Oracle Streams: What's New in Oracle Database 11g Release 2

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Program Agenda Example

• Oracle Streams Overview

• 11g Features

• CMPA and Streams on 11g
Oracle Streams

- Simple solution for information sharing
- Provides
  - Uniquely flexible information sharing
  - Active/Active replication
  - Real-time ETL for data warehouses
  - Availability during database migration
  - Availability during application upgrade
  - Message queuing
  - Event management and notification
Streams Functional Components

- Asynchronous Information Sharing
  - Capture messages at a database
  - Store messages in a queue
  - Propagate messages across databases
  - Apply messages at local or remote databases
- Integrated feature of the database
- Flexibility to meet business requirements beyond replication
Oracle Streams
Powerful Logical Database Replication Solution

- All sites active and updateable
- Automatic conflict detection & optional resolution
- Supports data transformations
- Flexible configurations – n-way, hub & spoke, …
- Database platform / release / schema structure can differ
- Provides HA for custom apps where update conflicts can be avoided or managed
Streams Process Architecture

Capture at Source, Downstream, or Target Database

Apply at Target Database

Redo Data Source Database

Reader → Preparer → Builder → Capture

Redo Records

ms01 ms02… ms0n cp01

Logical Change Records not grouped into transactions

Target Database Datafiles

Applier → Coordinator → Reader

Conflict Detection
Error Handling
Custom Code

Transactions to be applied

as02… ap01

Committed transactions grouped and sorted in dependency order

as01
11gR2 Streams Enhancements
Focus on Performance and Manageability

- High performance in more diverse configurations
  - Optimized one-to-many topologies - up to 2x faster than previous releases
    - N-way and hub-and-spoke configurations
  - Automatic management of unavailable destinations
    - Preserves high performance throughput even when some are down
    - High speed “catch-up”
    - No manual steps involved
  - Faster transformations - especially useful for application integration
    - Statement DML Handlers - up to 4x faster than procedural DML handlers
    - New Declarative Transformation - Keep Columns
- Improved JMS integration and performance improvements for Streams Advanced Queuing
  - AQ dequeue is 30%-100% faster than previous releases
Performance Optimizations

- Combined Capture & Apply
  - Capture processing
    - Capture directly from redo buffer, eliminating disk I/O
  - Apply processing
    - Internal Optimizations
- 11gR1 Streams performance white paper on OTN Streams site
  - LAN throughput: 20,000 LCRs/sec
  - WAN throughput: 15,000 LCRs/sec
- 11gR2 results even better

- Automatic optimization invoked between 11g databases
Enhanced Manageability

*And Enhance Performance, too*

- **KEEP_COLUMNS transformation**
  - Specify desired columns
  - `DBMS_STREAMS_ADM.KEEP_COLUMNS`

- **Manage unavailable destinations automatically**
  - Split off unavailable targets based on threshold
  - Enable all processes for fast recovery
  - Merge back when target caught up

- **Extend Streams API to manage change handlers**
  - `MAINTAIN_CHANGE_TABLE`
Automatic Split and Merge

Handle Unavailable Destinations

Tunable capture parameters

Split_threshold=1800 secs
Merge_threshold=60 secs
Site-A Unavailable
Split With Site-A Unavailable

**Split_threshold Exceeded**

![Diagram showing database connections and processes with red X indicating an issue with Site-A.](diagram.png)
Site A Available Again
Merge Back To Original Configuration

*Merge Threshold Reached*

**Views:**

- DBA_STREAMS_SPLIT_MERGE
- DBA_STREAMS_SPLIT_MERGE_HIST
Statement DML Handlers

• Fast
  – Up to 4x faster than procedural DML handlers
  – No LCR processing with PL/SQL

• Easy to Use
  – SQL statements, rather than PL/SQL procedures
  – `DBMS_APPLY_ADM.ADD_STMT_HANDLER`
    • Creates handler with SQL statement AND
    • Registers to Apply process
  – `DBMS_STREAMS_HANDLER_ADM` package procedures
    • Create or Drop handler
    • Add or Remove statements to/from handler
    • Register with apply
Statement Handler Example

Business Requirement: Retain all employee records in Warehouse

DECLARE
stmt CLOB;
BEGIN
stmt := 'update demo.employees set row_deleted="Y" where employee_id=:old.employee_id';
DBMS_APPLY_ADM.ADD_STMT_HANDLER(
    object_name => 'demo.employees',
    operation_name => 'DELETE',
    handler_name => 'employee_del',
    statement => stmt);
END;
/
Streams Change Handlers

Recording Table Changes

BEGIN

DBMS_STREAMS_ADM.MAINTAIN_CHANGE_TABLE(
    change_table_name=> 'hr.jobs_changes',
    source_table_name=> 'hr.jobs',
    column_type_list=> 'JOB_ID VARCHAR2(10),
                      JOB_TITLE VARCHAR2(35), MIN_SALARY NUMBER(6),
                      MAX_SALARY NUMBER(6)',
    capture_values=> '*',
    perform_actions=> TRUE);

END;
/

This creates a HR.JOBS_CHANGES table where changes to the HR.JOBS table will be recorded.
select source_table_name TABLE_NAME, handler_name, operation_name, capture_values from dba_apply_change_handlers where change_table_name='JOBS_CHANGES';

<table>
<thead>
<tr>
<th>TABLE_NAME</th>
<th>HANDLER_NAME</th>
<th>OPERATION</th>
<th>VAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOBS</td>
<td>HR_JOBS_CHG$14</td>
<td>INSERT</td>
<td></td>
</tr>
<tr>
<td>JOBS</td>
<td>HR_JOBS_CHG$15</td>
<td>DELETE</td>
<td></td>
</tr>
<tr>
<td>JOBS</td>
<td>HR_JOBS_CHG$16</td>
<td>UPDATE</td>
<td>*</td>
</tr>
</tbody>
</table>
Generated Update Change Handler
HR_JOBS_CHANGES$16

SEQ STATEMENT
   ----------------------------------------
1  INSERT INTO
   "HR"."JOBS_CHANGES"
      ("COMMAND_TYPE$""JOB_ID""""JOB_TITLE""""MAX_SALARY""""MIN_SALARY""""VALUE_TYPE$"")
   values ("COMMAND_TYPE""OLD.JOB_ID""""OLD.JOB_TITLE""""OLD.MAX_SALARY""""OLD.MIN_SALARY""""OLD"")

SEQ STATEMENT
   ----------------------------------------
2  INSERT INTO
   "HR"."JOBS_CHANGES"
      ("COMMAND_TYPE$""JOB_ID""""JOB_TITLE""""MAX_SALARY""""MIN_SALARY""""VALUE_TYPE$"")
   values ("COMMAND_TYPE""NEW.JOB_ID""""NEW.JOB_TITLE""""NEW.MAX_SALARY""""NEW.MIN_SALARY""""NEW")
XStream Overview
Fast Real-Time Programmatic Access to Data Changes

- 3rd party apps require fast real-time access to changes in Oracle database
- 3rd party apps require high performance interface to make changes in Oracle database
- Solution: eXtended Streams - XStream (API to Oracle Streams)
  - Client application attaches directly to Streams capture/apply processes
  - Outbound server (XStream Out)
  - Inbound server (XStream In)
Update EMP set job= 'coding' where empid= 510;

- High performance APIs to stream changes from Oracle database
- Initiated by clients
  - Languages: C, Java
  - Format: in-memory, file
- Continuous data stream feed to clients e.g., application servers, non-Oracle databases, file systems
XStream In Overview

- Journals, Data Feeds, etc

Client using XStream In Interface

Inbound Server

- Connect
- Data Stream
- ACK

empid|job | ..
100  | sales | ...
510  | coding| ...

- High performance APIs to Oracle database
- Initiated by clients
  - Languages: C, Java
  - Format: in-memory, file
- Continuous merged stream sent from clients e.g., application servers, non-Oracle databases, file systems
Additional Data Type Support

11gR2

- **Support for BASIC and OLTP table compression**
  - Alter TABLE ….. COMPRESS
  - Alter TABLE ….. COMPRESS FOR OLTP
  - Redo compatibility must be 11.2

- **Support for SecureFiles**
  - LOBs stored as SecureFile
  - SecureFile compression
  - Deduplication and Delta Updates (sliding insert), DBFS are **not** supported
Additional Data Type Support

11gR1

• **XMLType**
  - Support for XMLType columns stored as CLOB columns

• **Transparent Data Encryption (TDE)**
  - Capture: encrypted columns in are decrypted when row LCRs are staged in a buffered queue; transparently encrypted again upon disk spill
  - Propagation: encrypted columns are decrypted when transferred over the network (use Advanced Security Option otherwise)
  - Apply: changes to encrypted columns are encrypted when applied
    - **PRESERVE_ENCRYPTION** apply parameter controls behavior when destination columns are not encrypted
Streams Performance Advisor

- Auto-discovery of streams topology on multiple databases
- Automatic performance analysis across all databases
  - `DBMS_STREAMS_ADVISOR_ADM` package
- Per-Component Analysis:
  - Throughput and latency
  - Aborted or Enabled
- Per-Stream Analysis:
  - Time-based analysis of each component (waits, CPU, etc.) using ASH
- Bottleneck components
  - Top wait events of bottleneck
- Stream errors are integrated with Server-generated Alerts
- `UTL_SPADV` package
  - Performance Advisor based STRMMON
  - Start/Stop monitoring procedures
Comparing Table Data

- **DBMS_COMPARISON**
  - PL/SQL Package supplied with the database
  - Compares database objects (Tables, views, MVs) at different databases
    - Identify differences
    - Converge the database objects
    - Compare & converge entire objects or subsets
  - Steps
    - `DBMS_COMPARISON.CREATE_COMPARISON`
    - `DBMS_COMPARISON.COMPARE`
    - View results (`DBA_COMPARISON*` views)
    - `DBMS_COMPARISON.CONVERGE`
      - options => `CMP_CONVERGE_LOCAL_WINS, CMP_CONVERGE_REMOTE_WINS`
    - `DBMS_COMPARISON.RECHECK` - checks previously identified differences

- Can compare 11g objects with 10.1, 10.2, 11.1, or 11.2 objects
Streams Message Tracking

Streams Cross Database Tracing

- Enable Message Tracking in Session
- Execute DML to monitor
- Monitor View from any session
  - **Action** identifies processing within component
  - **Action_Details** provides further information about that processing
- Capture parameter **Message_Tracking_Frequency** controls frequency at which messages captured by the capture process are tracked automatically
Automatic Conflict Detection

Improved Error Messages

ORA-26786: A row with key ("ORDER NUMBER") 1028 exists but has conflicting column(s)
"STATUS" in table "DEMO_ORDERS", line 446 ORA-06512: at 'SYS.LCRS_ROW_RECORD', line 446 ORA-06512: at 'DEMO.ORDERS_DML_HANDLER', line 446 ORA-06512: at line 1

- Old Value shows the old column value in the row LCR. This is the column value for the row before the DML change.
- New Value shows the new column value in the row LCR. This is the column value for the row after the DML change.
- Current Value shows the column value in the row at the destination database. This is the row that will be modified by the row LCR when the apply process applies the change.
Enterprise Manager Streams Enhancements
Simplified Management, Fine-Grained Monitoring

- Oracle Grid Control 10.2.0.5 simplifies Streams configuration and maintenance
  - Set-up wizards
  - Monitoring by database or by path
  - Streams metrics for EM alerts notification
Monitor Streams Activity by Path

11g Database

<table>
<thead>
<tr>
<th>Type Status</th>
<th>State</th>
<th>Bottleneck</th>
<th>Latency (Seconds)</th>
<th>Throughput (Messages/Sec)</th>
<th>Component Database</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPTURING CHANGES</td>
<td></td>
<td>0</td>
<td>810.66</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enqueue Enabled, Dequeue Enabled</td>
<td></td>
<td>0</td>
<td>48353.51</td>
<td>STREAMSA US ORACLE.COM</td>
<td></td>
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<tr>
<td>Waiting on empty queue</td>
<td></td>
<td>0</td>
<td>46315.02</td>
<td>STREAMSA US ORACLE.COM</td>
<td></td>
</tr>
<tr>
<td>Waiting for message from propagation sender</td>
<td></td>
<td>0</td>
<td>46315.02</td>
<td>STREAMSA US ORACLE.COM</td>
<td></td>
</tr>
<tr>
<td>Enqueue Enabled, Dequeue Enabled</td>
<td></td>
<td>0</td>
<td>48333.56</td>
<td>STREAMSA US ORACLE.COM</td>
<td></td>
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<tr>
<td>DEQUEUE MESSAGES</td>
<td></td>
<td>0</td>
<td>46315.02</td>
<td>STREAMSA US ORACLE.COM</td>
<td></td>
</tr>
<tr>
<td>CAPTURING CHANGES</td>
<td></td>
<td>0</td>
<td>13062.27</td>
<td>STREAMS1 US ORACLE.COM</td>
<td></td>
</tr>
<tr>
<td>Enqueue Enabled, Dequeue Enabled</td>
<td></td>
<td>0</td>
<td>13062.27</td>
<td>STREAMS1 US ORACLE.COM</td>
<td></td>
</tr>
<tr>
<td>Creating LCRs</td>
<td></td>
<td>0</td>
<td>13062.27</td>
<td>STREAMS1 US ORACLE.COM</td>
<td></td>
</tr>
<tr>
<td>Waiting for message from client</td>
<td></td>
<td>0</td>
<td>13062.27</td>
<td>STREAMS2 US ORACLE.COM</td>
<td></td>
</tr>
<tr>
<td>Enqueue Enabled, Dequeue Enabled</td>
<td></td>
<td>0</td>
<td>13062.27</td>
<td>STREAMS2 US ORACLE.COM</td>
<td></td>
</tr>
<tr>
<td>EXECUTE TRANSACTION</td>
<td></td>
<td>0</td>
<td>13062.27</td>
<td>STREAMS2 US ORACLE.COM</td>
<td></td>
</tr>
</tbody>
</table>
Extended Datatype Support (EDS)

```
insert into EMP values (1001, 'Smith', 'Sales', 42, sysdate, 30000, 10, 19);
```

```
insert into CUST values (123, 'Acme Corp', address_typ('123 Any St', 'New York', 'NY', 10001));
```

EDS supports

- XMLType
- VARRAYs
- SDO_GEOMETRY
- Object columns with simple object types
- Object tables

Source Database

Target Database

Capture

Propagate

Apply

Metalink Article 556742.1
Oracle Streams: Advanced Queuing
Oracle Streams

Rules and Transformations

Queues

Auto-Capture
Auto-Apply

Event Monitor

Intranet

Internet

Auto-Capture
Auto-Apply

MQ/Series
Tibco

OCI
PL/SQL
JDBC
JMS

SOAP
Web services

DB2
Sybase
SQLServer
Streams Advanced Queuing (AQ) New Features

- **JMS/AQ performance improvements**
  - Direct Streams AQ support in JDBC
  - JMS Non-durable subscriber support
  - Improved performance across the board

- **Scalable event notification**
  - Grouping notification by time
  - Multiple processes notification for scalability

- **Improved Manageability**
  - Scheduler support
  - Performance views for additional visibility into queue activity
  - Disallow DDL operations on AQ created tables and views to prevent accidental corruption
AQ Performance Improvements

- Improved dequeue concurrency performance for persistent messaging
  - Uses streams pool memory for optimized in-memory locking of messages.
- Elimination of subscriber creation serialization
- Automatic index rebalancing
Scalable Event Notification

- EMON process set per instance
  - EMON (coordinator)
  - E000, E001, E002, E003
- Notification performed at originating instance
- Automatic cleanup of failed client’s registrations
Optimized Propagation Scheduling

Challenge:
• Increase scheduling choices
• Simplify management

Solution:
➢ Migrate to Oracle Scheduler
  – Standard Oracle database schedule
  – Improved job processing control
  – Automatic job process management
Subscribing for Events

Challenge

- Identify subscriber registration
- Control notification

Solution:

- New views for managing registrations
- Notification Groups
  - Limit volume of notifications received
  - Control notification interval
Notification Groups

• Notification control by Time
  – At most 1 notification for that the time period
  – 2 formats: Summary or Last
  – Includes COUNT of notifications for time period

• Registration options
  – Type (Summary or Last)
  – Repeat count
  – Start time
Monitoring Registrations and Notifications

**DBA_SUBSCR_REGISTRATIONS**
- General Subscription Registrations
- Notification Group Information

**V$SUBSCR_REGISTRATION_STATS**
- Run-time statistics for registrations
  - Number of notifications
  - Last notification, Last error information
  - Emon process servicing registration

**V$EMON**
- Run-time statistics for emon processes
- Number of notifications of different types and total processing times.
Run-time Views for Persistent Queues

**V$PERSISTENT_QUEUES**
- Statistics on enqueue/dequeue/browse of queue
- Elapsed time spent on rule evaluation, transformation

**V$PERSISTENT_SUBSCRIBERS**
- Subscriber name
- Number of enqueued/dequeued/browsed
- Time for last enqueue and dequeue

**V$PERSISTENT_PUBLISHERS**
- Publisher name
- Number of messages enqueued
- Time when last message enqueued
QMON Statistics

- **V$PERSISTENT_QMN_CACHE**
  - Background and time-management processing statistics per queue table.
- **V$QMON_COORDINATOR_STATS**
  - Statistics for the queue monitor coordinator (QMNC)
- **V$QMON_SERVER_STATS**
  - Statistics for the queue monitor server processes (QXXX)
- **V$QMON_TASKS**
  - Information about the currently active or pending background AQ tasks
- **V$QMON_TASK_STATS**
  - Cumulative statistics about each task type for the duration of the instance
Messaging Gateway

• Improved scalability
  – Configure multiple agents to service workload
  – Distribute load between RAC instances

• Simplified configuration

• Scheduler support
List of Oracle Streams New Features
Oracle Database 11g

11gR1
- Streams Performance Advisor
- Performance improvements in all components
- Compare table data between databases
- Additional datatype support for XMLType stored as CLOB and Transparent Data Encryption (TDE)
- Message Tracking across Streams path
- Improved error messages
- Improved scalability of Event Notifications
- New run-time views for monitoring AQ
- New 2-Day+ book: Data Replication and Integration

11gR2
- XStream IN & OUT
- Optimized one-to-many propagation
- Statement DML Handlers
- New Declarative Transformation
- Change handlers
- Improved JMS integration and performance improvements for AQ
- Support of OLTP Compression, SecureFiles, XA in RAC
- Extended Datatype Support package
CMPA Streams
HA Sessions, Labs, & Demos by Oracle Development

**Sunday, 11 October – Hilton Hotel Imperial Ballroom B**
3:45p Online Application Upgrade

**Monday, 12 October – Marriott Hotel Golden Gate B1**
11:30a Introducing Oracle GoldenGate Products

**Monday, 12 October – Moscone South**
1:00p Oracle’s HA Vision: What’s New in 11.2, Room 103
4:00p Database 11g: Performance Innovations, Room 103
2:30p Oracle Streams: What’s New in 11.2, Room 301
5:30p Comparing Data Protection Solutions, Room 102

**Tuesday, 13 October – Moscone South**
11:30a **Oracle Streams: Replication Made Easy**, Room 308
11:30a Backup & Recovery on the Database Machine, Room 307
11:30a Next-Generation Database Grid Overview, Room 103
1:00p Oracle Data Guard: What’s New in 11.2, Room 104
2:30p **GoldenGate and Streams - The Future**, Room 270
2:30p Backup & Recovery Best Practices, Room 104
2:30p Single-Instance RAC, Room 300
4:00p Enterprise Manager HA Best Practices, Room 303

**Tuesday, 13 October – Marriott Hotel Golden Gate B1**
11:30a GoldenGate Zero-Downtime Application Upgrades
1:00p GoldenGate Deep Dive: Architecture for Real-Time

**Wednesday, 14 October – Moscone South**
10:15a Announcing OSB 10.3, Room 300
11:45a Active Data Guard, Room 103
5:00p Exadata Storage & Database Machine, Room 104

**Thursday, 15 October – Moscone South**
9:00a Empowering Availability for Apps, Room 300
12:00p Exadata Technical Deep Dive, Room 307
1:30p Zero-Downtime DB Maintenance, Room 103

**Demos Moscone West DEMOGrounds**
Mon & Tue 10:30a - 6:30p; Wed 9:15a - 5:15p
Maximum Availability Architecture (MAA), W-045
Oracle Streams: Replication & Advanced Queuing, W-043
Oracle Active Data Guard, W-048
Oracle Secure Backup, W-044
Oracle Recovery Manager & Flashback, W-046
Oracle GoldenGate, 3709

**Hands-on Labs Marriott Hotel Golden Gate B2**
Monday 11:30a-2:00p Oracle Active Data Guard, Parts I & II
Thursday 9:00a-11:30a Oracle Active Data Guard, Parts I & II
For More Information

search.oracle.com

or

oracle.com
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