About Wells Fargo

Our vision: “We want to satisfy all our customers’ financial needs and help them succeed financially.”

- **Wells Fargo**
  - Top 20 Biggest Public Companies in the World (2013) – *Forbes*
  - Bank of the Year and Best Bank in the U.S. (2013) – *Euromoney*
  - Ranked 25th Revenue (U.S.) (2013) - *Fortune*
  - Ranked 27th Most Respected (World) (2013) - *Barron’s*

- **Enterprise Data Management (EDM)**
  - Centralized Technology Group Supporting Multiple Lines of Business
  - Support 2000+ Oracle Databases
  - Across 10 Data Centers in the U.S.

**Key Facts (6/30/13)**

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Assets</strong></td>
<td>$1.4 trillion</td>
</tr>
<tr>
<td><strong>Team members</strong></td>
<td>More than 275,000</td>
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<tr>
<td><strong>Customers</strong></td>
<td>70 million</td>
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Our Project

2012: Wells Fargo initiated a project for the brokerage to migrate away from using costly hardware-based replication and an “All or Nothing” data center failover model for Disaster Recovery (DR).

Our Goal:

- Enable a more flexible component level failover
- Reduce overall costs
- Leverage the DR hardware to improve ROI
What We Had

Apps/Services

Oracle Servers

SAN

Active
Active
Active

Storage Level (Async) Replication

Databases Replicated As a Single Consistency Group

400+ miles

Tape Backup

Tape Copies Shipped

Together we'll go far
Our Project

Our Requirements:

- Consolidate Multiple Databases Clusters
- Reduce Production Load by Offloading Backups & Ad/Hoc Queries
- Reduce DR Testing Requirements
- Support Component Level Failover
- Shared Services RO calls must run Locally due to Response Time SLA
- Ease of Maintenance
What We Deployed

Primary

RO Calls Stay Local

Apps/Services

Oracle Grid

SAN

Active

RW Calls Follow Active DB

RO

RW

Oracle Grid

SAN

Active

RW Calls Follow Active DB

RO

RW

Apps/Services

Oracle Grid

SAN

Active

Read Only

Apps/Services

Backup NAS

SAN

R/W Share

NAS Replication

R/O Share

NAS Replication

Backup NAS

R/W Share

R/O Share

R/W Share

R/O Share

10GigE

RMAN

10GigE

Redo Records (Async)

Active Data Guard

Backup NAS

NAS Replication

R/W Share

R/O Share

Backup NAS

NAS Replication

R/W Share

R/O Share

10GigE

RMAN

10GigE

Redo Records (Async)

Redo Records (Async)

Redo Records (Async)

Together we’ll go far
Experience to share

- During OLTP window, database averages 750 commits and 3MB of Redo per second. Standby side is able to maintain an Apply Lag $\leq 1$ second.

- The ability to offload backups to standby, reducing physical reads on the primary cluster by 18%.

- User Reports and Ad/Hoc queries make up approx 5% of workload. They are now able to be isolated to standby cluster to limit impact to online activity.

- The ability to monitor Active DR Databases and reduce the frequency for DR testing.
Keys To Our Success

- Tuning Redo Transport to limit Apply Lag
  - Enabling Redo Transport Compression
    - Helped lower bandwidth on average by 2.5x
    - Standby DB are able to catch up much quicker from Redo spikes
  - DB Parameter “LOG_ARCHIVE_MAX_PROCESSES”
    - Default value = 4
    - Increased value helped with heavy redo spikes during batch activity
The ability to backup and recover a database from either cluster

- All backup files are cataloged and available to both clusters
- Makes for EASY re-instantiation and incremental recovery of very large databases
Keys To Our Success

- Proper TNS Configuration
  - Leverages Role Based Named Services
  - Descriptions list the Local Cluster first
  - Tune Connection timeouts to limit login time when primary cluster is offline.
    - CONNECT_TIMEOUT, TRANSPORT_CONNECT_TIMEOUT & RETRY_COUNT

```sql
PROD_Reports =
  (DESCRIPTION_LIST = (LOAD_BALANCE=off))
  (DESCRIPTION = (LOAD_BALANCE=on) (CONNECT_TIMEOUT=5) (TRANSPORT_CONNECT_TIMEOUT=3) (RETRY_COUNT=0))
  (ADDRESS_LIST = (ADDRESS = (PROTOCOL = tcp) (HOST = LOCAL-SCAN) (PORT = 1521)))
  (CONNECT_DATA = (SERVICE_NAME=PROD_REPORTS)))
  (DESCRIPTION = (LOAD_BALANCE=on) (RETRY_COUNT=2))
  (ADDRESS_LIST = (ADDRESS = (PROTOCOL = tcp) (HOST = REMOTE-SCAN) (PORT = 1521)))
  (CONNECT_DATA = (SERVICE_NAME=PROD_REPORTS)))
```
Keys To Our Success

- Configure services to auto-start based on database role to manage where clients can connect, no system event triggers needed:

  ```
srvctl modify service -d db_unique_name -s PROD_RW -l PRIMARY
srvctl modify service -d db_unique_name -s PROD_REPORTS -l PHYSICAL_STANDBY
srvctl modify service -d db_unique_name -s PROD_RO -l PRIMARY,PHYSICAL_STANDBY
  ```

- The ability to monitor and report on standby apply lag:

  - Grid Control to alert when apply lag exceeds SLA
  - Dictionary views to monitor and troubleshoot issues
    - V$DATAGUARD_STATS – Shows current status
    - V$STANDBY_EVENT_HISTOGRAM – Histogram of Apply Lag
    - V$ARCHIVE_GAP – Any archive gap blocking recovery
Oracle Database 12c and Beyond

- Writeable Global Temp Tables on the Physical Standby to Enable Additional Offloading of Reports
- Better Audit Collection and Management for Physical Standby Activity
- Simplified Rolling Upgrades
In Closing

Thank you!