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Managing XML Content with XML DB: Getting the Best Bang for the Buck

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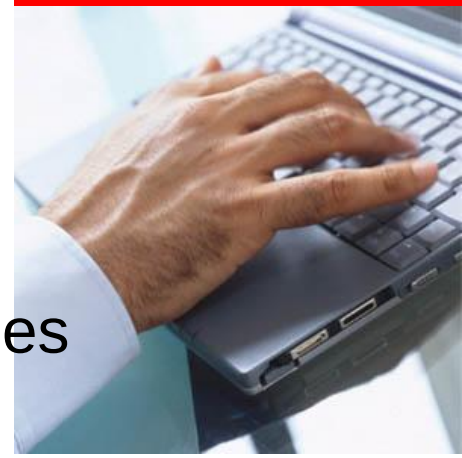
Agenda



- XQuery, SQL/XML Best Practices & Guidelines
- Structured Storage Guidelines
- Binary XML with XMLIndex Storage Guidelines
- Q & A

XQuery, SQL/XML Best Practices

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Using XMLQuery(), XMLExists()

SELECT XMLQuery('…' passing T.doc RETURNING CONTENT)
FROM table T
WHERE XMLExists('…' passing T.doc)

- Use XMLExists() to search
  - Typical database task to locating matching documents
  - XQuery expression must be index friendly to obtain good performance
  - Split complex XQuery expressions into index friendly and index unfriendly expressions joined by "AND"
- Use XMLQuery() to transform resulting documents
  - Typically runs on matching documents (much smaller set)
  - Can contain complex expressions and still obtain good performance

Performing XML DML operations

UPDATE Table t SET t.doc = DELETEXML(…)
WHERE XMLExists('…' passing t.doc)

- Use XMLExists() to identify documents being updated
  - As before, XQuery expression should take advantage of indexes to obtain good performance
- Use XPaths in DML operator to identify portion of document to update
- Piece-wise update operations are optimized
  - For Structured Storage, many operations rewritten to directly update relational columns
  - For Binary Storage, updates evaluated in streaming fashion and only updated portion changed on disk

Use XMLTable() for relational access

- XML documents are hierarchical
  - Can contain many master-detail relationalships
- Projecting out relational columns a common requirement

```
SELECT li.description, li.lineitem
FROM purchaseorder T, XMLTable('$p/PurchaseOrder/LineItems/LineItem'
                                        PASSING T.X AS “p”
                    COLUMNS lineitem NUMBER PATH '@ItemNumber',
                                description VARCHAR2(30) PATH 'Description',
                                partid NUMBER PATH 'Part/@Id',
                                unitprice NUMBER PATH 'Part/@UnitPrice',
                                quantity NUMBER PATH 'Part/@Quantity') li
WHERE li.unitprice > 30 and li.quantity < 20);
```

Use XMLTable() for relational access

- XQuery expressions should be storage/index friendly for good performance
- For structured storage, expressions should map down to relational columns for best performance
- For Binary XML storage with XMLIndex, expressions should be indexed
  - In particular, expression in predicates (WHERE clause)
- Multi level master-detail can be achieved by chaining multiple XMLTable clauses

Use XMLCast() for ORDER BY, GROUP BY

```
SELECT XMLCAST(XMLQUERY("$p/PurchaseOrder/@poDate"
            PASSING T.X
RETURNING CONTENT) AS DATE), COUNT(*)
FROM purchaseorder T
WHERE …
GROUP BY XMLCAST(XMLQUERY("$p/PurchaseOrder/@poDate"
                    PASSING T.X RETURNING CONTENT) AS DATE)
```

- If ordering or grouping multiple XPaths, use them in an XMLTable clause
- XMLTable allows expressions to be encapsulated in views for further BI analysis

XQuery on PL/SQL variable

```
DECLARE
   v_x XMLType;
   NumAcc NUMBER;
BEGIN
   v_x := XMLType(…); /* initialize xmltype variable */
   SELECT /*+ NO_XML_QUERY_REWRITE */
            XMLCAST(XMLQUERY('declare default element namespace
            "http://custacc";for $cust in $cadoc/Customer return
            fn:count($cust/Addresses/Address)'
   PASSING v_x AS "cadoc" RETURNING CONTENT) AS NUMBER)
   INTO NumAcc
   FROM DUAL;
END;
```

- Hint allows efficient DOM based evaluation
- XMLExists() can be used similarly

Datatype considerations

- XQuery specifies xs:untypedAtomic for non-schema documents
  - Different for schema-based documents
  - Can lead to confusing semantics
- Use explicit casting in XQuery and PASSING clause for numeric comparisons

$po/purchaseOrder[xs:decimal(@id)=$id]

PASSING T.X AS "po", CAST(:1 AS NUMBER) as "id“

- For non-numeric datatypes, XQuery can automatically cast to appropriate type of RHS

$po/purchaseOrder[@podate =xs:date($d)]

Accessing XML DB repository

- Repository data can be accessed using fn:doc and fn:collection
- Approach 1: Use SQL/XML and RESOURCE_VIEW

```
SELECT XMLQuery(…)
FROM RESOURCE_VIEW rv, purchaseorder p
WHERE ref(p) = XMLCast(XMLQuery('declare default element namespace
    "http://xmlns.oracle.com/xdb/XDBResource.xsd"; (: :) fn:data
    (/Resource/XMLRef)' PASSING rv.RES RETURNING CONTENT) AS REF
    XMLType) AND
equals_path(rv.RES, '/home/mydocs/podocs/1924.xml') = 1;
```

- Approach 2: Use XQuery pragma

```
for $doc in (#ora:defaultTable PURCHASEORDER #)
    {fn:doc("/home/mydocs/podocs/1924.xml")} …
```

XMLQuery() vs XMLTable() for top level XQuery

- Two variants for top level XQuery
  - SELECT * FROM XMLTable()
  - SELECT XMLQuery() FROM DUAL
- All rewrite optimizations are performed and appropriate indexes are leveraged
- Difference in semantics though:
  - XMLTable() construct produces many rows (one for each result item)
  - Avoids materializing large sequences and maps better to SQL's iterator model
  - XMLQuery() produces 1 row (the entire result sequence)

Structured Object Relational Storage Best Practices

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Default tables, Nested tables & Indexes

- Use annotation xdb:defaultTable
- Allows your tables to be recognized in the explain plan output
- Nested tables can be named using the VARRAY STORE AS clause
- If tables already created, use DBMS_XMLSCHEMA_MANAGE RENAMECOLLECTIONTABLE procedure
- Create B-tree indexes on underlying relational tables and columns

Indexing predicates

- Create Indexes on XPaths used in predicates (WHERE clause)
- Using the XPath directly (approach 1):

```
CREATE INDEX po_reference_ix ON purchaseorder
(XMLCast(XMLQuery ('$p/PurchaseOrder/Reference'
PASSING po.OBJECT_VALUE AS "p" RETURNING CONTENT)
AS VARCHAR2(128)));
```

- If function based index created, use approach 2 to obtain name of indexed column and then create index

```
select XDB.DBMS_MANAGE_XMLSTORAGE.xpath2TabColMapping(
'PURCHASEORDER_TAB',NULL, '/ipo:purchaseOrder/ Reference ',
'"http://www.example.com/IPO" as "ipo"') from dual;
```

Indexing predicates

- Create indexes on collection tables
- Composite index
  - The column in the collection table corresponding to XML attribute or element that needs to be indexed
  - The NESTED_TABLE_ID column

WHERE
XMLExists('$p/PurchaseOrder/LineItems/LineItem/Part[@Id="717951002372"]'

SELECT XDB.DBMS_MANAGE_XMLSTORAGE.xpath2TabColMapping(
'PURCHASEORDER_TAB', NULL, '/ipo:purchaseOrder/items/item/Part/Id',
'"http://www.example.com/IPO" as "ipo"')
FROM dual)

CREATE INDEX xxx ON tab_name (col_name, NESTED_TABLE_ID)

Loading large documents

- Large XML documents are loaded without building complete DOM in memory
- Pipelined storage directly into collection tables as document is scanned
- Can handle arbitrarily large documents (proven to many GB size)
- Use FTP PUT or CreateResource() for optimal performance
  - Ensure that xdb:defaultTable is specified correctly for root element in schema document
  - Ensure all collections are mapped to tables (default)
- Can also use SQL Insert statement (11gR2)

Configuring large document load

- Configuration file /xdbconfig.xml has parameters that control the amount of memory used by the loading operation
- Can tune the memory usage and performance of a load (or retrieval) operation by varying:
  - xdbcore-loadableunit-size – indicates the maximum size to which a ***loadable unit*** (partition) can grow in Kilobytes. Default is 16 KB.
  - xdbcore-xobmem-bound – indicates the maximum size in kilobytes that a document is allowed to occupy in memory. Default is 1024 KB.

```
DECLARE
  v_cfg XMLType;
BEGIN
  SELECT updateXML(DBMS_XDB.cfg_get(),
                   '/xdbconfig/sysconfig/xdbcore-xobmem-bound/text()',
                   '65536',
                   '/xdbconfig/sysconfig/xdbcore-loadableunit-size/text()',
                   '1024')
    INTO v_cfg FROM DUAL;
  DBMS_XDB.cfg_update(v_cfg);
  COMMIT;
END;
/
```

Binary XML Storage with XMLIndex Best Practices

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Binary XML Streaming evaluation

- Multiple XPaths evaluated in a single streaming access over XML document
- Automatically used for XMLExists(), XMLQuery() and XMLTable() constructs
- Execution plan shows “XPATH EVALUATION”
- Reverse axes should be converted by user to more optimal forward axes

  $p/PurchaseOrder//a[@id=”abc1”]/..*

  ➔

  $p/PurchaseOrder/[a/@id=”abc1”]*
- Avoid descendant and wildcard axes if exact XPaths can be used.
  - Especially for large documents to avoid scanning unnecessary portions

Binary XML DML considerations

- For DML heavy workloads, enable caching on writes of underlying LOB column
- Use securefile for Binary XML storage if:
  - Documents are very large
  - Piece-wise updates form an important part of the workload
  - XMLIndex has been created on the XML column

XMLIndex considerations

- Query paradigm can determine choice of index
- XMLIndex (structured component)
  - Ideal for scalar value lookups
  - Speeding up queries on islands of structure
  - Author, Date, Title fields for example
  - Captures the “attributes” of an “entity” together using E/R Model
- XMLIndex (unstructured component)
  - Can handle wide variety of queries
  - Scalar value lookups and fragment identification/retrieval
  - Can index desired sub-trees including hierarchies

XMLIndex considerations

- Queries suited to XMLIndex (structured component)
  - Applications with stable XPaths
  - Query hierarchy is expressable as XMLTable constructs
  - Key value search having data types (dates, numbers)
- Queries suited to XMLIndex (unstructured component)
  - Applications with ad-hoc queries
  - Exact list of paths cannot be predicted (path subsetting required)
  - Queries requiring hierarchy computations
- XMLIndex can have both components
  - Mix of either class of queries

Structured XMLIndex guidelines

- Use Structured XMLindex in place of multiple functional indexes
  - All expressions can be accessed and populated efficiently
- Index and Query datatypes should correspond
- Use structured XMLindex for relational paradigm over XML data
  - Relational views can be defined over XML using XMLTable()
  - XMLTable() construct can be efficiently indexed
- Create secondary indexes for predicates

Structured XMLIndex guidelines

- Split up fragment extraction from document identification
  - Fragment extraction in SELECT list using XMLQuery()
  - Can efficiently use Binary XML streaming evaluation
  - Document identification in WHERE clause using XMLExists()
  - Can use structured XMLindex
- Use SQL ORDER BY instead of XQuery “order by”
  - Project out ordering keys as columns in XMLTable()
  - Use them in SQL ORDER BY clause
  - Better match for picking up structured XMLindex

Unstructured XMLIndex guidelines

- Consists of path table (path, value pairs) and secondary indexes (PIKEY, VALUE)
- Execution plan should show usage of unstructured XMLIndex
  - The Path table name should appear
  - One of the secondary indexes should be used
- Drop PIKEY index if only simple XPath filtering is needed
  - Instead create PATHID index directly on PATHID column
- Create datatype aware secondary indexes
  - CreateNumberIndex and CreateDateIndex

Path subsetting considerations

- Path subsetting reduces index size
  - Faster population
  - Faster queries
- The explain plan output should be used to verify that path subsetted index is being picked
- Ensure paths used in predicates are indexed
- Exclude paths that are better evaluated by Binary XML streaming evaluation

Using SQL/XML for Text Searches

- Example query:

```
SELECT XMLQuery()
FROM DocTable
WHERE XMLExists()
AND CONTAINS()
```

- Create XMLIndex on *DocTable* with optional paths (structured or unstructured)
- Create Text Index on *DocTable* with desired settings
- Optimizer uses appropriate combination of indexes

Text Search Considerations

- Queries
  - Use SQL operator CONTAINS
- Path restriction
  - If complete document need not be indexed, use custom data source
  - Use INPATH inside CONTAINS for path restricted search (PATH_SECTION_GROUP)
  - Keywords can also be matched inside a particular complex element (XML_SECTION_GROUP with tags)
- Disk space usage
  - Optimal space usage since keywords are present only in text index
  - XML structure and values only in XMLIndex

Organizing Documents

- Documents can be stored in binary XML table
- Can be queried using XQuery
- In addition, XML DB repository can be used if:
  - Documents need to be organized and searched using a hierarchical file/folder metaphor
  - Documents need to be accessed using path/URL based protocols like FTP, HTTP, WebDaV etc.
  - Document lifecycle needs to be managed using Content Management models:
    - Security policies using ACLs
    - Simple versioning

Organizing Schema-based Documents

- Documents conforming to XML schema controlled by xdb:defaultTable annotation
- Automatically route document to binary XML table
  - Using DBMS_XDB.CreateResource
  - Using Protocols

DocSchema.xsd

```
<element name="DocRoot" xdb:defaultTable="DOC_TAB"…>
```

Doc.xml

```
<DocRoot xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance "
                xsi:schemaLocation="DocSchema.xsd" >
    …..
```

Organizing Schema-less Documents

- Document metadata in XML DB repository
- Document contents in user's binary XML table
- 2 ways of creating hierarchy
  - Using repository events
    - User's PLSQL or Java code
    - Triggered during repository create operations
    - Can store content in desired binary XML table
    - XML DB repository stores "REF" to content
  - Staging table with path, document key
    - Can store content in desired binary XML table using regular options like SQL-Loader etc.
    - XML DB repository stores "REF" to content

Oracle XML DB DEMOgrounds Booths

- **Come by our DEMOgrounds booths to have one-on-one conversation with our team members**
  - Moscone West: W-41, W-44, and W-61

Tuesday Sessions

S317480: Managing XML Content with Oracle XML: Getting the Best Bang for the Buck
Moscone South, Rm 200

2:00 PM – 3:00 PM

S317428: ProQuest Use Case
Moscone South, Rm 200

5:00 PM – 6:00 PM

Wednesday Sessions

S317650 : S&P Use Case
Hotel Nikko, Nikko Ballroom I

10:00 AM – 11:00 AM

S319105: Interfacing with Your Database via Oracle XML DB

Hotel Nikko/Bay View

11:30 AM – 12:30 PM

S317648: PolarLake Use Case, XDK, and XQJ
Hotel Nikko Nikko Ballroom I

1:00 PM – 2:00 PM

Thursday Sessions

S317504: Waters Use Case and Structured XMLIndex
Moscone South, Rm 200

10:30 AM – 11:30 AM

S317528: Working with Complex XML Schemas: Not as Hard as You Might Think
Hotel Nikko Nikko Ballroom I

2:00 PM – 3:00 PM

S317657: XBRL Expert Panel - Using Oracle Database as an XBRL Repository
Hotel Nikko Nikko Ballroom I

3:30 PM – 4:30 PM