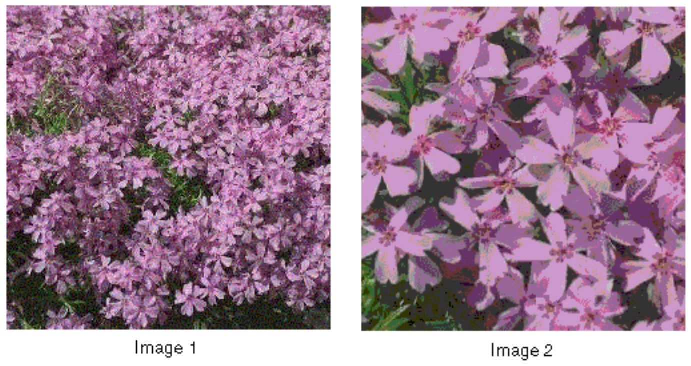
*inter*Media recognizes that the following visual attributes are similar in Image 1 and Image 2: the color of the background leaves and the texture of the flowers and the leaves. *inter*Media also recognizes that the colors of the flowers are different. Thus, the match based on color is good, but not perfect. This match is performed without identifying that the objects in the green background are leaves and the objects in the colored segments are flowers.

*inter*Media segments the images to identify the areas of different colors. Both images contain a large green area, because in both images the background is predominantly green. The smaller areas in Image 1 and Image 2 are identified as purple and white, respectively. Thus, these images match well in color because the predominant area of green color matches in both images. The images do not match perfectly however, because the smaller areas represented by the flowers are different. In addition, the texture of the leaves and the flowers is similar in both images, resulting in good matches based on texture.

6.5.3 Image Matching Example 3

The photographs in Figure 6–11 illustrate flowers of the same type and color, but of different sizes. These images are a better match than either the images in Section 6.5.1 or those in Section 6.5.2.

Figure 6–11 Images of Flowers of the Same Type and Color



Flowers of the same color and type comprise the contents of both Image 1 and Image 2. In Image 1, the flowers are smaller and more tightly spaced, with few details visible. In Image 2, however, the flowers are larger and more loosely spaced, with clearer details.

Because these flowers are the same color and occupy almost all the area in both images, *inter*Media segments the images by color and identifies the predominant areas of violet in both images. It does not matter that the flowers in Image 1 and Image 2 are not the same size; *inter*Media identifies the flowers in both images as areas of violet. Thus, the images match well based on color. Additionally, *inter*Media recognizes that the texture of the flowers is a match. *inter*Media performs this match without recognizing that the objects in both images are flowers. Based on color and texture, these images match well.

7

Extending Oracle *inter*Media

Oracle *inter*Media ("*inter*Media") can be extended to support:

- Other external sources of media data not currently supported (see Section 7.1)
- Other media data formats not currently supported (see Section 7.2)
- A new object type (see Section 7.3)
- Media (audio and video) data processing (see Section 7.4)

For each unique external media data source or each unique ORDAudio, ORDDoc, or ORDVideo data format that you want to support, you must:

1. Design your new data source or new ORDAudio, ORDDoc, or ORDVideo data format.
2. Implement your new data source or new ORDAudio, ORDDoc, or ORDVideo data format.
3. Install your new plug-in in the `ORDPLUGINS` schema.
4. Grant EXECUTE privileges on your new plug-in to `PUBLIC`.

7.1 Supporting Other External Sources

To implement your new data source, you must implement the required interfaces in the `ORDX_<srcType>_SOURCE` package in the `ORDPLUGINS` schema (where `<srcType>` represents the name of the new external source type). Use the package body example in Section 7.1.1.3 as a template to create the package body. Then, set the source type parameter in the setSourceInformation( ) call to the appropriate source value to indicate to the ORDAudio, ORDImage, ORDDoc, or ORDVideo object that package `ORDPLUGINS.ORDX_<srcType>_SOURCE` is available as a plug-in. Use the `ORDPLUGINS.ORDX_FILE_SOURCE` and `ORDPLUGINS.ORDX_HTTP_SOURCE` packages as guides when you extend support to other external audio, image, video, or other heterogeneous media data sources.

See Section 7.1.1.1, Section 7.1.1.2, and Section 7.1.1.3 for examples and for more information about extending the supported external sources of audio, image, video, or other heterogeneous media data.

7.1.1 Packages or PL/SQL Plug-ins

This section presents reference information on the packages or PL/SQL plug-ins provided.

Plug-ins must be named as ORDX_<name>_<module_name> where the <module_name> is SOURCE for ORDSource. For example, the FILE plug-in described in

Section 7.1.1.1, is named ORDX_FILE_SOURCE and the HTTP plug-in described in Section 7.1.1.2, is named ORDX_HTTP_SOURCE and <name> is the source type. Both source type names, FILE and HTTP, are reserved to Oracle.

Use the `ORDPLUGINS.ORDX_FILE_SOURCE` and `ORDPLUGINS.ORDX_HTTP_SOURCE` packages as a guide in developing your new source type package.

7.1.1.1 ORDPLUGINS.ORDX_FILE_SOURCE Package

The `ORDPLUGINS.ORDX_FILE_SOURCE` package or PL/SQL plug-in provides support for multimedia stored in the local file system external to the database.

```
CREATE OR REPLACE PACKAGE ORDX_FILE_SOURCE AS
  -- functions/procedures
  FUNCTION processCommand(obj     IN OUT NOCOPY ORDSYS.ORDSource,
                          ctx     IN OUT RAW,
                          cmd     IN VARCHAR2,
                          arglist IN VARCHAR2,
                          result  OUT RAW)
           RETURN RAW;
  PROCEDURE import(obj      IN OUT NOCOPY ORDSYS.ORDSource,
                   ctx      IN OUT RAW,
                   mimetype OUT VARCHAR2,
                   format   OUT VARCHAR2);
  PROCEDURE import(obj      IN OUT NOCOPY ORDSYS.ORDSource,
                   ctx      IN OUT RAW,
                   dlob     IN OUT NOCOPY BLOB,
                   mimetype OUT VARCHAR2,
                   format   OUT VARCHAR2);
  PROCEDURE importFrom(obj      IN OUT NOCOPY ORDSYS.ORDSource,
                       ctx      IN OUT RAW,
                       mimetype OUT VARCHAR2,
                       format   OUT VARCHAR2,
                       loc      IN VARCHAR2,
                       name     IN VARCHAR2);
  PROCEDURE importFrom(obj      IN OUT NOCOPY ORDSYS.ORDSource,
                       ctx      IN OUT RAW,
                       dlob     IN OUT NOCOPY BLOB,
                       mimetype OUT VARCHAR2,
                       format   OUT VARCHAR2,
                       loc      IN VARCHAR2,
                       name     IN VARCHAR2);
  PROCEDURE export(obj  IN OUT NOCOPY ORDSYS.ORDSource,
                   ctx  IN OUT RAW,
                   slob IN OUT NOCOPY BLOB,
                   loc  IN VARCHAR2,
                   name IN VARCHAR2);
  FUNCTION  getContentLength(obj  IN ORDSYS.ORDSource,
                             ctx  IN OUT RAW),
            RETURN INTEGER;
  PRAGMA RESTRICT_REFERENCES(getContentLength, WNDS, WNPS, RNDS, RNPS);
  FUNCTION  getSourceAddress(obj  IN ORDSYS.ORDSource,
                             ctx  IN OUT RAW,
                             userData IN VARCHAR2)
            RETURN VARCHAR2;
  PRAGMA RESTRICT_REFERENCES(getSourceAddress, WNDS, WNPS, RNDS, RNPS);

  FUNCTION open(obj IN OUT NOCOPY ORDSYS.ORDSource,
           userArg IN RAW,
           ctx OUT RAW) RETURN INTEGER;
  FUNCTION close(obj IN OUT NOCOPY ORDSYS.ORDSource, ctx IN OUT RAW)
```

```
         RETURN INTEGER;
  FUNCTION trim(obj IN OUT NOCOPY ORDSYS.ORDSource,
                ctx IN OUT RAW,
                newlen IN INTEGER) RETURN INTEGER;
PROCEDURE read(obj      IN OUT NOCOPY ORDSYS.ORDSource,
               ctx      IN OUT RAW,
               startPos IN INTEGER,
               numBytes IN OUT INTEGER,
               buffer   OUT RAW);
PROCEDURE write(obj      IN OUT NOCOPY ORDSYS.ORDSource,
                ctx      IN OUT RAW,
                startPos IN INTEGER,
                numBytes IN OUT INTEGER,
                buffer   OUT RAW);
END ORDX_FILE_SOURCE;
/
```

Table 7–1 shows the methods supported in the ORDX_FILE_SOURCE package and the exceptions raised if you call a method that is not supported.

Table 7–1 Methods Supported in the ORDPLUGINS.ORDX_FILE_SOURCE Package

Name of Method	Level of Support
processCommand	Not supported - raises exception: METHOD_NOT_SUPPORTED
import	Supported
import	Supported
importFrom	Supported
importFrom	Supported
export	Supported
getContentLength	Supported
getSourceAddress	Supported
open	Supported
close	Supported
trim	Not supported - raises exception: METHOD_NOT_SUPPORTED
read	Supported
write	Not supported - raises exception: METHOD_NOT_SUPPORTED

7.1.1.2 ORDPLUGINS.ORDX_HTTP_SOURCE Package

The ORDPLUGINS.ORDX_HTTP_SOURCE package or PL/SQL plug-in provides support for multimedia stored in any HTTP server and accessed through a URL.

```
CREATE OR REPLACE PACKAGE ORDX_HTTP_SOURCE AS
  -- functions/procedures
  FUNCTION processCommand(obj     IN OUT NOCOPY ORDSYS.ORDSource,
                          ctx     IN OUT RAW,
                          cmd     IN VARCHAR2,
                          arglist IN VARCHAR2,
                          result  OUT RAW)
           RETURN RAW;
  PROCEDURE import(obj      IN OUT NOCOPY ORDSYS.ORDSource,
                   ctx      IN OUT RAW,
                   mimetype OUT VARCHAR2,
                   format   OUT VARCHAR2);
  PROCEDURE import(obj      IN OUT NOCOPY ORDSYS.ORDSource,
                   ctx      IN OUT RAW,
                   dlob     IN OUT NOCOPY BLOB,
                   mimetype OUT VARCHAR2,
                   format   OUT VARCHAR2);
  PROCEDURE importFrom(obj      IN OUT NOCOPY ORDSYS.ORDSource,
                       ctx      IN OUT RAW,
                       mimetype OUT VARCHAR2,
                       format   OUT VARCHAR2,
                       loc      IN VARCHAR2,
                       name     IN VARCHAR2);
  PROCEDURE importFrom(obj      IN OUT NOCOPY ORDSYS.ORDSource,
                       ctx      IN OUT RAW,
                       dlob     IN OUT NOCOPY BLOB,
                       mimetype OUT VARCHAR2,
                       format   OUT VARCHAR2,
                       loc      IN VARCHAR2,
                       name     IN VARCHAR2);
  PROCEDURE export(obj  IN OUT NOCOPY ORDSYS.ORDSource,
                   ctx  IN OUT RAW,
                   dlob IN OUT NOCOPY BLOB,
                   loc  IN VARCHAR2,
                   name IN VARCHAR2);
  FUNCTION  getContentLength(obj  IN ORDSYS.ORDSource,
                             ctx  IN OUT RAW)
            RETURN INTEGER;
  PRAGMA RESTRICT_REFERENCES(getContentLength, WNDS, WNPS, RNDS, RNPS, TRUST);
  FUNCTION  getSourceAddress(obj  IN ORDSYS.ORDSource,
                             ctx  IN OUT RAW,
                             userData IN VARCHAR2)
            RETURN VARCHAR2;
  PRAGMA RESTRICT_REFERENCES(getSourceAddress, WNDS, WNPS, RNDS, RNPS);
  FUNCTION open(obj IN OUT NOCOPY ORDSYS.ORDSource, userArg IN RAW,
           ctx OUT RAW) RETURN INTEGER;
  FUNCTION close(obj IN OUT NOCOPY ORDSYS.ORDSource, ctx IN OUT RAW)
           RETURN INTEGER;
  FUNCTION trim(obj IN OUT NOCOPY ORDSYS.ORDSource,
           ctx IN OUT RAW,
           newlen IN INTEGER) RETURN INTEGER;
  PROCEDURE read(obj      IN OUT NOCOPY ORDSYS.ORDSource,
                 ctx      IN OUT RAW,
                 startPos IN INTEGER,
                 numBytes IN OUT INTEGER,
                 buffer   OUT RAW);
  PROCEDURE write(obj      IN OUT NOCOPY ORDSYS.ORDSource,
                  ctx      IN OUT RAW,
                  startPos IN INTEGER,
                  numBytes IN OUT INTEGER,
                  buffer   OUT RAW);
END ORDX_HTTP_SOURCE;
/
```

Table 7–2 shows the methods supported in the `ORDX_HTTP_SOURCE` package and the exceptions raised if you call a method that is not supported.

Table 7–2 Methods Supported in the ORDPLUGINS.ORDX_HTTP_SOURCE Package

Name of Method	Level of Support
processCommand	Not supported - raises exception: METHOD_NOT_SUPPORTED

Table 7–2 (Cont.) Methods Supported in the ORDPLUGINS.ORDX_HTTP_SOURCE

Name of Method	Level of Support
import	Supported
import	Supported
importFrom	Supported
importFrom	Supported
export	Not supported - raises exception: METHOD_NOT_SUPPORTED
getContentLength	Supported
getSourceAddress	Supported
open	Supported
close	Supported
trim	Not supported - raises exception: METHOD_NOT_SUPPORTED
read	Not supported - raises exception: METHOD_NOT_SUPPORTED
write	Not supported - raises exception: METHOD_NOT_SUPPORTED

7.1.1.3 Extending *inter*Media to Support a New Data Source

Extending *inter*Media to support a new data source consists of the following steps:

1. Design your new data source.
2. Implement your new data source and name it, for example, `ORDX_MY_SOURCE.SQL`.
3. Install your new `ORDX_MY_SOURCE.SQL` plug-in in the `ORDPLUGINS` schema.
4. Grant EXECUTE privileges on your new plug-in, for example, `ORDX_MY_SOURCE.SQL` plug-in to PUBLIC.
5. Set the srctype to `my` to cause your plug-in to be invoked.

A package body listing is provided in Example 7–1 to assist you in this operation. Add your variables to the places that say "--Your variables go here" and add your code to the places that say "--Your code goes here".

Example 7–1 Show the Package Body for Extending Support to a New Data Source

```
CREATE OR REPLACE PACKAGE BODY ORDX_MY_SOURCE
AS
  -- functions/procedures
  FUNCTION processCommand(
                  obj  IN OUT NOCOPY ORDSYS.ORDSource,
                  ctx  IN OUT RAW,
                  cmd  IN VARCHAR2,
                  arglist IN VARCHAR2,
                  result OUT RAW)
  RETURN RAW
  IS
   --Your variables go here.
  BEGIN
  --Your code goes here.
  END processCommand;
  PROCEDURE import( obj  IN OUT NOCOPY ORDSYS.ORDSource,
                  ctx  IN OUT RAW,
                  mimetype OUT VARCHAR2,
                  format   OUT VARCHAR2)
  IS
  --Your variables go here.
  BEGIN
  --Your code goes here.
  END import;
  PROCEDURE import( obj  IN OUT NOCOPY ORDSYS.ORDSource,
                  ctx  IN OUT RAW,
                  dlob IN OUT NOCOPY BLOB,
                  mimetype OUT VARCHAR2,
                  format   OUT VARCHAR2)
  IS
  --Your variables go here.
  BEGIN
  --Your code goes here.
  END import;
  PROCEDURE importFrom( obj      IN OUT NOCOPY ORDSYS.ORDSource,
                        ctx      IN OUT RAW,
                        mimetype OUT VARCHAR2,
                        format   OUT VARCHAR2,
                        loc      IN VARCHAR2,
                        name     IN VARCHAR2)
  IS
  --Your variables go here.
  BEGIN
  --Your code goes here.
  END importFrom;
  PROCEDURE importFrom( obj      IN OUT NOCOPY ORDSYS.ORDSource,
                        ctx      IN OUT RAW,
                        dlob     IN OUT NOCOPY BLOB,
                        mimetype OUT VARCHAR2,
                        format   OUT VARCHAR2,
                        loc      IN VARCHAR2,
                        name     IN VARCHAR2)
  IS
  --Your variables go here.
  BEGIN
  --Your code goes here.
  END importFrom;
  PROCEDURE export( obj  IN OUT NOCOPY ORDSYS.ORDSource,
                  ctx  IN OUT RAW,
                  slob IN OUT NOCOPY BLOB,
                  loc  IN VARCHAR2,
                  name IN VARCHAR2)
  IS
  --Your variables go here.
  BEGIN
  --Your code goes here.
  END export;

  FUNCTION  getContentLength( obj  IN ORDSYS.ORDSource,
                              ctx  IN OUT RAW)
  RETURN INTEGER
  IS
  --Your variables go here.
  BEGIN
  --Your code goes here.
  END getContentLength;
  FUNCTION  getSourceAddress(obj  IN ORDSYS.ORDSource,
                             ctx  IN OUT RAW,
                             userData IN VARCHAR2)
  RETURN VARCHAR2
  IS
  --Your variables go here.
  BEGIN
  --Your code goes here.
  END getSourceAddress;
  FUNCTION open(obj IN OUT NOCOPY ORDSYS.ORDSource, userArg IN RAW, ctx OUT RAW)
  RETURN INTEGER
  IS
  --Your variables go here.
  BEGIN
  --Your code goes here.
  END open;
  FUNCTION close(obj IN OUT NOCOPY ORDSYS.ORDSource, ctx IN OUT RAW)
  RETURN INTEGER
  IS
  --Your variables go here.
  BEGIN
  --Your code goes here.
  END close;
  FUNCTION trim(obj    IN OUT NOCOPY ORDSYS.ORDSource,
                       ctx    IN OUT RAW,
                       newlen IN INTEGER)
  RETURN INTEGER
  IS
  --Your variables go here.
  BEGIN
  --Your code goes here.
  END trim;
  PROCEDURE read(obj      IN OUT NOCOPY ORDSYS.ORDSource,
                 ctx      IN OUT RAW,
                 startPos IN INTEGER,
                 numBytes IN OUT INTEGER,
                 buffer   OUT RAW)
  IS
  --Your variables go here.
  BEGIN
  --Your code goes here.
  END read;
  PROCEDURE write(obj      IN OUT NOCOPY ORDSYS.ORDSource,
                  ctx      IN OUT RAW,
                  startPos IN INTEGER,
                  numBytes IN OUT INTEGER,
                  buffer   OUT RAW)
  IS
  --Your variables go here.
  BEGIN
  --Your code goes here.
  END write;
END ORDX_MY_SOURCE;
/
show errors;
```

7.2 Supporting Other Media Data Formats

To implement your new ORDAudio, ORDDoc, or ORDVideo data format, you must implement the required interfaces in the `ORDPLUGINS.ORDX_<format>_<media>`

package in the ORDPLUGINS schema (where <format> represents the name of the new audio or video, or other heterogeneous media data format and <media> represents the type of media ("AUDIO" or "VIDEO", or "DOC"). Use the ORDPLUGINS.ORDX_DEFAULT_<media> package as a guide when you extend support to other audio or video data formats or other heterogeneous media data formats. Use the package body examples in Section 7.2.1.2, Section 7.2.2.2 and Section 7.2.3.2 as templates to create the audio or video, or other heterogeneous media data package body, respectively. Then, set the new format parameter in the setFormat( ) call to the appropriate format value to indicate to the ORDAudio, ORDDoc, or ORDVideo object that package ORDPLUGINS.ORDX_<format>_<media> is available as a plug-in and should be used for method invocation.

7.2.1 Supporting Other ORDAudio Data Formats

Section 7.2.1.1 and Section 7.2.1.2 describe how to extend ORDAudio to support other data formats.

7.2.1.1 ORDPLUGINS.ORDX_DEFAULT_AUDIO Package

Use the following ORDPLUGINS.ORDX_DEFAULT_AUDIO package provided as a guide in developing your own ORDPLUGINS.ORDX_<format>_AUDIO audio format package. This package sets the mimeType field in the setProperties( ) method with a MIME type value that is dependent on the file format.

```
CREATE OR REPLACE PACKAGE ORDX_DEFAULT_AUDIO
authid current_user
AS
--AUDIO ATTRIBUTES ACCESSORS

PROCEDURE setProperties(ctx IN OUT RAW,
                        obj IN OUT NOCOPY ORDSYS.ORDAudio,
                        setComments IN NUMBER := 0);
FUNCTION checkProperties(ctx IN OUT RAW, obj IN OUT ORDSYS.ORDAudio)
                RETURN NUMBER;
FUNCTION getAttribute(ctx IN OUT RAW,
                      obj IN ORDSYS.ORDAudio,
                      name IN VARCHAR2) RETURN VARCHAR2;
PROCEDURE getAllAttributes(ctx IN OUT RAW,
                           obj IN ORDSYS.ORDAudio,
                           attributes IN OUT NOCOPY CLOB);
--AUDIO PROCESSING METHODS
FUNCTION processCommand(ctx       IN OUT RAW,
                        obj       IN OUT NOCOPY ORDSYS.ORDAudio,
                        cmd       IN VARCHAR2,
                        arguments IN VARHAR2,
                        result    OUT RAW)
         RETURN RAW;

END;
/
```

Table 7–3 shows the methods supported in the ORDPLUGINS.ORDX_DEFAULT_AUDIO package and the exceptions raised if you call a method that is not supported.

Table 7–3 Methods Supported in the ORDPLUGINS.ORDX_DEFAULT_AUDIO Package

Name of Method	Level of Support
setProperties	Supported; if the source is local, extract attributes from the local data and set the properties, but if the source is `NULL`, raise an ORDSYS.ORDSourceExceptions.EMPTY_SOURCE exception; if the source is a BFILE, then extract attributes from the BFILE and set the properties; if the source is neither local nor a BFILE, get the media content into a temporary LOB, extract attributes from the data, and set the properties.
checkProperties	Supported; if the source is local, extract the attributes from the local data and compare them with the attribute values of the object, but if the source is `NULL`, raise an ORDSYS.ORDSourceExceptions.EMPTY_SOURCE exception; if the source is a BFILE, extract the attributes from the BFILE and compare them with the attribute values of the object; if the source is neither local nor a BFILE, get the media content into a temporary LOB, extract the attributes from the media content and compare them with the attribute values of the object.
getAttribute	Not supported - raises exceptions: METHOD_NOT_SUPPORTED and AUDIO_PLUGIN_EXCEPTION.
getAllAttributes	Supported; if the source is local, get the attributes and return them, but if the source is `NULL`, raise an ORDSYS.ORDSourceExceptions.EMPTY_SOURCE exception; otherwise, if the source is external, raise an ORDSYS.ORDAudioExceptions.LOCAL_DATA_SOURCE_REQUIRED exception.
processCommand	Not supported - raises exceptions: METHOD_NOT_SUPPORTED and AUDIO_PLUGIN_EXCEPTION.

7.2.1.2 Extending *inter*Media to Support a New Audio Data Format

Extending *inter*Media to support a new audio data format consists of the following steps:

1. Design your new audio data format.
   a. To support a new audio data format, implement the required interfaces in the `ORDX_<format>_AUDIO` package in the `ORDPLUGINS` schema (where `<format>` represents the name of the new audio data format). See Section 7.2.1.1 for a complete description of the interfaces for the `ORDX_DEFAULT_AUDIO` package. Use the package body example in Example 7–2 as a template to create the audio package body.
   b. Then, set the new format parameter in the setFormat( ) call to the appropriate format value to indicate to the audio object that package `ORDPLUGINS.ORDX_<format>_AUDIO` is available as a plug-in.
2. Implement your new audio data format and name it, for example, `ORDX_MY_AUDIO.SQL`.
3. Install your new `ORDX_MY_AUDIO.SQL` plug-in in the `ORDPLUGINS` schema.
4. Grant EXECUTE privileges on your new plug-in, for example, `ORDX_MY_AUDIO` plug-in, to PUBLIC.
5. In an application, set the format attribute to `my` to cause your plug-in to be invoked.

A package body listing is provided in Example 7–2 to assist you in this operation. Add your variables to the places that say "--Your variables go here" and add your code to the places that say "--Your code goes here".

Example 7–2 Show the Package Body for Extending Support to a New Audio Data Format

```
CREATE OR REPLACE PACKAGE BODY ORDX_MY_AUDIO
AS
  --AUDIO ATTRIBUTES ACCESSORS
  PROCEDURE setProperties(ctx IN OUT RAW,
                         obj IN OUT NOCOPY ORDSYS.ORDAudio,
                         setComments IN NUMBER :=0)
  IS
--Your variables go here.
  BEGIN
--Your code goes here.
  END;
  FUNCTION checkProperties(ctx IN OUT RAW, obj IN OUT ORDSYS.ORDAudio)
  RETURN NUMBER
  IS
--Your variables go here.
  BEGIN
--Your code goes here.
  END;
  FUNCTION  getAttribute(ctx IN OUT RAW,
                        obj IN ORDSYS.ORDAudio,
                        name IN VARCHAR2)
  RETURN VARCHAR2
  IS
--Your variables go here.
  BEGIN
--Your code goes here.
  END;
  PROCEDURE getAllAttributes(ctx IN OUT RAW,
                            obj IN ORDSYS.ORDAudio,
                            attributes IN OUT NOCOPY CLOB)
  IS
--Your variables go here.
  BEGIN
--Your code goes here.
  END;
  -- AUDIO PROCESSING METHODS
  FUNCTION  processCommand(
                                ctx       IN OUT RAW,
                                obj       IN OUT NOCOPY ORDSYS.ORDAudio,
                                cmd       IN VARCHAR2,
                                arguments IN VARCHAR2,
                                result    OUT RAW)
  RETURN RAW
  IS
--Your variables go here.
  BEGIN
--Your code goes here.
  END;
END;
/
show errors;
```

7.2.2 Supporting Other ORDDoc Data Formats

Section 7.2.2.1 and Section 7.2.2.2 describe how to extend ORDDoc to support other data formats.

7.2.2.1 ORDPLUGINS.ORDX_DEFAULT_DOC Package

Use the following `ORDPLUGINS.ORDX_DEFAULT_DOC` package provided as a guide in developing your own `ORDPLUGINS.ORDX_<format>_DOC` media format package.

```
CREATE OR REPLACE PACKAGE ORDX_DEFAULT_DOC
authid current_user
AS

PROCEDURE setProperties(ctx IN OUT RAW,
                        obj IN OUT NOCOPY ORDSYS.ORDDoc,
                        setComments IN NUMBER := 0);

END;
/
```

Table 7–4 shows the method supported in the `ORDPLUGINS.ORDX_DEFAULT_DOC` package and the exception raised if the source is `NULL`.

Table 7–4 Method Supported in the ORDPLUGINS.ORDX_DEFAULT_DOC Package

Name of Method	Level of Support
setProperties	Supported; if the source is local, extract attributes from the local data and set the properties, but if the source is `NULL`, raise an ORDSYS.ORDSourceExceptions.EMPTY_SOURCE exception; if the source is a BFILE, then extract attributes from the BFILE and set the properties; if the source is neither local nor a BFILE, get the media content into a temporary LOB, extract attributes from the data, and set the properties.

7.2.2.2 Extending *inter*Media to Support a New ORDDoc Data Format

Extending *inter*Media to support a new ORDDoc data format consists of the following steps:

1. Design your new media data format.
   a. To support a new media data format, implement the required interfaces in the `ORDX_<format>_DOC` package in the `ORDPLUGINS` schema (where `<format>` represents the name of the new media data format). See Section 7.2.2.1 for a complete description of the interfaces for the `ORDX_DEFAULT_DOC` package. Use the package body example in Example 7–3 as a template to create the package body.
   b. Then, set the new format parameter in the setFormat( ) call to the appropriate format value to indicate to the media object that package `ORDPLUGINS.ORDX_<format>_DOC` is available as a plug-in.
2. Implement your new media data format and name it, for example, `ORDX_MY_DOC.SQL`.
3. Install your new `ORDX_MY_DOC.SQL` plug-in in the `ORDPLUGINS` schema.
4. Grant EXECUTE privileges on your new plug-in, for example, `ORDX_MY_DOC` plug-in, to PUBLIC.
5. In an application, set the format to `my` to cause your plug-in to be invoked.

A package body listing is provided in Example 7–3 to assist you in this operation. Add your variables to the places that say "--Your variables go here" and add your code to the places that say "--Your code goes here".

Example 7–3   Show the Package Body for Extending Support to a New ORDDoc Data Format

```
CREATE OR REPLACE PACKAGE BODY ORDX_MY_DOC
AS
  --DOCUMENT ATTRIBUTES ACCESSORS
  PROCEDURE setProperties(ctx IN OUT RAW,
                        obj IN OUT NOCOPY ORDSYS.ORDDoc,
                        setComments IN NUMBER :=0)
  IS
--Your variables go here.
  BEGIN
--Your code goes here.
  END;
END;
/
show errors;
```

7.2.3 Supporting Other Video Data Formats

Section 7.2.3.1 and Section 7.2.3.2 describe how to extend ORDVideo to support other data formats.

7.2.3.1 ORDPLUGINS.ORDX_DEFAULT_VIDEO Package

Use the following `ORDPLUGINS.ORDX_DEFAULT_VIDEO` package provided as a guide in developing your own `ORDPLUGINS.ORDX_<format>_VIDEO` video format package. This package sets the `mimeType` field in the setProperties( ) method with a MIME type value that is dependent on the file format.

```
CREATE OR REPLACE PACKAGE ORDX_DEFAULT_VIDEO
authid current_user
AS
--VIDEO ATTRIBUTES ACCESSORS
FUNCTION  getAttribute(ctx IN OUT RAW,
                       obj IN ORDSYS.ORDVideo,
                       name IN VARCHAR2)
          RETURN VARCHAR2;
PROCEDURE setProperties(ctx IN OUT RAW,
                        obj IN OUT NOCOPY ORDSYS.ORDVideo,
                        setComments IN NUMBER := 0);
FUNCTION checkProperties(ctx IN OUT RAW,obj IN ORDSYS.ORDVideo) RETURN NUMBER;

-- must return name=value; name=value; ...  pairs
PROCEDURE getAllAttributes(ctx IN OUT RAW,
                           obj IN ORDSYS.ORDVideo,
                           attributes IN OUT NOCOPY CLOB);
-- VIDEO PROCESSING METHODS
FUNCTION  processCommand(
                         ctx       IN OUT RAW,
                         obj       IN OUT NOCOPY ORDSYS.ORDVideo,
                         cmd       IN VARCHAR2,
                         arguments IN VARCHAR2,
                         result    OUT RAW)
         RETURN RAW;
```

```
END;
/
```

Table 7–5 shows the methods supported in the `ORDPLUGINS.ORDX_DEFAULT_VIDEO` package and the exceptions raised if you call a method that is not supported.

Table 7–5 Methods Supported in the ORDPLUGINS.ORDX_DEFAULT_VIDEO Package

Name of Method	Level of Support
getAttribute	Not supported - raises exceptions: METHOD_NOT_SUPPORTED and VIDEO_PLUGIN_EXCEPTION
setProperties	Supported; if the source is local, extract attributes from the local data and set the properties, but if the source is `NULL`, raise an ORDSYS.ORDSourceExceptions.EMPTY_SOURCE exception; if the source is a BFILE, then extract attributes from the BFILE and set the properties; if the source is neither local nor a BFILE, get the media content into a temporary LOB, extract attributes from the data, and set the properties.
checkProperties	Supported; if the source is local, extract attributes from the local data and compare them with the attribute values of the object, but if the source is `NULL`, raise an ORDSYS.ORDSourceExceptions.EMPTY_SOURCE exception; if the source is a BFILE, then extract attributes from the BFILE data and compare them with the attribute values of the object; if the source is neither local nor a BFILE, get the media content into a temporary LOB, extract attributes from the media content and compare them with the attribute values of the object.
getAllAttributes	Supported; if the source is local, get the attributes and return them, but if the source is `NULL`, raise an ORDSYS.ORDSourceExceptions.EMPTY_SOURCE exception; otherwise, if the source is external, raise an ORDSYS.ORDVideoExceptions.LOCAL_DATA_SOURCE_REQUIRED exception.
processCommand	Not supported - raises exceptions: METHOD_NOT_SUPPORTED and VIDEO_PLUGIN_EXCEPTION

7.2.3.2 Extending *inter*Media to Support a New Video Data Format

Extending *inter*Media to support a new video data format consists of the following steps:

1. Design your new video data format.
   a. To support a new video data format, implement the required interfaces in the `ORDX_<format>_VIDEO` package in the `ORDPLUGINS` schema (where `<format>` represents the name of the new video data format). See Section 7.2.3.1 for a complete description of the interfaces for the `ORDX_DEFAULT_VIDEO` package. Use the package body example in Example 7–4 as a template to create the video package body.
   b. Then, set the new format parameter in the setFormat( ) call to the appropriate format value to indicate to the video object that package `ORDPLUGINS.ORDX_<format>_VIDEO` is available as a plug-in.
2. Implement your new video data format and name it, for example, `ORDX_MY_VIDEO.SQL`.
3. Install your new `ORDX_MY_VIDEO.SQL` plug-in in the `ORDPLUGINS` schema.
4. Grant EXECUTE privileges on your new plug-in, for example, `ORDX_MY_VIDEO` plug-in, to PUBLIC.

5. In an application, set the video format to `my` to cause your plug-in to be invoked.

A package body listing is provided in Example 7–4 to assist you in this operation. Add your variables to the places that say "--Your variables go here" and add your code to the places that say "--Your code goes here".

Example 7–4 Show the Package Body for Extending Support to a New Video Data Format

```
CREATE OR REPLACE PACKAGE BODY ORDX_MY_VIDEO
AS
  --VIDEO ATTRIBUTES ACCESSORS
  FUNCTION  getAttribute(ctx IN OUT RAW,
                         obj IN ORDSYS.ORDVideo,
                         name IN VARCHAR2)
  RETURN VARCHAR2
  IS
--Your variables go here.
  BEGIN
--Your code goes here.
  END;
  PROCEDURE setProperties(ctx IN OUT RAW,
          obj IN OUT NOCOPY ORDSYS.ORDVideo,
          setComments IN NUMBER :=0)
  IS
--Your variables go here.
  BEGIN
--Your code goes here.
  END;
  FUNCTION checkProperties(ctx IN OUT RAW, obj IN ORDSYS.ORDVideo) RETURN NUMBER
  IS
--Your variables go here.
  BEGIN
--Your code goes here.
  END;
  PROCEDURE getAllAttributes(ctx IN OUT RAW,
                             obj IN ORDSYS.ORDVideo,
                             attributes IN OUT NOCOPY CLOB)
  IS
--Your variables go here.
  BEGIN
--Your code goes here.
  END;
  -- VIDEO PROCESSING METHODS
  FUNCTION  processCommand(
                                 ctx       IN OUT RAW,
                                 obj       IN OUT NOCOPY ORDSYS.ORDVideo,
                                 cmd       IN VARCHAR2,
                                 arguments IN VARCHAR2,
                                 result OUT RAW)
  RETURN RAW
  IS
--Your variables go here.
  BEGIN
--Your code goes here.
  END;
END;
/
show errors;
```

7.2.4 Supporting Other Image Data Formats

Oracle *inter*Media supports certain other image formats through the setProperties( ) method for foreign images. This method allows other image formats to be recognized by writing the values supplied to the setProperties( ) method for foreign images to the existing ORDImage data attributes. See the setProperties( ) for foreign images method in *Oracle interMedia Reference* for more information and to determine the type of images that can are supported this way.

7.3 Extending *inter*Media with a New Type

You can use any of the *inter*Media objects types as the basis for a new type of your own creation as shown in Example 7–5 for the ORDImage object type.

Note: When a type is altered, any dependent type definitions are invalidated. You will encounter this problem if you define a new type that includes an *inter*Media object type attribute and the *inter*Media object type is altered, which always occurs during an *inter*Media installation upgrade.

A workaround to this problem is to revalidate all invalid type definitions with the following SQL statement:

```
SQL> ALTER TYPE <type-name> COMPILE;
```

Example 7–5 Extend Oracle interMedia ORDImage with a New Object Type

```
CREATE TYPE AnnotatedImage AS OBJECT
    ( image ORDSYS.ORDImage,
      description VARCHAR2(2000),
      MEMBER PROCEDURE SetProperties(SELF IN OUT AnnotatedImage),
      MEMBER PROCEDURE Copy(dest IN OUT AnnotatedImage),
      MEMBER PROCEDURE ProcessCopy(command IN VARCHAR2,
                                   dest IN OUT AnnotatedImage)
    );
/

CREATE TYPE BODY AnnotatedImage AS
  MEMBER PROCEDURE SetProperties(SELF IN OUT AnnotatedImage) IS
  BEGIN
    SELF.image.setProperties();
    SELF.description :=
        'This is an example of using Image object as a subtype';
  END SetProperties;
  MEMBER PROCEDURE Copy(dest IN OUT AnnotatedImage) IS
  BEGIN
    SELF.image.copy(dest.image);
    dest.description := SELF.description;
  END Copy;
  MEMBER PROCEDURE ProcessCopy(command IN VARCHAR2,
                               dest IN OUT AnnotatedImage) IS
  BEGIN
    SELF.Image.processCopy(command,dest.image);
    dest.description := SELF.description;
  END ProcessCopy;
END;
/
```

After creating the new type, you can use it as you would any other type. For example:

```
CREATE OR REPLACE DIRECTORY ORDIMGDIR AS 'C:\TESTS';

CREATE TABLE my_example(id NUMBER, an_image AnnotatedImage);
INSERT INTO my_example VALUES (1,
    AnnotatedImage(
        ORDSYS.ORDImage.init('file','ORDIMGDIR','plaid.gif'));
COMMIT;
DECLARE
    myimage AnnotatedImage;
BEGIN
    SELECT an_image INTO myimage FROM my_example;
    myimage.SetProperties;
    DBMS_OUTPUT.PUT_LINE('This image has a description of ');
    DBMS_OUTPUT.PUT_LINE(myimage.description);
    UPDATE my_example SET an_image = myimage;
END;
/
```

7.4 Supporting Media Data Processing

Section 7.4.1 and Section 7.4.2 describe support for audio and video data processing.

7.4.1 Supporting Audio Data Processing

To support audio data processing, that is, the passing of an audio processing command and set of arguments to a format plug-in for processing, use the processAudioCommand( ) method. This method is available only for user-defined formats.

See the processAudioCommand( ) method in *Oracle interMedia Reference* for a description.

7.4.2 Supporting Video Data Processing

To support video data processing, that is, the passing of a command and set of arguments to a format plug-in for processing, use the processVideoCommand( ) method. This method is only available for user-defined formats.

See the processVideoCommand( ) method in *Oracle interMedia Reference* for a description.

8 Tuning Tips for the DBA

This chapter provides tuning tips for the Oracle DBA who wants to achieve more efficient storage and management of multimedia data in the database when using Oracle *inter*Media ("*inter*Media").

The goals of your *inter*Media application determine the resource needs and how those resources should be allocated. Because application development and design decisions have the greatest effect on performance, standard tuning methods must be applied to the system planning, design, and development phases of the project to achieve optimal results for your *inter*Media application in a production environment.

Multimedia data consists of a variety of media types including images, audio clips, video clips, line drawings, and so forth. All these media types are typically stored in LOBs, in either internal BLOBs (stored in an internal database tablespace) or in BFILEs (external LOBs in operating system files outside of the database tablespaces). This chapter discusses only the management of audio, image, and video data stored in BLOBs.

Internal LOBs consist of: CLOBs, NCLOBs, and BLOBs and can be of unlimited size (8 terabytes (TB) to 128 TB depending on the database block size of 2 kilobytes (KB) to 32 KB), which are supported in these programming environments: Java using Java Database Connectivity (JDBC), PL/SQL using the DBMS_LOB Package, and C using Oracle Call Interface (OCI).

However, in these programming environments: COBOL using Pro*COBOL precompiler, C/C++ using Pro*C/C++ precompiler, Visual Basic using Oracle Objects for OLE (OO4O), and SQL, you can create and use LOB instances only up to 4 gigabytes (GB) in size. *inter*Media supports BLOBs up to 4 GB in size for Oracle Database 10*g* Release 1 (10.1).

BFILEs can be as large as the operating system will allow up to a maximum of 8 TB. *inter*Media supports BFILEs up to a maximum of 4 GB in size.

The following general topics will help you to better manage your *inter*Media LOB data:

- Setting database initialization parameters (see Section 8.1)
- Issues to consider in creating tables with *inter*Media objects containing LOBs (see Section 8.2)
- Improving multimedia data INSERT performance in *inter*Media objects containing LOBs (see Section 8.3)
- Getting the best performance results (see Section 8.6)
- Improving *inter*Media LOB data retrieval and update performance (see Section 8.7)

For more information about LOB partitioning, LOB tuning, and LOB buffering, see *Oracle Database Application Developer's Guide - Large Objects*, *Oracle Call Interface Programmer's Guide*, *Oracle Database Concepts*, and *Oracle Database Performance Tuning Guide*.

For information about restrictions to consider when using LOBs, see *Oracle Database Application Developer's Guide - Large Objects*.

For guidelines on using the DIRECTORY feature in Oracle, see *Oracle Database Application Developer's Guide - Large Objects*. This feature enables a simple, flexible, nonintrusive, and secure mechanism for the DBA to manage access to large files in the file system.

8.1 Setting Database Initialization Parameters

The information that follows is an excerpt from *Oracle Database Performance Tuning Guide* and *Oracle Database Reference*, and is presented as an overview of the topic. Refer to *Oracle Database Performance Tuning Guide* and *Oracle Database Reference* for more information.

Database tuning of the Oracle instance consists of tuning the system global area (SGA). The SGA is used to store data in memory for fast access. The SGA consumes a portion of your system's physical memory. The SGA must be sufficiently large to keep your data in memory but neither too small nor so large that performance begins to degrade. Degrading performance occurs when the operating system begins to page unused information to disk to make room for new information needed in memory, or begins to temporarily swap active processes to disk so other processes needing memory can use it. Excessive paging and swapping can bring a system to a standstill. The goal in sizing the SGA is to size it for the data that must be kept in main memory to keep performance optimal. With this in mind, you must size the SGA required for your *inter*Media application. This may mean increasing the physical memory of your system and monitoring your operating system behavior to ensure paging and swapping remain minimal.

The size of the SGA is determined by the values of the following database initialization parameters: DB_BLOCK_SIZE, DB_CACHE_SIZE, SHARED_POOL_SIZE, and LOG_BUFFER.

Beginning with Oracle9*i*, the SGA infrastructure is dynamic. This means that the following primary parameters used to size the SGA can be changed while the instance is running:

- Buffer cache (DB_CACHE_SIZE) -- the size in bytes of the cache of standard blocks
- Shared pool (SHARED _POOL_SIZE) -- the size in bytes of the area devoted to shared SQL and PL/SQL statements
- Large pool (LARGE_POOL_SIZE) (default is 0 bytes) -- the size in bytes of the large pool used in shared server systems for session memory, parallel execution for message buffers, and by backup and restore processes for disk I/O buffers

The LOG_BUFFER parameter is used when buffering redo entries to a redo log. It is a static parameter and represents a very small portion of the SGA and can be changed only by stopping and restarting the database to read the changed value for this parameter from the initialization parameter file (`init.ora`).

Note that even though you cannot change the MAX_SGA_SIZE parameter value dynamically, you do have the option of changing any of its three dependent primary parameters (DB_CACHE_SIZE, SHARED_POOL_SIZE, and LARGE_POOL_SIZE) to make memory tuning adjustments on the fly. To help you specify an optimal cache value, you can use the dynamic DB_CACHE_ADVICE parameter with statistics gathering enabled to predict behavior with different cache sizes through the V$DB_CACHE_ADVICE performance view. Use the ALTER SYSTEM...SET clause... statement to enable this parameter. See *Oracle Database Performance Tuning Guide* for more information about using this parameter.

Beginning with Oracle9*i*, there is a concept of creating tablespaces with multiple block sizes and specifying cache sizes corresponding with each block size. The SYSTEM tablespace uses a standard block size and additional tablespaces can use up to five non-standard block sizes.

The standard block size is specified by the DB_BLOCK_SIZE parameter. Its cache size is specified by the DB_CACHE_SIZE parameter. Non-standard block sizes are specified by the BLOCKSIZE clause of the CREATE TABLESPACE statement. The cache size for each corresponding non-standard block size is specified using the notation: DB_*n*K_CACHE_SIZE parameter, where the value *n* is 2, 4, 8, 16, or 32 KB.

The standard block size, known as the default block size, is usually set to the same size in bytes as the operating system block size, or a multiple of this size. The DB_CACHE_SIZE parameter, known as the DEFAULT cache size, specifies the size of the cache of standard block size (default is 48 megabytes (MB)). The system tablespace uses the standard block size and the DEFAULT cache size.

Either the standard block size or any of the non-standard block sizes and their associated cache sizes can be used for any of your other tablespaces. If you intend to use multiple block sizes in your database storage design, you must specify at least the DB_CACHE_SIZE and one DB_*n*K_CACHE_SIZE parameter value. You must specify all sub-caches for all the other non-standard block sizes that you intend to use. This block size/cache sizing scheme lets you use up to five different non-standard block sizes for your tablespaces and lets you specify respective cache sizes for each corresponding block size. For example, you can size your system tablespace to the normal 8 KB standard block size with a default DB_CACHE_SIZE of 48 MB or whatever size you want to specify. Then you can use any of the block sizes of 2 KB, 4 KB, 8 KB, 16 KB, or the maximum 32 KB for storing your *inter*Media LOB data in appropriate block-sized tablespaces and respective caches to achieve optimal LOB storage and retrieval performance.

Because the DB_BLOCK_SIZE parameter value can be changed only by re-creating the database, the value for this parameter must be chosen carefully and remain unchanged for the life of the database. See the section "DB_BLOCK_SIZE" for more information about this parameter.

The following sections describe these and some related initialization parameters and their importance to *inter*Media performance.

DB_BLOCK_SIZE

The DB_BLOCK_SIZE parameter is the size in bytes of database blocks (2048-32768). Oracle manages the storage space in the data files of a database in units called data blocks. The data block is the smallest unit of I/O operation used by a database; this value should be a multiple of the operating system's block size within the maximum (port-specific) limit to avoid unnecessary I/O operations. This parameter value is set for each database from the DB_BLOCK_SIZE parameter value in the initialization parameter file when you create the database. This value cannot be changed unless you create the database again.

The size of a database block determines how many rows of data Oracle can store in a single database page. The size of an average row is one piece of data that a DBA can use to determine the correct database block size. *inter*Media objects with instantiated

LOB locators range in size from 175 bytes for ORDImage to 260 bytes for ORDDoc, ORDAudio, and ORDVideo. This figure does *not* include the size of the media data. (The difference in row sizes between instantiated image and audio and video data is that audio and video data contain a Comments attribute that is about 85 bytes in size to hold the LOB locator.)

If LOB data is less than 4000 bytes, then it can be stored inline or on the same database page as the rest of the row data. LOB data can be stored inline only when the block size is large enough to accommodate it.

LOB data that is stored out of line, on database pages that are separate from the row data, is accessed (read and written) by Oracle in CHUNK size pieces where CHUNK is specified in the LOB storage clause (see Section 8.2.2 for more information about the CHUNK option). CHUNK must be an integer multiple of DB_BLOCK_SIZE and defaults to DB_BLOCK_SIZE if not specified. Generally, it is more efficient for Oracle to access LOB data in large chunks, up to 32 KB. However, when LOB data is updated, it may be versioned (for read consistency) and logged both to the rollback segments and the redo log in CHUNK size pieces. If updates to LOB data are frequent then it may be more efficient space wise to manipulate smaller chunks of LOB data, especially when the granularity of the update is much less than 32 KB.

The preceding discussion is meant to highlight the differences between the initialization parameter DB_BLOCK_SIZE and the LOB storage parameter CHUNK. Each parameter controls different aspects of the database design, and though related, they should not be automatically equated.

Tuning Memory Allocation

Allocating memory to database structures and proper sizing of these structures can greatly improve database performance when working with LOB data. See *Oracle Database Performance Tuning Guide* for a comprehensive, in-depth presentation of this subject, including understanding memory allocation issues as well as detecting and solving memory allocation problems. The following sections describe a few of the important initialization parameters specifically useful for optimizing LOB performance relative to tuning memory allocation.

DB_CACHE_SIZE

The DB_CACHE_SIZE parameter specifies the size of the DEFAULT buffer pool for buffers in bytes. This value is the database buffer value that is displayed when you issue a SQL SHOW SGA statement. Because you cannot change the value of the DB_BLOCK_SIZE parameter without re-creating the database, change the value of the DB_CACHE_SIZE parameter to control the size of the database buffer cache using the ALTER SYSTEM...SET clause... statement. The DB_CACHE_SIZE parameter is dynamic.

BUFFER_POOL_KEEP and BUFFER_POOL_RECYCLE - Tuning Multiple Buffer Pools Using the Standard Block Size

To greatly reduce I/O operations while reading and processing LOB data, tune the database instance by partitioning your buffer cache into multiple buffer pools for the tables containing the LOB columns.

Note: Multiple buffer pools are available only for the standard block size. Non-standard block size caches have a single DEFAULT pool. Therefore, the information presented in this section applies to only the scenario in which you are using only the standard block size.

By default, all tables are assigned to the DEFAULT pool. Tune this main cache buffer using the DB_CACHE_SIZE initialization parameter and assign the appropriate tables to the keep pool using the DB_KEEP_CACHE_SIZE initialization parameter and to the recycle pool using the DB_RECYCLE_CACHE_SIZE initialization parameter.

The keep pool contains buffers that always stay in memory and is intended for frequently accessed tables that contain important data. The recycle pool contains buffers that can always be recycled and is intended for infrequently accessed tables that contain much less important data. The size of the main buffer cache (DEFAULT) is calculated from the value specified for the DB_CACHE_SIZE parameter minus the values specified for the DB_KEEP_CACHE_SIZE and DB_RECYCLE_CACHE_SIZE parameters. Tables are assigned to respective buffer pools (KEEP, RECYCLE, DEFAULT) using the STORAGE (buffer_pool) clause of the CREATE or ALTER TABLE statement. Determine what tables you want allocated to which of these memory buffers and the ideal size of each buffer when you implement your memory allocation design. These parameter values can be changed only in the initialization parameter file and take effect only after stopping and restarting the database.

When working with very large images, set the DB_CACHE_SIZE parameter to a large number for your Oracle instance. For example, to cache a 40 MB image, set this parameter to a value of 48 MB. Some general guidelines to consider when working with LOB data are:

- You should have enough buffers to hold the object, regardless of table LOB logging and cache settings. See Section 8.2 for more information.
- When using log files you should make the log files larger, otherwise, more time is spent waiting for log switches. See Section 8.2 for more information.
- If the same BLOB is to be accessed frequently, set the table LOB CACHE parameter to TRUE. See Section 8.2 for more information.
- Use a large page size (DB_BLOCK_SIZE) if the database is going to contain primarily large objects.

See *Oracle Database Performance Tuning Guide* for more information about tuning multiple buffer pools.

SHARED_POOL_SIZE

The SHARED_POOL_SIZE parameter specifies the size in bytes of the shared pool that contains the library cache of shared SQL requests, shared cursors, stored procedures, the dictionary cache, and control structures, Parallel Execution message buffers, and other cache structures specific to a particular instance configuration. This parameter value is dynamic. This parameter represents most of the variable size value that is displayed when you issue a SQL SHOW SGA statement. Specifying a large value improves performance in multiuser systems. A large value for example, accommodates the loading and execution of *inter*Media PL/SQL scripts and stored procedures; otherwise, execution plans are more likely to be swapped out. A large value can also accommodate many clients connecting to the server with each client connection using some shared pool space. However, when the shared pool is full, the database is unable to accept additional client connections.

SHARED_POOL_RESERVED_SIZE

The SHARED_POOL_RESERVED_SIZE parameter specifies the shared pool space that is reserved for large contiguous requests for shared pool memory. This static parameter should be set high enough to avoid performance degradation in the shared pool from situations where pool fragmentation forces Oracle to search for free chunks of unused pool to satisfy the current request.

Ideally, this parameter should be large enough to satisfy any request scanning for memory on the reserved list without flushing objects from the shared pool.

The default value is 5% of the shared pool size, while the maximum value is 50% of the shared pool size. For *inter*Media applications, a value at or close to the maximum can provide performance benefits.

LOG_BUFFER

The LOG_BUFFER parameter specifies the amount of memory, in bytes, used for buffering redo entries to the redo log file. Redo entries are written to the on disk log file when a transaction commits or when the LOG_BUFFER is full and space must be made available for new redo entries. Large values for LOG_BUFFER can reduce the number of redo log file I/O operations by allowing more data to be flushed for each write operation. Large values can also eliminate the waits that occur when redo entries are flushed to make space in the log buffer pool. *inter*Media applications that have buffering enabled for the LOB data can generate large amounts of redo data when media is inserted or updated. These applications would benefit from a larger LOG_BUFFER size. This is a static parameter.

8.2 Issues to Consider in Creating Tables with Column Objects Containing BLOBs

The following information provides some strategies to consider when you create tables with *inter*Media column objects containing BLOBs. You can explicitly indicate the tablespace and storage characteristics for each BLOB. These topics are discussed in more detail and with examples in *Oracle Database Application Developer's Guide - Large Objects*. The information that follows is excerpted from Chapter 2 and is briefly presented to give you an overview of the topic. Refer to *Oracle Database Application Developer's Guide - Large Objects* for more information.

8.2.1 Initializing Internal Column Objects Containing BLOBs to NULL or EMPTY

An *inter*Media column object containing a LOB value set to `NULL` has no locator. By contrast, an empty LOB stored in a table is a LOB of zero length that has a locator. So, if you select from an empty LOB column or attribute, you get back a locator, which you can use to fill the LOB with data using the OCI or DBMS_LOB routines or ORDxxx.import method.

Setting *inter*Media Column Objects Containing a BLOB to `NULL`

You may want to set the BLOB value to `NULL` upon inserting the row whenever you do not have the BLOB data at the time of the INSERT operation. In this case, you can issue a SELECT statement at some later time to obtain a count of the number of rows in which the value of the BLOB is `NULL`, and determine how many rows must be populated with BLOB data for that particular column object.

However, the drawback to this approach is that you must then issue a SQL UPDATE statement to reset the `NULL` BLOB column to EMPTY_BLOB( ). The point is that you cannot call the OCI or the PL/SQL DBMS_LOB functions on a BLOB that is `NULL`. These functions work only with a locator, and if the BLOB column is `NULL`, there is no locator in the row.

Setting an *inter*Media Column Object Containing a BLOB to `EMPTY`

If you do not want to set an *inter*Media column object containing a BLOB to `NULL`, another option is to set the BLOB value to `EMPTY` by using the EMPTY_BLOB( )

function in the INSERT statement. Even better, set the BLOB value to `EMPTY` by using the EMPTY_BLOB( ) function in the INSERT statement, and use the RETURNING clause (thereby eliminating a round-trip that is necessary for the subsequent SELECT statement). Then, immediately call OCI, the import method, or the PL/SQL DBMS_LOB functions to fill the LOB with data. See *Oracle Database Application Developer's Guide - Large Objects* for an example.

8.2.2 Specifying Tablespace and Storage Characteristics for Column Objects Containing BLOBs

When you create tables and define *inter*Media column objects containing BLOBs, you can explicitly indicate the tablespace and storage characteristics for each BLOB. The following guidelines can help you fine-tune BLOB storage.

Tablespace

The best performance for *inter*Media column objects containing BLOBs can often be achieved by specifying storage for BLOBs in a tablespace that is different from the one used for the table that contains the *inter*Media object with a BLOB. See the ENABLE | DISABLE STORAGE IN ROW clause near the end of this section for further considerations on storing BLOB data inline or out of line. If many different LOBs are to be accessed frequently, it may also be useful to specify a separate tablespace for each BLOB or attribute in order to reduce device contention. Preallocate the tablespace to the required allocation size to avoid allocation when inserting BLOB data. See *Oracle Database SQL Reference* for examples, specifically the CREATE TABLE statement and the LOB column example. See Example 8–1.

Example 8–1 assumes that you have already issued a CONNECT statement as a suitably privileged user. This example creates a separate tablespace, called MONTANA, that is used to store the *inter*Media column object containing BLOB data for the image column. Ideally, this tablespace would be located on its own high-speed storage device to reduce contention. Other image attributes and the imageID column are stored in the default tablespace. The initial allocation allows 100 MB of storage space. The images to be inserted are about 20 KB in size. To improve insert performance, NOCACHE and NOLOGGING options are specified along with a CHUNK size of 24 KB.

Example 8–1   Create a Separate Tablespace to Store an interMedia Column Object Containing LOB Data

```
SVRMGR> CREATE TABLESPACE MONTANA DATAFILE 'montana.tbs' SIZE 400M;
Statement processed.
SVRMGR> CREATE TABLE images (imageID INTEGER ,image ORDSYS.ORDImage)
     LOB (image.source.localData) STORE AS
            (
            TABLESPACE MONTANA
            STORAGE (
                   INITIAL 100M
                   NEXT 100M
                   )
            CHUNK 24K
            NOCACHE NOLOGGING
            );
```

LOB Index and LOB_index_clause

The LOB index is an internal structure that is strongly associated with the LOB storage.

Note: The LOB_index_clause in the CREATE TABLE statement is deprecated beginning with release 8.1.5. Oracle generates an index for each LOB column and beginning with release 8.1.5, LOB indexes are system named and system managed. For information about how Oracle manages LOB indexes in tables migrated from earlier releases, see *Oracle Database Upgrade Guide.*

PCTVERSION Option

When an *inter*Media column object containing a BLOB is modified, a new version of the BLOB page is made in order to support consistent reading of prior versions of the BLOB value.

PCTVERSION is the percent of all used LOB data space that can be occupied by old versions of LOB data pages. As soon as old versions of LOB data pages start to occupy more than the PCTVERSION amount of used LOB space, Oracle tries to reclaim the old versions and reuses them. In other words, PCTVERSION is the percentage of used LOB data blocks that is available for versions of old LOB data.

One way of approximating PCTVERSION is to set PCTVERSION = (% of LOBs updated at any given point in time) times (% of each LOB updated whenever a LOB is updated) times (% of LOBs being read at any given point in time). Allow for a percentage of LOB storage space to be used as old versions of LOB pages so users can get consistent read results of data that has been updated.

Setting PCTVERSION to twice the default allows more free pages to be used for old versions of data pages. Because large queries may require consistent reading of LOBs, it is useful to keep more old versions of LOB pages around. LOB storage may increase if you increase the PCTVERSION value because Oracle will not be reusing free pages aggressively.

The more infrequent and smaller the LOB updates are, the less space that needs to be reserved for old versions of LOB data. If existing LOBs are known to be read-only, you could safely set PCTVERSION to 0% because there would never be any pages needed for old versions of data.

CACHE or NOCACHE Option

Use the CACHE option on *inter*Media column objects containing BLOBs if the same BLOB data is to be accessed frequently. The CACHE option puts the data into the database buffer and makes it accessible for subsequent read operations. If you specify CACHE, then LOGGING is used; you cannot have CACHE and NOLOGGING.

Use the NOCACHE option (the default) if BLOB data is to be read only once or infrequently, or if you have too much BLOB data to cache, or if you are reading lots of images but none more frequently than others.

Use the CACHE READS option if the BLOB data is to be brought into the buffer cache only during frequent read operations and not during write operations.

See Example 8–1.

LOGGING or NOLOGGING Option

An example of when NOLOGGING is useful is with bulk loading or inserting of data. See Example 8–1. For instance, when loading data into the *inter*Media column objects containing BLOBs, if you do not care about redo logging and can just start the load over if it fails, set the BLOB data segment storage characteristics to NOCACHE NOLOGGING. This setting gives good performance for the initial loading of data.

Once you have successfully completed loading the data, you can use the ALTER TABLE statement to modify the BLOB storage characteristics for the BLOB data segment to the desired storage characteristics for normal BLOB operations, such as CACHE or NOCACHE LOGGING.

CHUNK Option

Set the CHUNK option to the number of bytes of *inter*Media column objects containing BLOB data that are to be accessed at one time. That is, the number of bytes that are to be read or written using the object.readFromSource( ) or object.writeToSource( ) *inter*Media audio and video object methods or call, OCILobRead( ), OCILobWrite( ), DBMS_LOB.READ( ), or DBMS_LOB.WRITE( ) during one access of the BLOB value. Note that the default value for the CHUNK option is 1 Oracle block and does not vary across systems. If only 1 block of BLOB data is accessed at a time, set the CHUNK option to the size of 1 block. For example, if the database block size is 2 KB, then set the CHUNK option to 2 KB.

Set the CHUNK option to the next largest integer multiple of database block size that is slightly larger than the audio, image, or video data size being inserted. Specifying a slightly larger CHUNK option allows for some variation in the actual sizes of the multimedia data and ensures that the benefit is realized. For large-sized media data, a general rule is to set the CHUNK option as large as possible; the maximum is 32 KB. For example, if the database block size is 2 KB or 4 KB or 8 KB and the image data is mostly 21 KB in size, set the CHUNK option to 24 KB. See Example 8–1.

INITIAL and NEXT Parameters

If you explicitly specify the storage characteristics for the *inter*Media column object containing a BLOB, make sure that the INITIAL and NEXT parameters for the BLOB data segment storage are set to a size that is larger than the CHUNK size. For example, if the database block size is 2 KB and you specify a CHUNK value of 8 KB, make sure that the INITIAL and NEXT parameters are at least 8 KB, preferably higher (for example, at least 16 KB).

For LOB storage, Oracle automatically builds and maintains a LOB index that allows quick access to any chunk and thus any portion of a LOB. The LOB index gets the same storage extent parameter values as its LOBs. Consequently, to optimize LOB storage space, you should calculate the size of your LOB index size as well as the total storage space needed to store the media data including its overhead.

Assume that *N* files composed of *M* total bytes of media data are to be stored and that the value *C* represents the size of the LOB CHUNK storage parameter. To calculate the total number of bytes Y needed to store the media data:

Y = M + (N*C)

The expression (N*C) accounts for the worst case in which the last CHUNK of each LOB contains a single byte. Therefore, an extra CHUNK is allowed for each file that is stored. On average, the last CHUNK will be half full.

To calculate the total number of bytes X to store the LOB index:

X = CEIL(M/C) * 32

The value 32 indicates that the LOB index requires roughly 32 bytes for each CHUNK that is stored.

The total storage space needed for the media data plus its LOB index is then X + Y.

The following two examples describe these calculations in detail.

Example 1: Assume you have 500 video clips comprising a total size of 250 MB with an average size is 512 KB. Assume a LOB CHUNK size of 32768 bytes. The total space needed for the media data is 250 MB + (5000*32768) or 266 MB. The overhead is 16 MB or about 6.5% storage overhead. The total space needed to store the LOB index is CEIL(250 MB/32768) * 32 or 244 KB. The total space needed to store the media data plus its LOB index is then about 266.6 MB.

```
SQL> SELECT 250000000+(500*32768)+CEIL(250000000/32768)*32 FROM dual;

250000000+(500*32768)+CEIL(250000000/32768)*32
----------------------------------------------
                                     266628160
```

The following table definition could be used to store this amount of data:

```
CREATE TABLE video_items
(
  video_id         NUMBER,
  video_clip      ORDSYS.ORDVideo
)
-- storage parameters for table in general
TABLESPACE video1 STORAGE (INITIAL 1M NEXT 10M)
-- special storage parameters for the video content
LOB(video_clip.source.localdata) STORE AS
  (TABLESPACE video2 STORAGE (INITIAL 260K NEXT 270M)
   DISABLE STORAGE IN ROW NOCACHE NOLOGGING CHUNK 32768);
```

Example 2: Assume you have 5000 images comprising a total size of 274 MB with an average size of 56 KB. Because the average size of the images are smaller than the video clips in the preceding example, it is more space efficient to choose a smaller CHUNK size, for example 8192 bytes to store the data in the LOB. The total space needed for the media data is 274 MB + (5000*8192) or 314 MB. The overhead is about 40 MB or about 15% storage overhead. The total space needed to store the LOB index is CEIL(274 MB/8192) * 32 or 1.05 MB. The total space needed to store the media data plus its LOB index is then about 316 MB.

```
SQL> SELECT 274000000+(5000*8192)+CEIL(274000000/8192)*32 FROM dual;

274000000+(5000*8192)+CEIL(274000000/8192)*32
---------------------------------------------
                                    316030336
```

The following table definition could be used to store this amount of data:

```
CREATE TABLE image_items
(
  image_id         NUMBER,
  image            ORDSYS.ORDImage
)
-- storage parameters for table in general
TABLESPACE image1 STORAGE (INITIAL 1M NEXT 10M)
-- special storage parameters for the image content
LOB(image.source.localdata) STORE AS
  (TABLESPACE image2 STORAGE (INITIAL 1200K NEXT 320M)
   DISABLE STORAGE IN ROW NOCACHE NOLOGGING CHUNK 8192);
```

When working with very large BLOBs of about 1 gigabyte in size, choose a proportionately large INITIAL and NEXT extent parameter size, for example an INITIAL value slightly larger than your calculated LOB index size and a NEXT value of 100 MB, to reduce the frequency of extent creation, or commit the transaction more often to reuse the space in the rollback segment; otherwise, if the number of extents is large, the rollback segment can become saturated.

PCTINCREASE Parameter

Set the PCTINCREASE parameter value to 0 to make the growth of new extent sizes more manageable. When working with very large BLOBs and the BLOB is being filled up piece by piece in a tablespace, numerous new extents are created in the process. If the extent sizes keep increasing by the default value of 50% each time one is created, extents will become unmanageably big and eventually will waste space in the tablespace.

MAXEXTENTS Parameter

Set the MAXEXTENTS parameter value to suit the projected size of the BLOB or set it to UNLIMITED for safety. That is, when MAXEXTENTS is set to UNLIMITED, extents will be allocated automatically as needed and this minimizes fragmentation.

ENABLE | DISABLE STORAGE IN ROW Clause

You use the ENABLE | DISABLE STORAGE IN ROW clause to indicate whether the *inter*Media column objects containing a BLOB should be stored inline (that is, in the row) or out of line. You may not alter this specification once you have made it: if you ENABLE STORAGE IN ROW, you cannot alter it to DISABLE STORAGE IN ROW or the reverse. The default is ENABLE STORAGE IN ROW.

The maximum amount of LOB data that will be stored in the row is the maximum VARCHAR size (4000). Note that this includes the control information as well as the LOB value. If the user indicates that the LOB should be stored in the row, once the LOB value and control information are larger than 4000 bytes, the LOB value is automatically moved out of the row.

This suggests the following guideline: If the *inter*Media column object containing a BLOB is small (that is, less than 4000 bytes), then storing the BLOB data out of line will decrease performance. However, storing the BLOB in the row increases the size of the row. This has a detrimental impact on performance if you are doing a lot of base table processing, such as full table scans, multiple row accesses (range scans), or doing many UPDATE or SELECT statements to columns other than the *inter*Media column objects containing BLOBs. If you do not expect the BLOB data to be less than 4000 bytes, that is, if all BLOBs are big, then the default is the best choice because:

- The LOB data is automatically moved out of line once it gets bigger than 4000 bytes.
- Performance can be better if the BLOB data is small (less than 4000 bytes including control information) and is stored inline because the LOB locator and the BLOB data can be retrieved in the same buffer, thus reducing I/O operations.

8.2.3 Segment Attributes and Physical Attributes

The following physical attribute is important for optimum storage of BLOB data in the data block and consequently achieving optimum retrieval performance.

PCTFREE Parameter

The PCTFREE parameter specifies the percentage of space in each data block of the table or partition reserved for future updates to each row of the table. Setting this parameter to an appropriate value is useful for efficient inline storage of multimedia data. The default value is 10%.

Set this parameter to a high enough value to avoid row chaining or row migration. Because the INSERT statement for BLOBs requires an EMPTY_BLOB column object initialization followed by an UPDATE statement to load the BLOB data into the data block, you must set the PCTFREE parameter value to a proper value especially if the BLOB data will be stored inline. For example, row chaining can result after a row INSERT operation when insufficient space is reserved in the existing data block to store the entire row, including the inline BLOB data in the subsequent UPDATE operation. As a result, the row would be broken into multiple pieces and each piece stored in a separate data block. Consequently, more I/O operations would be needed to retrieve the entire row, including the BLOB data, resulting in poorer performance. Row migration can also result if there is insufficient space in the data block to store the entire row during the initial INSERT operation, and thus the row is stored in another data block.

To make best use of the PCTFREE parameter, determine the average size of the BLOB data being stored inline in each row, and then determine the entire row size, including the inline BLOB data. Set the PCTFREE parameter value to allow for sufficient free space to store an entire row of data in the data block. For example, if you have a large number of thumbnail images that are about 3 KB in size, and each row is about 3.8 KB in size, and the database block size is 8 KB, set the value of PCTFREE to a value that ensures that two complete rows can be stored in each data block in the initial INSERT operation. This approach initially uses 1.6 KB of space (0.8 KB/row *2 rows) leaving 6.4 KB of free space. Because two rows initially use 20% of the data block and 95% after an UPDATE operation and adding a third row would initially use 30% of the data block causing a chain to occur when the third row is updated, set the PCTRFEE parameter value to 75. This setting permits a maximum of two rows to be stored in each data block and leaves sufficient space to update each row with its 3 KB thumbnail image leaving about 0.4 KB free space minus overhead for each data block.

8.3 Improving Multimedia Data INSERT Performance in Objects Containing LOBs

There are a number of bulk loading methods available for loading FILE data into *inter*Media objects containing BLOBs. These include:

- *inter*Media import( ) method in a PL/SQL stored procedure
- SQL*Loader (conventional path load and direct path load)
- OCILobLoadFromFile( ) relational function
- DBMS_LOB.LOADFROMFILE( ) procedure in the DBMS_LOB package
- DBMS_LOB.LOADBLOBFROMFILE( ) procedure in the DBMS_LOB package
- Java loadDataFromFile( ) or loadDataFromInputStream( ) methods of Oracle *inter*Media Java Classes to load media data from a client file

Using *inter*Media import( ) Method in a PL/SQL Stored Procedure

Example 8–2 shows the contents of the `load1.bat` file, which invokes SQL*Plus and runs the `t1.sql` procedure (Example 8–3). The db_block_size for this schema is 8 kilobytes.

Example 8–2 Show the load1.bat File

```
sqlplus scott/tiger@intertcp @t1
```

Example 8–3 shows the contents of the `t1.sql` file. This procedure:

- Creates two tablespaces.
- Creates the `image_items` table and defines the physical properties of the table, specifically the physical attributes and LOB storage attributes.
- Partitions the table storage into each tablespace by range using the `image_id` value.
- Creates the `load_image` stored procedure that:
  - Declares a variable `nxtseq` defined as the ROWID data type.
  - Inserts a row into the `image_items` table and uses the INSERT RETURNING ROWID statement to return the ROWID value for fastest access to the row for loading the image BLOB data into the object columns of each row using the import( ) method.
  - Sets the image attribute properties automatically (by means of the import operation) for each loaded image (note that thumbnail images are stored inline, and regular images are stored out of line).
  - Commits the update operation.

Example 8–3 Show the t1.sql Procedure

```
spool t1.log
set echo on
connect sys/change_on_install as sysdba

create tablespace Image_h default storage (initial 30m next 400m pctincrease 0)
   datafile 'h:\IMPB\Image_h.DBF'
   size 2501M reuse;

create tablespace Image_i default storage (initial 30m next 400m pctincrease 0)
   datafile 'i:\IMPB\Image_i.DBF'
   size 2501M reuse;

connect scott/tiger

drop table image_items;

create table image_items(
  image_id             number,-- constraint pl_rm primary key,
  image_title          varchar2(128),
  image_artist         varchar2(128),
  image_publisher      varchar2(128),
  image_description varchar2(1000),
  image_price          number(6,2),
  image_file_path varchar2(128),
  image_thumb_path varchar2(128),
  image_thumb          ordsys.ordimage,
  image_clip           ordsys.ordimage
)
--
-- physical properties of table
--
  -- physical attributes clause
  pctfree 35 storage (initial 30M next 400M pctincrease 0)

  -- LOB storage clause (applies to LOB column)
  LOB (image_clip.source.localdata)
      store as (disable storage in row nocache nologging chunk 32768)
```

```
--
-- table properties (applies to whole table)
--
Partition by range (image_id)
(
Partition Part1 values less than (110001)
Tablespace image_h,
Partition Part2 values less than (maxvalue)
Tablespace image_i
);

connect scott/tiger;

create or replace procedure load_image
(
  image_id           number,
  image_title        varchar2,
  image_artist       varchar2,
  image_publisher    varchar2,
  image_description  varchar2,
  image_price        number,
  image_file_path    varchar2,
  image_thumb_path   varchar2,
  thumb_dir          varchar2,
  content_dir        varchar2,
  file_name1         varchar2,
  file_name2         varchar2)
as
  ctx raw(4000) := NULL;
  obj1           ORDSYS.ORDIMAGE;
  obj2           ORDSYS.ORDIMAGE;
  nxtseq         rowid;

Begin
  Insert into image_items(
    image_id,
    image_title,
    image_artist,
    image_publisher,
    image_description,
    image_price,
    image_file_path,
    image_thumb_path ,
    image_thumb,
    image_clip)
 values (
    image_id,
    image_title,
    image_artist,
    image_publisher,
    image_description,
    image_price,
    image_file_path,
    image_thumb_path ,
    ORDSYS.ORDIMAGE.init('FILE',upper(thumb_dir),file_name1),
    ORDSYS.ORDIMAGE.init('FILE',upper(content_dir),file_name2))
    returning rowid into nxtseq;

-- load up the thumbnail image
  select t.image_thumb,
t.image_clip
  into obj1, obj2
  from image_items t
    where t.rowid = nxtseq for update;
  obj1.import(ctx);        -- import sets properties
  obj2.import(ctx);
  Update image_items I
  set I.image_thumb = obj1,
      I.image_clip  = obj2
    where i.rowid = nxtseq;

  Commit;
End;
/
spool off
set echo off
```

Example 8–4 shows the contents of the `load1.sql` file. The image load directories are created and specified for each tablespace and user `scott` is granted read privilege on each load directory. The stored procedure named `load_image` is then executed, which loads values for each column row. By partitioning the data into different tablespaces, each partition can be loaded in a parallel data load operation.

Example 8–4   Show the load1.sql File That Executes the load_image Stored Procedure

```
connect sys/change_on_install as sysdba
drop directory IMAGE_H;
drop directory IMAGE_I;
create directory IMAGE_H as 'h:\image_files';
create directory IMAGE_I as 'i:\image_files';
grant read on directory IMAGE_H to scott;
grant read on directory IMAGE_I to scott;
EXEC Load_image(100001,'T_100001',1916,'Publisher','Visit our WEB page'
,8.71,'image_I\T_100001.jpg','image_I\T_100001_thumb1.jpg','image_I','image_I','T_
100001_thumb1.jpg','T_100001.jpg');
EXEC Load_image(100002,'T_100002',2050,'Publisher','Visit our WEB page'
,9.61,'image_I\T_100002.jpg','image_I\T_100002_thumb10.jpg','image_I','image_
I','T_100002_thumb10.jpg','T_100002.jpg');
exit
```

Using SQL*Loader

SQL*Loader provides two methods for loading data:

- Conventional Path Load

  A conventional path load (the default) uses the SQL INSERT statement and a bind array buffer to load data into database tables. When SQL*Loader performs a conventional path load, it competes equally with all other processes for buffer resources. This can slow the load significantly. Extra overhead is added as SQL statements are generated, passed to Oracle, and executed. Oracle looks for partially filled blocks and attempts to fill them on each insert operation. Although appropriate during normal use, this can slow bulk loads dramatically. Use conventional path load if you encounter certain restrictions on direct path loads.

- Direct Path Load

  A direct path load eliminates much of the database overhead by formatting Oracle data blocks and writing the data blocks directly to the database files. A direct load does not compete with other users for database resources, so it can usually load data at near disk speed. In addition, if the asynchronous I/O operations feature is available on your host platform, multiple buffers are used for the formatted data blocks to further increase load performance.

See *Oracle Database Utilities* for a complete list of restrictions for using either the conventional path load or direct path load method for loading data using SQL*Loader. See *Oracle Database Application Developer's Guide - Fundamentals* for more information about LOBs.

Using SQL*Loader to Load Multimedia Data into Oracle Database Using *inter*Media Column Objects

Example 8–5 shows the use of the control file to load one ORDVideo object for each file into a table named `JUKE` that has three columns, with the last one being a column object. Each LOB file is the source of a single LOB and follows the column object name with the LOBFILE data type specifications. Two LOB files are loaded in this example.

Example 8–5 Show the Control File for Loading Video Data

```
LOAD DATA
INFILE *
INTO TABLE JUKE
REPLACE
FIELDS TERMINATED BY ','
( id integer external,
 file_name char(1000),
  mediacontent column object
   (
       source column object
       (
1)      localData_fname FILLER CHAR(128),
2)      localData LOBFILE (mediacontent.source.localData_fname) terminated by EOF
       )

    )
)

BEGINDATA
1,slynne,slynne.rm
2,Commodores,Commodores - Brick House.rm
```

Notes:

1. The FILLER field is mapped to the 128-byte long data field which is read using the SQL*Loader CHAR data type.
2. SQL*Loader gets the LOB file name from the localData_fname FILLER field. It then loads the data from the LOB file (using the BLOB data type) from its beginning to the EOF character, whichever is reached first. Note that if no existing LOB file is specified, the `localData` field is initialized to empty.

Using the OCILobLoadFromFile( ) Relational Function

Oracle Call Interface (OCI) is an application programming interface (API) that enables you to manipulate data and schemas in a database using a host programming language, such as C.

The OCI relational function, OCILobLoadFromFile( ), loads or copies all or a portion of a file into an *inter*Media column object containing a specified BLOB. The data is copied from the source file to the destination *inter*Media column objects containing a BLOB. When binary data is loaded into an *inter*Media column object containing a BLOB, no character set conversions are performed. Therefore, the file data must already be in the same character set as the BLOB in the database. No error checking is performed to verify this.

See *Oracle Call Interface Programmer's Guide* for more information.

Using the DBMS_LOB.LOADFROMFILE( ) Procedure in the DBMS_LOB Package

The DBMS_LOB package provides subprograms to operate on BLOBs, CLOBs, NCLOBs, BFILEs, and temporary LOBs. You can use the DBMS_LOB package for access and manipulation of specific parts of an *inter*Media column object containing a BLOB, as well as complete BLOBs. DBMS_LOB can read as well as modify BLOBs, CLOBs, and NCLOBs, and provides read-only operations for BFILEs. The majority of the LOB operations are provided by this package.

The DBMS_LOB.LOADFROMFILE( ) procedure copies all, or part of, a source-external LOB (BFILE) to a destination internal LOB.

You can specify the offsets for both the source LOB (BFILE) and destination *inter*Media column object containing the BLOB and the number of bytes to copy from the source BFILE. The amount and src_offset, because they refer to the BFILE, are in terms of bytes, and the destination offset is either in bytes or characters for BLOBs and CLOBs respectively.

The input BFILE must have been opened prior to using this procedure. No character-set conversions are performed implicitly when binary BFILE data is loaded into a CLOB. The BFILE data must already be in the same character set as the CLOB in the database. No error checking is performed to verify this. See *Oracle Database PL/SQL Packages and Types Reference* for more information.

Using the DBMS_LOB.LOADBLOBFROMFILE( ) Procedure in the DBMS_ LOB Package

The DBMS_LOB.LOADBLOBFROMFILE( ) procedure loads a persistent or temporary BLOB instance with data from a BFILE. This procedure achieves the same result as using DBMS_LOB.LOADFROMFILE, but returns the new offset in bytes in the destination BLOB right after the end of the write operation, which is also where the next write operation should begin and the offset in bytes in the source BFILE right after the end of the read operation, which is also where the next read operation should begin.

To use this procedure, you can specify the offsets for both the source and destination LOBs, and the number of bytes to copy from the source BFILE. The value you pass for the `amount` parameter to the DBMS_LOB.LOADBLOBFROMFILE function must be either an amount less than or equal to the actual size (in bytes) of the BFILE you are loading or the maximum allowable LOB size: DBMS_LOB.LOBMAXSIZE. Passing this latter value causes the function to load the entire BFILE, which is a useful technique for loading the entire BFILE without introspecting the size of the BFILE.

To use this procedure, the target BLOB instance and the source BFILE must both exist and the BFILE must be opened and later closed after calling this procedure.

See *Oracle Database PL/SQL Packages and Types Reference* for more information.

Using Java loadDataFrom...( ) Methods to Load Media Data from a Client File

From the Java client, you can use the Java loadDataFromByteArray( ), loadDataFromFile( ), or loadDataFromInputStream( ) methods of Oracle *inter*Media Java Classes to load media data from a given file into a server-side media object designated by the corresponding media locator parameters. You must specify the name of the file from which to load the data and the method returns true if loading is successful, false otherwise. See *Oracle interMedia Java Classes API Reference* for more information.

8.4 Transferring Multimedia Data Using Oracle Data Pump

Oracle Data Pump ("Data Pump") enables very high-speed movement of data and metadata from one database to another using the Data Pump Export and Data Pump Import utilities. Data Pump enables you to specify whether or not a job should move a subset of the data and metadata. This is done using data filters and metadata filters, which are implemented through Export and Import parameters using the Metadata API and the Data Pump API. The Metadata API uses the procedures provided in the DBMS_METADATA PL/SQL package and the Data Pump API uses the procedures provided in the DBMS_DATAPUMP PL/SQL package. See *Oracle Database Concepts*, *Oracle Database Utilities*, and *Oracle Database PL/SQL Packages and Types Reference* for more information.

8.5 Reading Data from an ORDVideo Object Using the readFromSource( ) Method in a PL/SQL Script

Example 8–6 shows the contents of the `readvideo1.sql` file. This procedure reads data from an ORDVideo object with the video stored in a BLOB in the database using the readFromSource( ) method in a PL/SQL script until no more data is found. The procedure then returns a NO_DATA_FOUND exception when the read operation is complete and displays an "End of data" message.

Note: This example can be modified to work with the ORDAudio, ORDDoc, and ORDImage objects too.

Example 8–6 Read Data from an ORDVideo Column Object Using the interMedia readFromSource( ) Method in a PL/SQL Stored Procedure

```
create or replace procedure readVideo1(i integer)  as

   obj ORDSYS.ORDVideo;
   buffer RAW (32767);
   numbytes BINARY_INTEGER := 32767;
   startpos integer := 1;
   read_cnt integer := 1;
   ctx RAW(4000) := NULL;

BEGIN

   Select  mediacontent into obj from juke where id = 100001;

   LOOP
           obj.readFromSource(ctx,startpos,numbytes,buffer);
           startpos := startpos + numBytes;
           read_cnt := read_cnt + 1;

   END LOOP;

EXCEPTION

   WHEN NO_DATA_FOUND THEN
   DBMS_OUTPUT.PUT_LINE('End of data ');
   DBMS_OUTPUT.PUT_LINE('doing read  '|| read_cnt);
   DBMS_OUTPUT.PUT_LINE('start position :'|| startpos);

END;

/
show errors
```

8.6 Getting the Best Performance Results

The following guidelines can be used to help you achieve the best performance when working with *inter*Media objects:

- Because *inter*Media objects are big, attain the best performance by reading and writing large CHUNKS of an *inter*Media object value at a time. This helps in several respects:
  - If you are accessing the *inter*Media object from the client side and the client is on a different node than the server, large read/write operations reduce network overhead.
  - If you are using the NOCACHE option, each small read/write operation incurs an I/O impact. Reading and writing large quantities of data reduces the I/O impact.
  - Writing to the *inter*Media object creates a new version of the *inter*Media object CHUNK. Therefore, writing small amounts at a time will incur the cost of a new version for each small write operation. If logging is on, the CHUNK is also stored in the redo log.
- If you need to read or write small pieces of *inter*Media object data on the client, use LOB buffering (see OCILobEnableBuffering( ), OCILobDisableBuffering( ), OCILobFlushBuffer( ), OCILobWrite( ), OCILobRead( ) in *Oracle Call Interface Programmer's Guide* for more information.). Turn on LOB buffering before reading or writing small pieces of *inter*Media object data. For more information about LOB buffering, its advantages, guidelines for use, and usage, see *Oracle Database Application Developer's Guide - Large Objects*.
- Use *inter*Media methods (readFromSource( ) and writeToSource( )) for audio and video data or OCILobWrite( ) and OCILobRead( ) with a callback for image data so media data is streamed to and from the BLOB. Ensure that the length of the entire write operation is set in the `numBytes` parameter using *inter*Media methods or in the `amount` parameter using OCI calls on input. Whenever possible, read and write in multiples of the LOB CHUNK size.
- Use a checkout/checkin model for LOBs. LOBs are optimized for the following:
  - Updating *inter*Media object data: SQL UPDATE operations, which replaces the entire BLOB value.
  - Copying the entire LOB data to the client, modifying the LOB data on the client side, and copying the entire LOB data back to the database. This can be done using OCILobRead( ) and OCILobWrite( ) with streaming.
- Commit changes frequently.
- Follow temporary LOB performance guidelines.

  See *Oracle Database Application Developer's Guide - Large Objects* for information and guidelines about using temporary LOBs.

- Use *inter*Media column objects containing BLOBs in table partitions.

  See the information about LOBs in partitioned tables in *Oracle Database Application Developer's Guide - Large Objects* and see *Oracle Database SQL Reference* for examples, specifically the CREATE TABLE statement and the Partitioned Table with LOB Columns example.

See *Oracle Database Application Developer's Guide - Large Objects* for more information.

8.7 Improving Multimedia LOB Data Retrieval and Update Performance

Once the LOB data is stored in the database, a modified strategy must be used to improve the performance of retrieving and updating the LOB data compared to the insertion strategy described in Section 8.3. The following guidelines should be considered:

- Use the CACHE option on LOBs if the same LOB data is to be accessed frequently by other users.
- Increase the number of buffers if you are going to use the CACHE option.
- Have enough buffers to hold the object. Using a small number of buffers for large objects is not good. Set the DB_CACHE_SIZE parameter to a value that you know will hold the object.
- Ensure that your redo log files are much larger than they usually are; otherwise, you may be waiting for log switches, especially if you are making many updates to your LOB data.
- Ensure that you use a larger page size (DB_BLOCK_SIZE), especially if the majority of the data in the database is LOB data.

9

Oracle *inter*Media Examples

This chapter provides examples that show common operations with Oracle *inter*Media ("*inter*Media"). The examples are presented by the following data groups:

- Audio (Section 9.1)
- Media (Section 9.2)
- Image (Section 9.3)
- Video (Section 9.4)

These sections include scripts that perform common operations, including these:

- Populating an ORDAudio object with BLOB data (Section 9.1.2)
- Populating an ORDDoc object from a file data source (Section 9.2.1)
- Populating an ORDImage object from a file data source (Section 9.3.1)
- Loading an image table from an HTTP data source (Section 9.3.2)
- Addressing globalization support issues (Section 9.3.3)

These scripts, and other examples, can be found on the Oracle *inter*Media Sample Code section of the Oracle Technology Network (OTN) Web site at

`http://www.oracle.com/technology/products/intermedia/index.html`

Select **Sample Code** under **Oracle *inter*Media Resources** to go to the Oracle *inter*Media Sample Code Web page. On that page, select **Use *inter*Media and PL/SQL to manage media content** under ***inter*Media Code Samples**.

9.1 Audio Data Examples

Audio data examples using *inter*Media include the following common operations:

- Using *inter*Media with object views (See Section 9.1.1)
- Using a set of scripts for populating an ORDAudio object with BLOB data stored in the database (See Section 9.1.2)

Reference information on the methods used in these examples is presented in *Oracle interMedia Reference*.

9.1.1 Using Audio Types with Object Views

This section describes how to use audio types with object views. Just as a view is a virtual table, an object view is a virtual object table.

Oracle provides object views as an extension of the basic relational view mechanism. By using object views, you can create virtual object tables -- of either built-in or user-defined types -- from data stored in the columns of relational or object tables in the database.

Object views can offer specialized or restricted access to the data and objects in a database. For example, you might use an object view to provide a version of an employee object table that does not have attributes containing sensitive data or a deletion method. Object views also let you try object-oriented programming without permanently converting your tables. Using object views, you can convert data gradually and transparently from relational tables to object-relational tables.

In Example 9–1, consider the following relational table (containing no ORDAudio objects).

Example 9–1 Define a Relational Table Containing No ORDAudio Object

```
create table flat (
   id                NUMBER,
   description       VARCHAR2(4000),
   localData         BLOB,
   srcType           VARCHAR2(4000),
   srcLocation       VARCHAR2(4000),
   srcName           VARCHAR2(4000),
   upDateTime        DATE,
   local             NUMBER,
   format            VARCHAR2(31),
   mimeType          VARCHAR2(4000),
   comments          CLOB,
   encoding          VARCHAR2(256),
   numberOfChannels  NUMBER,
   samplingRate      NUMBER,
   sampleSize        NUMBER,
   compressionType   VARCHAR2(4000),
   audioDuration     NUMBER,
);
```

You can create an object view on the relational table shown in Example 9–1 as follows in Example 9–2.

Example 9–2 Define an Object View Containing an ORDAudio Object and Relational Columns

```
create or replace view object_audio_v as
  select
      id,
      ORDSYS.ORDAudio(T.description,
      ORDSYS.ORDSource(
         T.localData, T.srctype, T.srcLocation, T.srcName, T.updateTime,
         T.local),
         T.format,
         T.mimeType,
         T.comments,
         T.encoding,
         T.numberOfChannels,
         T.samplingRate,
         T.sampleSize,
         T.compressionType,
         T.audioDuration)
   from flat T;
```

Object views provide the flexibility of looking at the same relational or object data in more than one way. Therefore, you can use different in-memory object representations for different applications without changing the way you store the data in the database. See *Oracle Database Concepts* for more information about defining, using, and updating object views.

9.1.2 Scripts for Populating an ORDAudio Object with BLOB Data

The scripts presented in this section demonstrate how to populate an *inter*Media ORDAudio object from an existing BLOB stored in the database.

Table 9–1 lists each script by name, along with a brief description of the operations it performs. Each script is included and described in further detail in the sections that follow.

Table 9–1 Audio Scripts

Script Name	Operations Performed
`create_mediadir.sql` Example 9–3	Creates an audio data load directory. (See Section 9.1.2.1)
`create_soundtable.sql` Example 9–4	Creates and populates the `soundtable` table. (See Section 9.1.2.2)
`create_audtable.sql` Example 9–5	Creates and populates the `audio_table` table. (See Section 9.1.2.3)
`import_aud.sql` Example 9–6	Loads the audio data. This script imports the audio data from the `soundtable` table into the `audio_table` table using the ORDAudio import( ) method. (See Section 9.1.2.4)
`copy_audblob.sql` Example 9–7	Copies the BLOB data from the `soundtable` table to the `audio_table` table using a SQL UPDATE statement. (See Section 9.1.2.5)
`showprop_aud.sql` Example 9–8	Displays the properties of the loaded audio data stored in the `audio_table` table. (See Section 9.1.2.6)
`setup_audsample.sql` Example 9–9	Automates the process by running the previous audio scripts in the required order. (See Section 9.1.2.7)
`cleanup_audsample.sql` Example 9–10	Cleans up the process by removing the sample tables, directories, and procedures from your database. (See Section 9.1.2.8)

9.1.2.1 Create an Audio Data Load Directory

The `create_mediadir.sql` script creates the audio data load directory. This script is shown in Example 9–3.

To successfully load the audio data, you must have a `mediadir` directory created on your system. This directory must contain your sample audio clip file, `aud1.wav`, which is installed in the *`<ORACLE_HOME>`*`/ord/aud/demo` directory. Actually, you can copy any supported audio data clip file to the `mediadir` directory to run this script. Be sure to change the data file name in the script to correspond with the name of the data file you use. This directory path and disk drive must be specified in the CREATE DIRECTORY statement in the `create_mediadir.sql` file.

Note: You must have the CREATE ANY DIRECTORY privilege to run this script. If you wish to delete previous instances of the audio data load directory, you will also need the DROP ANY DIRECTORY privilege. You must edit the `create_mediadir.sql` file to replace the directory path in the CREATE DIRECTORY statement. If you run the `create_mediadir.sql` script under a different user than you run the other demo scripts, you must also replace the user in the GRANT READ statement. See the following script for detailed instructions.

Example 9–3 create_mediadir.sql

```
-- create_mediadir.sql
-- You must have the CREATE ANY DIRECTORY privilege to run this script.
--
-- You must edit this script to:
--  o replace the directory path in the CREATE DIRECTORY statement
--    with your own (see below for details)
--  o uncomment the GRANT READ ON DIRECTORY statement and grant to the
--    user under which you will run this demo

SET SERVEROUTPUT ON;
SET ECHO ON;

-- You need DROP ANY DIRECTORY privilege to delete a directory. If there
-- is no need to delete the directory, then leave the next line
-- commented out.
-- DROP DIRECTORY mediadir;

-- Create the mediadir load directory, the directory where the image
-- clips reside. You must specify the disk drive and path in the
-- CREATE DIRECTORY statement below. Edit this file to replace the
-- directory specification with your own.
CREATE OR REPLACE DIRECTORY mediadir AS 'C:/mediadir';

-- If you intend to run this demo under a user other than the user
-- that just created this directory, edit the following grant to grant
-- READ on the directory just created to the user under which you will
-- run the demo scripts.  For example, if you will run the demo scripts
-- under user 'SCOTT', then replace the string "<USER>" with "SCOTT".
-- Then uncomment the following GRANT statement.  There is no need to
-- do this if the user creating the directory will also be used to run
-- the other demo scripts.
-- GRANT READ ON DIRECTORY mediadir TO <USER>;
```

9.1.2.2 Create and Populate the soundtable Table

The `create_soundtable.sql` script creates and populates the `soundtable` table. This table contains a BLOB column; it shows how to populate a table with an *inter*Media ORDAudio column from a table with a BLOB column. The `soundtable` table is created for demonstration purposes only. This script is shown in Example 9–4.

To demonstrate how to populate a table with an *inter*Media ORDAudio column from a table with a BLOB column, first we must have a table with a BLOB column. The `soundtable` table is our sample table with a BLOB column. This script creates the soundtable table, inserts a row with an empty BLOB, loads the BLOB with with audio data, and then checks the length of the BLOB data.

> **Note:** This script must be run from a user with the CREATE TABLE privilege.

Example 9–4 create_soundtable.sql

```
-- create_soundtable.sql
--
-- This script must be run from a user with CREATE TABLE privilege.
--
-- Create the soundtable table.  This table is used ONLY to show
-- how to copy data from a BLOB column to an ORDAudio column.
--
-- Insert a row into the table with an empty BLOB.
-- Load the row with BLOB data by pointing to the audio file to
-- be loaded from the directory specified using the BFILE data
-- type.
-- Close the files and commit the transaction.
-- Check the length of the BLOB loaded. Is the length
-- what you are expecting?
--

SET SERVEROUTPUT ON;
SET ECHO ON;

DROP TABLE soundtable PURGE;
CREATE TABLE soundtable (id number,
                         sound BLOB
       default EMPTY_BLOB());

INSERT INTO soundtable(id, sound) VALUES (1, EMPTY_BLOB());
COMMIT;
DECLARE
   f_lob BFILE := BFILENAME('MEDIADIR','aud1.wav');
   b_lob BLOB;
   Lob BLOB;
   Length INTEGER;
BEGIN

  SELECT sound INTO b_lob FROM soundtable WHERE id=1 FOR UPDATE;

-- Open the LOBs.
  dbms_lob.open(f_lob, dbms_lob.file_readonly);
  dbms_lob.open(b_lob, dbms_lob.lob_readwrite);

-- Populate the BLOB from the 'aud1.wav' file in the BFILE
  dbms_lob.loadfromfile
     (b_lob, f_lob, dbms_lob.getlength(f_lob));

-- Close the LOBs.
  dbms_lob.close(b_lob);
  dbms_lob.close(f_lob);
  COMMIT;
```

```
-- Select the LOB:
  SELECT sound INTO Lob FROM soundtable
      WHERE ID = 1;

-- Opening the LOB is optional.
  DBMS_LOB.OPEN (Lob, DBMS_LOB.LOB_READONLY);
-- Get the length of the LOB and verify length is not null.
  length := DBMS_LOB.GETLENGTH(Lob);
  IF length IS NULL THEN
    DBMS_OUTPUT.PUT_LINE('LOB is null.');
  ELSE
    DBMS_OUTPUT.PUT_LINE('The length is ' || length);
  END IF;
-- Closing the LOB is mandatory if you have opened it.
  DBMS_LOB.CLOSE (Lob);
END;
/
```

9.1.2.3 Create and Populate the audio_table Table

The `create_audtable.sql` script creates and populates the `audio_table` table. This table contains an ORDAudio column. This script creates the `audio_table` table with two columns (`id`, `audio`), inserts two rows, and initializes the `audio` column. This script is shown in Example 9–5.

Note: Calling the ORDAudio.init( ) method initializes the blob attribute of the ORDAudio object. This is necessary to populate the BLOB with data.

This script must be run from a user with the CREATE TABLE privilege.

Example 9–5 create_audtable.sql

```
-- create_audtable.sql
--
-- This script must be run from a user with the CREATE TABLE privilege.
--
-- Create the audio_table table.
-- Insert two rows with empty BLOBs and initialize object attributes.


SET SERVEROUTPUT ON;
SET ECHO ON;

DROP TABLE audio_table PURGE;


CREATE TABLE audio_table (id NUMBER,
                       audio ORDAudio)
LOB(audio.source.localData) --store audio with 32k chunk
store as (chunk 32K);


-- Insert rows with an empty BLOB and initialize the object attributes.

INSERT INTO audio_table VALUES(1,ORDAudio.init());
INSERT INTO audio_table VALUES(2,ORDAudio.init());
```

```
COMMIT;
```

9.1.2.4 Load the Audio Data

The `import_aud.sql` script imports audio data from an audio file (in the `soundtable` table) into the ORDAudio column in the `audio_table` table using the ORDAudio import( ) method. To import data into a blob attribute where the audio clip will be stored, the audio column in the row must be selected `for update`. This script is shown in Example 9–6.

To successfully run this script, you must copy one audio clip to your `mediadir` directory using the names specified in this script, or modify this script to match the file names of your audio clips.

This script should load the same audio clip that was loaded by the `create_soundtable.sql` script. It is used later in the `showprop_aud.sql` script to show that data loaded with the import( ) method matches the data copied from the BLOB column of the `soundtable` table.

Note: This script should be run from the same user as the scripts inExample 9–4 and Example 9–5.

Example 9–6 import_aud.sql

```
--import_aud.sql

DECLARE
  obj ORDAUDIO;
  ctx RAW(64) := NULL;

BEGIN

  -- selects the audio column for update
  SELECT audio INTO obj FROM audio_table WHERE id = 1 FOR UPDATE;

  --import audio clip aud1.wav from mediadir
  obj.setSource('FILE','MEDIADIR','aud1.wav');
  obj.import(ctx);

  --set properties
  obj.setProperties(ctx);

  --update table with audio object
  UPDATE audio_table SET audio = obj WHERE id = 1;


  COMMIT;

END;
/
```

9.1.2.5 Copy the BLOB Data to the ORDAudio Object

The `copy_audblob.sql` script copies the audio data in the `sound` column of the `soundtable` table into the ORDAudio object column of the `audio_table` table for a row with `id=2`. The script uses a SQL UPDATE statement to copy the BLOB data from the `soundtable` table into the `T.audio.source.localData` attribute in the `audio_table` table, which performs the copy operation. It also sets the properties and updates the time stamp for the new BLOB stored in the ORDAudio object. This script is shown in Example 9–7.

Note: This script must be run from the same user as the scripts inExample 9–4, Example 9–5, and Example 9–6.

Example 9–7 copy_audblob.sql

```
--copy_audblob.sql
--

SET SERVEROUTPUT ON;
SET ECHO ON;

-- Use the SQL UPDATE statement to set the contents of
-- T.audio.source.localData to be the same as the BLOB stored
-- in the sound column of the soundtable table. This is an easy way
-- to copy a BLOB stored in the database into a row containing
-- a column defined as an interMedia ORDAudio object type.
--
-- In this case, the BLOB (an audio clip), which was stored in
-- a row in the soundtable table containing a sound column
-- defined as a BLOB data type for an ID=1 is copied to a row
-- in the audio_table table containing an audio column defined as
-- an ORDAudio object type in which the ID=2. The audio
-- clip is referenced through the source attribute of the
-- ORDAudio object type to the underlying localData attribute
-- of the ORDSource object type.
--
-- Then (1) Call setProperties() and (2) call setUpdateTime()
-- for this new BLOB stored in the ORDAudio object type.
-- Create a procedure to do this.

CREATE OR REPLACE PROCEDURE update_proc IS

  obj ORDAudio;
  ctx RAW(64) :=NULL;

BEGIN
  UPDATE audio_table T SET T.audio.source.localData = (SELECT sound FROM
         soundtable S WHERE S.id = 1) WHERE T.id=2;
  COMMIT;

  SELECT audio INTO obj FROM audio_table WHERE id = 2 FOR UPDATE;
  obj.setProperties(ctx);
  obj.setUpdateTime(SYSDATE);
  UPDATE audio_table SET audio = obj WHERE id = 2;
  COMMIT;

EXCEPTION
  WHEN OTHERS THEN
    DBMS_OUTPUT.PUT_LINE('Operation failed');

END;
/

EXECUTE UPDATE_PROC;
```

9.1.2.6 Show the Properties of the Loaded Audio Data

The `showprop_aud.sql` script displays the properties of the audio data clips stored in the `audio_table` table in rows with `id=1` and `id=2`. They should be identical. Different load methods were used to load the same audio clip from the `soundtable` table into two rows in the `audio_table` table. This script verifies that audio data loaded using the ORDAudio import( ) method matches audio data copied from a BLOB column of the `soundtable` table. This script is shown in Example 9–8.

Note: This script must be run from the same user as the scripts inExample 9–4, Example 9–5, Example 9–6, and Example 9–7.

Example 9–8 showprop_aud.sql

```
-- showprop_aud.sql
--

SET SERVEROUTPUT ON;
SET ECHO ON;

--Query audio_table for ORDAudio content.
--
-- This script verifies that the properties of the audio data
-- in the row with ID=1 (which was populated with the ORDAudio
-- import() method), match the properties of the audio data
-- in the row with ID-2 (which was populated by copying data
-- from a BLOB in the soundtable table.
--

DECLARE
  audio ORDAudio;
  idnum integer;
  properties_match BOOLEAN;
  ctx RAW(64) :=NULL;

BEGIN
-- Check the properties of the audio data clip imported into the
-- ORDAudio object type. Properties for ID=1 should be identical
-- with ID=2.

  dbms_output.put_line(' Properties of these audio clips are identical:');

  SELECT id, audio INTO idnum, audio FROM audio_table WHERE id=1;
  dbms_output.put_line('Properties for id: ' || idnum);

  dbms_output.put_line('audio encoding: ' || audio.getEncoding);
  dbms_output.put_line('audio number of channels: ' ||
                       audio.getNumberOfChannels);
  dbms_output.put_line('audio MIME type: ' || audio.getMimeType);
  dbms_output.put_line('audio file format: ' || audio.getFormat);
  dbms_output.put_line('BLOB Length: ' ||
                       TO_CHAR(audio.getContentLength(ctx)));
  dbms_output.put_line
        ('----------------------------------------------');

-- Check the properties of the audio data clip copied into the
-- ORDAudio object type from a BLOB stored in the database.
-- Properties for ID=1 should be identical with ID=2.
```

```
  SELECT id, audio INTO idnum, audio FROM audio_table WHERE id=2;
  dbms_output.put_line('Properties for id: ' || idnum);
  dbms_output.put_line('audio encoding: ' || audio.getEncoding);
  dbms_output.put_line('audio number of channels: ' ||
                       audio.getNumberOfChannels);
  dbms_output.put_line('audio MIME type: ' || audio.getMimeType);
  dbms_output.put_line('audio file format: ' || audio.getFormat);
  dbms_output.put_line('BLOB Length: ' ||
                       TO_CHAR(audio.getContentLength(ctx)));
  dbms_output.put_line
        ('----------------------------------------------');

END;
/
```

The results from running the script `showprop_aud.sql` show that the properties are identical for each stored audio clip.

```
Properties of these audio clips are identical:

      Properties for  id:           1

audio encoding:        MS_PCM
audio number of channels:  1
audio MIME type:       audio/x-wav
audio file format:     WAVE
BLOB Length:           15932
----------------------------------------------
      Properties for id:           2

audio encoding:        MS_PCM
audio number of channels:  1
audio MIME type:       audio/x-wav
audio file format:     WAVE
BLOB Length:           15932
----------------------------------------------

PL/SQL procedure successfully completed.
```

9.1.2.7 Automate the ORDAudio Examples

The `setup_audsample.sql` script runs each of the previous audio scripts in the correct order to automate this process. This script is shown in Example 9–9.

Note: This script must be run from a user with CREATE ANY DIRECTORY and CREATE TABLE privileges.

Example 9–9 setup_audsample.sql

```
-- setup_audsample.sql
--
-- This script automates the demo by invoking each script in
-- the required order.
--

-- Create the mediadir load directory
@create_mediadir.sql

-- Create a soundtable table and populate it with
-- an audio clip:
@create_soundtable.sql

-- Create an audtable table
@create_audtable.sql

--import an audio clip
@import_aud.sql

-- Copy a BLOB into an ORDAudio object, set the properties,
-- and update the time:
@copy_audblob.sql

-- Check the properties of the audio clips. The properties
-- should be identical:
@showprop_aud.sql

--exit;
```

9.1.2.8 Clean Up the ORDAudio Examples

The `cleanup_audsample.sql` script removes the sample tables, directories, and procedures created by the previous audio scripts from your database. This script is shown in Example 9–10.

> **Note:** This script must be run from a user with DROP ANY DIRECTORY privilege. This script should be run from the user that was used to run the previous audio scripts.

Example 9–10 cleanup_audsample.sql

```
-- cleanup_audsample.sql
--
-- This script removes all tables, procedures, and directories
-- created by this demonstration.  You must have the DROP ANY
-- DIRECTORY privilege to drop the audio load directory.  This
-- script should be run under the same user as the demo was run
-- under.

-- drop the audio load directory.
DROP DIRECTORY mediadir;

-- Drop the tables created by the demo.
DROP TABLE soundtable PURGE;
DROP TABLE audio_table PURGE;

-- Drop the Update procedure.
DROP PROCEDURE update_proc;

commit;
```

9.2 Media Data Examples

Media data examples using *inter*Media include the following common operation on heterogeneous data:

- Using a set of scripts for populating an ORDDoc object from a file data source (See Section 9.2.1)

Reference information on the methods used in these examples is presented in *Oracle interMedia Reference*.

9.2.1 Scripts for Populating an ORDDoc Object from a File Data Source

The scripts presented in this section demonstrate how to populate an ORDDoc object from an existing file.

Table 9–2 lists each script by name, along with a brief description of the operations it performs. Each script is included and described in further detail in the sections that follow.

Table 9–2 Media Scripts

Script Name	Operations Performed
`create_mediadir.sql` Example 9–11	Creates a media data load directory. (See Section 9.2.1.1)
`create_doctable.sql` Example 9–12	Creates and populates the `doc_table` table. (See Section 9.2.1.2)
`import_doc.sql` Example 9–13	Loads the media data. This script imports the media data from a file into the `doc_table` table using the ORDDoc import( ) method. (See Section 9.2.1.3)
`read_doc.sql` Example 9–14	Reads the media data from a BLOB using a stored procedure. (See Section 9.2.1.4)
`showprop_doc.sql` Example 9–15	Displays the properties of the loaded media data stored in the `doc_table` table. (See Section 9.2.1.5)
`setup_docsample.sql` Example 9–16	Automates the process by running the previous media scripts in the required order. (See Section 9.2.1.6)
`cleanup_docsample.sql` Example 9–17	Cleans up the process by removing the sample tables, directories, and procedures from your database. (See Section 9.2.1.7)

9.2.1.1 Create a Media Data Load Directory

The `create_mediadir.sql` script creates the media data load directory. This script is shown in Example 9–11.

To successfully load the media data, you must have a `mediadir` directory created on your system. This directory must contain your sample audio media files, `aud1.wav` and `aud2.mp3`, which are installed in the `<`*`ORACLE_HOME`*`>/ord/aud/demo` directory. Actually, you can copy any supported media files to the `mediadir` directory to run this script. Be sure to change the data file name in the script to correspond with the name of the data file you use. This directory path and disk drive must be specified in the CREATE DIRECTORY statement in the `create_mediadir.sql` file.

Note: You must have the CREATE ANY DIRECTORY privilege to run this script. If you wish to delete previous instances of the media data load directory, you will also need the DROP ANY DIRECTORY privilege. You must edit the `create_mediadir.sql` file to replace the directory path in the CREATE DIRECTORY statement. If you run the `create_mediadir.sql` script under a different user than you run the other demo scripts, you must also replace the user in the GRANT READ statement. See the following script for detailed instructions.

Example 9–11 create_mediadir.sql

```
-- create_mediadir.sql
-- You must have the CREATE ANY DIRECTORY privilege to run this script.
--
-- You must edit this script to:
--  o replace the directory path in the CREATE DIRECTORY statement
--    with your own (see below for details)
--  o uncomment the GRANT READ ON DIRECTORY statement and grant to the
--    user under which you will run this demo

SET SERVEROUTPUT ON;
SET ECHO ON;

-- You need DROP ANY DIRECTORY privilege to delete a directory. If there
-- is no need to delete the directory, then leave the next line
-- commented out.
-- DROP DIRECTORY mediadir;

-- Create the mediadir load directory, the directory where the media
-- data resides. You must specify the disk drive and path in the
-- CREATE DIRECTORY statement below. Edit this file to replace the
-- directory specification with your own.
CREATE OR REPLACE DIRECTORY mediadir AS 'C:/mediadir';

-- If you intend to run this demo under a user other than the user
-- that just created this directory, edit the following grant to grant
-- READ on the directory just created to the user under which you will
-- run the demo scripts.  For example, if you will run the demo scripts
-- under user 'SCOTT', then replace the string "<USER>" with "SCOTT".
-- Then uncomment the following GRANT statement.  There is no need to
-- do this if the user creating the directory will also be used to run
-- the other demo scripts.
-- GRANT READ ON DIRECTORY mediadir TO <USER>;
```

9.2.1.2 Create and Populate the doc_table Table

The `create_doctable.sql` script creates and populates the `doc_table` table. This table contains an ORDDoc column. This script creates the `doc_table` table with two columns (`id`, `document`), inserts two rows, and initializes the `document` column. This script is shown in Example 9–12.

Note: Calling the ORDDoc.init( ) method initializes the blob attribute of the ORDDoc object. This is necessary to populate the BLOB with data.

This script must be run from a user with the CREATE TABLE privilege.

Example 9–12 create_doctable.sql

```
-- create_doctable.sql
--
-- This script must be run from a user with the CREATE TABLE privilege.
--
-- Create the doc_table table.
-- Insert two rows with empty ORDDoc columns.
--

SET SERVEROUTPUT ON;
SET ECHO ON;

DROP TABLE doc_table PURGE;
CREATE TABLE doc_table (id NUMBER,
                        document ORDDoc)
LOB(document.source.localData) --store media with 32k chunk
store as (chunk 32K);

-- Insert a row with an empty ORDDoc object.
INSERT INTO doc_table VALUES(1,ORDDoc.init());
-- Insert a row with an empty BLOB.
INSERT INTO doc_table VALUES(2,ORDDoc.init());

COMMIT;
```

9.2.1.3 Load the Media Data

The `import_doc.sql` script imports media data from a media file into the ORDDoc column in the `doc_table` table using the ORDDoc import( ) method. To import data into a blob attribute where the media data will be stored, the `document` column in the row must be selected `for update`. This script is shown in Example 9–13.

To successfully run this script, you must copy two media files to your `mediadir` directory using the names specified in this script, or modify this script to match the file names of your media files.

Note: This script should be run from the same user as the script in Example 9–12.

Example 9–13 import_doc.sql

```
-- import_doc.sql
--
-- This script uses the import method to load the media data into the
-- ORDDoc column.  It then extracts properties from the media using
-- the setProperties method.
--
-- To successfully run this script, you must copy two media files to your
-- MEDIADIR directory using the names specified in this script, or modify
-- this script to match the file names of your media.
```

```
--

SET SERVEROUTPUT ON;
SET ECHO ON;

DECLARE
  obj ORDDOC;
  ctx RAW(64) := NULL;

BEGIN
-- This imports the audio file aud1.wav from the MEDIADIR directory
-- on a local file system (srcType=file) and sets the properties.

  SELECT document INTO obj FROM doc_table WHERE id = 1 FOR UPDATE;
  obj.setSource('FILE','MEDIADIR','aud1.wav');
  obj.import(ctx,TRUE);

  UPDATE doc_table SET document = obj WHERE id = 1;
  COMMIT;

-- This imports the audio file aud2.mp3 from the MEDIADIR directory
-- on a local file system (srcType=file) and sets the properties.
  SELECT document INTO obj FROM doc_table WHERE id = 2 FOR UPDATE;
  obj.setSource('FILE','MEDIADIR','aud2.mp3');
  obj.import(ctx,TRUE);

  UPDATE doc_table SET document = obj WHERE id = 2;
  COMMIT;
END;
/
```

9.2.1.4 Read the Media Data from the BLOB

The `read_doc.sql` script reads media data from a BLOB by creating the stored procedure `readdocument`. This procedure reads a specified amount of media data from the BLOB attribute, beginning at a particular offset, until all the media data is read. This script is shown in Example 9–14.

> **Note:** This script must be run from the same user as the scripts in Example 9–12 and Example 9–13.

Example 9–14 read_doc.sql

```
--read_doc.sql


SET SERVEROUTPUT ON
SET ECHO ON

----Read from the OrdDoc object column in the doc_table.
create or replace procedure readdocument as
obj ORDDoc;
buffer RAW (32767);
numBytes BINARY_INTEGER := 32767;
startpos integer := 1;
read_cnt integer := 1;
ctx RAW(64) := NULL;
BEGIN
  select document into obj from doc_table where id = 1;
  LOOP
    obj.readFromSource(ctx,startPos,numBytes,buffer);
    DBMS_OUTPUT.PUT_LINE('BLOB Length: ' || TO_CHAR(obj.getContentLength()));
    DBMS_OUTPUT.PUT_LINE('start position: '|| startPos);
    DBMS_OUTPUT.PUT_LINE('doing read: ' || read_cnt);
    startpos := startpos + numBytes;
    read_cnt := read_cnt + 1;
   END LOOP;

   -- Note: Add your own code here to process the media data being read;
   -- this routine just reads the data into the buffer 32767 bytes
   -- at a time, then reads the next chunk, overwriting the first
   -- buffer full of data.
   EXCEPTION
     WHEN NO_DATA_FOUND THEN
       DBMS_OUTPUT.PUT_LINE('End of data ');
     WHEN ORDSYS.ORDSourceExceptions.METHOD_NOT_SUPPORTED THEN
       DBMS_OUTPUT.PUT_LINE('ORDSourceExceptions.METHOD_NOT_SUPPORTED caught');
     WHEN OTHERS THEN
       DBMS_OUTPUT.PUT_LINE('EXCEPTION caught');
END;
/
show errors
```

To execute the stored procedure, enter the following SQL statements:

```
SQL> set serveroutput on;
SQL> execute readdocument
Content Length: 93594
start position: 1
doing read: 1
start position: 32768
doing read: 2
start position: 65535
doing read: 3
----------------
End of data

PL/SQL procedure successfully completed.
```

9.2.1.5 Show the Properties of the Loaded Media Data

The `showprop_doc.sql` script displays the properties of the media data loaded into the `doc_table` table. This script is shown in Example 9–15.

Note: This script must be run from the same user as the scripts in Example 9–12, Example 9–13, and Example 9–14.

Example 9–15 showprop_doc.sql

```
-- showprop_doc.sql
--

SET SERVEROUTPUT ON;
SET ECHO ON;

--
-- Query doctable for ORDDoc.

DECLARE
```

```
  document ORDDoc;
  idnum integer;
  ctx RAW(64) := NULL;
BEGIN
  FOR I IN 1..2 LOOP
  SELECT id, document INTO idnum, document FROM doc_table WHERE id=I;
  dbms_output.put_line('document id: '|| idnum);
  dbms_output.put_line('document MIME type: '|| document.getMimeType());
  dbms_output.put_line('document file format: '|| document.getFormat());
  dbms_output.put_line('BLOB Length: '|| TO_CHAR(document.getContentLength()));
  dbms_output.put_line('----------------------------------------------');
  END loop;
END;
/
```

The results from running the script `showprop_doc.sql` are the following:

```
SQL> @showprop_doc.sql
document id:          1
document MIME type:       audio/xwav
document file format:     WAVE
BLOB Length:           93594
----------------------------------------------
document id:          2
document MIME type:       audio/mpeg
document file format:     MPGA
BLOB Length:           51537
----------------------------------------------
PL/SQL procedure successfully completed.
```

9.2.1.6 Automate the ORDDoc Examples

The `setup_docsample.sql` script runs each of the previous media scripts in the correct order to automate this process. This script is shown in Example 9–16.

Note: This script must be run from a user with CREATE ANY DIRECTORY and CREATE TABLE privileges.

Example 9–16 setup_docsample.sql

```
-- setup_docsample.sql
--
-- This script automates the demo by invoking each script in
-- the required order.
--

-- Create the mediadir load directory
@create_mediadir.sql

-- Create the media table:
@create_doctable.sql

--Import 2 media clips and set properties:
@import_doc.sql

--Display the properties of the media clips:
@showprop_doc.sql

--create stored procedure to read from ordDoc
@read_doc.sql
```

```
--Execute stored procedure
execute readdocument

--exit;
```

9.2.1.7 Clean Up the ORDDoc Examples

The `cleanup_docsample.sql` script removes the sample tables, directories, and procedures created by the previous media scripts from your database. This script is shown in Example 9–17.

Note: This script must be run from a user with DROP ANY DIRECTORY privilege. This script should be run from the user that was used to run the previous media scripts.

Example 9–17 cleanup_docsample.sql

```
-- cleanup_docsample.sql
--
-- This script removes all tables and directories created by this
-- demonstration.  You must have the DROP ANY DIRECTORY privilege
-- to drop the doc load directory.  This script should be run under
-- the same user as the demo was run under.

-- drop the doc load directory.
DROP DIRECTORY mediadir;

-- Drop the table created by the demo.
DROP TABLE doc_table PURGE;
```

9.3 Image Data Examples

Image data examples using *inter*Media include the following common operations:

- Using a set of scripts for populating an ORDImage object from a file data source (See Section 9.3.1)
- Using a set of scripts for loading an image table from an HTTP data source (See Section 9.3.2)
- Addressing globalization support issues

Reference information on the methods used in these examples is presented in *Oracle interMedia Reference*.

9.3.1 Scripts for Populating an ORDImage Object from a File Data Source

The scripts presented in this section demonstrate how to populate an *inter*Media ORDImage object from an existing file.

Table 9–3 lists each script by name, along with a brief description of the operations it performs. Each script is included and described in further detail in the sections that follow.

Table 9–3 Image Scripts

Script Name	Operations Performed
`create_mediadir.sql` Example 9–18	Creates an image data load directory. (See Section 9.3.1.1)
`create_imgtable.sql` Example 9–19	Creates and populates the `image_table` table. (See Section 9.3.1.2)
`import_img.sql` Example 9–20	Loads the image data. This script imports the image data from a file into the `image_table` table using the ORDImage import( ) method. (See Section 9.3.1.3)
`read_image.sql` Example 9–21	Reads the image data from a BLOB using a stored procedure. (See Section 9.3.1.4)
`showprop_img.sql` Example 9–22	Displays the properties of the loaded image data stored in the `image_table` table. (See Section 9.3.1.5)
`setup_imgsample.sql` Example 9–23	Automates the process by running the previous image scripts in the required order. (See Section 9.3.1.6)
`cleanup_imgsample.sql` Example 9–24	Cleans up the process by removing the sample tables, directories, and procedures from your database. (See Section 9.3.1.7)

9.3.1.1 Create an Image Data Load Directory

The `create_mediadir.sql` script creates the image data load directory. This script is shown in Example 9–18.

To successfully load the image data, you must have a `mediadir` directory created on your system. This directory must contain your sample image media files, `img71.gif` and `img50.gif`, which are installed in the <*ORACLE_HOME*>`/ord/img/demo` directory. Actually, you can copy any supported image files to the `mediadir` directory to run this script. Be sure to change the data file name in the script to correspond with the name of the data file you use. This directory path and disk drive must be specified in the CREATE DIRECTORY statement in the `create_mediadir.sql` file.

Note: You must have the CREATE ANY DIRECTORY privilege to run this script. If you wish to delete previous instances of the image data load directory, you will also need the DROP ANY DIRECTORY privilege. You must edit the `create_mediadir.sql` file to replace the directory path in the CREATE DIRECTORY statement. If you run the `create_mediadir.sql` script under a different user than you run the other demo scripts, you must also replace the user in the GRANT READ statement. See the following script for detailed instructions.

Example 9–18 create_mediadir.sql

```
-- create_mediadir.sql
-- You must have the CREATE ANY DIRECTORY privilege to run this script.
--
```

```
-- You must edit this script to:
--  o replace the directory path in the CREATE DIRECTORY statement
--    with your own (see below for details)
--  o uncomment the GRANT READ ON DIRECTORY statement and grant to the
--    user under which you will run this demo

SET SERVEROUTPUT ON;
SET ECHO ON;

-- You need DROP ANY DIRECTORY privilege to delete a directory. If there
-- is no need to delete the directory, then leave the next line
-- commented out.
-- DROP DIRECTORY mediadir;

-- Create the mediadir load directory, the directory where the image
-- clips reside. You must specify the disk drive and path in the
-- CREATE DIRECTORY statement below. Edit this file to replace the
-- directory specification with your own.
CREATE OR REPLACE DIRECTORY mediadir AS 'C:/mediadir';

-- If you intend to run this demo under a user other than the user
-- that just created this directory, edit the following grant to grant
-- READ on the directory just created to the user under which you will
-- run the demo scripts.  For example, if you will run the demo scripts
-- under user 'SCOTT', then replace the string "<USER>" with "SCOTT".
-- Then uncomment the following GRANT statement.  There is no need to
-- do this if the user creating the directory will also be used to run
-- the other demo scripts.
-- GRANT READ ON DIRECTORY mediadir TO <USER>;
```

9.3.1.2 Create and Populate the image_table Table

The `create_imgtable.sql` script creates and populates the `image_table` table. This table contains an ORDImage column. This script creates the `image_table` table with two columns (`id`, `image`), inserts two rows, and initializes the `image` column. This script is shown in Example 9–19.

Note: Calling the ORDImage.init( ) method initializes the blob attribute of the ORDImage object. This is necessary to populate the BLOB with data.

This script must be run from a user with the CREATE TABLE privilege.

Example 9–19 create_imgtable.sql

```
-- create_imgtable.sql
--
-- This script must be run from a user with the CREATE TABLE privilege.
--
-- Create the image_table table.
-- Insert two  rows with empty OrdImage columns  and initialize object attributes.

SET SERVEROUTPUT ON;
SET ECHO ON;

DROP TABLE image_table PURGE;
CREATE TABLE image_table (id NUMBER,
                       image ORDImage)
```

```
LOB(image.source.localData) --store image with 32k chunk
store as (chunk 32K);


-- Insert rows with empty OrdImage columns and initialize the object attributes.

INSERT INTO image_table VALUES(1,ORDImage.init());
INSERT INTO image_table VALUES(2,ORDImage.init());

COMMIT;
```

9.3.1.3 Load the Image Data

The `import_img.sql` script imports image data from an image file into the ORDImage column in the `image_table` table using the ORDImage import( ) method. To import data into a blob attribute where the image will be stored, the `image` column in the row must be selected `for update`. This script is shown in Example 9–20.

To successfully run this script, you must copy two image files to your `mediadir` directory using the file names specified in this script, or modify this script to match the file names of your image files.

> **Note:** This script should be run from the same user as the script in Example 9–19.

Example 9–20 import_img.sql

```
-- import_img.sql
--
SET SERVEROUTPUT ON
SET ECHO ON

-- Import the two files into the database.

DECLARE
  obj ORDIMAGE;
  ctx RAW(64) := NULL;
BEGIN
-- This imports the image file img71.gif from the MEDIADIR directory
-- on a local file system (srcType=file).
-- the import method  also sets the object properties by reading the image blob.
  select Image into obj from image_table where id = 1 for update;
  obj.setSource('file','MEDIADIR','img71.gif');
  obj.import(ctx);
  update image_table set image = obj where id = 1;
commit;

-- This imports the image file img50.gif from the MEDIADIR directory
select Image into obj from image_table where id = 2 for update;
obj.setSource('file','MEDIADIR','img50.gif');
obj.import(ctx);
update image_table set image = obj where id = 2;
commit;
END;
/
```

9.3.1.4 Read the Image Data from the BLOB

The `read_image.sql` script reads image data from a BLOB by creating the stored procedure `readimage`. This procedure reads a specified amount of image data from the BLOB attribute, beginning at a particular offset, until all the image data is read. This script is shown in Example 9–21.

Note: This script must be run from the same user as the scripts in Example 9–19 and Example 9–20.

Example 9–21 read_image.sql

```
-- read_image.sql
set serveroutput on
set echo on
create or replace procedure readimage as
-- Note: ORDImage has no readFromSource method like ORDAudio
-- and ORDVideo; therefore, you must use the DBMS_LOB package to
-- read image data from a BLOB.
buffer RAW (32767);
src BLOB;
obj ORDImage;
amt BINARY_INTEGER := 32767;
pos integer := 1;
read_cnt integer := 1;
BEGIN
  Select t.image.getcontent() into src from image_table t where t.id = 1;
  Select image into obj from image_table t where t.id = 1;
DBMS_OUTPUT.PUT_LINE('Content length is: '||      TO_
CHAR(obj.getContentLength()));
LOOP
DBMS_LOB.READ(src,amt,pos,buffer);
DBMS_OUTPUT.PUT_LINE('start position: '|| pos);
DBMS_OUTPUT.PUT_LINE('doing read '|| read_cnt);
pos := pos + amt;
read_cnt := read_cnt + 1;
-- Note: Add your own code here to process the image data being read;
-- this routine just reads data into the buffer 32767 bytes
-- at a time, then reads the next chunk, overwriting the first
-- buffer full of data.
END LOOP;
EXCEPTION
WHEN NO_DATA_FOUND THEN
DBMS_OUTPUT.PUT_LINE('----------------');
DBMS_OUTPUT.PUT_LINE('End of data ');
END;
/
show errors
```

To execute the stored procedure, enter the following SQL statements:

```
SQL> set serveroutput on;
SQL> execute read_image;
Content length is: 1124
start position: 1
doing read  1
----------------
End of data

PL/SQL procedure successfully completed.
```

9.3.1.5 Show the Properties of the Loaded Image Data

The `showprop_img.sql` script displays the properties of the image data loaded into the `image_table` table. This script is shown in Example 9–22.

Note: This script must be run from the same user as the scripts in Example 9–19, Example 9–20, and Example 9–21.

Example 9–22 showprop_img.sql

```
-- showprop_img.sql
--


SET SERVEROUTPUT ON;
SET ECHO ON;

-- This script displays properties of the image stored in image_table
--

DECLARE
 image ORDImage;
 idnum integer;
 rowcount integer;
BEGIN

  FOR I IN 1..2 LOOP
    SELECT id, image into idnum, image from image_table where id=I;
    dbms_output.put_line('Image properties:');
    dbms_output.put_line('image id: '|| idnum);
    dbms_output.put_line('image height: '|| image.getHeight());
    dbms_output.put_line('image width: '|| image.getWidth());
    dbms_output.put_line('image MIME type: '|| image.getMimeType());
    dbms_output.put_line('image file format: '|| image.getFileFormat());
    dbms_output.put_line('BLOB Length: '|| TO_CHAR(image.getContentLength()));
    dbms_output.put_line('-------------------------------------------');
  END loop;
END;
/
```

The results from running the script `showprop_img.sql` are the following:

```
SQL> @showprop_img.sql
image id:          1

image height:      15
image width:       43
image MIME type:   image/gif
image file format: GIFF
BLOB Length:       1124
-------------------------------------------
image id:          2

image height:      32
image width:       110
image MIME type:   image/gif
image file format: GIFF
BLOB Length:       686
-------------------------------------------
```

```
PL/SQL procedure successfully completed.
```

9.3.1.6 Automate the ORDImage Examples

The `setup_imgsample.sql` script runs each of the previous image scripts in the correct order to automate this process. This script is shown in Example 9–23.

Note: This script must be run from a user with CREATE ANY DIRECTORY and CREATE TABLE privileges.

Example 9–23 setup_imgsample.sql

```
-- setup_imgsample.sql
--
-- This script automates the demo by invoking each script in
-- the required order.
--

-- Create the imgdir load directory
@create_mediadir.sql

-- Create image table:
@create_imgtable.sql

--Import images into image_table
@import_img.sql

--Show properties of images
@showprop_img.sql

--create stored procedure to read from ordImage
@read_image.sql

--Execute stored procedure
execute readimage

--exit;
```

9.3.1.7 Clean Up the ORDImage Examples

The `cleanup_imgsample.sql` script removes the sample tables, directories, and procedures created by the previous image scripts from your database. This script is shown in Example 9–24.

Note: This script must be run from a user with DROP ANY DIRECTORY privilege. This script should be run from the user that was used to run the previous image scripts.

Example 9–24 cleanup_imgsample.sql

```
-- cleanup_imgsample.sql
--
-- This script removes all tables, procedures, and directories
-- created by this demonstration.  You must have the DROP ANY
-- DIRECTORY privilege to drop the image load directory.  This
-- script should be run under the same user as the demo was run
-- under.
-- drop the image load directory.
DROP DIRECTORY mediadir;

-- Drop the tables created by the demo.
DROP TABLE image_table PURGE;

-- Drop the Update procedure.
DROP PROCEDURE read_image;

commit;
exit;
```

9.3.2 Script for Loading an Image Table from an HTTP Data Source

The `import_imghttp.sql` script imports the image data from an HTTP data source . This script inserts two rows into the `image_table` table and loads the image data from the specified HTTP data source (source type `HTTP`, URL location, and HTTP object name). This script is shown in Example 9–25.

To successfully run this script, you must modify it to point to two images located on your Web site.

Example 9–25 import_imghttp.sql Script

```
--import_imghttp.sql
-- Import the two HTTP images from a Web site into the database.
-- PreRequisites:
--    You will need to do the following  before running this script
--        1. Run create_imgdir.sql
--        2. Run create_imgtable.sql
--        3. Modify the HTTP URL and object name to point to two images on
--           your own Web site.

SET SERVEROUTPUT ON
SET ECHO ON

-- Import two images from HTTP source URLs.


-- Insert two rows with an empty BLOB.
-- See above section on pre requisites
insert into image_table values (7,ORDImage.init(
'http','http://your_website/images','image1.jpg'));

insert into image_table values (8,ORDImage.init(
'http','http://your_website/images','image2.gif'));

commit;

DECLARE
  obj ORDIMAGE;
  ctx RAW(64) := NULL;
BEGIN
-- This imports the image file image1.gif from the HTTP source URL
-- (srcType=HTTP), and automatically sets the properties.
  select Image into obj from image_table where id = 7 for update;
  obj.import(ctx);
  update image_table set image = obj where id = 7;
  commit;
-- This imports the image file image2.gif from the HTTP source URL
-- (srcType=HTTP), and automatically sets the properties.
  select Image into obj from image_table where id = 8 for update;
  obj.import(ctx);
  update image_table set image = obj where id = 8;
  commit;
END;
/
```

9.3.3 Addressing Globalization Support Issues

Example 9–26 shows how to use the processCopy( ) method with language settings that use the comma as the decimal point. For example, when the territory is `FRANCE`, the decimal point is expected to be a comma. Notice that the `",75"` is specified as the scale factor. This example addresses globalization support issues.

Example 9–26 Address a Globalization Support Issue

```
ALTER SESSION SET NLS_LANGUAGE = FRENCH;
ALTER SESSION SET NLS_TERRITORY = FRANCE;
DECLARE
  myimage ORDImage;

BEGIN

  SELECT image into myimage from image_table where id=1 for update;


  myimage.ProcessCopy('scale=",75"', myimage);
  myimage.setProperties();
  UPDATE image_table SET image = myimage where id=1;
  COMMIT;
END;
/
```

Run the `showprop_img.sql` script to see the properties of the scaled image.

9.4 Video Data Examples

See *Oracle interMedia Reference* for video data examples.

A

Sample Programs

Oracle *inter*Media ("*inter*Media") includes a number of scripts and sample programs that you can use. These consist of SQL, OCI, Java, PL/SQL, and ASP/VBScript sample applications (demos).

Sample *inter*Media SQL, Java, and OCI applications are available in the following directories after you install *inter*Media:

```
On UNIX
<ORACLE_HOME>/ord/img/demo/
<ORACLE_HOME>/ord/http/demo/
<ORACLE_HOME>/ord/im/demo/java/

On Windows
<ORACLE_HOME>\ord\img\demo\
<ORACLE_HOME>\ord\http\demo\
<ORACLE_HOME>\ord\im\demo\java\
```

A.1 Sample OCI C Program for Modifying Images or Testing Image Installation

Once you have installed *inter*Media, you may choose to run the *inter*Media image OCI C program. This program can also be used as a test to confirm successful installation.

This section describes how to run the *inter*Media image sample program.

The *inter*Media image sample files are located in <*ORACLE_HOME*>`/ord/img/demo` on UNIX and <*ORACLE_HOME*>`\ord\img\demo` on Windows where <*ORACLE_HOME*> is the Oracle home directory.

A.1.1 Sample Program Installation Steps

For *inter*Media image features, see the `README.txt` file at <*ORACLE_HOME*>`/ord/img/demo` (on UNIX), and <*ORACLE_HOME*>`\ord\img\demo` (on Windows), where <*ORACLE_HOME*> is the Oracle home directory.

A.1.2 Running the Program

The file `imgdemo.c` is a sample program that shows how *inter*Media image features can be used from within a program. The program is written in C and uses OCI, Oracle Call Interface, to access the database and use *inter*Media image features.

The program operates on `imgdemo.dat`, which is a bitmap (BMP) image in the demo directory. Optionally, you can supply an image file name on the command line, provided the file resides in the same directory as the program. In either case, once the image has been manipulated by *inter*Media, the resulting image is written to the file `imgdemo.out` and can then be viewed with common rendering tools that you supply.

When the program is run, it deletes and re-creates a table named `IMGDEMOTAB` in the `SCOTT` schema of the default database. This table is used to hold the program data. Once the table is created, a reference to the image file is inserted into the table. The data is then loaded into the table and converted to JFIF using the processCopy( ) method of ORDImage.

The image properties are extracted within the database using the setProperties( ) method. An UPDATE statement is issued after the setProperties( ) invocation. This is required to make the object attributes permanent because the setProperties( ) invocation has updated only a local copy of the type attributes.

Next, the process( ) method is used to cut and scale the image within the database. This is followed by an update that commits the change. The program cuts a portion of the image 100 pixels wide by 100 pixels high, starting from pixel location (100,100). This subimage is scaled to twice its original size and the resulting image is written out to the file system in a file named `imgdemo.out`.

Upon completion, the program leaves the `imgdemo.out` file in the current directory. It also leaves the table `IMGDEMOTAB` in the `SCOTT` schema of the database.

Execute the program by typing `imgdemo` on the command line.

Use the command shown in Example A–1.

Example A–1 Execute the Sample Program from the Command Line

```
$ imgdemo <optional-image-filename>
```

The program displays a number of messages describing its progress, along with any errors encountered in the event that something was not set up correctly. Expect to see the following messages:

```
Dropping table IMGDEMOTAB...
Creating and populating table IMGDEMOTAB...
Loading data into cartridge...
Modifying image characteristics...
Writing image to file imgdemo.out...
Disconnecting from database...
Logged off and detached from server.
Demo completed successfully.
```

If the program encounters any errors, it is likely that either *inter*Media software has not been installed correctly, or the database has not been started. If the program completes successfully, the original image and the resulting image, which has undergone the cutting and scaling described earlier, can be viewed with common image rendering tools.

See Section A.2 for a description of the Java sample application that is provided to help you learn to use the multimedia client-side Java classes so you can build your own applications.

A.2 Java Sample Applications

An IMExample Java sample application has been provided to help you learn to use the audio, video, image, and media (ORDDoc) client-side Java classes so you can build your own applications. In this sample application, the sample schema is used to demonstrate the use of the OrdAudio, OrdVideo, OrdImage, and OrdDoc Java objects.

See the `README.txt` file in the *<ORACLE_HOME>*`/ord/im/demo/java` directory on UNIX and *<ORACLE_HOME>*`\ord\im\demo\java` directory on Windows for requirements and instructions on how to run this Java sample application. See Chapter 4 for a description of this Java sample application. See *Oracle Application Server 10g Multimedia Tag Library for JSP User's Guide and Reference* for information about using Oracle Application Server 10*g* Multimedia Tag Library for JSP. (This manual is available in the Oracle Application Server 10*g* Online Documentation Library.)

The IMExample Java sample application files are located in:

<ORACLE_HOME>`/ord/im/demo/java` (on UNIX)

<ORACLE_HOME>`\ord\im\demo\java` (on Windows)

The *inter*Media Java Classes Java Servlet Photo Album application shows how to use *inter*Media Java Classes for Servlets and JSP to upload and retrieve multimedia data. See the `README.txt` file at:

<ORACLE_HOME>`/ord/http/demo/servlet` (on UNIX)

<ORACLE_HOME>`\ord\http\demo\servlet` (on Windows)

The *inter*Media JavaServer Pages Photo Album application shows how to use *inter*Media Java Classes for Servlets and JSP to upload and retrieve multimedia data. See the `README.txt` file at:

<ORACLE_HOME>`/ord/http/demo/jsp` (on UNIX)

<ORACLE_HOME>`\ord\http\demo\jsp` (on Windows)

A.3 Additional PL/SQL Sample Packages

Two additional PL/SQL sample application packages are available after installing *inter*Media. These packages include:

- Oracle *inter*Media PL/SQL Web Toolkit Photo Album application

  The *inter*Media PL/SQL Web Toolkit Photo Album application shows how to upload and retrieve image data using the PL/SQL Web Toolkit and PL/SQL Gateway. The SQL scripts and `README.txt` file are at:

  <ORACLE_HOME>`/ord/http/demo/plsqlwtk` (on UNIX)

  <ORACLE_HOME>`\ord\http\demo\plsqlwtk` (on Windows)

  See Section 3.1 in Chapter 3 for more information about installing and using this application.

- Oracle *inter*Media Code Wizard for the PL/SQL Gateway

  The *inter*Media Code Wizard for the PL/SQL Gateway is an example of a tool that lets you create PL/SQL procedures for the PL/SQL Gateway to upload and retrieve media data stored in the database using any of the *inter*Media object types. The SQL scripts and `README.txt` file are at:

  <ORACLE_HOME>`/ord/http/demo/plsgwycw` (on UNIX)

  <ORACLE_HOME>`\ord\http\demo\plsgwycw` (on Windows)

  See Section 3.3 in Chapter 3 for more information about installing and using this application.

A.4 Additional ASP/VBScript Sample Application

The *inter*Media ASP/VBScript Photo Album application illustrates how to upload and retrieve multimedia data with an ASP/VBScript application. See the `README.txt` file at:

`<ORACLE_HOME>/ord/http/demo/asp` (on UNIX)

`<ORACLE_HOME>\ord\http\demo\asp` (on Windows)

A.5 Other Sample Programs

See the program examples available from the *inter*Media Web page on the Oracle Technology Network at

`http://www.oracle.com/technology/sample_`
`code/products/intermedia/index.html`

B

Installing and Upgrading Oracle *inter*Media

This appendix describes the manual installation of Oracle *inter*Media ("*inter*Media") (see Section B.1) as well as the manual upgrading of an installed version of Oracle *inter*Media (see Section B.2).

Note: See the *inter*Media `README.txt` file located in `<ORACLE_HOME>/ord/im/admin` for the latest information.

B.1 Installing Oracle *inter*Media

Oracle *inter*Media is installed and configured with Oracle Database. If, for some reason, you need to install *inter*Media manually, you can follow the instructions in this section, according to the following topics:

- Installation decisions
- Preinstallation steps
- Installation steps

B.1.1 Installation Decisions

The installation procedure creates the `ORDSYS`, `ORDPLUGINS`, `SI_INFORMTN_SCHEMA`, and `MDSYS` users. These user IDs are the standard Oracle Database account with special privileges.

Decision: Decide which tablespace to use for *inter*Media users (`ORDSYS`, `ORDPLUGINS`, and `SI_INFORMTN_SCHEMA`), and which tablespace to use for the Spatial/*inter*Media Location Services user (`MDSYS`). Oracle suggests you use the SYSAUX tablespace for both.

Decision: Decide on passwords for the `ORDSYS`, `ORDPLUGINS`, `SI_INFORMTN_SCHEMA`, and `MDSYS` users. The installation uses default passwords for `ORDSYS`, `ORDPLUGINS`, `SI_INFORMTN_SCHEMA`, and `MDSYS`. Then, it locks the accounts and expires the passwords. You must change these passwords and unlock the accounts after the installation completes if you want to log in to these accounts directly.

The default password for the `ORDSYS` user during automatic installation is `ORDSYS`, for `ORDPLUGINS` is `ORDPLUGINS`, for `SI_INFORMTN_SCHEMA` is `SI_INFORMTN_SCHEMA`, and for `MDSYS` is `MDSYS`.

The installation process grants the EXECUTE privilege to the user group PUBLIC for the *inter*Media packages and objects installed in the `ORDSYS`, `ORDPLUGINS`, and `SI_INFORMTN_SCHEMA` schemas.

B.1.2 Preinstallation Steps

Perform the following preinstallation tasks prior to manually installing and configuring *inter*Media. For instructions, see *Oracle Installation Guide* for your operating system:

1. Install Oracle Database, including PL/SQL, Oracle JVM, and Oracle XML DB.
2. Create the database.
3. Start the database.
4. Verify that Oracle JVM is installed and is valid.

   You can verify that Oracle JVM is correctly installed by running SQL*Plus, connecting as SYSDBA, and issuing the following query:

   ```
   SQL> select version, status from dba_registry where comp_id='JAVAVM';
   ```

   Ensure that the version is correct and the status is `VALID`.

B.1.3 Installation Steps

Perform the following mandatory configuration steps. Remember, you need to do this only if you are configuring *inter*Media manually. You do *not* need to do this if you use the Database Configuration Assistant.

References to *`<ORACLE_HOME>`* in these instructions represent the Oracle home directory.

1. Use Oracle Universal Installer to install the files that make up *inter*Media on your system.
2. Create the users and grant the appropriate privileges.

   ```
   Start SQL*Plus.

   % sqlplus

   Connect as SYSDBA.

   SQL> connect / as SYSDBA

   Invoke ordinst.sql with two parameters for interMedia tablespace and
   Location Services tablespace.

   SQL> @<ORACLE_HOME>/ord/admin/ordinst.sql SYSAUX SYSAUX (on UNIX)
        @<ORACLE_HOME>\ord\admin\ordinst.sql SYSAUX SYSAUX (on Windows)
   ```

3. Install *inter*Media types and packages.

   ```
   SQL> @<ORACLE_HOME>/ord/im/admin/iminst.sql (on UNIX)
        @<ORACLE_HOME>\ord\im\admin\iminst.sql (on Windows)
   ```

4. Start the listener.

   The listener must be configured to use external procedure calls. Check your `tnsnames.ora` file for an entry called `extproc_connection_data` and in the `listener.ora` file for an entry called `extproc`.

   See your network documentation for details. If this is not done properly, *inter*Media will *not* work for all supported formats.

Once these mandatory installation steps have been completed, *inter*Media is ready for use.

B.2 Upgrading an Installed Version of Oracle *inter*Media

If you upgrade a database from an earlier release of Oracle Database, *inter*Media will be upgraded automatically if detected in the source database. See *Oracle Database Upgrade Guide* for detailed instructions.

B.3 Verifying an Installed Version of Oracle *inter*Media

After installing or upgrading *inter*Media, you can verify the *inter*Media installation by invoking the *inter*Media check script.

To run the *inter*Media check script, connect as SYSDBA and invoke `imchk.sql` as follows:

1. Start SQL*Plus.

   ```
   % sqlplus
   ```

2. Connect as SYSDBA.

   ```
   SQL> connect / as SYSDBA
   ```

3. Invoke `imchk.sql`.

   ```
   On UNIX
   SQL> @<ORACLE_HOME>/ord/im/admin/imchk.sql

   On Windows
   SQL> @<ORACLE_HOME>\ord\im/admin\imchk.sql
   ```

The check script will produce the list of *inter*Media components and their status values, and a summary line indicating whether or not the *inter*Media installation is valid. All *inter*Media components are expected to have the status `VALID`.

B.4 Downgrading an Installed Version of Oracle *inter*Media

Oracle *inter*Media is automatically downgraded when you downgrade a database with the *inter*Media feature installed. See *Oracle Database Upgrade Guide* for detailed instructions.

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