Poor Man's Auditing with Oracle Log Miner

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Who is Caleb?

- Lifelong IT career
- Oracle DBA since v7.0
- Former Instructor for Oracle Corp.
- Independent consultant
- Faculty appointment Camosun College
- U of W night courses
- Vice-president, VicOUG
- Director, PSOUG

What does he know about Oracle?

- Installing Oracle Databases for 15yrs
- Studied RAC on 9i
- Re-wrote RAC curriculum for 10gR2
- Teaching RAC workshop for PSOUG
- Various RAC & DataGuard installations
- Setup PSOUG and VicOUG RAC labs

Case Study

- Software development company
- Medical research application
- Audit requirement driven by customer research funding rules
- Also desirable to track erroneous entries and changes
- Data access not an issue
- “Audit all changes to the database”
- Implement with least amount of resources, preferable no code changes

Architecture

- Typical middle tier Java application
- Hibernate/C3PO connection pool
- Uses database as back end store
- User authentication within the app
- Single point of interface with the DB

Possible Solutions

- Audit Vault – too complex, infrastructure requirements
- Standard auditing – does not capture values
- Fine Grained Auditing – too focused, not broad based
- Trigger based – code generation & maintenance
- Application auditing – don’t want to write code
- Log Miner

Advantages of Log Miner

- Mature technology
- Built in
- Simple implementation
- Broad based – *all* tables
- Captures before & after values
- Captures user & date
- Searchable
- No additional audit trail

Pre-requisites

- DB must be in archivelog mode
- Procedures *must* be in place to protect archive and online redo logs
- Archive logs *must* be kept for duration of audit period
- Gaps *may* be tolerable but represent lost audit information

Most production systems already meet these requirements

Additional Requirements

- Enable Supplemental Logging
  - Every txn writes addn’l info to redo log to identify the row being modified
  - Slight system overhead, slightly larger log files
- Periodically save the data dictionary
  - Data dictionary changes over time
  - Changes can be tracked but still require a starting point
  - RESETLOGS requires a new dictionary

Supplemental Logging

- Minimal (not recommended)
  - Stores physical ROWID
  - Only valid on source database, if row has not moved
- Primary Key
  - Stores PK, or alternately UK or all columns
- Unique, Foreign Key, All Column
  - More overhead
  - Useful if before and after image of entire row is required (not just columns that change)
- Can be confined to specific tables rather than whole database

Data Dictionary

1. On-line catalogue
   - Uses dictionary in source database
   - Simple and easy
   - Cannot reconstruct SQL across DDL changes!
2. Dictionary written to redo logs
   - ~10M addn’l redo
   - Provides starting point for mining sessions
   - DDL changes can be tracked seamlessly
   - Use DB job to write once/day or week
   - *Must* be re-written after RESETLOGS
3. Dictionary written to flat file
   - Deprecated

Setup Complete

With these simple steps complete,

Log Miner is already working!

Starting LogMiner

- Can reconstruct REDO and UNDO SQL
- Can mine on-line and archived redo
- Can be run on original source database or a different database
- Different database must:
  - Have the same, or a superset of, the character set
  - Be the same hardware platform
  - Be the same or a higher database version

Starting LogMiner – mining period

1. SCNs - only truly accurate measurement of time in the database, but difficult to determine after the fact.
2. Timestamps (date and time) - map to SCNs, but have a granularity of at least 3 seconds, possibly much more.   Not always be possible for older data.
3. Log sequence numbers - most coarse time period specification, but may be the only option for older logs that have aged out of the control file.

- The time period must include a copy of the dictionary.
- Consider RMAN recovery catalogue for long term retention of archive log records

Starting LogMiner – Basic Steps

1. If necessary, add individual archived log files to the session
2. Start LogMiner with various options, including time or SCN range
3. Perform analysis by querying `v$logmnr_contents`
4. Optionally, restart LogMiner with different options or time/SCN range
5. End the LogMiner session

Supplemental Logging - Options

`DICT_FROM_ONLINE_CATALOG`

use the online catalog, only valid if no DDL has been done

`DICT_FROM_REDO_LOGS`

scan the redo logs for a copy of the dictionary

`CONTINUOUS_MINE`

automatically locate redo logs for requested time/SCN period

`COMMITTED_DATA_ONLY`

show only committed transactions

`SKIP_CORRUPTION`

skip corrupt redo blocks, rather than terminate select

`NO_SQL_DELIMITER`

format the appearance of reconstructed SQL

`PRINT_PRETTY_SQL`

format the appearance of reconstructed SQL

`NO_ROWID_IN_STMT`

omit the ROWID in reconstructed SQL, use at least primary key supplemental logging with this option

`DDL_DICT_TRACKING`

seamlessly track and report DDL changes

Starting LogMiner – Start Session

```
EXECUTE SYS.DBMS_LOGMNR.START_LOGMNR( -
   STARTTIME => TO_DATE( '15-DEC-2007 17:00:00',
                         'DD-MON-YYYY hh24:mi:ss'), -
   ENDTIME =>   TO_DATE( '16-DEC-2007 09:00:00',
                         'DD-MON-YYYY hh24:mi:ss'), -
   OPTIONS =>   SYS.DBMS_LOGMNR.DICT_FROM_REDO_LOGS + -
                SYS.DBMS_LOGMNR.DDL_DICT_TRACKING + -
                SYS.DBMS_LOGMNR.COMMITTED_DATA_ONLY + -
                SYS.DBMS_LOGMNR.NO_ROWID_IN_STMT + -
                SYS.DBMS_LOGMNR.CONTINUOUS_MINE);
```

Starting LogMiner – Perform Analysis

Select from v$logmnr_contents to perform analysis

Useful to store results in temp table for repeated query

```
CREATE TABLE lmtemp AS
  SELECT scn, timestamp, tx_name, seg_name, seg_type,
         operation, sql_redo,
  SYS.DBMS_LOGMNR.MINE_VALUE( UNDO_VALUE, 'LMUSER.EMP.SAL' )
     as oldsal,
  SYS.DBMS_LOGMNR.MINE_VALUE( REDO_VALUE, 'LMUSER.EMP.SAL' )
     as newsal
  FROM v$logmnr_contents
  WHERE seg_owner='LMUSER'
  AND SYS.DBMS_LOGMNR.COLUMN_PRESENT
      ( UNDO_VALUE,'LMUSER.EMP.SAL' ) = 1;
```

Re-Start LogMiner Session

`DBMS_LOGMNR.START_LOGMNR` can be called repeatedly within a given session without ending the current session.

- Useful to refine the mining period or to specify other mining options, without having to reload the dictionary.
- Loading the dictionary generates significant overhead as internal LogMiner objects are rebuilt - 90M of additional redo on a test database.

End the LogMiner Session

- Release resources
- Perform cleanup

```
EXEC DBMS_LOGMNR.END_LOGMNR();
```

If’s, and’s & but’s

The following data types are not supported:

- – BFILE datatype
- – Simple and nested abstract datatypes (ADTs)
- – Collections (nested tables and VARRAYs)
- – Object refs
- – XMLTYPE datatype
- – Tables using table compression

If’s, and’s & but’s

Middle Tier application does not set Oracle username!

SET_CLIENT_INFO does not help – not supported by LogMiner

Use TRANSACTION NAME instead

If’s, and’s & but’s

Running LogMiner on source database can generate a lot of redo

Use GLOBAL TEMPORARY table to store results of query to v$logmnr_contents

Consider mining from a separate database less flexibility (eg. Log seq #), but no addn’d redo

If’s, and’s & but’s

Record dictionary writes in a permanent table for future reference

Consider a DDL trigger to enforce dictionary write after RESETLOGS

References

Oracle Database Utilities, ch. 17 Using LogMiner to Analyze Redo Log Files

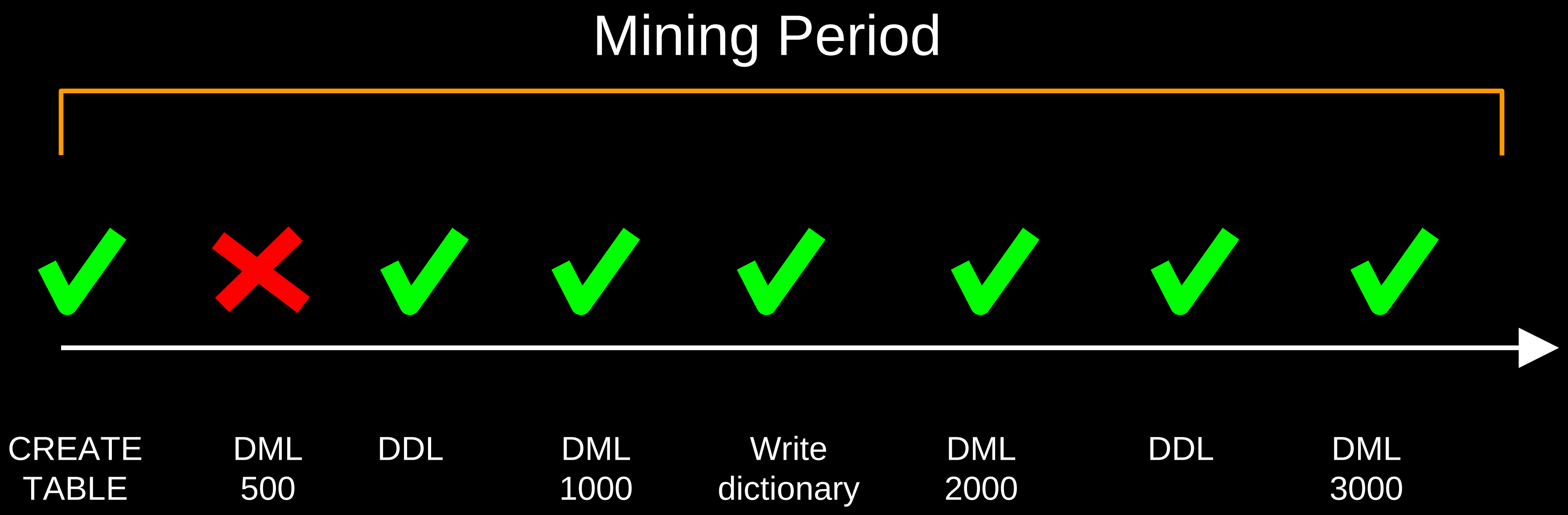
Oracle Database PL/SQL Packages and Types Reference, ch. 54 DBMS_LOGMNR and ch. 55 DBMS_LOGMNR_D

Package header files in $ORACLE_HOME/rdbms/admin: dbmslmd.sql & dbmslm.sql

Spoofing Oracle Session Information, Stephen Kost and Jack Kanter, Integrity Corporation, Chicago, Illinois, 2006

Oracle's Log Miner Part 2, Darryl Hurley, Mobile Data Solutions, March, 2000

Crash and Burn Demo



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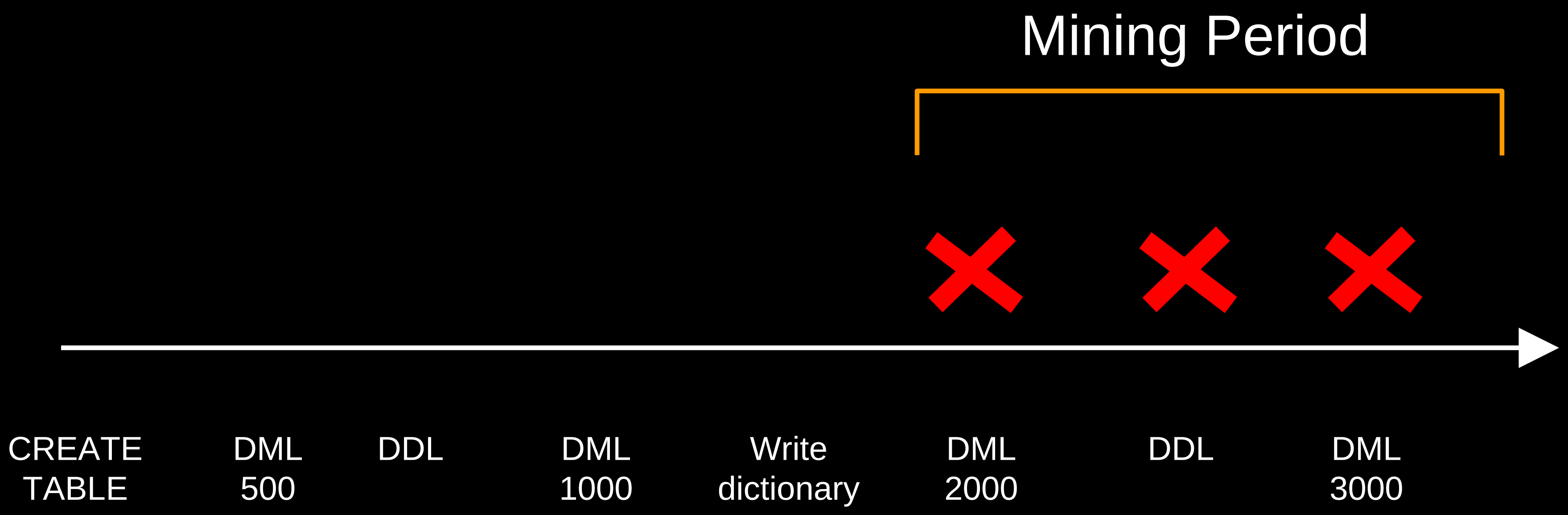

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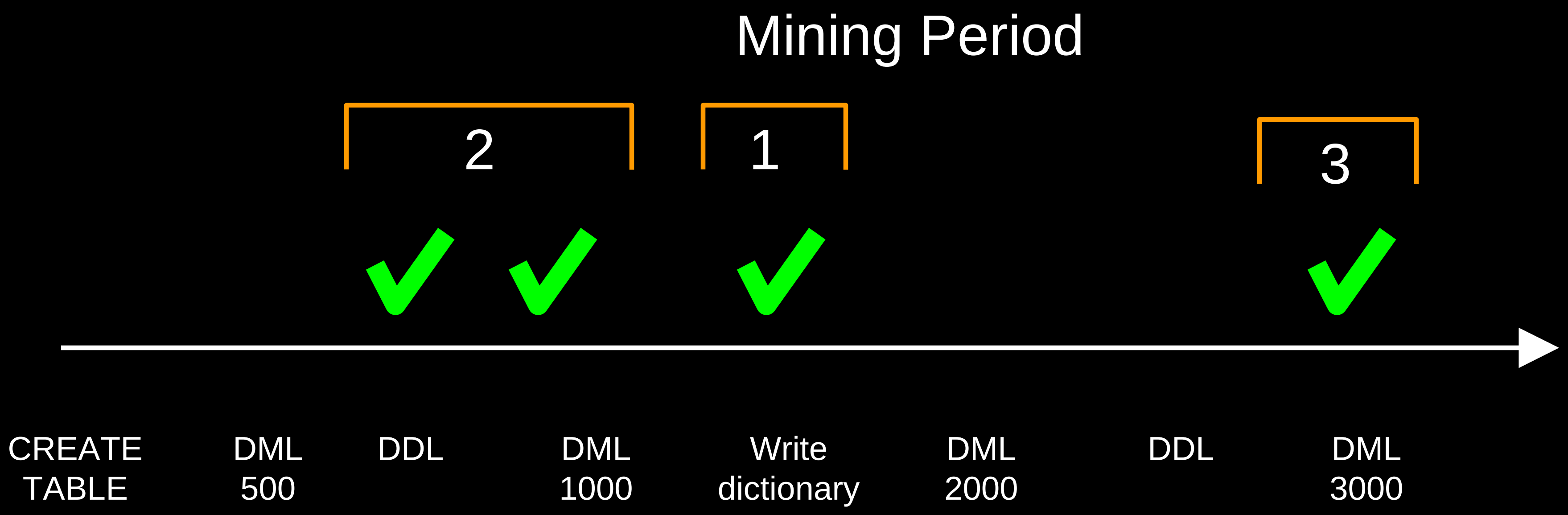

Mining Period
2
1
3
✓
✓
✓
✓
CREATE TABLE
DML 500
DDL
DML 1000
Write dictionary
DML 2000
DDL
DML 3000