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XQuery Support in Oracle Database 10g Release 2

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- **Overview**
- Oracle Database-Native XQuery
- Nextance Case Study
- Conclusion

What is XQuery?

- A W3C standards effort to enable data to be extracted from XML documents
- XQuery is designed to work with the XML data model
- A comprehensive query language for data expressed in XML, as
  - SQL for structured relational data
  - Keyword searches for unstructured information access on the Internet
- Also useful for constructing and transforming XML documents
- Oracle Database 10g Release 2 debuts a full-featured database-native XQuery engine

Oracle XML DB

- A native XML store introduced in Oracle Database 9i Release 2
- Useful for a certain data-management tasks
  - Content Management – standards-based life-cycle management (e.g., technical manuals, multi-media messages, legal statutes, regulatory filings)
  - Exchange and Storage – generation and storage of template-based business documents (e.g., purchase orders, bills, invoices, and reports to exchange between applications)
  - Data Integration – querying across different types of information assets (e.g., database records, files, web servers, news feeds)
- The rapidly maturing Oracle XML DB technologies are being used for a variety of applications incorporating the above tasks

Why XQuery?

- The initial use of XML as a storage format is broadening into the need for querying the stored XML
- Conciseness and simplicity
  - One-fifth the code of XSLT-oriented approaches
  - One-twentieth the code of DOM-based approaches
- Heterogeneous queries
  - XML can map to a large number of different data models, and therefore XQuery can be used to search databases, files, and web-services simultaneously
- Semi-structured XML data model
  - the XML Schema-based data model is best suited for representing semi-structured data and queried by XQuery
- XML construction and transformation
  - XQuery can construct XML as the result of evaluating query expressions, in many cases more expressively and efficiently than XSLT

The Structure of XQuery

A simple document named emp.xml:

```
<empset>
 <emp empno="21" ename="SCOTT" salary="50000"/>
 <emp empno="22" ename="JONES" salary="100000"/>
</empset>
```

To get the names of those employees with salary > 80000,

```
for $i in doc("emp.xml")/empset
let $j = 80000
where $i/@salary > $j
return $i/@ename
```

The result is the following attribute node: Jones

FLWOR Expressions

- For: Analogous to the SQL FROM clause
  - Iterates across a range of sequence values
- Let:
  - Let clause lets you define variables and assign them in turn during iteration through a FOR clause
- Where: Analogous to the SQL WHERE clause
  - Provides a set of conditions that filter or limit the initial selection in a For statement
- Order-By: Analogous to ORDER BY in SQL
  - Provides the ordering constraints on a sequence.
- Return: Analogous to the SQL SELECT clause
  - Creates output in a custom formatting language

Other XQuery Expressions

- Namespaces: the *declare namespace* prolog declaration
  - Associates a namespace URI with a prefix, crucial for indicating scoping rules on functionality
- Functions and Operators: Analogous to SQL functions and operators
  - Built-in functions and operators: numerics, strings, etc.
  - User-defined functions
- XPath: XQuery and XPath 2.0 share the same data model and the functions and operators specifications

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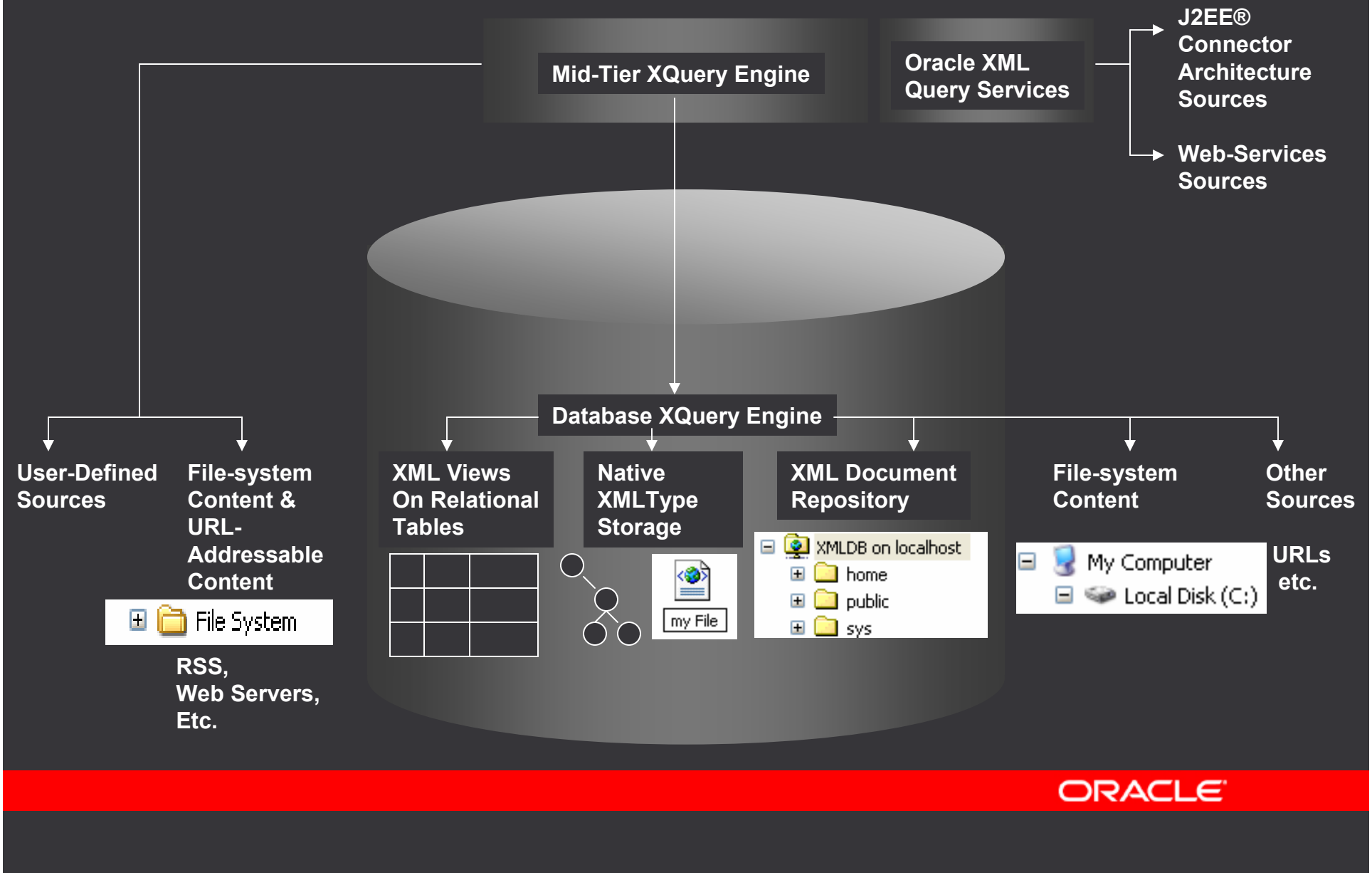
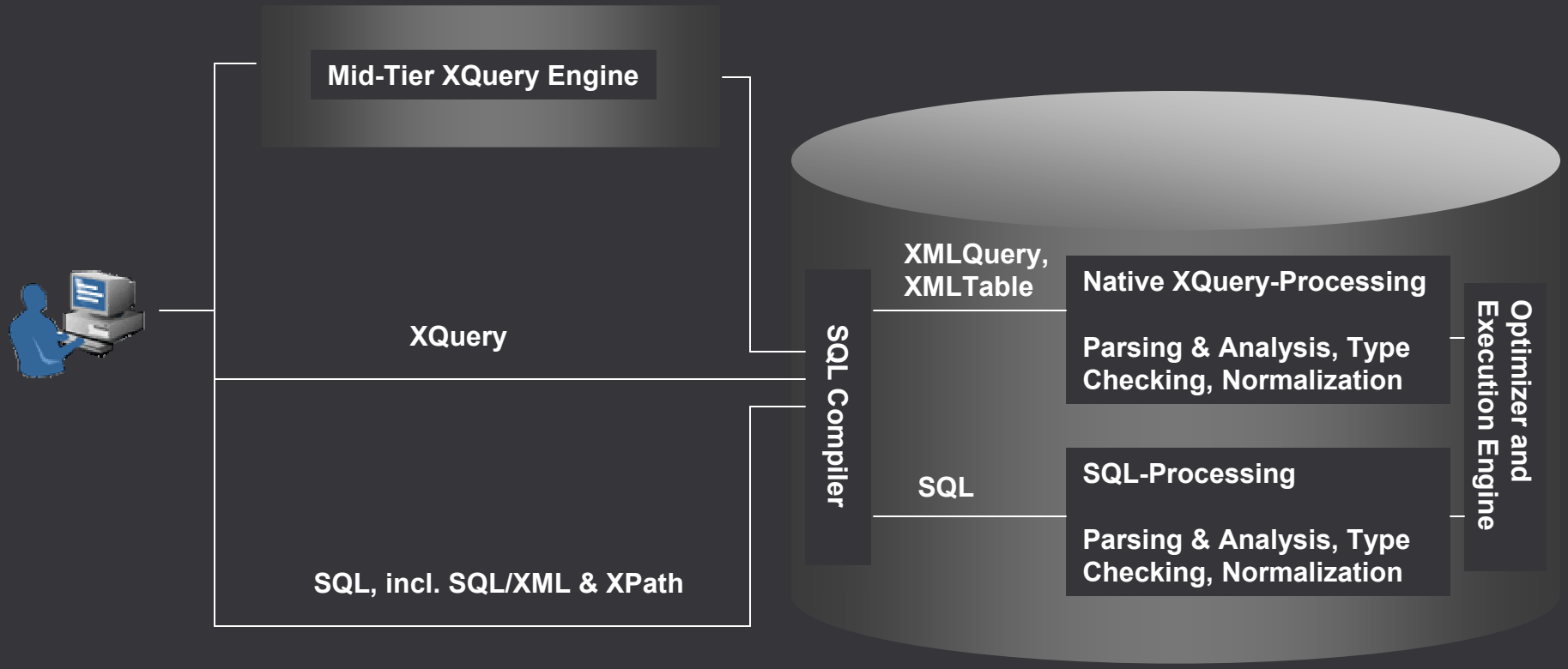
Oracle XQuery Architecture



Oracle XQuery Architecture

- Oracle supports XQuery running in both database and mid-tier
  - The database XQuery engine: For large amounts of persistent data (relational or XML)
  - The mid-tier XQuery engine: For small amounts of metadata, transient messages, or configuration information; or a large number of heterogeneous sources
- Oracle Database is the leading platform for storing all your data
- Oracle Database supports XML data model, XQuery, Web Services, etc.
- With ‘duality’ at the heart of Oracle XML DB, operational data and content, can be
  - Stored in databases
  - Modeled as XML or SQL
  - Queried by whichever metaphor is more appropriate

Oracle's Native XQuery Implementation



Native XQuery Implementation

- Goes deeper than the co-processor approach
- Directly generates low-level database query execution structures and query sub-blocks
  - Optimizes XQuery expressions in the context of the global SQL statement
- Further optimized by the underlying database optimizer
- Efficiently executed by the Oracle execution engine
- Tightly integrates XQuery and SQL/XML within the database kernel
- Delivers performance that is orders of magnitude faster than the co-processor approach
- Utilizes standard indexes
- Eliminates unnecessary materializations of XML values
- It is *transparent* to end users

Using XQuery in The Database

- **Querying the Oracle XML DB Repository**
  - XQuery is a natural way to query documents stored in Oracle
- **Querying a Relational Table or View as XML data**
  - Oracle XQuery function *ora:view()* creates an XML view over the relational data
- **Querying native XMLType data in Oracle XML DB**
  - XQuery can operate on natively stored XMLType data
- **Querying across Databases, File Systems, and Websites**
  - Call out from the database
  - Read in a file using the *doc() or the collection()* function
  - Perform a query across both data in the database and a document read in from an external source

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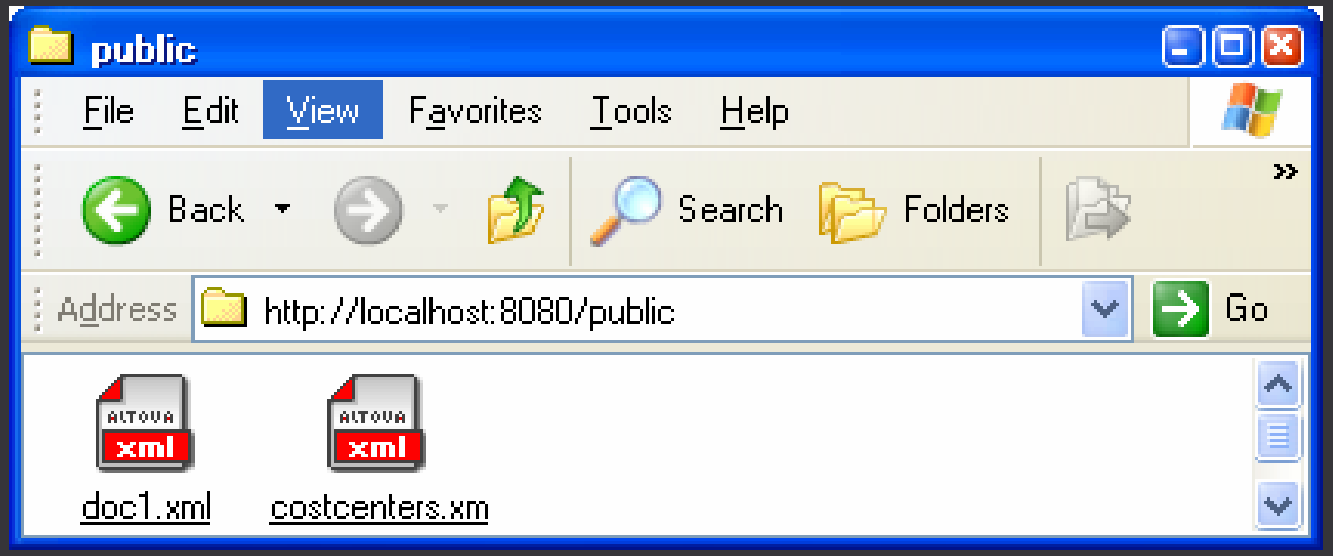
Querying the Oracle XML DB Repository

- Oracle XML DB uses the term ‘resource’ to describe content – documents, messages, metadata – stored in the Repository
- As an example, let us create two ‘resources’ in the Repository
  - A project summaries document carries summary information of the projects
  - A document that describes the cost centers
- These resources can be thought of documents managed as ‘XML files’ in Oracle XML DB
  - Oracle builds hierarchical indexes to traverse the directory-structure of these documents efficiently
  - Content-based indexes (full-text, B-Tree, XPath) can also be built

An Example (Cont'd)

- The new resources are shown as files in a WebDAV client



Using XQuery for the Example

```
SELECT XMLQuery(
'for $p in
  doc("/public/doc1.xml")/doc1/body/project
 let $c :=
  doc("/public/costcenters.xml")//costcenter
       [@costcenterno = $p/@costcenterno]/@name
 where $p/@budget > 4000
 order by $p/@projectno
 return <project Name="{$p/summary}" CC="{$c}"/>'
  RETURNING CONTENT) FROM DUAL;

<project Name="Web Service Implementation for Self
  Service Vacation Reporting  " CC="Application
  Development"></project>
```

Full-Text Searches of XML

- XQuery 1.0 does not support full-text searching of XML documents
- A related standards effort, *XQuery 1.0 and XPath 2.0 Full-Text* is still in the early stages of formulation
- Oracle adds a function *ora:contains()* to enable full-text keyword searches as part of XQuery
  - Leverages an Oracle Text index on the XML documents if one has been created
  - Otherwise, it will be evaluated functionally using in-memory indexing

An Example

```
for $p in doc("/public/doc1.xml")/doc1/body/project,
 $c in doc("/public/costcenters.xml")//costcenter
where $p/@costcenterno = $c/@costcenterno and
   ora:contains($p/summary,''Migration or "web
   service"'') > 0
order by $p/@projectno
return <project Name="{$p/summary}" CC="{$c/@name}"
</project>

<project Name="Oracle 10gR1 to 10gR2 Migration for
   Project Management Database " CC="Database
   Administration">
</project>
<project Name="Web Service Implementation for Self
   Service Vacation Reporting    " CC="Application
   Development">
</project>
```

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Querying a Relational Table or View as XML Data

- Querying across relational data is common for Application-to-Application data Exchange scenarios
- SQL will be usually be more expressive and intuitive for querying relational data,
- In certain cases you may want to use XQuery
  - For instance, if you have to feed the results to an XML-consumer or a web service

Using XQuery

```
SELECT XMLQuery('
       for $i in ora:view("REGIONS"),
           $j in ora:view("COUNTRIES")
       where $i/ROW/REGION_ID = $j/ROW/REGION_ID
         and $i/ROW/REGION_NAME = "Asia"
       return $j'
     RETURNING CONTENT) AS asian_countries
FROM DUAL;

<ROW>
  <COUNTRY_ID>AU</COUNTRY_ID>
  <COUNTRY_NAME>Australia</COUNTRY_NAME>
  <REGION_ID>3</REGION_ID>
</ROW>
...
```

The XQuery Explain Plan

```
-----------------------------------------------------
| Id  | Operation                    | Name           |
-----------------------------------------------------
|   0 | SELECT STATEMENT             |                |
|   1 |  SORT AGGREGATE              |                |
|   2 |   NESTED LOOPS               |                |
|   3 |    INDEX FULL SCAN           | COUNTRY_C_ID_PK |
|*  4 |    TABLE ACCESS BY INDEX ROWID| REGIONS        |
|*  5 |     INDEX UNIQUE SCAN        | REG_ID_PK      |
|   6 |  FAST DUAL                   |                |
-----------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   4 - filter("REGION_NAME"='Asia')
   5 - access("REGION_ID"="REGION_ID")
```

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Querying Native XMLType Data in Oracle XML DB

- XMLType data stored natively in Oracle XML DB can be based on an XML Schema
- For data based on XML Schema (e.g., *purchaseorder* in the *oe* sample schema),
  - Use the XMLQuery or the XMLTable function
  - Along with the PASSING clause to provide the *purchaseorder* table as the context item for the XQuery execution

An Example

```
SELECT xtab.COLUMN_VALUE
  FROM purchaseorder, XMLTable('for $i in
  /PurchaseOrder
        where $i/CostCenter eq "A10"
        and $i/User eq "SMCCAIN"
        return <A10po pono="{$i/Reference}"/>'
        PASSING OBJECT_VALUE) xtab;

<A10po pono="SMCCAIN-20021009123336151PDT"></A10po>
<A10po pono="SMCCAIN-20021009123336341PDT"></A10po>
...
```

- The pseudocolumn COLUMN_VALUE of the resulting virtual table holds a constructed element, A10po

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Querying Across Data Sources

- A database may contain information that references other content stored externally (e.g., file systems, web sites)
- Some queries need to address both the internal and external content
- As XML becomes the an über model that can be used to map a variety of other models, XQuery can be used to ‘join’ them with each other

An Example

```
SELECT XMLQuery(
'for $i in ora:view("COSTCENTERS")/ROW,
     $j in $ext/doc1/body/project
where $i/COSTCENTERNO eq $j/@costcenterno
return $j'
passing xmlparse (document httpuritype
  ('http://localhost:80/public/doc1.xml').getclob(
  ))as "ext"
returning content) from dual;

<project projectno="1278" budget="1000"
  costcenterno="A01">
  <summary>Oracle 10gR1 to 10gR2 Migration for
  Project Management Database
  </summary>
</project>
...
```

Querying a RSS Feed

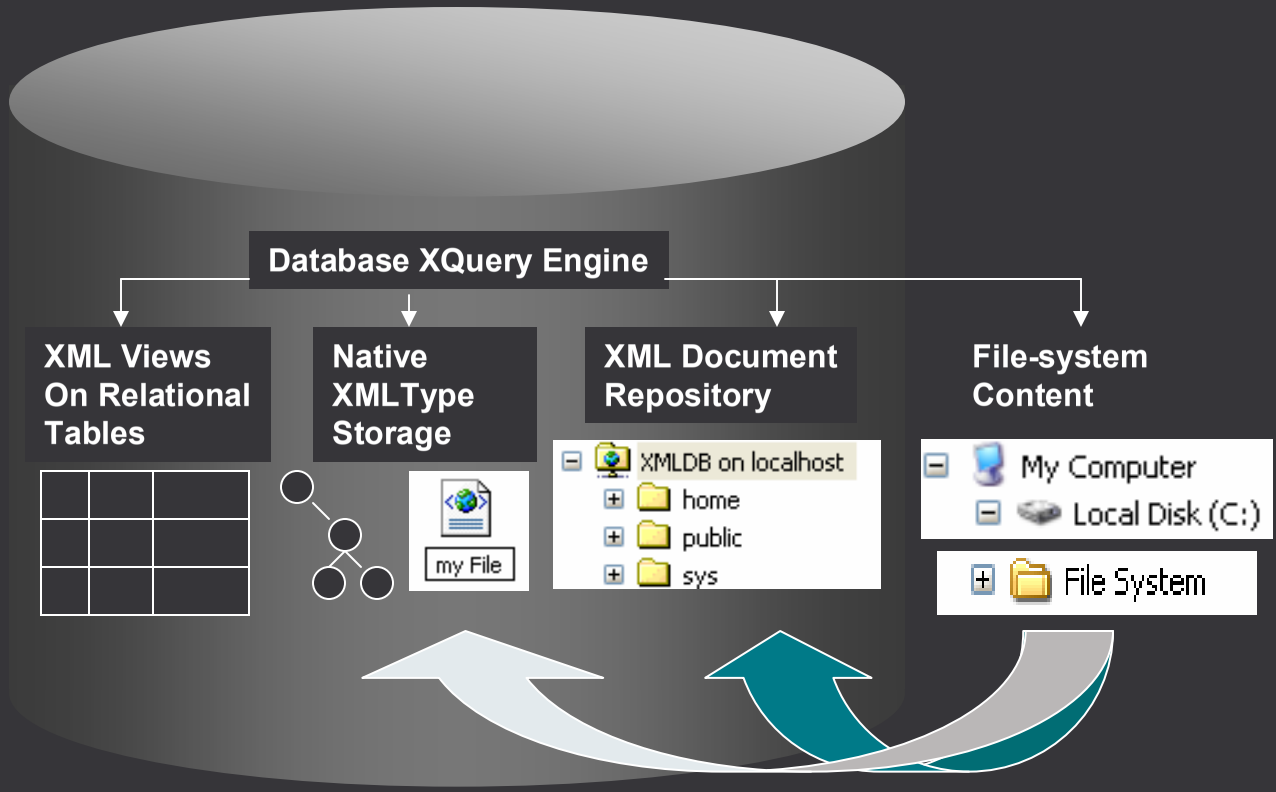
- You can query an XML RSS feed (Really Simple Syndication)
  - A format for syndicating news and the content of news-like sites like web-logs
  - Also for publishing web-site content with richer metadata than HTML
  - Any XML sources that you reach through an URL, including dynamic pages generated by applications, can be queried in this manner

An XQuery Example

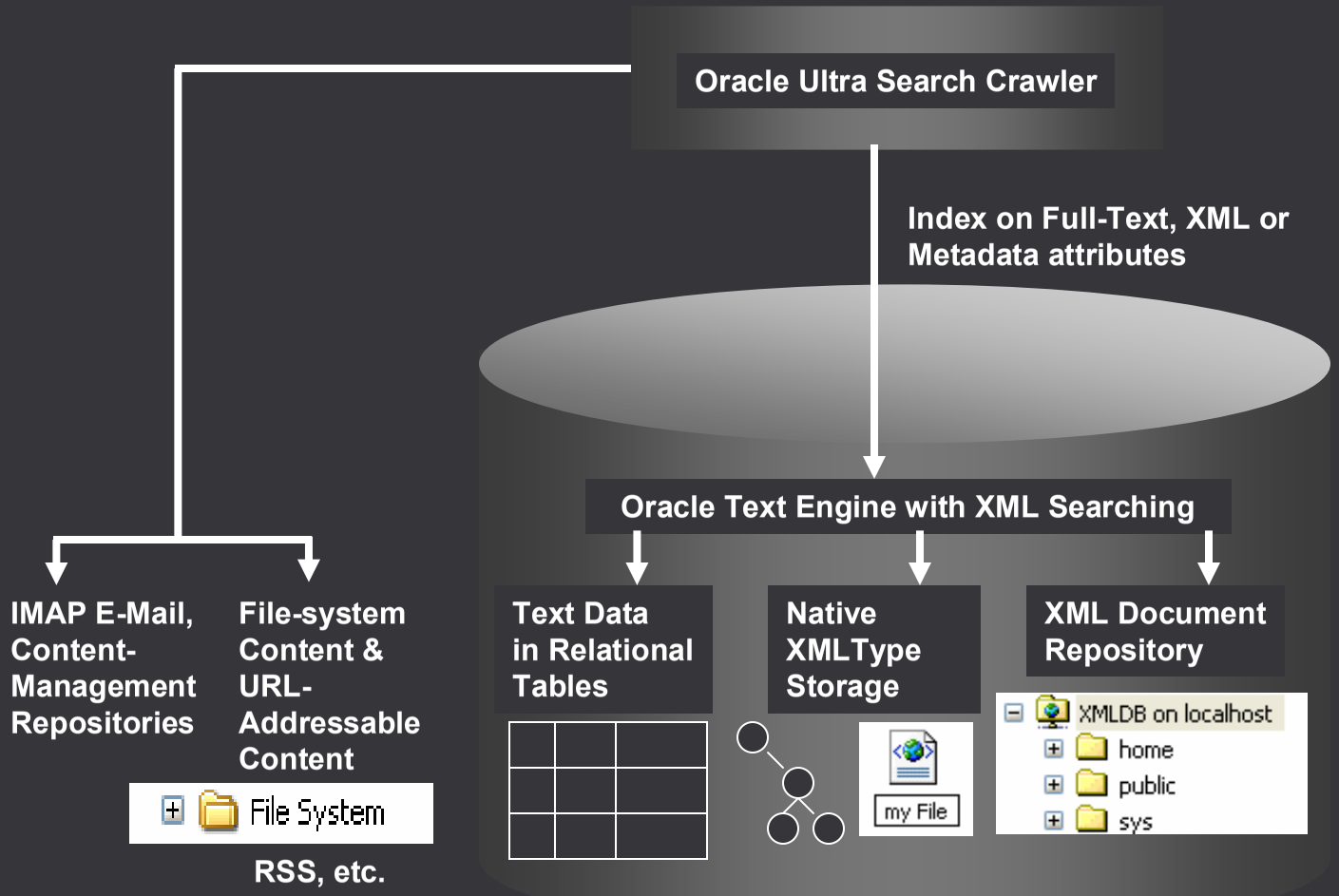
```
SELECT XMLQuery('for $i in $k//item  where contains
  ($i/title ,"Film") return $i'
  passing xmlparse( document
  httpuritype('http://www.rediff.com/rss/inrss.xml')
  .getclob()) as "k" returning content') from dual;
```

```
<item>
  <title>Filmmaker Ismail Merchant dies </title>
  <link>
  http://www.rediff.com/rss/redirect.php?url=http://
  www.rediff.com/movies/2005/may/25ismail.htm
  </link>
  <description> The filmmaker was 68.
  </description>
</item>
```

Oracle XML DB Repository



Oracle Enterprise Search



Benefits of XQuery

- There are three major advantages to using XQuery for querying XML data:
  - Conciseness and Simplicity
  - Heterogeneous Queries
  - Leveraging the XML Data Model
    - XML construction
    - XML transformation

XML Construction and Transformation

```
CONNECT HR/HR
GRANT SELECT ON LOCATIONS TO OE
CONNECT OE/OE
SELECT XMLQuery(
  'for $i in ora:view("OE", "WAREHOUSES")/ROW
    return
    <Warehouse id="{$i/WAREHOUSE_ID}">
      <Location>
        {for $j in ora:view("HR", "LOCATIONS")/ROW
         where $j/LOCATION_ID eq $i/LOCATION_ID
         return ($j/STREET_ADDRESS, $j/CITY,
                 $j/STATE_PROVINCE)}
      </Location>
    </Warehouse>'
RETURNING CONTENT) FROM DUAL;
```

XQuery vs. XSLT

- Constructing a new XML document based on a source document may be thought of either as
  - Transformation from the source to a result (XSLT), or
  - Building new document basing on a query on the source (XQuery)
- Oracle provides a native XSLT processor as part of Oracle XML DB
- XQuery will be more efficient for XML construction where optimizations can be done dynamically
  - What the type is? How the data flowing is through expressions? Where data it comes from and where is it going?
  - An example might be path expressions which have to be sorted
  - Dataflow analysis is easier to do in XQuery (using expressions) than in XSLT (using templates)

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The Database XQuery Environment

- In addition to the database execution runtime, XQuery support in Oracle Database 10g Release2 is well integrated with the rest of the Oracle environment
  - SQL*Plus
  - Web Services functionality in the database
  - The XML Developer's Kit (XDK)
  - APIs (PL/SQL, JDBC, ODP.NET, etc.)

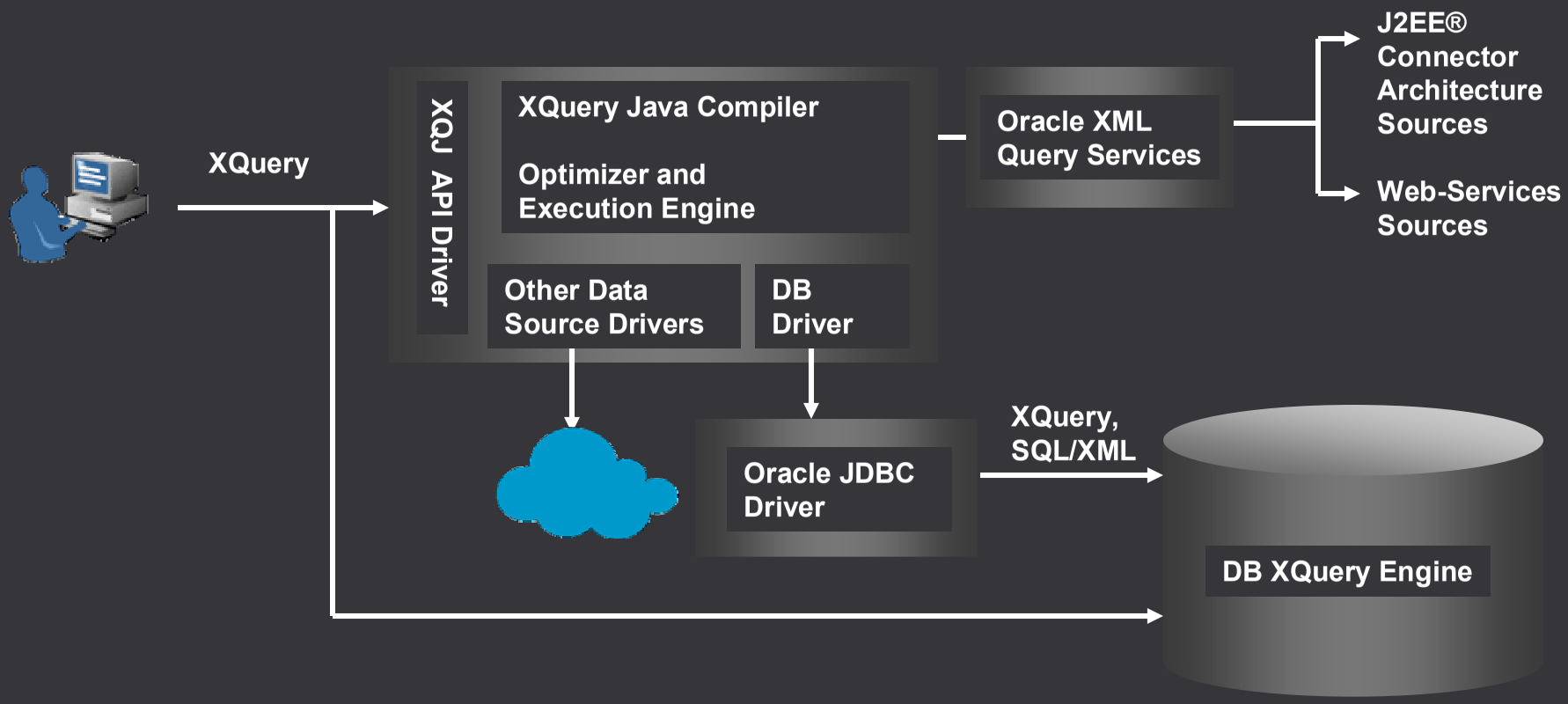
Top Level Query Support through SQL*Plus

```
SQLPLUS > xquery
for $p in doc("/public/doc1.xml")/doc1/body/project,
    $c in doc("/public/costcenters.xml")//costcenter
where $p/@costcenterno = $c/@costcenterno and
      $p/@budget > 4000
order by $p/@projectno
return <project Name="{$p/summary}“ CC="{$c/@name}"/>
SQLPLUS > /
```

XQuery APIs

- XDK
  - The XML Developer's Kit in Oracle Database 10g Release 2 supports the XPATH 2.0 and XQuery 1.0 Functions and Operators in Java
- XQuery in the Mid-Tier (XML Query Services)
  - Oracle also provides a mid-tier XQuery implementation in Java
  - Available for download from the Oracle Technology Network
  - Will be part of the Oracle Application Server 10g release
- XQJ (XQuery API for Java)
  - Currently under development as JSR 225
  - Allows invocation of and integration with functionality not part of XQuery – such a DOM, SAX, StAX, and Web Services
  - What JDBC is to SQL, XQJ is to XQuery

Query Pushdown



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Oracle XQuery

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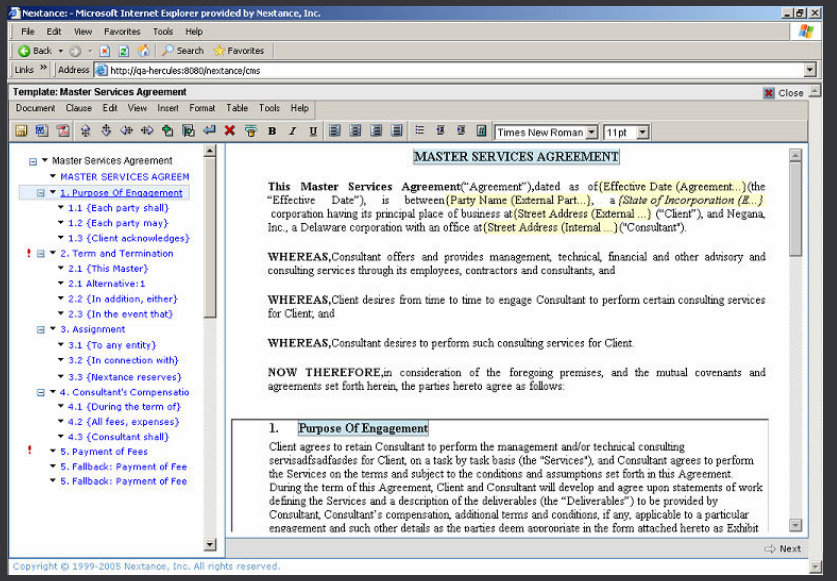
- Founded 2000 to help companies optimize their Contract Lifecycle Management and Contract Lifetime Value
- Procurement, Sales & Intellectual Property Contracts
- Proven Success in the Market
  - Over 40 Customers - majority Global 1000
  - Global deployments in over 40 countries
  - Over 80,000 users
  - Optimizing over 200,000 contracts



ECM Overview

- What is ECM ?
  - Enterprise Contract Management (ECM) enables you to
    - Create, Store, Track, Manage, Analyze, Optimize, and Renew your Sales, IP, and Procurement Contracts with Customers, Partners, and Suppliers
  - Features of an ECM
    - Contract Repository
    - Searching (both structure and full text search)
    - Reporting
    - Automatic notifications and escalations based on contractual obligations or milestones
    - Approval Workflow
    - Contract Authoring and Publishing
    - Integration to ERP, CRM etc

ECM Architecture

- XML (End to End)
  - Data model, Data, Metadata, Business rules, UI Markup
- XML Schema for strong typing
- Standards-based middleware - J2EE platform
- Standards-based XML technologies - XML Schema, XSLT, SQL/XML + XQUERY, XMLDB, DOM, STAX, SAX
- Web services API for integration

Why XML ?

- Content self describing and readable by both humans and computers
- Hierarchical structure
  - Express data more naturally (e.g. contract has multiple parties, each party has a name, address and multiple contacts)
- Open standard and medium neutral structure
  - Seamless integration with ERP, CRM, Web portals, Dashboards
- XML schema
  - Rich grammar for flexible data models
  - Evolve quickly with minimum impact
  - Unified data model for data and content
- Unstructured content
  - Random shape
  - Difficult to model in a relational database
- XML based markup
  - Improves search, processing, organization and integration
- Contracts
  - Structured business terms and Unstructured content
  - Vary in structure based on the contract type and industry
  - XML a natural fit

Why XQuery ?

- Industry standard query language for searching XML documents, offers significant query functionality beyond what SQL can do
- Designed to extract data from an XML data model
- Supports XML fragments to be constructed thereby reducing bandwidth requirements
- Supports Joins across multiple XML documents

Why Oracle XML DB/XQuery ?

- Native Support for XML Type
- Enforces validity and integrity of XML data using XML Schema
- Multiple storage mechanisms (CLOB, Structured storage etc)
- XML Schema evolution which allows easy data upgrades
- XMLType views
  - Report XML with SQL Report writers
- XQuery engine in the database
  - Query optimization, scalability and performance
- Support for SQL/XML
  - Query structured data and text in a single SQL statement
  - Advanced text search with Oracle Text

D E M O N S T R A T I O N

Nextance ECM Using Oracle XQuery

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Conclusion

- Introducing a native XQuery processing engine
  - C*ompiles* XQuery expressions into the same underlying structures as SQL queries
  - Leverages both relational- and XQuery-specific optimization
- With Oracle's XQuery support in the database and in the middle-tier, you can:
  - Search with any language –XQuery/Xpath/SQL/XSL/Full-Text
  - Search anywhere - mid tier or backend
  - Search anything - files, relational data, message, web-service etc.
  - … and search everything – structured tables, semi-structured XML, unstructured documents
  - Search any size - a native, scalable implementation
  - Search any time - an unbreakable solution, built on Oracle's robust enterprise platform.

Next Steps…

- Visit the Oracle XQuery Demo pod (A28) in the Oracle Database Demoground
- Check out the OTN Oracle XQuery page:
  http://otn.oracle.com/tech/xml/xquery
  http://otn.oracle.com/tech/xml/xmldb
- Download Oracle Database 10g Release 2:
  http://otn.oracle.com/products/database/oracle10g


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