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S317428: Building Really Scalable XML Applications with Oracle XML DB and Oracle Text

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Background Information

- ProQuest Company is a privately-held global information services company
- 1500 employees
- \$500 million revenue
- ProQuest partners with leading newspaper and academic journal providers in disciplines such as medicine, technology, social sciences, and humanities
- ProQuest aggregates materials and distributes digitized content to academic institutions, public libraries and schools
- ProQuest has a portfolio of 1,500 products and relationships with over 9,000 content providers
- 10 major product lines

Background Information

- Who am I?
 - Data Technology Manager
 - Have Worked with Oracle Products Since 1987
 - Rejoined ProQuest in June, 2007
 - Manage the Database Team
 - 3 DBAs; 3 Architects; 4 Developers
 - Part of the Global Product Development Organization
 - Support Other Areas of the Business
 - JDeveloper for Custom Internal Applications
 - New to Oracle XML DB
 - Initiated Proof of Concept in August, 2009
 - Started with 11gR2 Beta

Oracle XML DB Product/Project Overview

- Project Morningstar
 - Enterprise-wide effort to consolidate technology across multiple business units, each with its own “silo” of content
 - Two-year plan to establish new platform, integrating business units in phases
 - Approximately 100 staff members involved
 - Ultimate goal is a single, integrated vault comprising all ProQuest content, which can be searched from a single entry point
 - Technical Strategies/Challenges
 - Huge volume of documents
 - Very complex, internally developed XML Schema

Oracle XML DB Product/Project Specifics

- Application Architecture
 - Front-end (Customer Facing Application)
 - Web-based interface for user login
 - Never interacts directly with the content store
 - Documents are searched and served to users by FAST search engine
 - Content Store (Internal Editorial Application)
 - Complete store of documents in Oracle XML DB
 - Content Store User Interface directly interacts with content store
 - XML Search being investigated and prototyped now
 - Document Manufacturing
 - Ingest rate of 10 million documents/day

Oracle XML DB Product/Project Specifics

- Data Characteristics
 - Typical document size is 10-12k
 - XML Schema has on the order of 700 nodes
 - Flexible model
 - Supports many content types: newspaper, journal, dissertations, etc
- Data Volume
 - Proof of concept: scaled to 82 million documents
 - Production: Now just shy of 800 million documents
 - Next phase (2011) will ramp document count up over 2.5 billion
 - Database is currently 7TB in size
 - XML Table and LOB segment is 5 TB

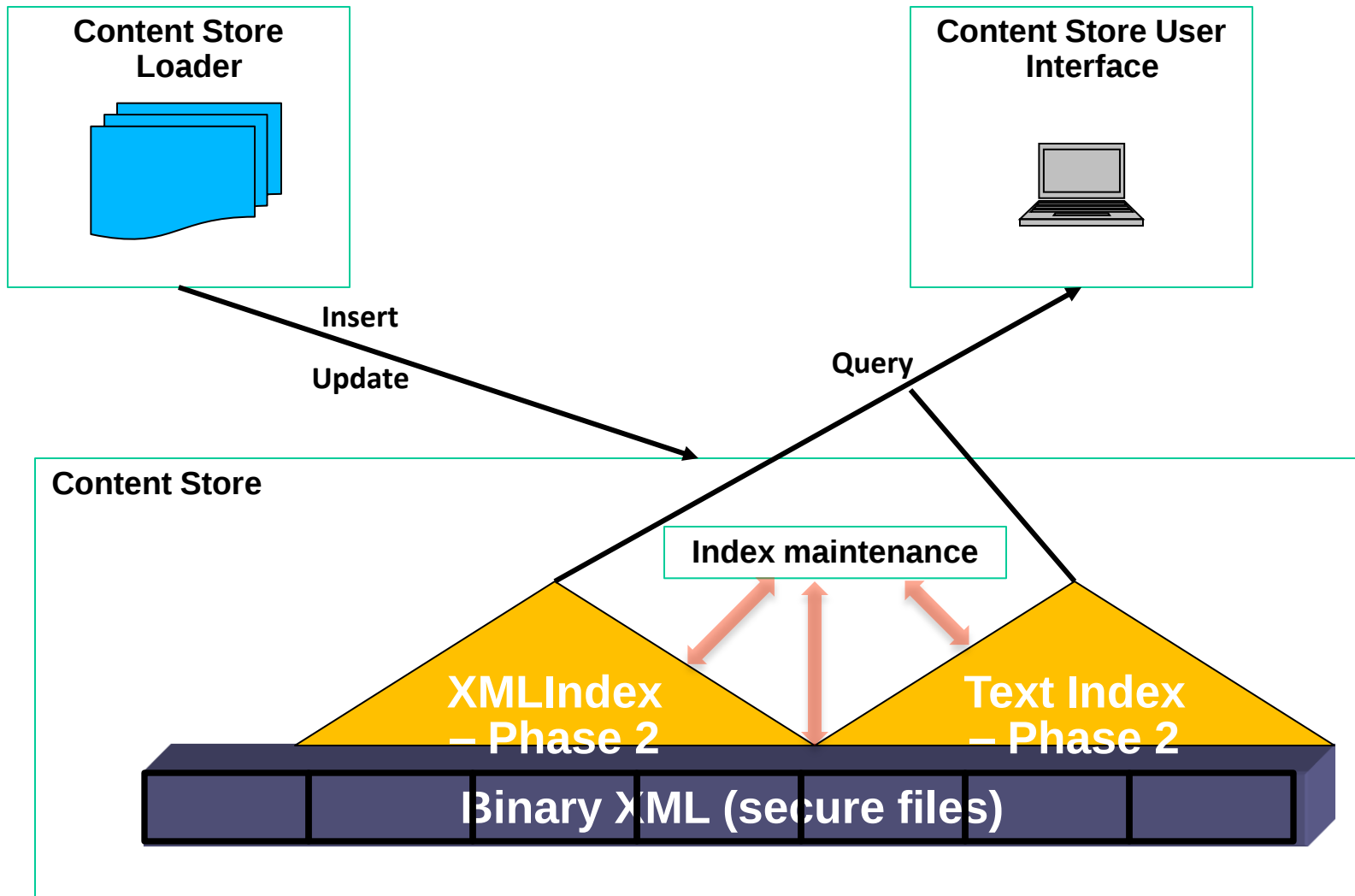
Oracle XML DB Product/Project Specifics

- Environment
 - 4 node cluster, HP DL360 G6, 2 quad core CPUs 144GB RAM
 - Running 11.2.0.1 (11gR2) on RHEL 5.3
 - Supports all online users, internal/editorial operations, and manufacturing activity
 - XML Table is Range Partitioned
- Launch Schedule
 - August 2010 – Customer Preview Successfully Launched!
 - December 2010 – General Release
- Next Steps
 - Continue to increase document manufacturing ingest rates
 - XML Index and Text Index Prototyping

Two Phases

- Phase 1
 - Live in 2010
 - Focus on
 - Ingestion speed
 - Scalability
 - Disk Storage
- Phase 2
 - Work in Progress – plan to go live in 2011
 - Focus on Query performance
 - Build XML and Text Indexes

Proquest Morningstar with XML DB



Data Model

- Binary XMLType column in a relational table
- Partitioned by range on primary key
- Non-schema based to avoid schema evolution later
- Locally partitioned XMLIndex and Text Index
- Running on a RAC system

Ingestion Performance

- Range Partitioned Binary XML Table
- Asynchronous index for both XMLIndex and Text Index
- POC numbers
 - Target : 300 docs/sec
 - Achieved : 475 docs/sec (SQL Loader)
 - CPU utilization < 60%

Scalability

- 800 million rows
- About 50 partitions
- Concurrent load
- Parallel Query
- Ingestion rate constant
- >5 TB of XML data

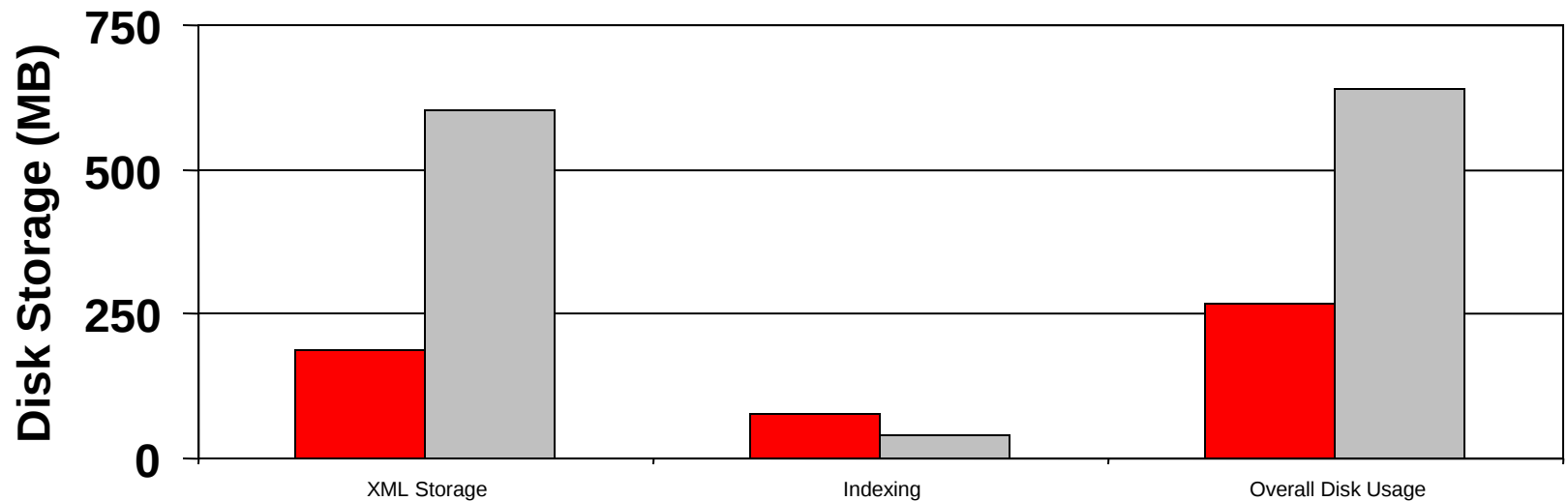
Storage

- 25% compression for Binary XML
- Disk storage less than competitors
- Less I/O
- More rows in memory
- Indexes use around 3x of raw xml data

TPoX Benchmark – XML DB

Comparison of Storage Space with another DB

Oracle uses 2.4x less storage



XML Storage and Indexing

■ Oracle 11gR2 Binary Storage with XTIDX ■ Another DB with SB with XIDX



Phase 2 – Query Performance

Query Performance

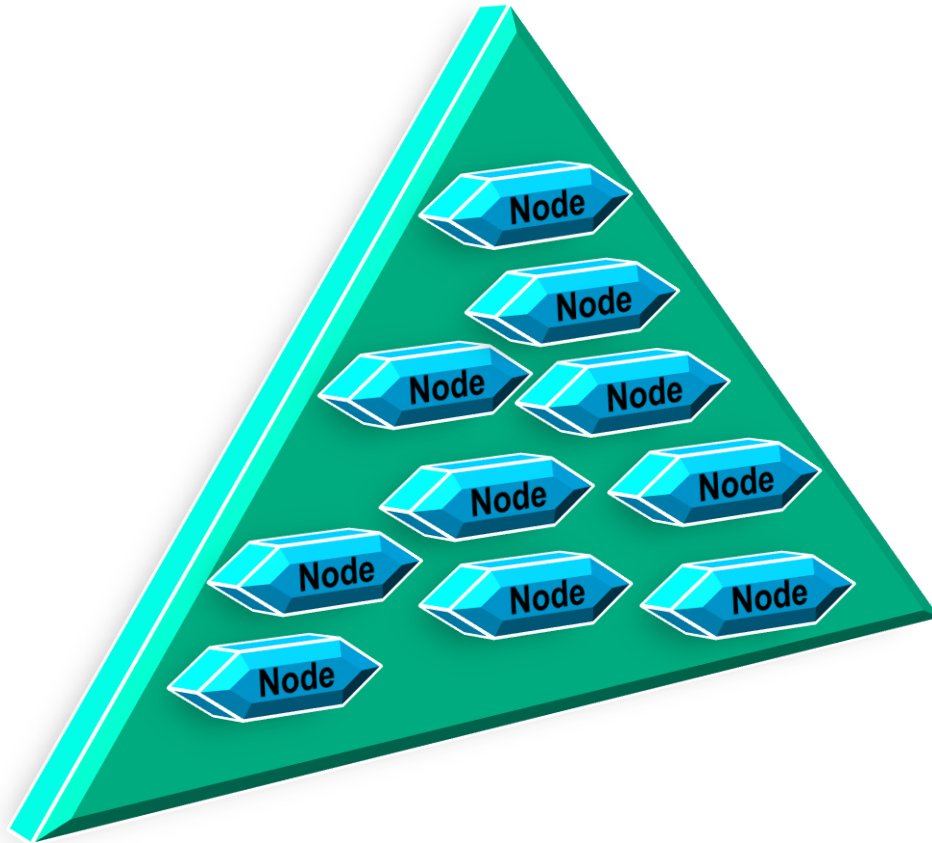
- Mixed queries containing *XMLEXISTS* and *CONTAINS*
- *CONTAINS* may use *INPATH*, *HASPATH*
- One predicate uses index, the other evaluated as a post filter
- Cost of predicates determines index usage
- Queries use parallel processing to utilize available CPU
- *Contains* clause optimized to push down most processing, including *count*, to text index
- Result Set Interface with parallel table function

Proquest Sample Queries

```
select p.doc
from PROQUEST_DATA p
where
  xmlexists('/RECORD/ObjectInfo/Copyright/CopyrightData' passing
p.doc) and
  xmlexists('/RECORD/ObjectInfo/RecInfo/ObjectRevisions/ObjectRevis
ion[UpdatedDate="20090614150554"]' passing p.doc)
order by goid
/
```

```
select /*+ FIRST_ROWS(50) no_index(p pd_text_index) rparse*/ p.doc
from PROQUEST_DATA p
where
  xmlexists('/RECORD/ParentInfo/Parent[GroupingID="23468"]'
passing p.doc) and
  contains (p.doc, 'new') > 0
order by goid
/
```

XML Index



- Primary use case in conjunction with Binary XML
- Accelerates path, predicate and structural attribute searches
- Path based index : 11gR1
- Structured index : 11gR2

XMLIndex (Path Based)

- Accelerates path and predicate searches
- Organizes paths and values in single path table
- Supports searching and fragment extraction
- Path sub-setting for indexing specific paths
- Asynchronous mode for deferred maintenance
- Ideal when XPath to be queried not known in advance
- Also called Unstructured XMLIndex

XMLIndex (Path Based) Layout

RID	PATHID	ORDER KEY	LOCATOR	VALUE
10	/Document	1	Locator to get binary content	
10	/Document/Title	1.1	Locator to get binary content	Indexing XML Techniques
10	/Document/Affiliation	1.2	Locator to get binary content	Oracle
10	/Document/pubDate	1.3	Locator to get binary content	2007-04-10
20	/Document	1	Locator to get binary content	
20	/Document/Title	1.1	Locator to get binary content	Object relational storage

XMLIndex (Structured)

- Project out commonly searched structured attributes
- Pivot each item as a column in the table
 - All xpath matching is avoided at run time
- Secondary Indexes can be created on Structured Index
 - Relational indexes on projected scalar attributes
 - Text Index on projected text attributes
 - Domain specific Index on domain attributes, e.g. image
- Physical rewrite using XQuery/XPath expression matching

XMLIndex (Structured) Layout

XML data

```
<Document>
  <title>Indexing XML Techniques</title>
  <affiliation>Oracle</affiliation>
  <pubdate>2007-04-10</pubdate>
  ....
</Document>

<Document>
  <title>Object relational storage</title>
  <affiliation>Oracle</affiliation>
  <pubdate>2003-03-15</pubdate>
  ...
</Document>
```

Structured XMLIndex

Row ID	Title	Affil	Pubdate
10	Indexing XML Techniques	Oracle	2007-04-10
20	Object relational storage	Oracle	2003-03-15

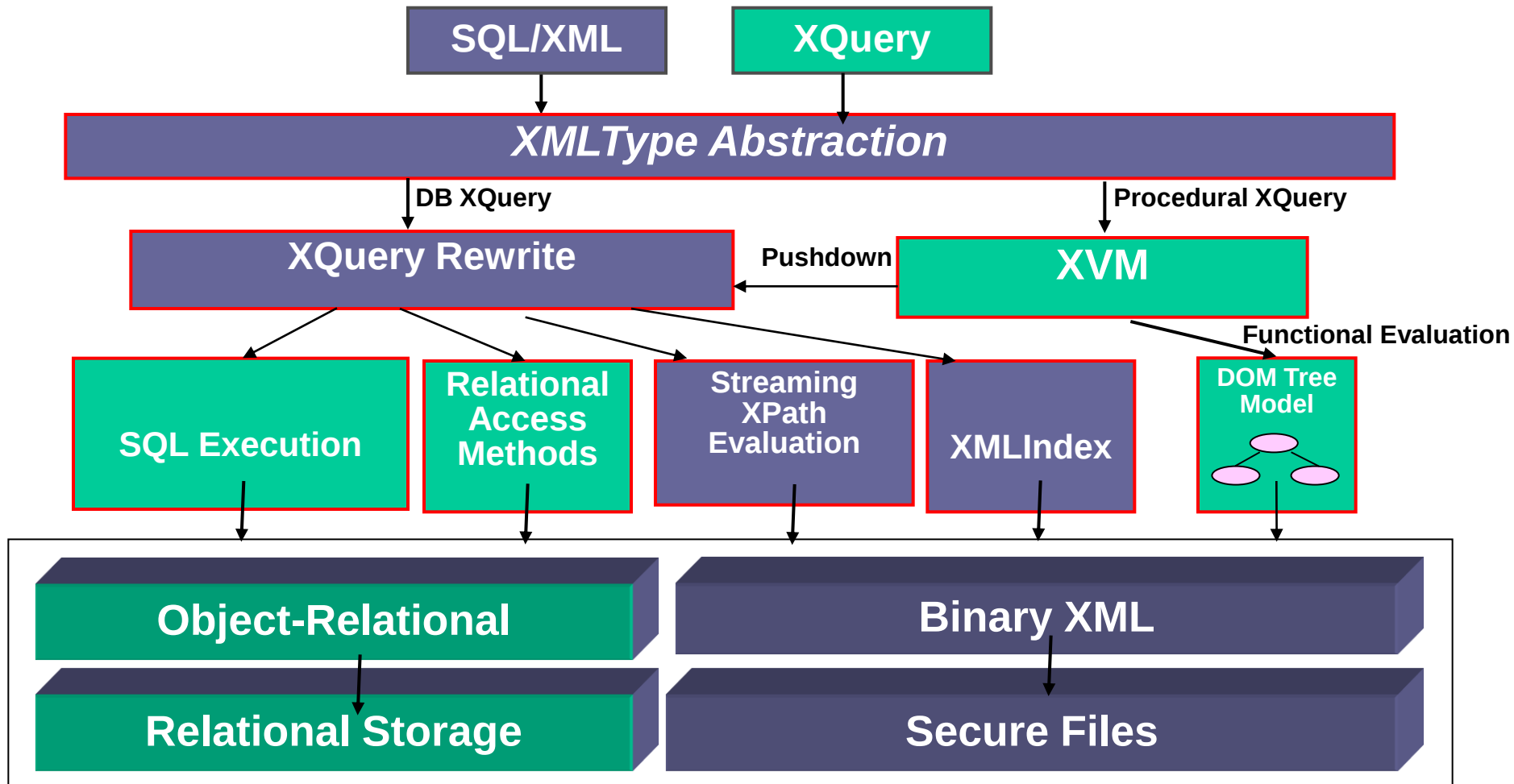
Oracle Text and XML

- Oracle Text is the full text search engine in Oracle Database
- Free with all versions of the database
- The power of a standalone search engine plus full integration with the Oracle stack
- Can perform fast free-text search within XML text
 <title>Crouching Tiger, Hidden Dragon</title>
 ... contains(movieInfo, 'tiger within title') ...
- Result Set Interface (new in 11.2.0.2) allows you to
 - Specify Query request and hitlist requirements in XML
 - Fetch Hitlist as XML

Indexes for Query Performance

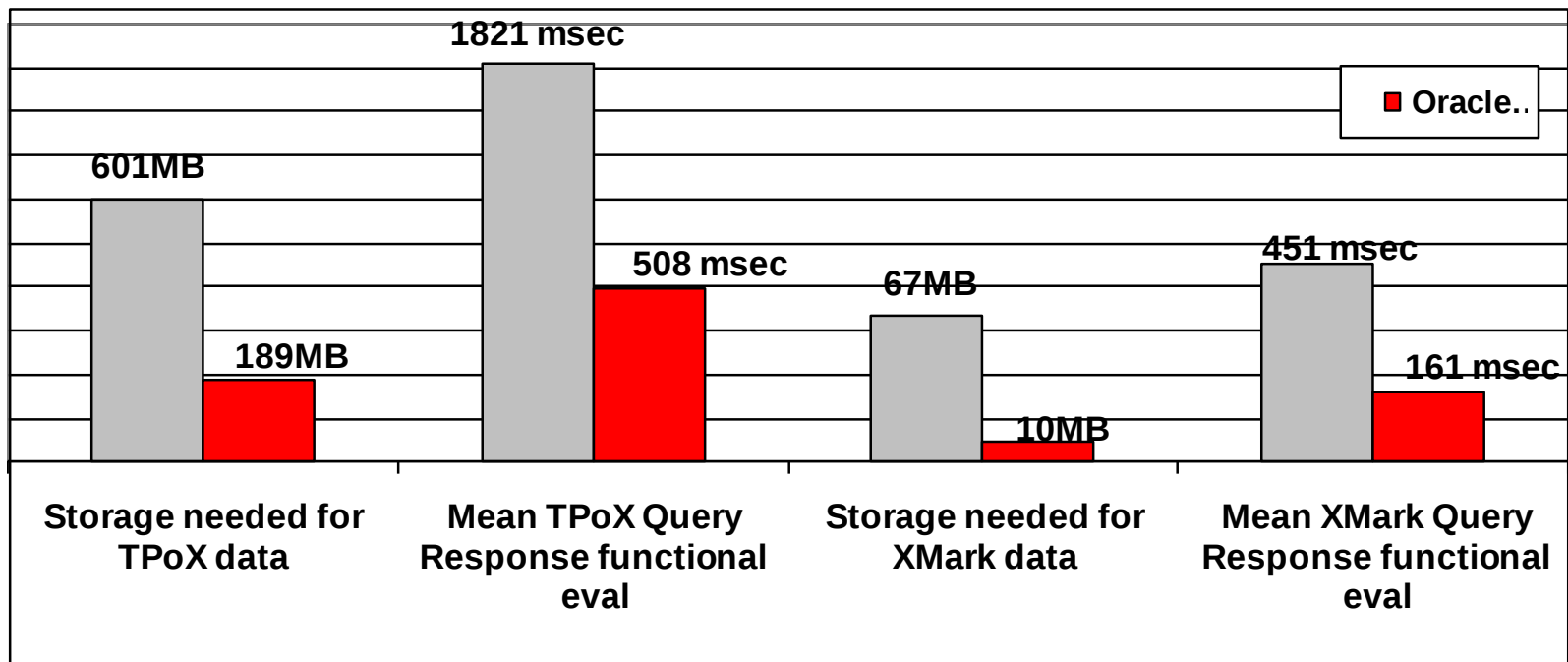
- XMLIndex
 - Path Subsetted
 - Asynchronous maintenance
 - Structured XML Index
- Text Index
 - AUTO LEXER
 - Path Section Group
 - Interval Sync
 - Asynchronous maintenance

Querying XML Content in XML DB



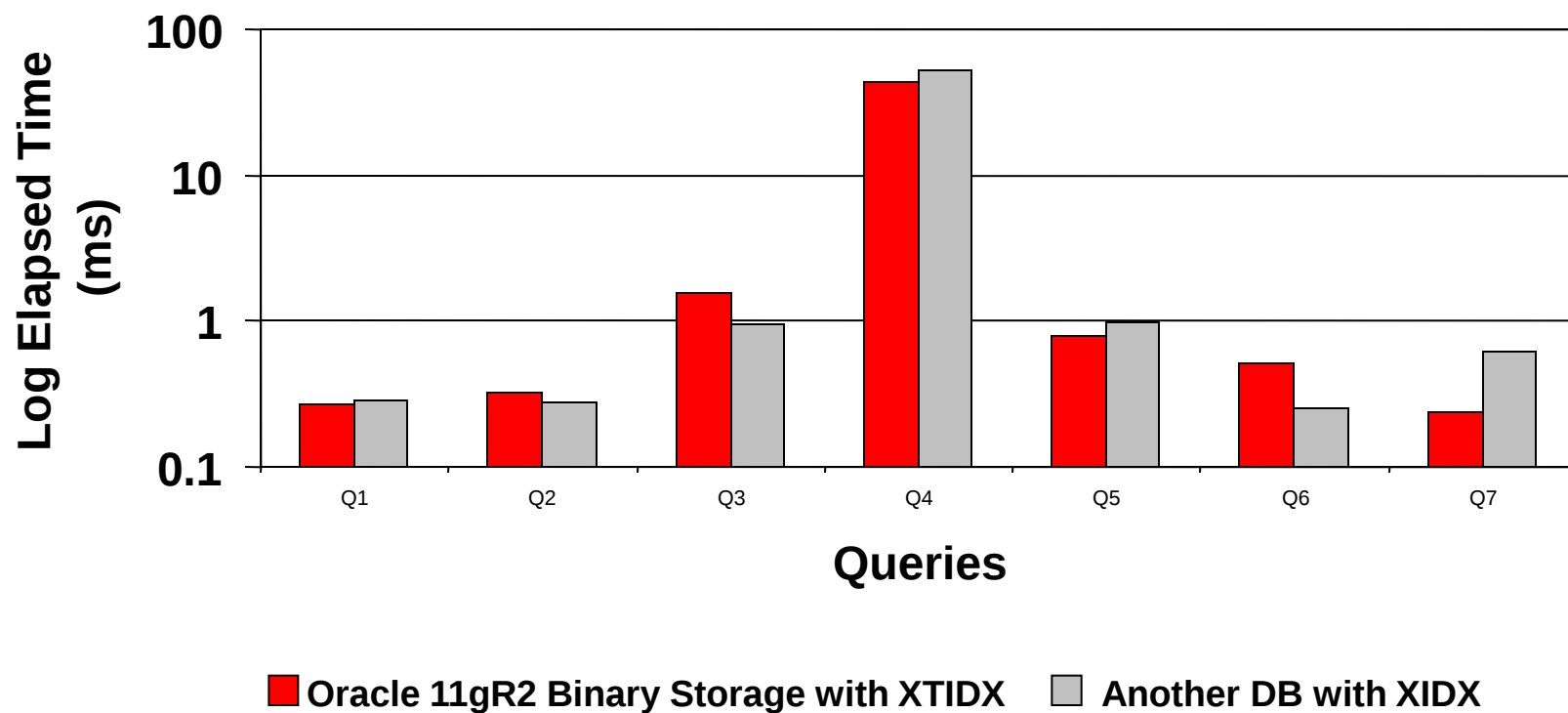
Binary XML - Comparison with another DB

1/3rd the size 3x faster



TPoX Benchmark

Comparison of Oracle XML DB with another DB (with Indexes)



Conclusion

- Proquest live on 11gR2 with XML DB
 - Focus on Ingestion speed and scalability
 - Binary XML Storage
 - Range Partitioning
 - 1TB of data
- Prototype underway for Content Store
 - Focus on Query performance
 - XML Index
 - Text Index



Q&A