Practical Applications of Oracle XML DB

Joshua Feinstein
September 21, 2010
Use Case Outline & Agenda

• S&P Equity Research Services
• Data Management Overview
• ERS Global Data Architecture & Oracle XML DB
• Configuring Oracle XML DB Repository
• Querying, Inserting and Updating data
• Performance and Indexing Oracle XML DB
1830-1870s
The rise of private capital markets in the U.S. is fostered largely by rapid development and construction in the railroad industry through public and private financing. Transparency and availability of corporate records, company financial dealings and independent third-party analysis are very limited.

1860
Henry Varnum Poor (1812–1905) publishes History of the Railroads and Canals of the United States, the first major attempt at compiling a comprehensive account of both the financial and operational details of U.S. railroads, by far the largest and most capital-intensive industry in the U.S. This publication is the predecessor of Poor’s Manual of the Railroads of the United States.

1868
After forming H.V. and H.W. Poor Co. with his son, Henry William Poor (1844–1915), the Poor’s publish the Manual of the Railroads of the United States. Within a few months, they sell all 2,500 copies of the first issue. Each copy, at 442 pages, is priced at $5 and contains essential information for investors in the U.S. railroad industry. The Manual is updated annually, keeping investors current and allowing them to chart a company’s progress over the years.
The history of Standard & Poor’s closely parallels the history of modern financial markets.  
(On the below table, the right column gears toward S&P Equity Research.)

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1860</td>
<td>Henry Varnum Poor (1812 – 1905) publishes <em>History of the Railroads and Canals of the United States</em>.</td>
<td>The first major attempt at compiling a comprehensive account of both the financial and operational details of the U.S. railroads.</td>
</tr>
<tr>
<td>1906</td>
<td>Luther Lee Blake (1874 – 1953) like H.V. Poor, recognizes the need for an accurate, centralized source of financial information for investors and forms the Standard Statistics Bureau.</td>
<td></td>
</tr>
<tr>
<td>1986</td>
<td>Equity Research launched its Stock Appreciation Ranking System (STARS®) on stocks in the U.S.</td>
<td>The STARS ranking ultimately will cover more than 1,500 U.S. stocks and nearly 500 in Europe and Asia Pacific.</td>
</tr>
<tr>
<td>1991</td>
<td>Introduces the S&amp;P MidCap 400 Index®, an index designed to cover the U.S. mid-cap market.</td>
<td></td>
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<tr>
<td>1996</td>
<td>Introduces new industry groups covering more than 8,700 securities in the Stock Guide Database, dividing the stock universe into 10 economic sectors, which are divided into 122 industry groups.</td>
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<tr>
<td>2004</td>
<td>Acquires Capital IQ®, a leading provider of high-impact information solutions to the global investment and financial services communities.</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>S&amp;P Equity Research launches MarketScope® Advisor, and ETF Reports that features proprietary holdings based methodology.</td>
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# Multi-Asset Class Research & Analysis

<table>
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<tr>
<th>Equities</th>
<th>ETFs</th>
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<tr>
<td>• Qualitative &amp; Quantitative</td>
<td>• Proprietary holdings-based analysis of over 800 ETFs</td>
</tr>
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<td>• Global Scope</td>
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<tr>
<th>Mutual Funds</th>
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<tbody>
<tr>
<td>• Qualitative Ratings (Europe, Middle East and Australia)</td>
<td>• Robust options reports, screeners, alerts, news and tools</td>
</tr>
<tr>
<td>• Quantitative Rankings (US)</td>
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<table>
<thead>
<tr>
<th>Variable Annuities</th>
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<tr>
<td>• Extensive information on thousands of VA sub accounts and contracts.</td>
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</tbody>
</table>
**Global Multi-Asset Class Coverage**

- High standards of integrity, objectivity and rigor to their work.
- Wide range of asset classes
- Qualitative Research: S&P Analyst expresses an opinion on an investment
- Quantitative Research: Performed using a mathematical models.
- In some instances, these two disciplines, Quant & Qual are combined.

<table>
<thead>
<tr>
<th>Equities</th>
<th>Over 1,700 stocks covered qualitatively and 7,900 stocks covered quantitatively across the US, Europe, Middle East, Australia and Asia;</th>
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<tbody>
<tr>
<td>Mutual Funds</td>
<td>1,900 funds in the US, Europe, Middle East, Australia and Asia with a mutual fund analyst’s qualitative rating; 21,200 funds in the US with a quantitative ranking.</td>
</tr>
<tr>
<td>ETFs</td>
<td>ETF holdings-based analysis reports on over 800 ETFs (U.S.) with an overweight, market weight or underweight recommendation.</td>
</tr>
<tr>
<td>Bonds</td>
<td>S&amp;P’s bond portal includes research, tools and a bond ladder builder covering over 200,000 issues from more than 40,000 issuers.</td>
</tr>
<tr>
<td>Annuities</td>
<td>S&amp;P provides coverage and screener for approximately 70,000 subaccounts and 1,600 policies</td>
</tr>
<tr>
<td>Options</td>
<td>Based on stock coverage of approximately 1,200 U.S. stocks and ADRs, S&amp;P publishes covered call and calendar spread strategies on 3, 4, and 5 STARs stocks, PowerPicks and Top 10.</td>
</tr>
</tbody>
</table>
## News & Commentary

<table>
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<tr>
<th>European MarketScope</th>
<th>U.S. MarketScope</th>
<th>Industry Surveys</th>
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| • Real-time, independent, value-added news and commentary on European Equities.  
• A unique combination of strategies and market-moving news.  
• Delivered via custom XML feeds to integrate with client systems. | • In-depth, real time market news, intelligence, and data that provides S&P’s investment outlook, including technical, thematic, sector, and key stock recommendations.  
• Delivered via MarketScope Advisor and through customized data feeds. | • In-depth exploration of 55 U.S. and global industries, with emphasis on trends and developments  
• Produced twice a year and used every day  
• Also provides deep-dive coverage of sub-industries and sectors |
MarketScope content features independent commentary and analysis with a focus stock-moving stories.

- XML Feed
- Flash Headlines
- Market Movers
- Broker News & Views
- EMS Breakfast Briefing
- Midday European Commentary
- Tomorrow’s Key Events
- Trends & Ideas and more

Delivery to Bloomberg
With real-time access to some of the best thinking of S&P's leading equity analysts, economists and equity strategists, MarketScope provides timely and informative investment insights for financial professionals and their clients.
A wholly owned subsidiary of The McGraw-Hill Companies, Inc., Standard & Poor’s Investment Advisory Services LLC (“SPIAS”) provides non-discretionary investment advice to major financial institutions which in turn provide the investment solution to their end retail clients.

S&P’s Investment Advisory Services group leverages its intellectual capital to create customized investment solutions and strategies for leading asset management, mutual fund and insurance firms – among others.

Working with our clients’ requirements, we perform independent analysis and create custom-tailored recommendations. Our advice and research can be employed in a variety of investment vehicles and programs including:

- Mutual Funds
- Unit Investment Trusts
- Variable Annuities
- Fund of Funds
- Exchange Traded Funds (ETFs)
- Managed Account Programs
- Wrap Programs
Global Clients

A wide range of services which contribute intelligence, insight and utility to every segment of the capital markets.

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<td>HIGH NET WORTH</td>
<td>FINANCIAL PLANNERS</td>
<td>REGIONAL BANKS</td>
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<td>ULTRA HIGH NET WORTH</td>
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<td>FAMILIES</td>
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<td>BROKER DEALERS</td>
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<td>ENDOWMENTS</td>
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<td>FOUNDATIONS</td>
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<td>CUSTODY FIRMS</td>
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<tr>
<td>INSTITUTIONS</td>
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<td>GLOBAL EXCHANGES</td>
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S&P Equity Research Services Data Management (ERS-DAMA)
Basic Terminology

**FINANCIAL ENTITY:** An entity which releases financial statements which are of interest to the financial community (e.g. Corporations, municipalities, not-for-profit institutions, mutual funds, sovereign nations, etc.)

**INSTRUMENT:** An investment vehicle issued by a Financial Entity. Some examples include stock or equity, bonds or fixed income, mutual funds, warrants, options, etc.
S&P Equity Research Services Data Management (ERS-DAMA)

Instrument Based vs. Product Based Architecture

- RDBMS: Instrument Data
- XML Data-Stores: Product Content
ERS-DAMA
Instrument Master Groupings

GROUPING

GICS
- GICS: A primary example of grouping items together via association

INDEX
- Indexes: Appear to be instruments, but are actually groups or a group.

PEER GROUPING
- Equity Peer Group
- Fund Style Grouping
- Peer Groupings: Commonly used to compare attributes and/or performance of similar instruments
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GCC Data Initiative: Overall Project Goals

Corporate Goals:

• To consolidate and normalize global information about financial entities and their instruments into one system – a single finished goods repository that will house all consumer ready data.

• To reduce the number of siloed systems holding financial entity and instrument information - domestically and around the world – all of which maybe currently individually supported.
Global Data Systems Architecture
Design Evolution Phase II
Global Data Systems Architecture
Phase IV: Cached Solution

Third party software configured to update global cache in near-real time
Scenario:
Given a qualitative change on behalf of an S&P Analyst

Possible solutions:
1. Create a bridge
2. Leverage third party tool
3. Update systems independently & reconcile at end-of-hour, end-of-day or end-of-week.
4. Other
The Oracle XML-DB exists as a natural part of the Oracle instance.
"Oracle XML DB is a set of Oracle Database technologies related to high-performance XML storage and retrieval. It provides native XML support by encompassing both SQL and XML data models in an interoperable manner."
Data Persistence and Oracle XML DB Architecture

- Browser or other UI
- JDBC Application
- Direct HTTP Access
- Oracle Net Services Access
- Oracle Streams AQ Access
- WebDAV Access
- FTP Access

Oracle Database

Oracle XML DB

XML Type Tables & Views

Oracle XML DB Repository

XML Services
- XML Validation
- XML Transformation
- XML Schema Registration
- Create Tables
- Insert, Delete, Update XMLType tables
- Indexing

Retrieve / Generate XML Using XMLType APIs
- SQL
- Java
- PL/SQL
- C
- C++

XML Services
- Versioning
- ACL Security
- Folding

Retrieve / Generate XML Using Resource APIs
- SQL
- Java
- PL / SQL
Data Persistence and Oracle XML DB Architecture drill down
Oracle XML DB Repository
Drill down
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Creating and configuring Oracle’s XDB:

» Configuring Http Access
» Configure the servlet
» Setting the User Privileges
» Base Folder View via WebDav
» Creating the Folders & Resources
» Grant Privileges to ALPHA** & BETA**
» Set the Access Control Lists
» ALPHA XML TABLE(S) & DCLS

**Alpha, Beta, Gamma, etc. are pseudonyms that will be used throughout this presentation
To configure and set the HTTP port, DBA executes the following SQL script:

```sql
set echo on
set DEFINE ^
DEFINE logDir_var=^1
spool ^logDir_var.Configure_HTTP_Access.txt
SELECT dbms_xdb.gethttpport FROM dual;
EXEC xdb.dbms_xdb.sethttpport(8080);
SELECT dbms_xdb.gethttpport FROM dual;
spool off
set echo off
set DEFINE off
```

Further, the following series of slides illustrate configuration and creation scripts that need to be executed by the Oracle DBA.

**Alpha, Beta, Gamma, etc. are pseudonyms that will be used throughout this presentation**
set echo on
set DEFINE ^

DEFINE logDir_var=^1

DECLARE
  _servlet_name VARCHAR2(32) := 'orawsv';
BEGIN
  DBMS_XDB.deleteServletMapping(_servlet_name);
  DBMS_XDB.deleteServlet(_servlet_name);
  DBMS_XDB.addServlet( name => _servlet_name, language => 'C', dispname => 'Oracle Query Web Service', descript => 'Servlet for issuing queries as a Web Service', schema => 'XDB');

  DBMS_XDB.addServletSecRole( servname => _servlet_name, rolename => 'XDB_WEBSERVICES', rolelink => 'XDB_WEBSERVICES');

  DBMS_XDB.addServletMapping( pattern => '/orawsv/*', name => _servlet_name);
END;
Setting the User Privileges for ALPHA

```
set echo on
set DEFINE ^

DEFINE logDir_var=^1

GRANT XDB_WEBSERVICES TO ALPHA;
GRANT XDB_WEBSERVICES_OVER_HTTP TO ALPHA;
GRANT XDB_WEBSERVICES_WITH_PUBLIC TO ALPHA;

GRANT XDB_WEBSERVICES TO BETA;
GRANT XDB_WEBSERVICES_OVER_HTTP TO BETA;
GRANT XDB_WEBSERVICES_WITH_PUBLIC TO BETA;

GRANT execute on XDB.DBMS_XDB to ALPHA;
GRANT execute on XDB.DBMS_XDB BETA;

set echo off
set DEFINE off
```
Oracle XDB
ALPHA - Base Folder View via WebDav

To be created in the next slide…
declare
result boolean;
begin
    result := dbms_xdb.createFolder ('/ALPHA');
    result := dbms_xdb.createFolder ('/ALPHA/OMEGA');
    result := dbms_xdb.createFolder ('/ALPHA/OMEGA/GAMMA');
    result := dbms_xdb.createFolder ('/ALPHA/OMEGA/DELTA');
    commit;
end;
DECLARE
b BOOLEAN;
BEGIN
b := DBMS_XDB.createResource('/sys/acls/all_ALPHA_acl.xml',
' <acl description="myacl"
xmlns="http://xmlns.oracle.com/xdb/acl.xsd" xmlns:dav="DAV:"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  <ace>
    <grant>true</grant><principal>BETA</principal>
    <privilege><all/></privilege>
  </ace>
  <ace>
    <grant>true</grant><principal>ALPHA</principal>
    <privilege>
      <all/>
    </privilege>
  </ace>
</acl>');
END;
Set the Access Control Lists

```
begin
  dbms_xdb.setacl ('/ALPHA/OMEGA/GAMMA','/sys/acls/all_ALPHA_acl.xml');
end;
commit;
begin
  dbms_xdb.setacl ('/ALPHA/OMEGA/DELTA','/sys/acls/all_ALPHA_acl.xml');
end;
commit;
begin
  dbms_xdb.setacl ('/ALPHA/OMEGA','/sys/acls/all_ALPHA_acl.xml');
end;
commit;
begin
  dbms_xdb.setacl ('/ALPHA','/sys/acls/all_ALPHA_acl.xml');
end;
commit;
```
CREATE TABLE ALPHA.ALPHAXMLTAB OF SYS.XMLTYPE
TABLESPACE ALPHA_XMLDATA_BUF;

GRANT DELETE, INSERT, SELECT, UPDATE ON
ALPHA.ALPHAXMLTAB TO BETA;

GRANT SELECT ON ALPHA.ALPHAXMLTAB TO ****_SELECT;

GRANT DELETE, INSERT, SELECT, UPDATE ON
ALPHA.ALPHAXMLTAB TO ****_SUDIX;
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XML Functions

The XML functions operate on or return XML documents or fragments. The SQL XML functions are:

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<th>Function</th>
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<th>Function</th>
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</thead>
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<tr>
<td>APPENDCHILDXML</td>
<td>SYS_DBURIGEN</td>
<td>XMLFOREST</td>
</tr>
<tr>
<td>DELETEXML</td>
<td>SYS_XMLAGG</td>
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<tr>
<td>DEPTH</td>
<td>SYS_XMLGEN</td>
<td>XMLPI</td>
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<tr>
<td>EXTRACT (XML)</td>
<td>UPDATEXML</td>
<td>XMLQUERY</td>
</tr>
<tr>
<td>EXISTSNODE</td>
<td>XMLAGG</td>
<td>XMLROOT</td>
</tr>
<tr>
<td>EXTRACTVALUE</td>
<td>XMLCDATA</td>
<td>XMLSEQUENCE</td>
</tr>
<tr>
<td>INSERTCHILDXML</td>
<td>XMLCOLATTVAL</td>
<td>XMLSERIALIZE</td>
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<tr>
<td>INSERTXMLBEFORE</td>
<td>XMLCOMMENT</td>
<td>XMLTABLE</td>
</tr>
<tr>
<td>PATH</td>
<td>XMLCONCAT</td>
<td>XMLTRANSFORM</td>
</tr>
</tbody>
</table>
Oracle XML Functions

**EXTRACT (XML)**
Applies a VARCHAR2 XPath string and returns an XMLType instance containing an XML fragment. You can specify an absolute *XPath_string* with an initial slash or a relative *XPath_string* by omitting the initial slash. If you omit the initial slash, the context of the relative path defaults to the root node.

**EXTRACTVALUE**
Takes as arguments an XMLType instance and an XPath expression and returns a scalar value of the resultant node. The result must be a single node and be either a text node, attribute, or element. If the result is an element, then the element must have a single text node as its child, and it is this value that the function returns. You can specify an absolute *XPath_string* with an initial slash or a relative *XPath_string* by omitting the initial slash. If you omit the initial slash, the context of the relative path defaults to the root node. If the specified XPath points to a node with more than one child, or if the node pointed to has a non-text node child, then Oracle returns an error.
Java get methods to illustrate prepared strings with select statements

private static final String selectTodaysOmegaArticles =
    "select EXTRACT(object_value,""/"").getClobVal() as xmlContent from alphaxmltab "
    + "where EXTRACTVALUE(object_value, "/OmegaContent/@type")=:articleType "
    + "and trunc(to_timestamp_tz(translate(EXTRACTVALUE(object_value,
    "/OmgaContent/MetaData/Property[@name="PublishDate"]"), "T", "" ),"YYYY-MM-DD
    HH24:MI:SSTZH:TZM") at time zone "{0}" )=trunc(current_timestamp at time zone "{0}" ) "
    + "order by to_timestamp_tz(translate(EXTRACTVALUE(object_value,
    "/OmgaContent/MetaData/Property[@name="PublishDate"]"), "T", " " ),"YYYY-MM-DD
    HH24:MI:SSTZH:TZM") desc " ;

private static final String selectLatestOmegaArticleFromDB =
    " select EXTRACT(object_value,""/"").getClobVal()  as xmlContent from alphaxmltab "+
    "where EXTRACTVALUE(object_value, "/Editorial/@type")=:articleType " 
    + "and trunc(to_timestamp_tz(translate(EXTRACTVALUE(object_value,
    "/OmgaContent/MetaData/Property[@name="PublishDate"]"), "T", "" ),"YYYY-MM-DD
    HH24:MI:SSTZH:TZM") at time zone "{0}" )=trunc(current_timestamp at time zone "{0}" ) "
    + "order by to_timestamp_tz(translate(EXTRACTVALUE(object_value,
    "/OmgaContent/MetaData/Property[@name="PublishDate"]"), "T", " " ),"YYYY-MM-DD
    HH24:MI:SSTZH:TZM") desc "
    + " ) where rownum <2" ;
**EXISTSRESOURCE Function**

This function indicates if a resource is in the hierarchy. Matches resource by a string that represents its absolute path.

**Syntax**

```sql
DBMS_XDB.EXISTSRESOURCE(abspath IN VARCHAR2)
RETURN BOOLEAN;
```

**Parameters**

- `abspath`: Path name of the resource whose ACL document is required.

**Return Values**

- TRUE if the resource is found.
**CREATERESOURCE Functions**

The functions create a new resource. Overload options are below.

1) Creates a new resource with the given XMLType data as its contents:
   ```sql
   DBMS_XDB.CREATERESOURCE(  
   path IN VARCHAR2,  
   data IN SYS.XMLTYPE)  
   RETURN BOOLEAN;
   ```

2) Given a REF to an existing XMLType row, creates a resource whose contents point to that row. That row should not already exist inside another resource:
   ```sql
   DBMS_XDB.CREATERESOURCE(  
   path IN VARCHAR2,  
   datarow IN REF SYS.XMLTYPE)  
   RETURN BOOLEAN;
   ```

Other overload options:

3) String. 4) BLOB. 5) CLOB. 6) BFILE.
FUNCTION FUNC_ALPHA_OMEGA_INSERT(Article_ID VARCHAR2, Article_type VARCHAR2, xmlFile CLOB) RETURN NUMBER

IS

v_xmlRepName varchar2(20) := 'ALPHA'; refr ref xmltype; v_result boolean;
v_product varchar2(20) := 'OMEGA'; xmlFile_tgt xmltype; v_article_type VARCHAR2(50);
v_article_type VARCHAR2(50); xmlFileName varchar2(100); v_rowCount number := 0;

BEGIN
xmlFile_tgt := XMLType.createXML(xmlFile);
v_article_type := UPPER(Article_type); v_acticle_id := Article_ID;

INSERT INTO ALPHA.APLHAXMLTAB X VALUES (xmlFile_tgt) returning ref(X) into refr;

IF dbms_xdb.existsResource('/'|| v_xmlRepName || '/' || v_product || '/' || v_article_type ) THEN
v_result := dbms_xdb.createResource('/'|| v_xmlRepName || '/' || v_product || '/' || v_article_type || '/' || v_acticle_id||'_' || xmlFileName, refr);
END IF;
COMMIT;
return v_rowCount;
ELSE
update remusxmltab set OBJECT_VALUE = xmlFile_tgt where (EXTRACTVALUE(object_value,'/Editorial/@id')) = Article_ID
AND (EXTRACTVALUE(object_value,'/Editorial/@type')) =v_article_type ;

return v_rowCount;
END IF;

END FUNC_ALPHA_OMEGA_INSERT;
/
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Function-Based Indexes

A function-based index is created by evaluating the specified functions for each row in the target table or column and storing the value in the index.

Creating Function-Based Indexes on Unstructured XMLType Tables and Columns
If a function-based index is defined on XML data that is not managed using structured storage, then the index is created by invoking the function on the XML content and indexing the result.

Our use case leverages function based indexes for improving the query performance.
These examples show the creation of an index based on the SQL function extractValue, where the XML data is in unstructured (CLOB) storage.

create index APLHA.alpha_xml_doc_id_idx on ALPHA.alphaxmltab
(extractvalue(Object_value,'/AlphaXMLDocs/@id'));

create index ALPHA.alpha_xml_doc_type_idx on ALPHA.alphaxmltab
(extractvalue(Object_value,'/AlphaXMLDocs/@type'));

create index APLHA.alpha_xml_Pen_Name_idx ON ALPHA.alphaxmltab
(extractValue(Object_value,'/AlphaXMLDocs/MetaData/PropertyGroup/Property[@name="PenName"]]'));

create index APLHA.alpha_xml_User_Name_idx ON ALPHA.alphaxmltab
(extractValue(Object_value,'/AlphaXMLDocs/MetaData/PropertyGroup/Property[@name="UserFullName"]]'));
• **Problem scenario:**
  ‘…Unstructured Storage Presents an Indexing Problem for XML Data…’
  “For unstructured XML storage, indexing a database column using the standard sorts of index (B-tree, bitmap) is generally not helpful for accessing particular parts of an XML document. If an XMLType column that contains an XML document is stored as a Binary XML instance, then the details within that document are inaccessible to the column index—the entire document acts as a single unit as far as the column index is concerned…”

• **Solution: XMLIndex**
  “XMLIndex provides a general, XML-specific index that indexes the internal structure of XML data. One of its main purposes is to overcome the indexing limitation presented by unstructured storage of XML data, that is, Binary XML storage. It does this by indexing the XML tags of your document and identifying document fragments based on XPath expressions that target them. It can also index scalar node values, to provide quick lookup based on individual values or ranges of values…”
Selected Further Reading

**Suggested Books**
- Database in Depth: Relational Theory for Practitioners by C. J. Date. Published, May, 2005.
- Date on Database: Writings 2000-2006 by C. J. Date. Published Nov, 2006.

**Articles and Reference**
Opinions & observations expressed in this presentation are my own and do not necessarily represent those of my employer.
Wrap Up and Q&A