Eliminating Downtime When Migrating or Upgrading to Oracle 10g
Agenda

- GoldenGate Overview
  - What is Transactional Data Management?

- Why Migrate/Upgrade to Oracle 10g?

- High Availability Concerns: Upgrades and Migrations
- Technology Choices and Trade-offs
- Near-Zero Downtime Solution: Using Oracle XTTS and GoldenGate
  - Process for 9i → 10g Cross-Platform
  - Failback Contingency

- Post Migration: Data Verification
- Summary, Q&A
Background

• Software architect for GoldenGate's High Availability and Disaster Tolerance offerings.
• 10 years of kernel development experience in Recovery group.
• Responsible for redo generation component of the database from 8i to 10.2
• Patent-filed contributions at Oracle include the development of Cross Platform Transportable Tablespaces (Oracle 10g), Multi-threaded redo generation (9i), Multiple block size cache support (9i), and Whole database transport (10.2).
• Led technical team responsible for high-speed data movement across platforms as part of Oracle's cost-cutting initiatives.
About GoldenGate Software

GoldenGate Software is a privately held software company that offers **Transactional Data Management** solutions.

250 customers... 1500+ solutions implemented... in 35 countries

**Established, Loyal Customer Base**

**Leading Industry Solutions**

- 18,000 Node ATM Network with 24/7 Availability
- 2 Million Real-Time Transactions Per Day Synchronized to Customer Websites
- 3.7 billion transactions processed annually
- Achieving paperless enterprise for this visionary healthcare provider
- Saving $ millions with real-time DW and zero downtime migrations.
**Transactional Data Management**

TDM provides **guaranteed** capture, routing, transformation, delivery, and verification of data transactions across **heterogeneous** environments in **real time**.

<table>
<thead>
<tr>
<th>TDM must be:</th>
<th>GoldenGate differentiates on:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Real time</td>
<td>• Performance</td>
</tr>
<tr>
<td> Moves with sub-second latency</td>
<td> Handles thousands of transactions per second with very low impact on IT systems</td>
</tr>
<tr>
<td>• Heterogeneous</td>
<td>• Extensibility &amp; Flexibility</td>
</tr>
<tr>
<td> Moves transactions across different databases and platforms</td>
<td> Open architecture to meet demanding customer needs and data environments</td>
</tr>
<tr>
<td>• Transactional</td>
<td>• Reliability</td>
</tr>
<tr>
<td> Maintains transaction integrity</td>
<td> Supports continuous operations and availability</td>
</tr>
</tbody>
</table>
Sohan DeMel
Senior Director
Clustering and Storage Products
Oracle Corporation

Oracle Database 10g:
Why upgrade now?
• Automatic Storage Management
• Automatic Workload Management
• Self Managing Database
A **Database File System** which provides cluster file system and volume manager capabilities that are integrated into the Oracle database 10g kernel at no additional cost.
• Low Cost
  – Eliminates need for volume manager and file systems
  – Works well with inexpensive, modular storage
  – Better storage utilization
  – Easy – up to 50% less DBA/Sys Admin work

• Fault tolerant

• Raw disk performance

• Capacity on demand

• Automatic I/O load balancing
Note the even distribution of data across the storage array.
An On-line Retailer’s Assessment of I/O Performance

ASM vs ext3 and OCFS for full scan and index build

![Graph showing comparison of ASM, ext3, and OCFS]

- Full Scan 100G parallel 32
- Create index parallel 32

**speed to perform operation - small is better**
- “Service” - a database service abstraction for directing workloads
- Services provide an infrastructure for managing multiple application workloads in a shared database environment
- Management of performance and high availability at a granular level
An On-line Retailer’s Implementation of RAC/ASM/Lintel

Scale it out to 16+ Gbytes per second of I/O
10g Release 2 Beta Customer’s Test Results

![Graph showing response time for 500, 1000, and 4000 queries comparing Oracle 9i RAC and Oracle RAC 10g.](graph.png)
• Built-in Intelligent Infrastructure
  – Code instrumentation
  – Workload repository
• Automation of Routine Tasks
  – Automatic disk-based backup and recovery
  – Automatic optimizer statistics collection
  – Automatic PGA and SGA Memory Management
  – Automatic Storage Management
• Tools to Empower the DBA
  – Automatic Database Diagnostic Monitor
  – Automatic Tuning Optimizer
• Lots more …
HA/DR – Systematic View

1. Active

2. Unplanned outage
   - System Failure
   - Node death
   - Power failure
   - Data Failure
   - Physical Media
   - Logical corruption

3. Planned outage
   - System Changes
   - Migrations
   - Upgrades
   - Maintenance
   - Data Changes
Upgrades vs. Migrations

- **Upgrade** – Change of database version only
  - In place upgrades
  - Rolling upgrades (least amount of outage time)

- **Migration** – Change in database vendor, platform, hardware
Challenges in HA Environments

- **Maintaining SLA during planned outage**
  - Revenue Impact
  - Customer Expectations
  - Interdependencies, Integration

- **Data issues**
  - Instantiating Terabytes/Petabytes
  - Staging areas
  - Change Management
  - Special Handling

- **Synchronization issues**
  - Incremental data movement
  - Source database impact

- **Failback strategy**
  - System/Application verification
  - Continued data growth
Technology Choices for Oracle Migrations

“Traditional Solutions”…
- Export/Import
- Flat files/SQL*Loader
- Data Pump
- Synchronous replication
- Backup/Recovery

Non mission-critical systems

High availability systems
- Transportable tablespaces
- Cross-platform transportable tablespaces
- Standby databases
- Streams
- Transactional Data Management

Alok Pareek, GoldenGate Software / NYOUG Dec 13, 2005
Technology Choices for Oracle Migrations

“Traditional Solutions”...
- Export/Import
- Flat files/ SQL*Loader
- Data Pump
- Synchronous replication
- Backup/Recovery

Non mission-critical systems

- Migration time dependent on size of data
- Assume a moderate to significant amount of planned downtime
- Significant overhead on the source database
- No ongoing management of transactions
- Complex, error prone, unmanageable
- No real-time data verification strategy
- No manageable failback strategy
Technology Choices for Oracle Migrations

- **Transportable Tablespaces**
  - No updates possible
  - No incremental solution
  - No failback solution

- **Standby Databases (Logical)**
  - No Rolling upgrade in 9i
  - Cannot be used for heterogeneous migration/upgrade
  - No real time verification solution

- **Streams**
  - Rolling Upgrade not supported in 9i
  - Limited Datatype support (e.g. no LONG support in 9i)
  - No real time verification solution

- **Transportable tablespaces**
- **Cross-platform transportable tablespaces**
- **Standby databases**
- **Streams**
- **Transactional Data Management**

**High availability systems**
### Available Solutions/Techniques, Tradeoffs

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Unload/Load</th>
<th>Export/Import</th>
<th>Backup/Roll Forward</th>
<th>Transportable TableSpaces</th>
<th>Standby Databases</th>
<th>TDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>9i → 10g</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>&lt; 9i → 10g</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>9i → 10g cross platform</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>9i → 10g RAC/ASM</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Non-Oracle → 10g</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

#### Extended downtime

#### Real Time

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Alok Pareek, GoldenGate Software / NYOUG Dec 13, 2005
Eliminating Downtime Using TDM

Oct 13, 2005
06:30:05

Application Server

9i
Solaris

10g
Linux

Transaction Data Management

Oracle GoldenGate

XTTS
Eliminating Downtime Using TDM

- Zero DB Downtime
- <1 minute App switchover time

* Depends on Application Switchover time

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How GoldenGate TDM Works

**Capture:** Committed changes are captured (and can be filtered) as they occur by reading the transaction logs.

**Trail files:** Stages and queues data for routing.

**Route:** Data is compressed, encrypted for routing to targets.

**Delivery:** Applies transactional data with guaranteed integrity.

Bi-Directional TDM Configuration
No Downtime Migration: 9i → 10g Cross-Platform

- Start GoldenGate TDM’s Capture process
- Set up Clone database, then Upgrade to 10g
- Cross platform transportable tablespaces metadata export
- Use a full database NOROWS export (Views, Packages, etc)
No Downtime Migration: 9i → 10g Cross-Platform

1. Start GoldenGate TDM’s Capture process
2. Set up Clone database, then Upgrade to 10g
3. Cross platform transportable tablespaces metadata export
4. Use a full database NOROWS export (Views, Packages, etc)
5. Set up a new 10g vanilla target
6. Cross platform transportable tablespaces metadata import
7. Full import with IGNORE option
No Downtime Migration: 9i → 10g Cross-Platform

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- Cross platform transportable tablespaces metadata export
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- Set up a new 10g vanilla target

- Cross platform transportable tablespaces metadata import
- Full import with IGNORE option
- Start GoldenGate TDM Apply process at target
- **SWITCHOVER** (not depicted)
No Downtime Migration: 9i → 10g Cross-Platform

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- Use a full database NOROWS export (Views, Packages, etc)
- Set up a new 10g vanilla target
- Cross platform transportable tablespaces metadata import
- Full import with IGNORE option
- Start GoldenGate TDM Apply process at target
- **SWITCHOVER** (not depicted)
- Start TDM Capture at target (new source)
- Start TDM Apply at target (old source)
Migration/Upgrade Detailed Steps

- Start GoldenGate TDM Capture process (captures consistent data point = QScn)
- Do a point-in-time recovery of an existing backup until Qscn in a staging area. Call this database Dpitr.
- Upgrade Dpitr to 10g on Solaris. Advance compatibility to 10.0 or higher.
- Set up a vanilla 10g database on Linux. Call this database Dtarget.
- Unplug the user tablespaces from Dpitr using the Oracle Cross Platform Transportable Tablespaces feature using source side endian conversion. Also take a NOROWS full export.  
  (Note the conversion would not be required if the endian systems were the same.)
- Plug the set of tablespaces into Dtarget using the Cross Platform transportable tablespace feature.
- Make the set if user tablespaces in Dtarget Read Write; Do a NOROWS import with IGNORE=Y option.
- Start GoldenGate Apply process at Dtarget and synchronize up to the changes generated since Qscn.
- Switchover the application from Dprod to Dtarget.
Migration/Upgrade with Failback

- Start GoldenGate TDM Capture process (captures consistent data point = QScn)
- Do a point-in-time recovery of an existing backup until Qscn in a staging area. Call this database *Dpitr*.
- Upgrade *Dpitr* to 10g on Solaris. Advance compatibility to 10.0 or higher.
- Set up a vanilla 10g database on Linux. Call this database *Dtarget*.
- Unplug the user tablespaces from *Dpitr* using the Oracle Cross Platform Transportable Tablespaces feature using source side endian conversion. Also take a NOROWS full export.
  (Note the conversion would not be required if the endian systems were the same.)
- Plug the set of tablespaces into *Dtarget* using the Cross Platform transportable tablespace feature.
- Make the set if user tablespaces in *Dtarget* Read Write; Do a NOROWS import with IGNORE=Y option.
- Start GoldenGate Apply process at *Dtarget* and synchronize up to the changes generated since Qscn.
- **Start GoldenGate Capture on Dtarget.**
- Switchover the application from *Dprod* to *Dtarget*.
- **Start GoldenGate Apply on Dprod.**
Addressing Failback

- Stop application at new Primary (10g)
- Real-time TDM synchronization ensures old primary is synchronized
- Switchover Application to old primary (9i)
- Start Primary database
GoldenGate Veridata™

- Comparisons run while data sources are kept online
- Support for large data volumes
- Selective comparison options
- Unparalleled speed and efficiency
- Flexible reporting for discrepancy analysis

Post Upgrade/Migration: Data Verification
GoldenGate Veridata: How it Works

- The user chooses tables or files on the source and target databases
- The comparison is initiated from the GUI, command line or batch
- As the databases continue to change, GoldenGate Veridata reports:
  - Persistent discrepancies
  - In-flight data discrepancies (user configurable)
Key Technical Highlights

- Rolling upgrade/migration using two databases
- No instantiation using primary database
- Offload any conversion to staging database
- Synchronize transactions across databases
- Verify data replication and transactional integrity
- Have a failover strategy
# TDM Upgrade/Migration Advantages

<table>
<thead>
<tr>
<th>Feature</th>
<th>Advantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real Time</td>
<td>Allows for highest application availability</td>
</tr>
<tr>
<td>Heterogeneous</td>
<td>Allows movement across platforms/databases</td>
</tr>
<tr>
<td>Transactional</td>
<td>Maintains transactional integrity</td>
</tr>
<tr>
<td>Performance</td>
<td>No impact on source database</td>
</tr>
<tr>
<td>Downtime</td>
<td>Only incurred during Application switchover</td>
</tr>
<tr>
<td>Verification</td>
<td>Real time (dual) verification after migration</td>
</tr>
<tr>
<td>Failback</td>
<td>With no data loss, in real time</td>
</tr>
</tbody>
</table>
Thank You

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## Technology Environments Supported

<table>
<thead>
<tr>
<th>Databases</th>
<th>O/S and Platforms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oracle</td>
<td>Unix</td>
</tr>
<tr>
<td>DB2 OS/390</td>
<td>Windows NT, 2000, XP</td>
</tr>
<tr>
<td>DB2 UDB</td>
<td>Linux</td>
</tr>
<tr>
<td>Microsoft SQL Server</td>
<td>Sun Solaris</td>
</tr>
<tr>
<td>MySQL</td>
<td>HP-UX</td>
</tr>
<tr>
<td>Enscribe</td>
<td>IBM AIX</td>
</tr>
<tr>
<td>SQL/MP</td>
<td>HP NonStop</td>
</tr>
<tr>
<td>SQL/MX</td>
<td>TRU64</td>
</tr>
<tr>
<td>Sybase</td>
<td>IBM OS/390 and z/OS</td>
</tr>
<tr>
<td>Teradata</td>
<td></td>
</tr>
<tr>
<td>…and all ODBC compatible databases</td>
<td></td>
</tr>
</tbody>
</table>

In addition, GoldenGate's technology solutions offer open APIs that allow for access to custom data sources, data targets and adapters.