State Street Case Study
Oracle OpenWorld 2013

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Agenda

• State Street Company Overview
• Exadata Environment
• RMAN 11g Features Used
• ZFS with Direct NFS
• RMAN 12c Excitement
Our Company Today

Strong Global Enterprise

**STATE STREET.**

**STATE STREET GLOBAL ADVISORS.**

Developing investment strategies that make the best use of client capital

- Assets under management of $2.1 trillion*
- One of the world’s largest managers of institutional assets
- Provider of a comprehensive range of investment strategies that span the risk/return spectrum
- With approximately $340 billion* in ETF assets under management, we have one of the broadest ranges of ETFs in the industry

**STATE STREET GLOBAL MARKETS.**

Research and trading solutions that improve the efficient use of client capital

- Global leader in investment research, trading and securities lending
- Total of approximately $2.5 trillion in average lendable assets for Q4 2012
- $16.8 trillion in foreign exchange and interbank volume traded in 2012
- Source of investor behavior and other research, advanced portfolio strategies, trade process optimization and global connectivity across multiple asset classes and markets

**STATE STREET GLOBAL SERVICES.**

Maintaining the inventory of client capital and dividends/interest

- Assets under custody and administration of $24.4 trillion*
- One of the world’s leading investment service providers
- Provides fund accounting, fund administration, custody, investment operations outsourcing, recordkeeping, performance and analytics, and transfer agency services

* As of December 31, 2012
Our Company Today

Strong Global Presence*

29,660 employees worldwide

AUSTRALIA
Sydney

AUSTRIA
Vienna

BELGIUM
Brussels
La Hulpe

BRUNEI DARUSSALAM
Jerudong

CANADA
Montreal
Toronto

CAYMAN ISLANDS
George Town,
Grand Cayman

CHANNEL ISLANDS
Guernsey
Jersey

FRANCE
Paris

GERMANY
Cologne
Frankfurt
Munich

INDIA
Bangalore
Mumbai
Pune

IRELAND
Drogheda
Dublin

ITALY
Milan
Turin

JAPAN
Tokyo

LIECHTENSTEIN
Vaduz

LUXEMBOURG
Luxembourg

MALAYSIA
Kuala Lumpur

MAURITIUS
Port Louis

NETHERLANDS
Amsterdam

PEOPLE’S REPUBLIC OF CHINA
Beijing
Hangzhou
Hong Kong
Shanghai

QATAR
Doha

SINGAPORE
Singapore

SOUTH AFRICA
Cape Town

SOUTH KOREA
Seoul

SWITZERLAND
Altishofen
St. Gallen
Zurich

TAIWAN
Taipei City

UNITED ARAB EMIRATES
Dubai

UNITED KINGDOM
Edinburgh
London
Windsor

UNITED STATES
California
Connecticut
Florida
Georgia
Illinois
Massachusetts
Missouri
New Hampshire
New Jersey
New York
Oregon
Pennsylvania
Texas

* As of December 31, 2012
Exadata Environment Components

• Exadata X2-2/X3-2 also utilizing multi-racking
  – 12 full rack and 1 half rack used with multi-racking
  – Largest database 28TB, with most in 4-10TB range and some in 500GB to 2TB range
  – All running Oracle Database 11.2.0.3

• ZFS 7420 (2 write heads) for RMAN backups
  – 2 Exadatas share a ZFS
  – Golden Gate trail files also stored on ZFS
  – TSM RMAN Proxy Copy used to copy ZFS backups to tape for long term retention needs

• ASR (Hardware failures via Automatic Service Request creation)
• Golden Gate for data replication
• Oracle Enterprise Manager 12c
  – SNMP traps to Netcool -> Remedy
  – ZFS Plugin for OEM12c
Exadata

Oracle Net services client access

Node 1
Instance 1
App Schema1
App Schema2
ASM
OEL

Node 2
Instance 2
App Schema1
ASM
OEL

Node n
Instance n
App Schema3
ASM
OEL

Oracle Database
Cell Server
Cell Server
Cell Server
Cell Server

Exadata Storage
InfiniBand Switch / Network
Flash Cache
IORM (IO Resource Manager)
Smart Scan capability
Storage Index

Automatic Storage Management
Oracle Enterprise Linux

Query Offloading capability to Cell Server
RMAN 11g Features Used at State Street

• **Compression using ZLIB**
  - RMAN> CONFIGURE COMPRESSION ALGORITHM 'ZLIB';
  - Typical compression ratios of at least 25%
  - Requires Advanced Compression Option

• **Parallel backup of the same data file**
  - In Oracle Database 11g RMAN, channels can break data files into chunks known as ‘sections’.
    • BACKUP INCREMENTAL LEVEL 0 DATABASE .. SECTION SIZE <x>
  - Our setup is on Exadata using ASM.
  - On traditional systems, if the data file resides on a single disk, there is no advantage to using parallel backups within the data file.

• **DUPLICATE database from backup**
  - Used for creating standby and non-production testing environments
  - RMAN enhances DUPLICATE so that a connection to the source database is no longer required
    • Eliminates RMAN session dependency on WAN network connection back to source when creating new standby databases.
  - In an event of a failure during DUPLICATE, RMAN identifies the failure point and resumes from that point the next time DUPLICATE is run.

• **Backup Strategy**
  - Weekly Full and Daily Incremental Backups
RMAN 11g Features Used at State Street

• “Oops”..dropped a tablespace
  – With RMAN 11g, recovery of a tablespace has been further simplified
  – Once completed, tablespace will be offline so only thing left to do is:
    • SQL> ALTER TABLESPACE TS_NAME ONLINE;

• Archived Log Deletion Policy Enhancements
  – Used to ensure log shipment for the Active Data Guard environment is completed prior to deletion of archived logs via RMAN on primary database.
  – CONFIGURE ARCHIVELOG DELETION POLICY
    {CLEAR |
      TO {APPLIED ON [ALL] STANDBY |
      BACKED UP integer TIMES TO DEVICE TYPE deviceSpecifier |
      NONE |
      SHIPPED TO [ALL] STANDBY}
RMAN Backups Utilizing ZFS and Direct NFS

- **RMAN / ZFS / DNFS**
  - Performance boost for backups using out of the box ZFS setup
  - CPU reduction on compute nodes using out of the box ZFS setup
    - Direct NFS Client is capable of performing concurrent direct I/O, which bypasses any operating system level caches and eliminates any operating system write-ordering locks.
    - Direct NFS Client performs asynchronous I/O, which allows processing to continue while the I/O request is submitted and processed.
  - DNFS Setup
    - To enable Direct NFS Client, you must replace the standard Oracle Disk Manager (ODM) library with one that supports Direct NFS Client while the DB is down.
      - `Exadata_Host#>` `cd $ORACLE_HOME/lib`
      - `Exadata_Host#>` `cp libodm11.so libodm11.so_stub`
      - `Exadata_Host#>` `ln -s libnfsodm11.so libodm11.so`
    - Validation/Management via views
      - `(v$dnfs_servers, v$dnfs_stats, v$dnfs_channels)`
Future Promising Technologies

• RMAN 12c Excitement
  – Taking Exports on large databases is time consuming - there have been certain situations in the past where an export would make sense, but was not desirable.
  – Of the several great 12c features presented, the one we’re most excited about is table recovery.
    • On our Exadata platforms, we do not perform exports - only RMAN backups - and these can now be used to perform any type of recovery per our requirements.
Thank You !!

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