7 Transformation and Validation of XMLType Data

There are several Oracle SQL functions and `XMLType` APIs for transforming `XMLType` data using XSLT stylesheets and for validating `XMLType` instances against an XML schema.

- XSL Transformation and Oracle XML DB
  You can apply XSL transformations to XML Schema-based documents using the built-in Oracle XML DB XSLT processor. In-database XML-specific optimizations can significantly reduce the memory required, eliminate the overhead associated with parsing, and reduce network traffic.
- Validation of XMLType Instances
  Besides needing to know whether a particular XML document is well-formed, you often need to know whether it conforms to a given XML schema, that is, whether it is valid with respect to that XML schema.

XSL Transformation and Oracle XML DB

You can apply XSL transformations to XML Schema-based documents using the built-in Oracle XML DB XSLT processor. In-database XML-specific optimizations can significantly reduce the memory required, eliminate the overhead associated with parsing, and reduce network traffic.

The W3C XSLT Recommendation defines an XML language for specifying how to transform XML documents from one form to another. See XSL Transformations (XSLT) Version 1.0 for information about the XSLT standard.

Transformation can include mapping from one XML schema to another or mapping from XML to some other format such as HTML or WML.

XSL transformation can be costly in terms of the amount of memory and processing required. In typical XSL processors, the entire source document and stylesheet must be parsed and loaded into memory, before processing can begin. Typically, XSL processors use DOM to provide dynamic memory representations of document and stylesheet, to allow random access to their different parts. The XSL processor then applies the stylesheet to the source document, generating a third document.

Parsing and loading the document and stylesheet into memory before beginning transformation requires significant memory and processor resources. It is especially inefficient when only a small part of the document needs to be transformed.

Oracle XML DB includes an XSLT processor that performs XSL transformations *inside the database*. In this way, it can provide XML-specific optimizations that can significantly reduce the memory required to perform the transformation, eliminate overhead associated with parsing, and reduce network traffic.

These optimizations are available, however, *only* when the source for the transformation is a *schema-based* XML document. In that case, there is no need to parse before processing can begin. The Oracle XML DB lazily loaded virtual DOM loads content only on demand, as the nodes are accessed. This also reduces the memory required, because only parts of the document that need to be processed are loaded.

You can transform XML data in the following ways:

- In Oracle Database – Using Oracle SQL function `XMLtransform`, `XMLType` method `transform()`, or PL/SQL package `DBMS_XSLPROCESSOR`
- In the middle tier – Using Oracle XML Developer's Kit transformation options , such as XSLT Processor for Java.

See Also:

- *Oracle Database SQL Language Reference* for information about SQL function `XMLTransform`
- PL/SQL XSLT Processor for XMLType (DBMS_XSLPROCESSOR) and *Oracle Database PL/SQL Packages and Types Reference* for information about PL/SQL package `DBMS_XSLPROCESSOR`
- *Oracle XML Developer's Kit Programmer's Guide* for information about XSLT Processor for Java

Each of these XML transformation methods takes as input a source XML document and an XSL stylesheet in the form of `XMLType` instances. For SQL function `XMLtransform` and `XMLType` method `transform()`, the result of the transformation can be an XML document or a non-XML document, such as HTML. However, for PL/SQL package `DBMS_XSLPROCESSOR`, the result of the transformation is expected to be a valid XML document. Any HTML data generated by a transformation using package `DBMS_XSLPROCESSOR` is XHTML data, which is both valid XML data and valid HTML data.

Example 7-1 shows part of an XSLT stylesheet, `PurchaseOrder.xsl`. The complete stylesheet is given in XSLT Stylesheet Example, PurchaseOrder.xsl.

These is nothing Oracle XML DB-specific about the stylesheet of Example 7-1. A stylesheet can be stored in an `XMLType` table or column or stored as non-schema-based XML data inside Oracle XML DB Repository.

Example 7-1 XSLT Stylesheet Example: PurchaseOrder.xsl

```
<?xml version="1.0" encoding="WINDOWS-1252"?>
<xsl:stylesheet version="1.0"
  xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
  xmlns:xdb="http://xmlns.oracle.com/xdb"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <xsl:template match="/">
    <html>
      <head/>
      <body bgcolor="#003333" text="#FFFFCC" link="#FFCC00" vlink="#66CC99" alink="#669999">
        <FONT FACE="Arial, Helvetica, sans-serif">
          <xsl:for-each select="PurchaseOrder"/>
          <xsl:for-each select="PurchaseOrder">
            <center>
              <span style="font-family:Arial; font-weight:bold">
                <FONT COLOR="#FF0000">
                  <B>PurchaseOrder </B>
                </FONT>
              </span>
            </center>
            <br/>
            <center>
              <xsl:for-each select="Reference">
                <span style="font-family:Arial; font-weight:bold">
                  <xsl:apply-templates/>
                </span>
              </xsl:for-each>
            </center>
          </xsl:for-each>
          <P>
            <xsl:for-each select="PurchaseOrder">
              <br/>
            </xsl:for-each>
            <P/>
            <P>
              <xsl:for-each select="PurchaseOrder">
                <br/>
              </xsl:for-each>
            </P>
          </P>
          <xsl:for-each select="PurchaseOrder"/>
          <xsl:for-each select="PurchaseOrder">
            <table border="0" width="100%" BGCOLOR="#000000">
              <tbody>
                <tr>
                  <td WIDTH="296">
                    <P>
                      <B>
                        <FONT SIZE="+1" COLOR="#FF0000" FACE="Arial, Helvetica, sans-serif">Internal</FONT>
                      </B>
                    </P>

                    ...

                  </td>
                  <td width="93"/>
                  <td valign="top" WIDTH="340">
                    <B>
                      <FONT COLOR="#FF0000">
                        <FONT SIZE="+1">Ship To</FONT>
                      </FONT>
                    </B>
                    <xsl:for-each select="ShippingInstructions">
                      <xsl:if test="position()=1"/>
                    </xsl:for-each>
                    <xsl:for-each select="ShippingInstructions">
                    </xsl:for-each>

                      ...
```

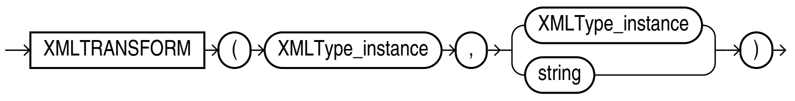
- SQL Function XMLTRANSFORM and XMLType Method TRANSFORM()
  SQL function `XMLtransform` transforms an XML document by using an XSLT stylesheet. It returns the processed output as XML, HTML, and so on, as specified by the stylesheet.
- XSL Transformation Using DBUri Servlet
  You can apply an XSL transformation to XML content that is generated by the DBUri servlet.

SQL Function XMLTRANSFORM and XMLType Method TRANSFORM()

SQL function `XMLtransform` transforms an XML document by using an XSLT stylesheet. It returns the processed output as XML, HTML, and so on, as specified by the stylesheet.

Figure 7-1 shows the syntax of Oracle SQL function `XMLtransform`. This function takes as arguments an `XMLType` instance and an XSLT stylesheet. The stylesheet can be an `XMLType` instance or a `VARCHAR2` string literal. It applies the stylesheet to the instance and returns an `XMLType` instance.

Figure 7-1 XMLTRANSFORM Syntax



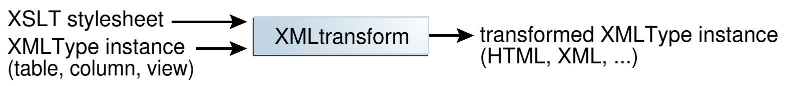
You can alternatively use `XMLType` method `transform()` as an alternative to Oracle SQL function `XMLtransform`. It has the same functionality.

Figure 7-2 shows how `XMLtransform` transforms an XML document by using an XSLT stylesheet. It returns the processed output as XML, HTML, and so on, as specified by the XSLT stylesheet. You typically use `XMLtransform` when retrieving or generating XML documents stored as `XMLType` in the database.

See Also:

Figure 1-3 in Introduction to Oracle XML DB

Figure 7-2 Using XMLTRANSFORM



- XMLTRANSFORM and XMLType.transform(): Examples
  Examples illustrate how to use Oracle SQL function `XMLtransform` and `XMLType` method `transform()` to transform XML data stored as `XMLType` to various formats.

XMLTRANSFORM and XMLType.transform(): Examples

Examples illustrate how to use Oracle SQL function `XMLtransform` and `XMLType` method `transform()` to transform XML data stored as `XMLType` to various formats.

Example 7-2 sets up an XML schema and tables that are needed to run other examples in this chapter. The call to `deleteSchema` here ensures that there is no existing XML schema before creating one. If no such schema exists, then `deleteSchema` raises an error.

Example 7-3 stores an XSLT stylesheet, then retrieves it and uses it with Oracle SQL function `XMLTransform` to transform the XML data stored in Example 7-2.

Example 7-4 uses `XMLType` method `transform()` with an XSL stylesheet created on the fly.

Example 7-5 uses `XMLTransform` to apply an XSL stylesheet to produce HTML code. PL/SQL constructor `XDBURIType` reads the XSL stylesheet from Oracle XML DB Repository.

Only part of the HTML result is shown in Example 7-5. Omitted parts are indicated with an ellipsis (`. . .`). Figure 7-3 shows what the transformed result looks like in a Web browser.

Example 7-2 Registering an XML Schema and Inserting XML Data

```
BEGIN
  -- Delete the schema, if it already exists.
  DBMS_XMLSCHEMA.deleteSchema('http://www.example.com/schemas/ipo.xsd',4);
END;
/
BEGIN
  -- Register the schema
  DBMS_XMLSCHEMA.registerSchema(
    SCHEMAURL => 'http://www.example.com/schemas/ipo.xsd',
    SCHEMADOC => '<schema targetNamespace="http://www.example.com/IPO"
                          xmlns="http://www.w3.org/2001/XMLSchema"
                          xmlns:ipo="http://www.example.com/IPO">
                    <!-- annotation>
                      <documentation xml:lang="en">
                       International Purchase order schema for Example.com
                       Copyright 2000 Example.com. All rights reserved.
                      </documentation>
                    </annotation -->
                    <element name="purchaseOrder" type="ipo:PurchaseOrderType"/>
                    <element name="comment" type="string"/>
                    <complexType name="PurchaseOrderType">
                      <sequence>
                        <element name="shipTo"     type="ipo:Address"/>
                        <element name="billTo"     type="ipo:Address"/>
                        <element ref="ipo:comment" minOccurs="0"/>
                        <element name="items"      type="ipo:Items"/>
                      </sequence>
                      <attribute name="orderDate" type="date"/>
                    </complexType>
                    <complexType name="Items">
                      <sequence>
                        <element name="item" minOccurs="0" maxOccurs="unbounded">
                          <complexType>
                            <sequence>
                              <element name="productName" type="string"/>
                              <element name="quantity">
                                <simpleType>
                                  <restriction base="positiveInteger">
                                    <maxExclusive value="100"/>
                                  </restriction>
                                </simpleType>
                              </element>
                              <element name="USPrice"    type="decimal"/>
                              <element ref="ipo:comment" minOccurs="0"/>
                              <element name="shipDate"   type="date" minOccurs="0"/>
                            </sequence>
                            <attribute name="partNum" type="ipo:SKU" use="required"/>
                          </complexType>
                        </element>
                      </sequence>
                    </complexType>
                    <complexType name="Address">
                      <sequence>
                        <element name="name"    type="string"/>
                        <element name="street"  type="string"/>
                        <element name="city"    type="string"/>
                        <element name="state"   type="string"/>
                        <element name="country" type="string"/>
                        <element name="zip"     type="string"/>
                      </sequence>
                    </complexType>
                    <simpleType name="SKU">
                      <restriction base="string">
                        <pattern value="[0-9]{3}-[A-Z]{2}"/>
                      </restriction>
                    </simpleType>
                  </schema>',
    LOCAL     => TRUE,
    GENTYPES  => TRUE);
END;
/

-- Create table to hold XML purchase-order documents, and insert the documents
DROP TABLE po_tab;
CREATE TABLE po_tab (id NUMBER, xmlcol XMLType)
 XMLType COLUMN xmlcol
 XMLSCHEMA "http://www.example.com/schemas/ipo.xsd"
 ELEMENT "purchaseOrder";

INSERT INTO po_tab
  VALUES(1, XMLType(
              '<?xml version="1.0"?>
               <ipo:purchaseOrder
                 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                 xmlns:ipo="http://www.example.com/IPO"
                 xsi:schemaLocation="http://www.example.com/IPO
                                     http://www.example.com/schemas/ipo.xsd"
                 orderDate="1999-12-01">
                 <shipTo>
                   <name>Helen Zoe</name>
                   <street>121 Broadway</street>
                   <city>Cardiff</city>
                   <state>Wales</state>
                   <country>UK</country>
                   <zip>CF2 1QJ</zip>
                 </shipTo>
                 <billTo>
                   <name>Robert Smith</name>
                   <street>8 Oak Avenue</street>
                   <city>Old Town</city>
                   <state>CA</state>
                   <country>US</country>
                   <zip>95819</zip>
                 </billTo>
                 <items>
                   <item partNum="833-AA">
                     <productName>Lapis necklace</productName>
                     <quantity>1</quantity>
                     <USPrice>99.95</USPrice>
                     <ipo:comment>Want this for the holidays!</ipo:comment>
                     <shipDate>1999-12-05</shipDate>
                   </item>
                 </items>
               </ipo:purchaseOrder>'));
```

Example 7-3 Using SQL Function XMLTRANSFORM to Apply an XSL Stylesheet

```
DROP TABLE stylesheet_tab;
CREATE TABLE stylesheet_tab (id NUMBER, stylesheet XMLType);
INSERT INTO stylesheet_tab
  VALUES (1,
          XMLType(
            '<?xml version="1.0" ?>
             <xsl:stylesheet version="1.0"
                             xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
               <xsl:template match="*">
```

```
                  <td>
                    <xsl:choose>
                      <xsl:when test="count(child::*) > 1">
                        <xsl:call-template name="nested"/>
                      </xsl:when>
                      <xsl:otherwise>
                        <xsl:value-of select="name(.)"/>:<xsl:value-of
                                                            select="text()"/>
                      </xsl:otherwise>
                    </xsl:choose>
                  </td>
                </xsl:template>
                <xsl:template match="*" name="nested" priority="-1" mode="nested2">
                  <b>
                    <!-- xsl:value-of select="count(child::*)"/ -->
                    <xsl:choose>
                      <xsl:when test="count(child::*) > 1">
                        <xsl:value-of select="name(.)"/>:<xsl:apply-templates
                                                            mode="nested2"/>
                      </xsl:when>
                      <xsl:otherwise>
                        <xsl:value-of select="name(.)"/>:<xsl:value-of
                                                            select="text()"/>
                      </xsl:otherwise>
                    </xsl:choose>
                  </b>
                </xsl:template>
              </xsl:stylesheet>'));

SELECT XMLSerialize(DOCUMENT XMLtransform(x.xmlcol, y.stylesheet)
                    AS VARCHAR2(1000))
  AS result FROM po_tab x, stylesheet_tab y WHERE y.id = 1;
```

This produces the following output (pretty-printed here for readability):

```
RESULT
---------------------------------------------------------
<td>
  <b>ipo:purchaseOrder:
    <b>shipTo:
      <b>name:Helen Zoe</b>
      <b>street:100 Broadway</b>
      <b>city:Cardiff</b>
      <b>state:Wales</b>
      <b>country:UK</b>
      <b>zip:CF2 1QJ</b>
    </b>
    <b>billTo:
      <b>name:Robert Smith</b>
      <b>street:8 Oak Avenue</b>
      <b>city:Old Town</b>
      <b>state:CA</b>
      <b>country:US</b>
      <b>zip:95819</b>
    </b>
    <b>items:</b>
  </b>
</td>
```

Example 7-4 Using XMLType Method TRANSFORM() with a Transient XSL Stylesheet

```
SELECT XMLSerialize(
         DOCUMENT
         x.xmlcol.transform(
           XMLType('<?xml version="1.0" ?>
                  <xsl:stylesheet
                      version="1.0"
                      xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
                    <xsl:template match="*">
                      <td>
                        <xsl:choose>
                          <xsl:when test="count(child::*) > 1">
                            <xsl:call-template name="nested"/>
                          </xsl:when>
                          <xsl:otherwise>
                            <xsl:value-of
                               select =
                                 "name(.)"/>:<xsl:value-of select="text()"/>
                          </xsl:otherwise>
                        </xsl:choose>
                      </td>
                    </xsl:template>
                    <xsl:template match="*" name="nested" priority="-1"
                                mode="nested2">
                      <b>
                        <!-- xsl:value-of select="count(child::*)"/ -->
                        <xsl:choose>
                          <xsl:when test="count(child::*) > 1">
                            <xsl:value-of select="name(.)"/>:
                            <xsl:apply-templates mode="nested2"/>
                          </xsl:when>
                          <xsl:otherwise>
                            <xsl:value-of
                               select =
                                 "name(.)"/>:<xsl:value-of select="text()"/>
                          </xsl:otherwise>
                        </xsl:choose>
                      </b>
                    </xsl:template>
                  </xsl:stylesheet>'))
         AS varchar2(1000))
  FROM po_tab x;
```

Example 7-5 Using XMLTRANSFORM to Apply an XSL Stylesheet Retrieved Using XDBURIType

```
SELECT
  XMLTransform(
    OBJECT_VALUE,
    XDBURIType('/source/schemas/poSource/xsl/purchaseOrder.xsl').getXML())
  FROM purchaseorder
  WHERE XMLExists('$p/PurchaseOrder[Reference="SBELL-2002100912333601PDT"]'
                  PASSING OBJECT_VALUE AS "p");

XMLTRANSFORM(OBJECT_VALUE, XDBURITYPE('/SOURCE/SCHEMAS/POSOURCE/XSL/PURCHASEORDER.XSL').GET
---------------------------------------------------------------------------------------------
<html xmlns:xdb="http://xmlns.oracle.com/xdb"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <head/>
  <body bgcolor="#003333" text="#FFFFCC" link="#FFCC00" vlink="#66CC99" alink="#669999">
    <FONT FACE="Arial, Helvetica, sans-serif">
      <center>
        <span style="font-family:Arial; font-weight:bold">
          <FONT COLOR="#FF0000">
            <B>PurchaseOrder </B>
          </FONT>
        </span>
      </center>
```

```
        <br/>
        <center>
          <span style="font-family:Arial; font-weight:bold">SBELL-2002100912333601PDT</span>
        </center>
        <P>
          <br/>
          <P/>
          <P>
            <br/>
          </P>
        </P>
        <table border="0" width="100%" BGCOLOR="#000000">
          <tbody>
            <tr>
              <td WIDTH="296">
                <P>
                  <B>
                    <FONT SIZE="+1" COLOR="#FF0000" FACE="Arial, Helvetica,
                          sans-serif">Internal</FONT>
                  </B>
                </P>
                <table border="0" width="98%" BGCOLOR="#000099">

                                                       . . .

                </table>
              </td>
              <td width="93">
              </td>
              <td valign="top" WIDTH="340">
                <B>
                  <FONT COLOR="#FF0000">
                    <FONT SIZE="+1">Ship To</FONT>
                  </FONT>
                </B>
                <table border="0" BGCOLOR="#999900">
                  . . .
                </table>
              </td>
            </tr>
          </tbody>
        </table>
        <br/>
        <B>
          <FONT COLOR="#FF0000" SIZE="+1">Items:</FONT>
        </B>
        <br/>
        <br/>
        <table border="0">
          . . .
        </table>
      </FONT>
    </body>
  </html>

  1 row selected.
```

XSL Transformation Using DBUri Servlet

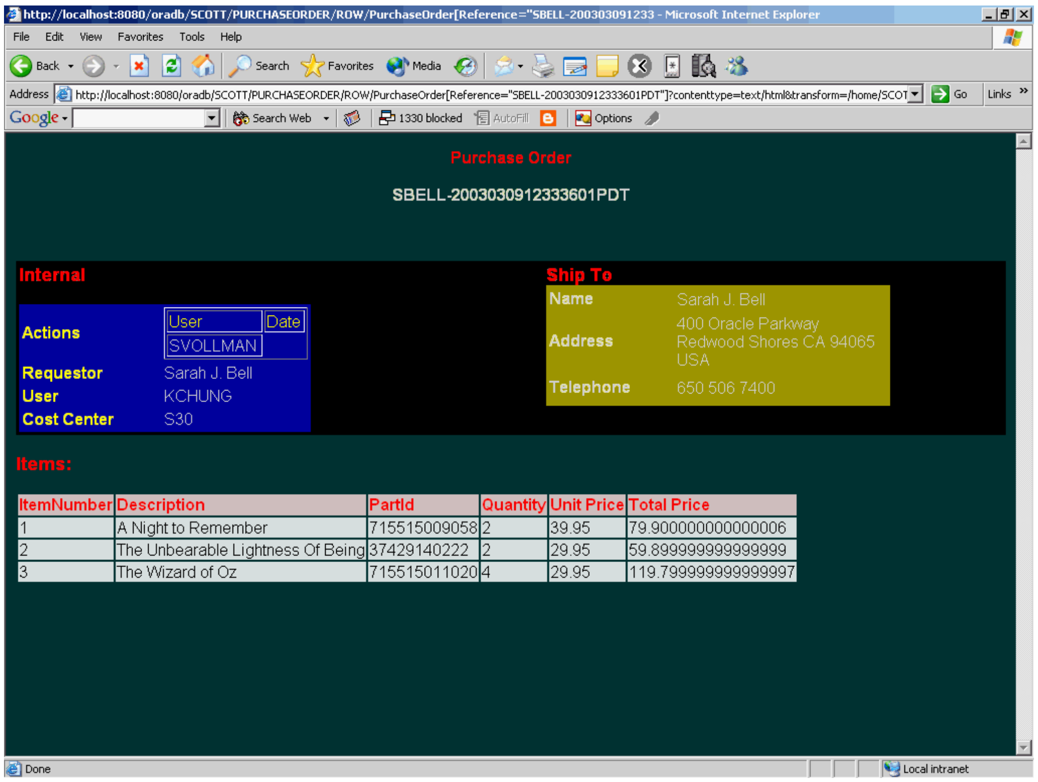
You can apply an XSL transformation to XML content that is generated by the DBUri servlet.

Figure 7-3 shows the result of such a transformation. The URL is the following (it is split and truncated here):

```
http://localhost:8080/oradb/SCOTT/PURCHASEORDER/ROW/PurchaseOrder[Reference="SBELL-2003030912333601PDT"]
contenttype=text/html&transform=/home/SCOTT/xsl/purchaseOrder.xsl...
```

The presence of parameter `transform` causes the DBUri servlet to use SQL function `XMLTransform` to apply the XSL stylesheet at `/home/SCOTT/xsl/purchaseOrder.xsl` to the `PurchaseOrder` document that is identified by the main URL. The result of the transformation, which is HTML code, is returned to the browser for display. The URL also uses parameter `contentType` to specify that the MIME-type of the final document is `text/html`.

Figure 7-3 Database XSL Transformation of a PurchaseOrder Using DBUri Servlet


http://localhost:8080/oradb/SCOTT/PURCHASEORDER/ROW/PurchaseOrder[Reference="SBELL-200303091233 - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://localhost:8080/oradb/SCOTT/PURCHASEORDER/ROW/PurchaseOrder[Reference="SBELL-2003030912333601PDT"]?contenttype=text/html&transform=/home/SCOT
Go Links
Search Web 1330 blocked AutoFill Options
Done
Local intranet

Purchase Order

SBELL-2003030912333601PDT

Internal

Actions	User / Date: SVOLLMAN
Requestor	Sarah J. Bell
User	KCHUNG
Cost Center	S30

Ship To

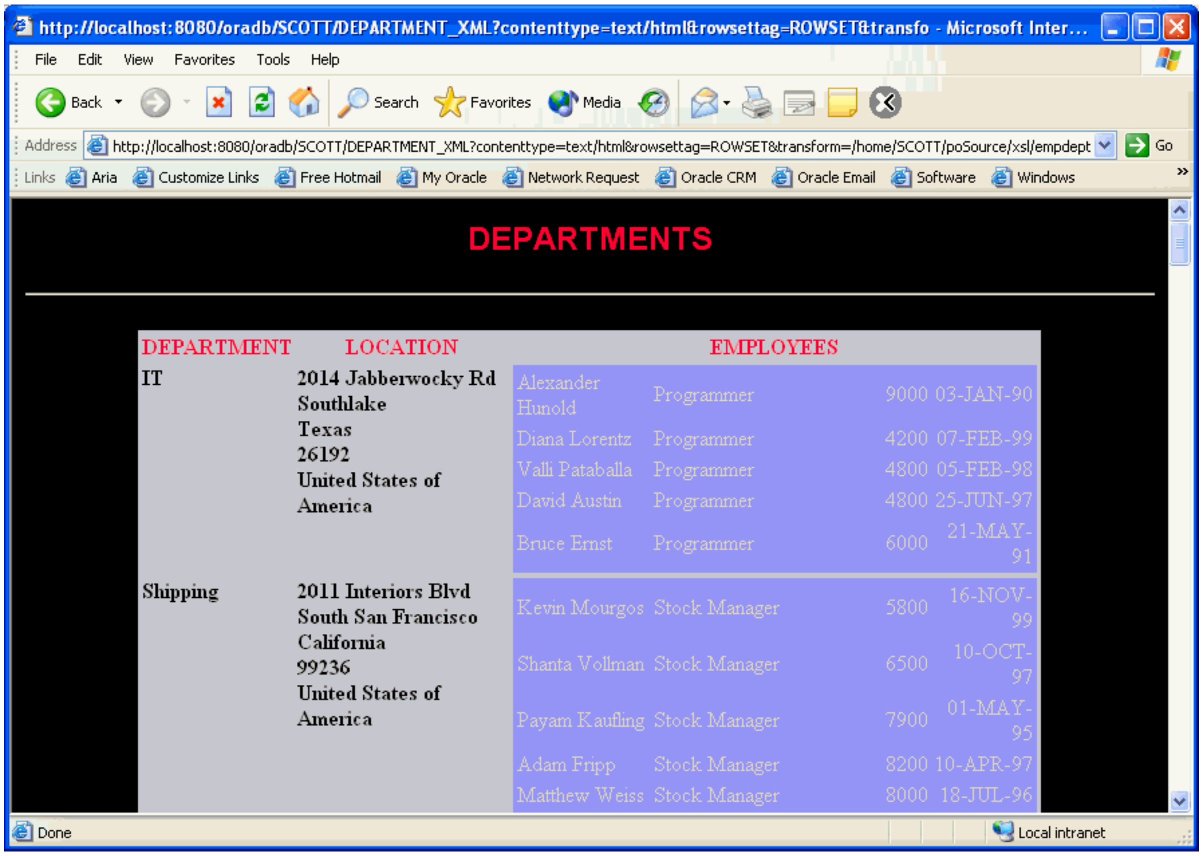
Name	Sarah J. Bell
Address	400 Oracle Parkway Redwood Shores CA 94065 USA
Telephone	650 506 7400

Items:

ItemNumber	Description	PartId	Quantity	Unit Price	Total Price
1	A Night to Remember	715515009058	2	39.95	79.900000000000006
2	The Unbearable Lightness Of Being	37429140222	2	29.95	59.899999999999999
3	The Wizard of Oz	715515011020	4	29.95	119.799999999999997

Figure 7-4 shows table `departments` displayed as an HTML document. You need no code to achieve this. You need only an `XMLType` view based on SQL/XML functions, an industry-standard XSL stylesheet, and `DBUri` servlet.

Figure 7-4 Database XSL Transformation of Departments Table Using DBUri Servlet



http://localhost:8080/oradb/SCOTT/DEPARTMENT_XML?contenttype=text/html&rowsettag=ROWSET&transfo - Microsoft Inter...

http://localhost:8080/oradb/SCOTT/DEPARTMENT_XML?contenttype=text/html&rowsettag=ROWSET&transform=/home/SCOTT/poSource/xsl/empdept

DEPARTMENTS

DEPARTMENT	LOCATION	EMPLOYEES			
IT	2014 Jabberwocky Rd Southlake Texas 26192 United States of America	Alexander Hunold	Programmer	9000	03-JAN-90
		Diana Lorentz	Programmer	4200	07-FEB-99
		Valli Pataballa	Programmer	4800	05-FEB-98
		David Austin	Programmer	4800	25-JUN-97
		Bruce Ernst	Programmer	6000	21-MAY-91
Shipping	2011 Interiors Blvd South San Francisco California 99236 United States of America	Kevin Mourgos	Stock Manager	5800	16-NOV-99
		Shanta Vollman	Stock Manager	6500	10-OCT-97
		Payam Kaufling	Stock Manager	7900	01-MAY-95
		Adam Fripp	Stock Manager	8200	10-APR-97
		Matthew Weiss	Stock Manager	8000	18-JUL-96

Validation of XMLType Instances

Besides needing to know whether a particular XML document is well-formed, you often need to know whether it conforms to a given XML schema, that is, whether it is valid with respect to that XML schema.

XML schema-based data that is stored as binary XML it is automatically validated fully whenever it is inserted or updated. This validation does not require building a DOM. It is done using streaming, which is efficient and minimizes memory use.

For `XMLType` data that is stored object-relationally, full validation requires building a DOM, which can be costly in terms of memory management. For this reason, Oracle XML DB does not automatically perform full validation when you insert or update data that is stored object-relationally.

However, in the process of decomposing XML data to store it object-relationally, Oracle XML DB does automatically perform partial validation, to ensure that the structure of the XML document conforms to the SQL data type definitions that were derived from the XML schema.

If you require full validation for `XMLType` data stored object-relationally, then consider validating on the client before inserting the data into the database or updating it.

You can use the following to perform full validation and manipulate the recorded validation status of XML documents:

- Oracle SQL function **`XMLIsValid`** and `XMLType` method **`IsSchemaValid()`** – Run the validation process unconditionally. Do not record any validation status. Return:
  - `1` if the document is determined to be *valid*.
  - `0` if the document is determined to be *invalid* or the validity of the document *cannot be determined*.
- `XMLType` method **`SchemaValidate()`** – Runs the validation process if the validation status is `0`, which it is by default. Sets the validation status to `1` if the document is determined to be *valid*. (Otherwise, the status remains `0`.)
- `XMLType` method **`isSchemaValidated()`** returns the recorded validation status of an `XMLType` instance.
- `XMLType` method **`setSchemaValidated()`** sets (records) the validation status of an `XMLType` instance.

The validation status indicates knowledge of validity, as follows:

- `1` means that the document is known to be *valid*.
- `0` means that validity of the document is *unknown*. The document might have been shown to be invalid during a validation check, but that invalidity is not recorded. A recorded validation status of `0` indicates only a lack of knowledge about the document's validity.

- Partial and Full XML Schema Validation
  When you insert XML Schema-based documents into the database they can be validated partially or fully.
- Validating XML Data Stored as XMLType: Examples
  Examples here illustrate how to use Oracle SQL function `XMLIsValid` and `XMLType` methods `isSchemaValid()` and `schemaValidate()` to validate XML data being stored as `XMLType` in Oracle XML DB.

See Also:

- *Oracle Database SQL Language Reference* for information about Oracle SQL function `XMLIsValid`
- *Oracle Database PL/SQL Packages and Types Reference* for information about `XMLType` methods `IsSchemaValid()`, `IsSchemaValidated()`, `SchemaValidate()`, and `setSchemaValidated()`

Partial and Full XML Schema Validation

When you insert XML Schema-based documents into the database they can be validated partially or fully.

- Partial Validation
  For binary XML storage, Oracle XML DB validates XML Schema-based documents fully when they are inserted into an `XMLType` table or column. For object-relational XML storage, only a partial validation is performed. This is because complete XML schema validation is quite costly for object-relational storage, in terms of performance.

- Full Validation
  Loading XML Schema-based data into binary XML storage fully validates it against the target XML schemas. For object-relational `XMLType` storage, you can force full validation at any time.

Partial Validation

For binary XML storage, Oracle XML DB validates XML Schema-based documents fully when they are inserted into an `XMLType` table or column. For object-relational XML storage, only a partial validation is performed. This is because complete XML schema validation is quite costly for object-relational storage, in terms of performance.

Partial validation ensures only that all of the mandatory elements and attributes are present, and that there are no unexpected elements or attributes in the document. That is, it ensures only that the structure of the XML document conforms to the SQL data type definitions that were derived from the XML schema. Partial validation does not ensure that the instance document is fully compliant with the XML schema.

Example 7-6 provides an example of failing partial validation while inserting an XML document into table `PurchaseOrder`, which is stored object-relationally.

Example 7-6   Error When Inserting Incorrect XML Document (Partial Validation)

```
INSERT INTO purchaseorder
  VALUES(XMLType(bfilename('XMLDIR', 'InvalidElement.xml'),
                 nls_charset_id('AL32UTF8')));
  VALUES(XMLType(bfilename('XMLDIR', 'InvalidElement.xml'),
         *
ERROR at line 2:
ORA-30937: No schema definition for 'UserName' (namespace '##local') in parent
'/PurchaseOrder'
```

Full Validation

Loading XML Schema-based data into binary XML storage fully validates it against the target XML schemas. For object-relational `XMLType` storage, you can force full validation at any time.

To force full validation, use either of the following:

- Table level `CHECK` constraint
- PL/SQL `BEFORE INSERT` trigger

Both approaches ensure that only valid XML documents can be stored in the `XMLType` table.

The advantage of a `TABLE CHECK` constraint is that it is easy to code. The disadvantage is that it is based on Oracle SQL function `XMLisValid`, so it can only indicate whether or not the XML document is valid. If an XML document is invalid, a `TABLE CHECK` constraint cannot provide any information about *why* it is invalid.

A `BEFORE INSERT` trigger requires slightly more code. The trigger validates the XML document by invoking `XMLType` method `schemaValidate()`. The advantage of using `schemaValidate()` is that the exception raised provides additional information about what was wrong with the instance document. Using a `BEFORE INSERT` trigger also makes it possible to attempt corrective action when an invalid document is encountered.

- Full XML Schema Validation Costs Processing Time and Memory Usage
  Unless you are using binary XML storage, full XML schema validation costs processing time and memory. You should thus perform full XML schema validation only when necessary.

Full XML Schema Validation Costs Processing Time and Memory Usage

Unless you are using binary XML storage, full XML schema validation costs processing time and memory. You should thus perform full XML schema validation only when necessary.

If you can rely on your application to validate an XML document then you can obtain higher overall throughput with non-binary XML storage, by avoiding the overhead associated with full validation. If you cannot be sure about the validity of incoming XML documents, you can rely on the database to ensure that an `XMLType` table or column contains only schema-valid XML documents.

Example 7-7 shows how to force a full XML schema validation by adding a `CHECK` constraint to an `XMLType` table. In Example 7-7, the XML document `InvalidReference` is a not valid with respect to the XML schema. The XML schema defines a minimum length of 18 characters for the text node associated with the `Reference` element. In this document, the node contains the value `SBELL-20021009`, which is only 14 characters long. Partial validation would not catch this error. Unless the constraint or trigger is present, attempts to insert this document into the database would succeed.

Example 7-7 Forcing Full XML Schema Validation Using a CHECK Constraint

```
ALTER TABLE purchaseorder
  ADD CONSTRAINT validate_purchaseorder
  CHECK (XMLIsValid(OBJECT_VALUE) = 1);

Table altered.

INSERT INTO purchaseorder
  VALUES (XMLType(bfilename('XMLDIR', 'InvalidReference.xml'),
                  nls_charset_id('AL32UTF8')));

INSERT INTO purchaseorder
*

ERROR at line 1:
ORA-02290: check constraint (QUINE.VALIDATE_PURCHASEORDER) violated
```

Pseudocolumn `OBJECT_VALUE` can be used to access the content of an `XMLType` table from within a trigger. Example 7-8 illustrates this, showing how to use a `BEFORE INSERT` trigger to validate that the data being inserted into the `XMLType` table conforms to the specified XML schema.

Example 7-8 Enforcing Full XML Schema Validation Using a BEFORE INSERT Trigger

```
CREATE OR REPLACE TRIGGER validate_purchaseorder
   BEFORE INSERT ON purchaseorder
   FOR EACH ROW
BEGIN
  IF (:new.OBJECT_VALUE IS NOT NULL) THEN :new.OBJECT_VALUE.schemavalidate();
  END IF;
END;
```

```
/

INSERT INTO purchaseorder
  VALUES (XMLType(bfilename('XMLDIR', 'InvalidReference.xml'),
                  nls_charset_id('AL32UTF8')));
  VALUES (XMLType( bfilename('XMLDIR', 'InvalidReference.xml'),
          *
ERROR at line 2:
ORA-31154: invalid XML document
ORA-19202: Error occurred in XML processing
LSX-00221: "SBELL-20021009" is too short (minimum length is 18)
LSX-00213: only 0 occurrences of particle "sequence", minimum is 1
ORA-06512: at "SYS.XMLTYPE", line 354
ORA-06512: at "QUINE.VALIDATE_PURCHASEORDER", line 3
ORA-04088: error during execution of trigger 'QUINE.VALIDATE_PURCHASEORDER'
```

Validating XML Data Stored as XMLType: Examples

Examples here illustrate how to use Oracle SQL function `XMLIsValid` and `XMLType` methods `isSchemaValid()` and `schemaValidate()` to validate XML data being stored as `XMLType` in Oracle XML DB.

Example 7-9 and Example 7-10 show how to validate an XML instance against an XML schema using PL/SQL method `isSchemaValid`().

`XMLType` method `schemaValidate()` can be used within `INSERT` and `UPDATE` triggers to ensure that all instances stored in the table are validated against the XML schema. Example 7-11 illustrates this.

Example 7-12 uses Oracle SQL function `XMLIsValid` to do the following:

- Verify that the `XMLType` instance conforms to the specified XML schema
- Ensure that the incoming XML documents are valid by using `CHECK` constraints

Note:

The validation functions and procedures described in Validation of XMLType Instances facilitate validation checking. Of these, `schemaValidate` is the only one that raises errors that indicate why validation has failed.

Example 7-9 Validating XML Using Method ISSCHEMAVALID() in SQL

```
SELECT x.xmlcol.isSchemaValid('http://www.example.com/schemas/ipo.xsd',
                              'purchaseOrder')
    FROM po_tab x;
```

Example 7-10 Validating XML Using Method ISSCHEMAVALID() in PL/SQL

```
DECLARE
  xml_instance XMLType;
BEGIN
  SELECT x.xmlcol INTO xml_instance FROM po_tab x WHERE id = 1;
  IF xml_instance.isSchemaValid('http://www.example.com/schemas/ipo.xsd') = 0
    THEN raise_application_error(-20500, 'Invalid Instance');
    ELSE DBMS_OUTPUT.put_line('Instance is valid');
  END IF;
END;
/
Instance is valid

PL/SQL procedure successfully completed.
```

Example 7-11 Validating XML Using Method SCHEMAVALIDATE() within Triggers

```
DROP TABLE po_tab;
CREATE TABLE po_tab OF XMLType
  XMLSCHEMA "http://www.example.com/schemas/ipo.xsd" ELEMENT "purchaseOrder";

CREATE TRIGGER emp_trig BEFORE INSERT OR UPDATE ON po_tab FOR EACH ROW

DECLARE
  newxml XMLType;
BEGIn
  newxml := :new.OBJECT_VALUE;
  XMLTYPE.schemavalidate(newxml);
END;
/
```

Example 7-12 Checking XML Validity Using XMLISVALID Within CHECK Constraints

```
DROP TABLE po_tab;
CREATE TABLE po_tab OF XMLType
   (CHECK(XMLIsValid(OBJECT_VALUE) = 1))
   XMLSCHEMA "http://www.example.com/schemas/ipo.xsd" ELEMENT "purchaseOrder";
```