GOLDENGATE™

Transactional Data Management Solutions

Eliminating Downtime When Migrating or Upgrading to Oracle 10*g*

ORACLE
10*g*
DATABASE

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 10*g*), 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.

Established, Loyal Customer Base	250 customers... 1500+ solutions implemented… in 35 countries

Leading Industry Solutions	**Bank of America**	**Federated**	**Paymentech** the payment solutions company	**MAYO CLINIC**	**Overstock.com** Your Online Outlet™
	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.

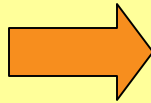# Transactional Data Management

TDM provides guaranteed capture, routing, transformation, delivery, and verification of data transactions across heterogeneous environments in real time.
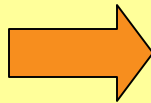
TDM must be:	GoldenGate differentiates on:
Real time Moves with sub-second latency	**Performance** Handles thousands of transactions per second with very low impact on IT systems
Heterogeneous Moves transactions across different databases and platforms	**Extensibility & Flexibility** Open architecture to meet demanding customer needs and data environments
Transactional Maintains transaction integrity	**Reliability** Supports continuous operations and availability

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ORACLE®

Sohan DeMel

Senior Director
Clustering and Storage Products
Oracle Corporation

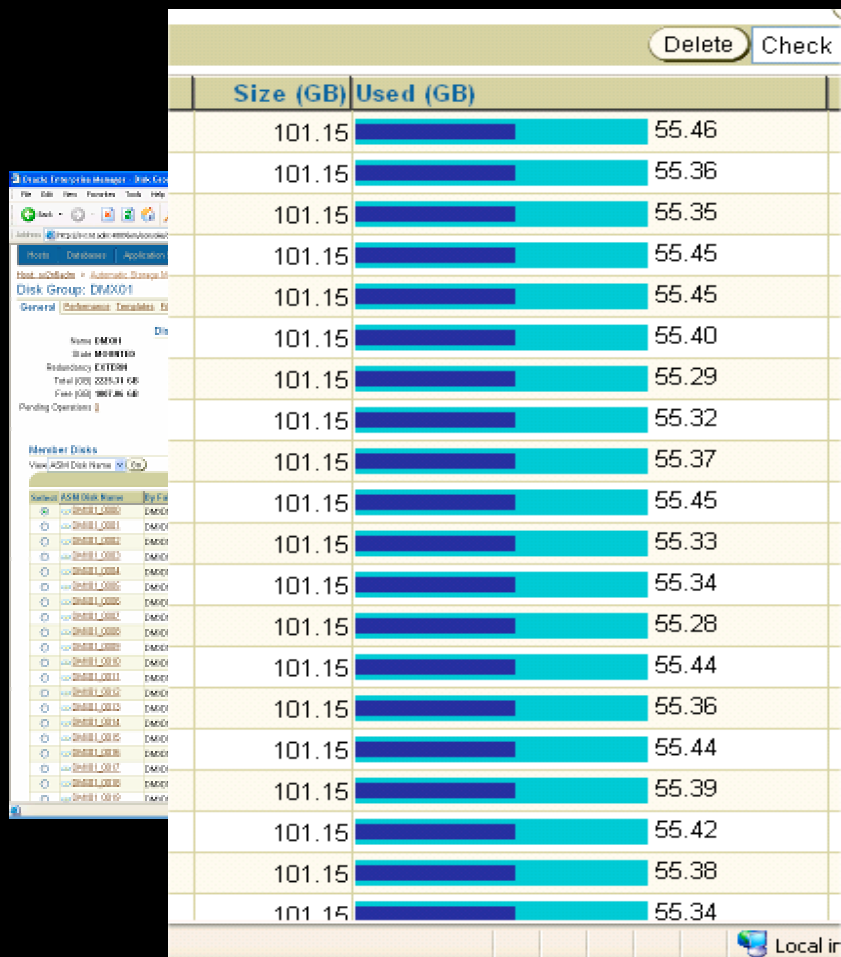**Oracle Database 10g:**
Why upgrade now?

- Automatic Storage Management

- Automatic Workload Management

- Self Managing Database

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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**

Size (GB)	Used (GB)
101.15	55.46
101.15	55.36
101.15	55.35
101.15	55.45
101.15	55.45
101.15	55.40
101.15	55.29
101.15	55.32
101.15	55.37
101.15	55.45
101.15	55.33
101.15	55.34
101.15	55.28
101.15	55.44
101.15	55.36
101.15	55.44
101.15	55.39
101.15	55.42
101.15	55.38
101.15	55.34

Delete | Check

Note the even distribution of data across the storage array

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An On-line Retailer's Assessment of I/O Performance
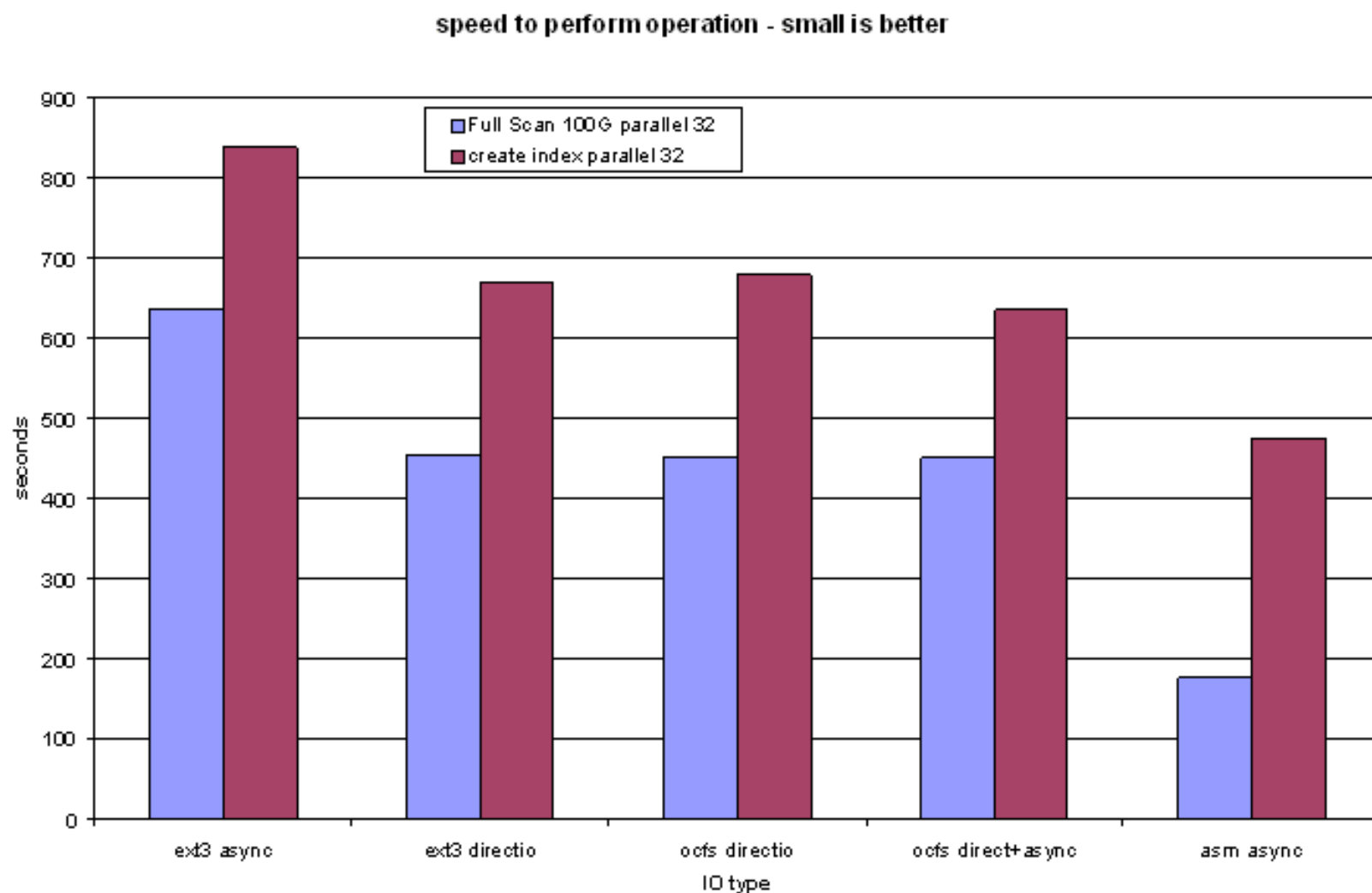
- "Service" - a database service abstraction for directing workloads
- Services provide an infrastructure for managing multiple application workloads in a shared database environment
- Management of performance and high availability at a granular level

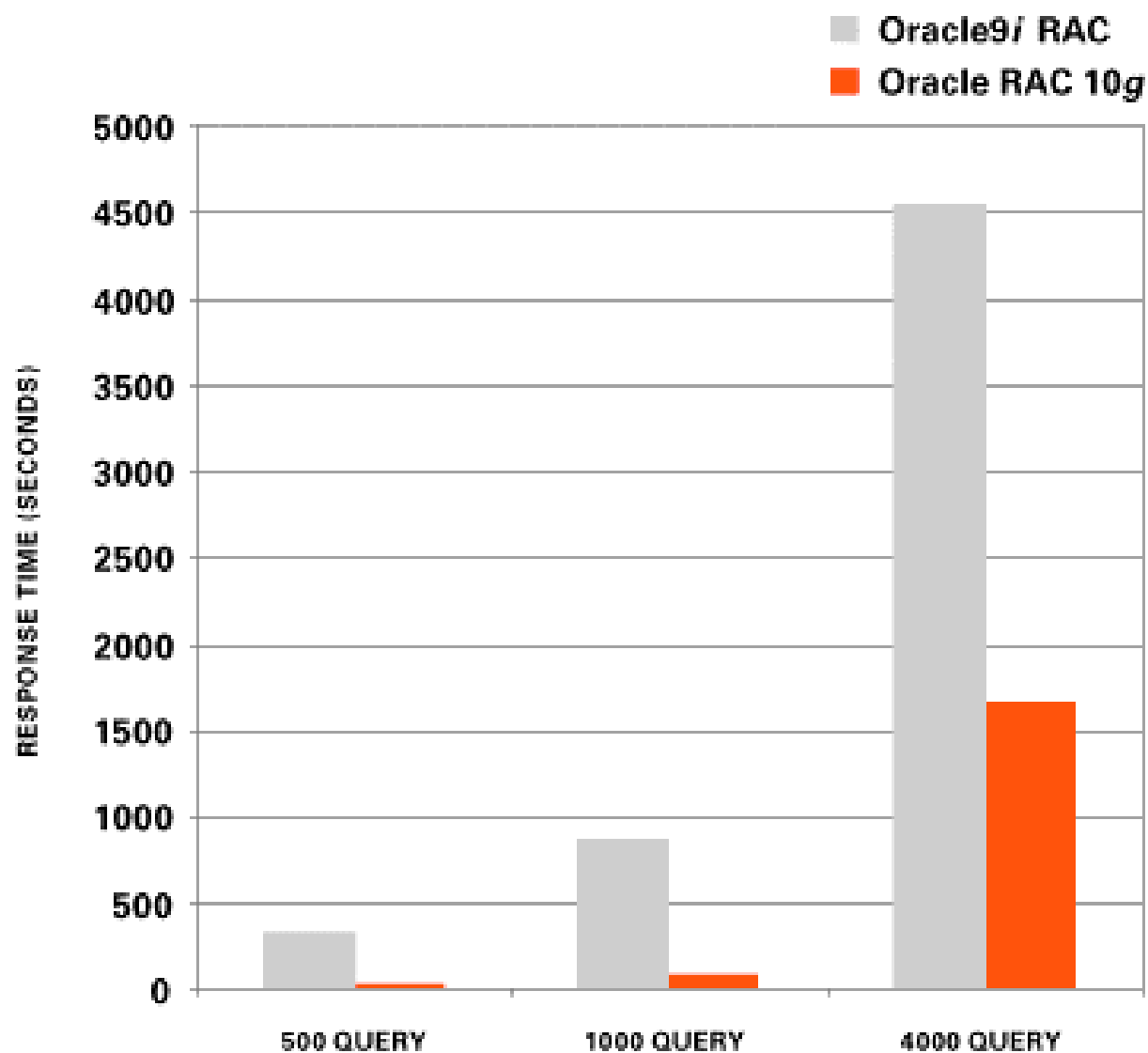## Scale it out to 16+ Gbytes per second of I/O

16 – 4 Processor Servers with 8 Fiber Ports
8 Fiber Switches
128 – Fiber Arrays (1 port each)
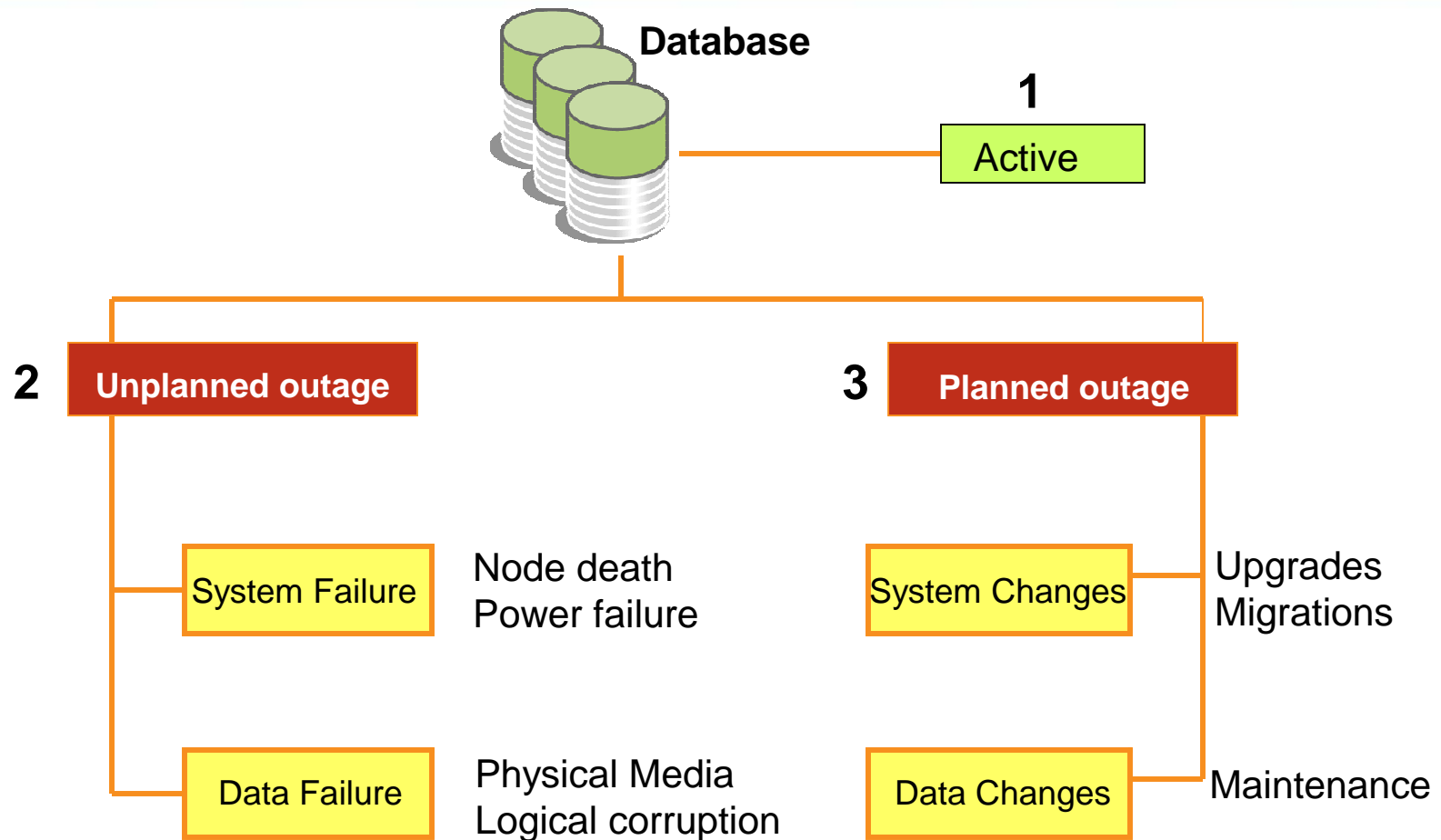1920 – 72G 15K Disk Drives
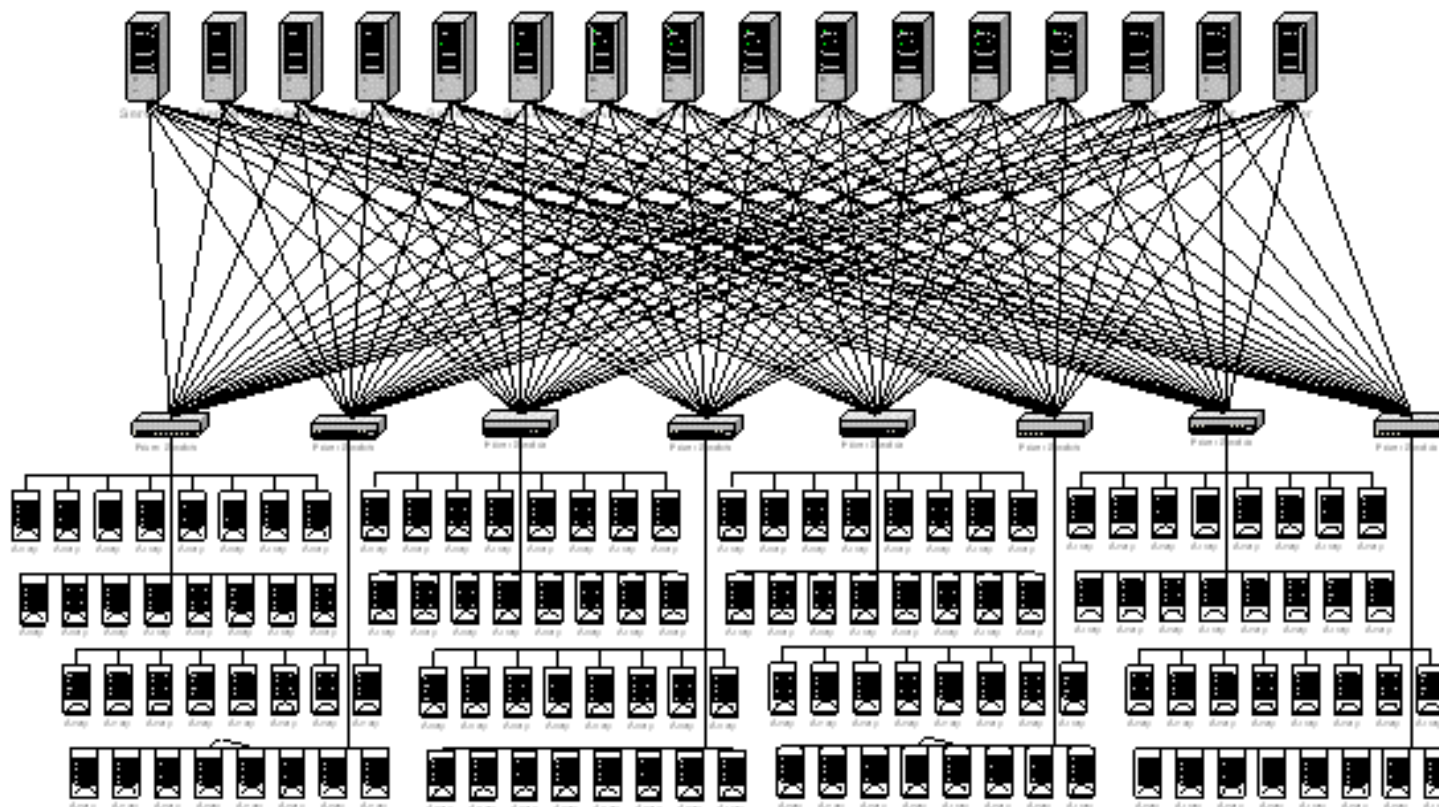
# 10g Release2 Beta Customer's Test Results

- **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 …**

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HA/DR – Systematic View

Database

1 Active

2 Unplanned outage

System Failure — Node death / Power failure

Data Failure — Physical Media / Logical corruption

3 Planned outage

System Changes — Upgrades / Migrations

Data Changes — Maintenance

Upgrades vs. Migrations

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

- **<u>Migration</u>** – Change in database vendor, platform, hardware
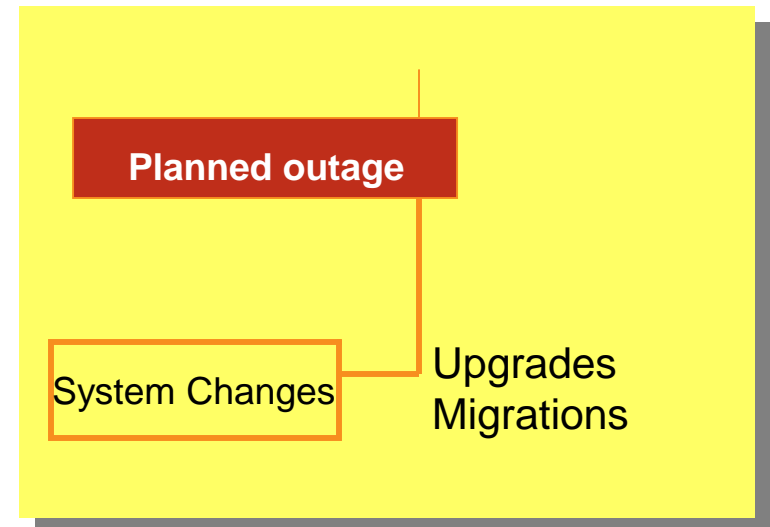
Challenges in HA Environments

- **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

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

High availability systems

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
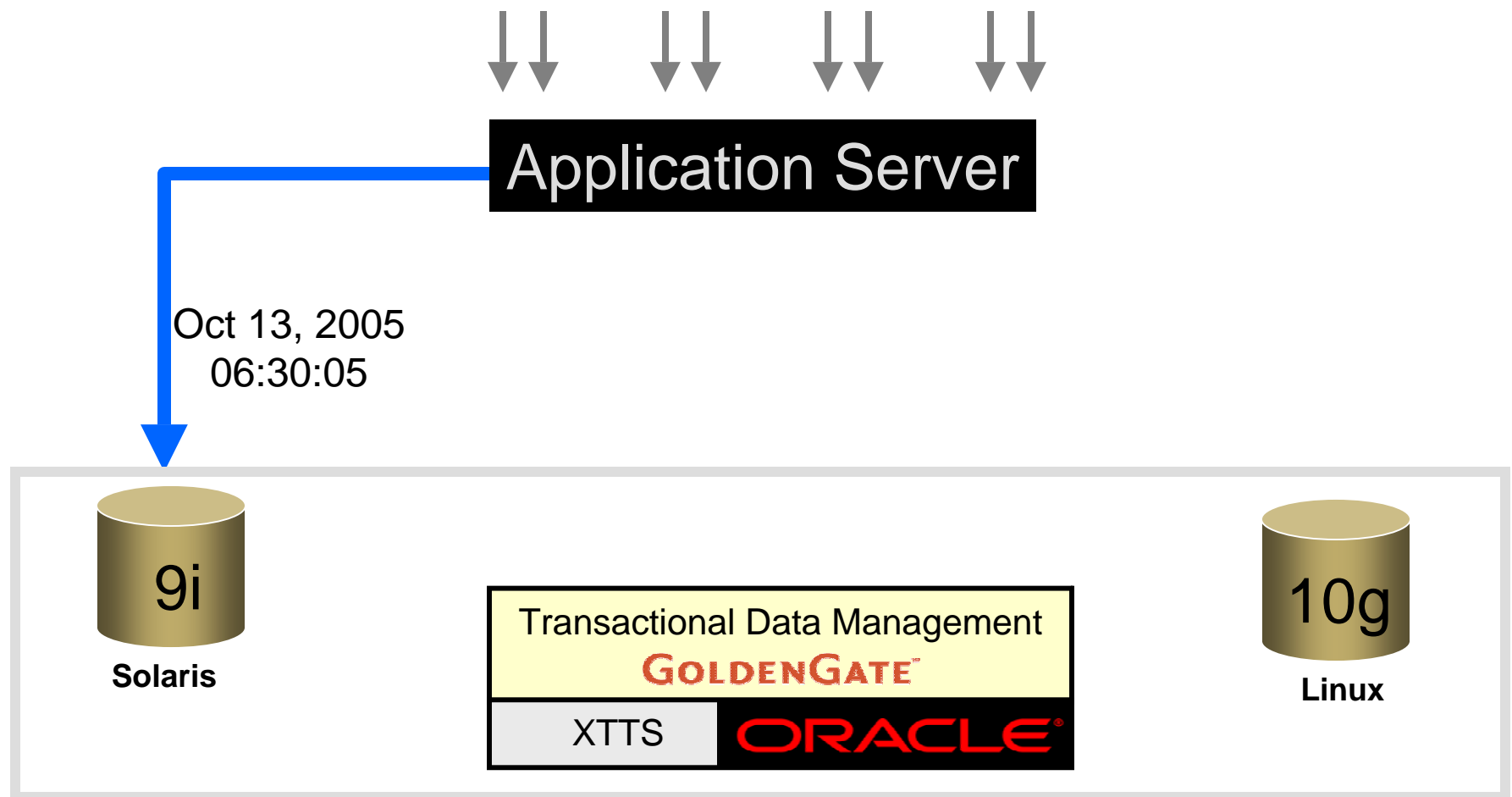- **Transactional Data Management**

High availability systems

Available Solutions/Techniques, Tradeoffs

Downtime ➡

Weeks/Days   *Hours/Minutes*   *Minutes/Seconds*

Scenario	Unload/ Load	Export/ Import	Backup/ Roll Forward	Transportable TableSpaces	Standby Databases Dataguard	Streams	TDM
9i → 10g	Yes	Yes	No	Yes	No	No	Yes
< 9i → 10g	Yes	Yes	No	Yes	No	No	Yes
9i → 10g cross platform	Yes	Yes	No	No	No	No	Yes
9i → 10g RAC/ ASM	Yes	Yes	No	Yes	No	No	Yes
Non-Oracle → 10g	Yes	No	No	No	No	No	Yes

Extended downtime   Real Time

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Eliminating Downtime Using TDM

Application Server

Oct 13, 2005
06:30:05

9i

Solaris

Transactional Data Management
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XTTS | **ORACLE**®

10g

Linux

Eliminating Downtime Using TDM

Application Server

Oct 13, 2005
06:30:05

✓ **Zero DB Downtime**

✓ **<1 minute App switchover time**

Oct 13, 2005
06:30:30*

9i

Solaris

Transactional Data Management
GOLDENGATE™

XTTS | **ORACLE**®

10g

Linux
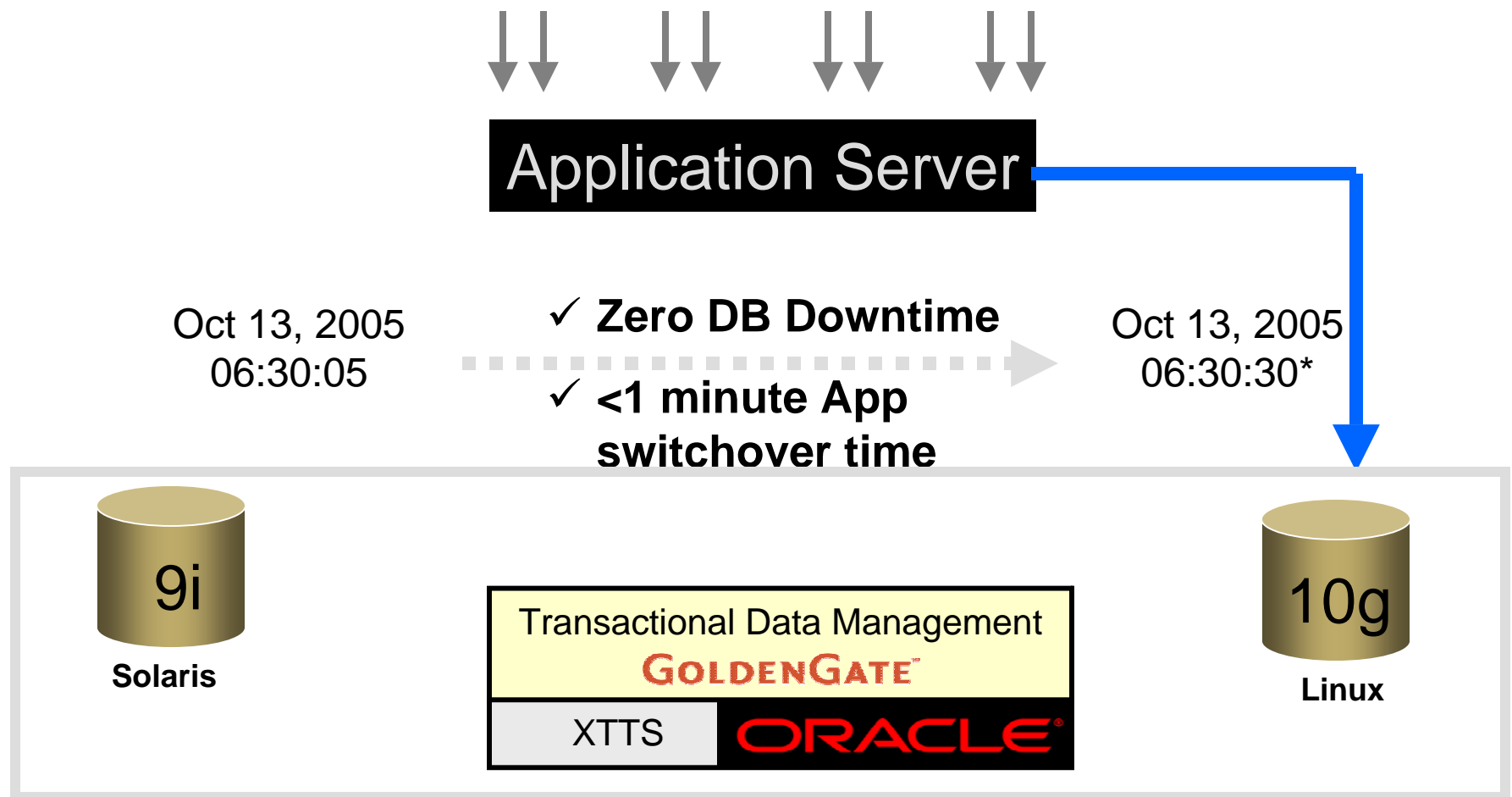
* Depends on Application Switchover time

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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.
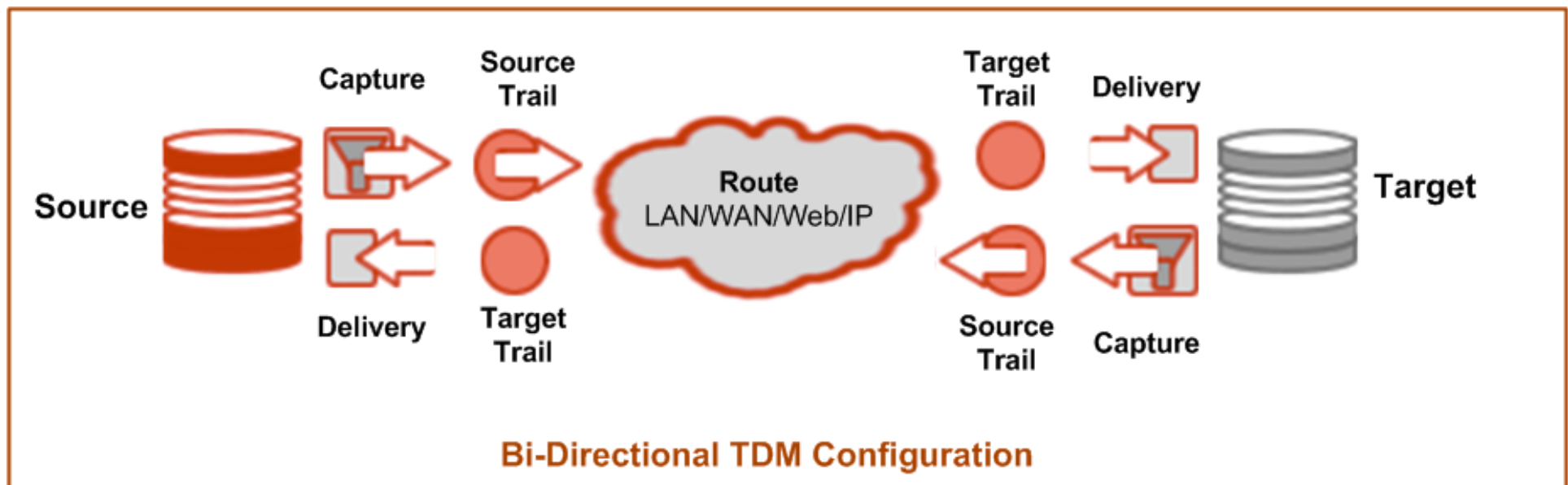
Source — Capture — Source Trail — Route LAN/WAN/Web/IP — Target Trail — Delivery — Target

Delivery — Target Trail — Source Trail — Capture

Bi-Directional TDM Configuration

No Downtime Migration: 9i → 10g Cross-Platform

9i Solaris

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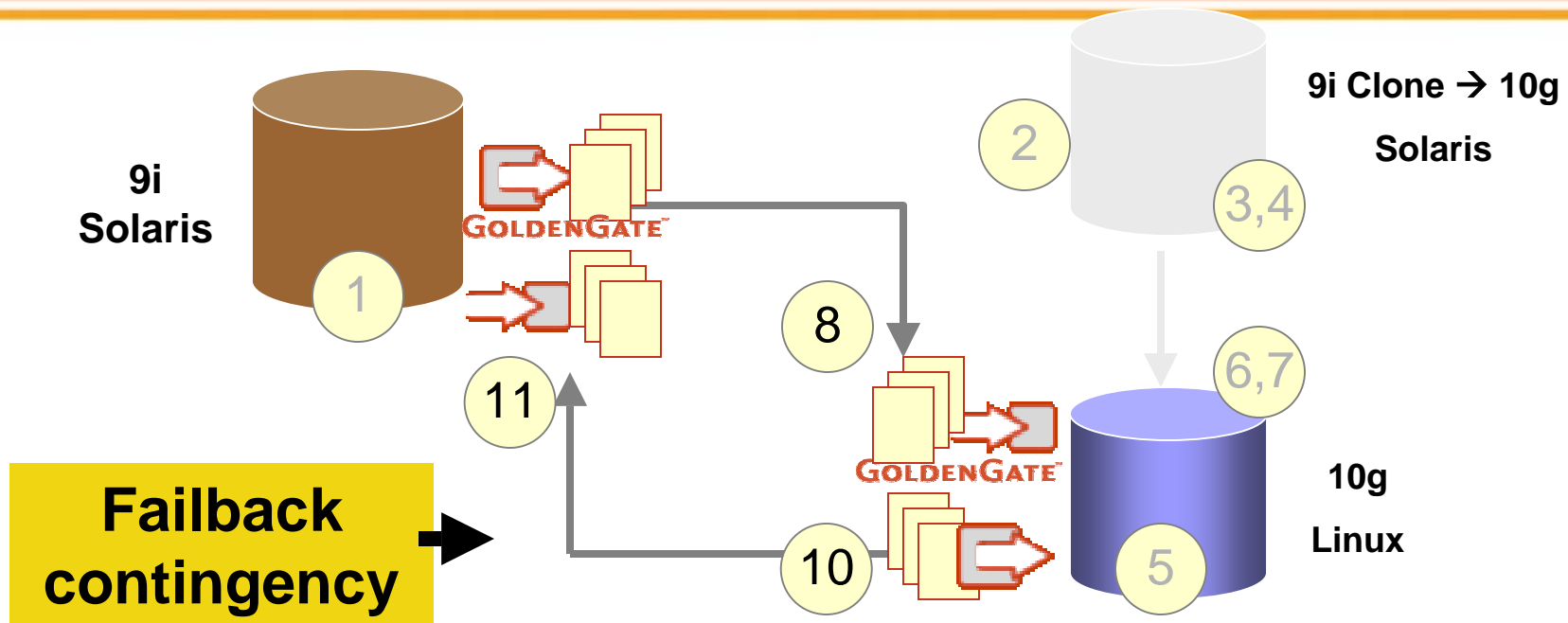
1

2

3,4

9i Clone → 10g

Solaris

- 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

9i Solaris

(1)

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9i Clone → 10g

Solaris

(2)

(3,4)

(6,7)

10g

Linux

(5)

- 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)
- Set up a new 10g vanilla target

- Cross platform transportable tablespaces metadata import
- Full import with IGNORE option

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No Downtime Migration: 9i → 10g Cross-Platform

- Start GoldenGate TDM's Capture process
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- Cross platform transportable tablespaces metadata import
- Full import with IGNORE option
- Start GoldenGate TDM Apply process at target
- **SWITCHOVER** (not depicted)

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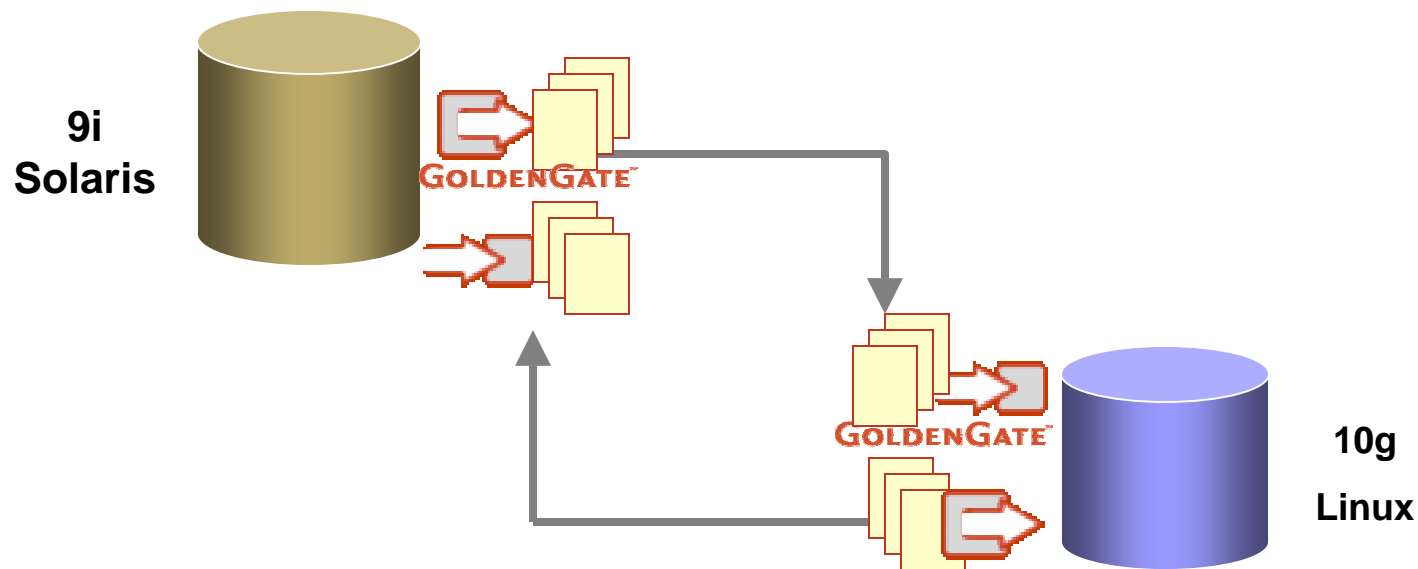
- ✓ Stop application at new Primary (10g)
- ✓ Real-time TDM synchronization ensures old primary is synchronized
- ✓ Switchover Application to old primary (9i)
- ✓ Start Primary database

Post Upgrade/Migration: Data Verification

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

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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)
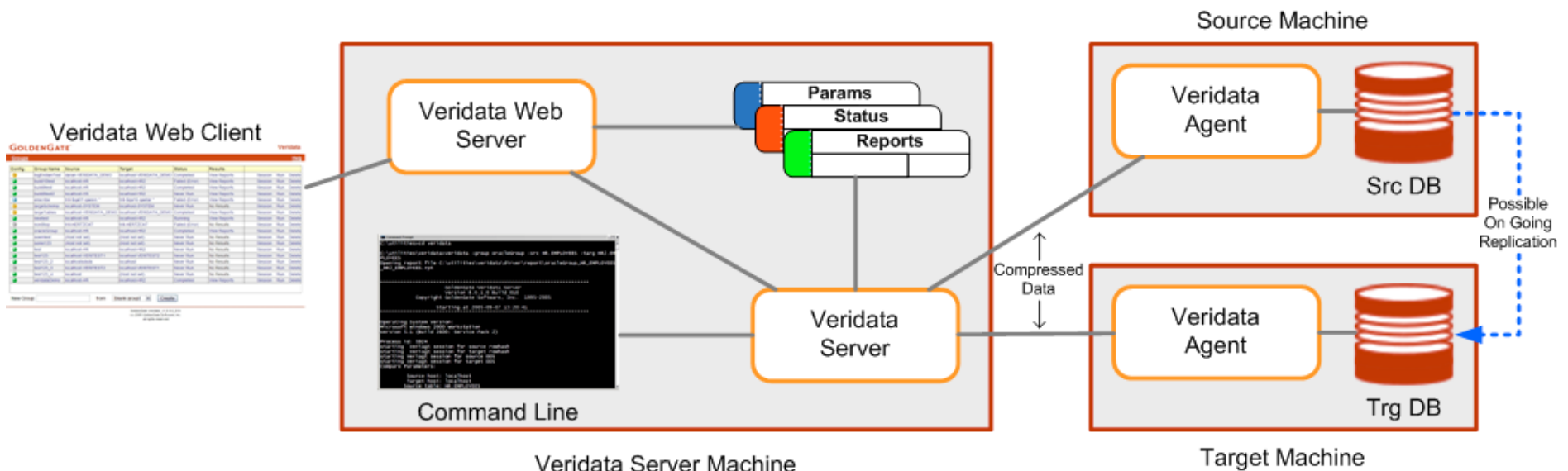
Key Technical Highlights

- 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

Real Time	Allows for highest application availability
Heterogeneous	Allows movement across platforms/databases
Transactional	Maintains transactional integrity
Performance	No impact on source database
Downtime	Only incurred during Application switchover
Verification	Real time (dual) verification after migration
Failback	With no data loss, in real time

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Thank You

Q+A

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Technology Environments Supported

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

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

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