Multi-Terabyte Database Backup and Restores Over High Speed Networks

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Discover Financial Service’s Most Recognizable Brands

- 1 in 4 US Households
- Leading cash rewards program

- 50+ Franchises / 80+ Licensees
- Over 110K corporate clients

- #3 Market share in PIN debit
- 4,400+ Issuers

- Home loans, refinances, equity loans
- Real Estate Cash Rewards

- Online Bank
- Introducing Cashback Checking in 2014

- College and Graduate Student Loans
As Real Time as Possible

• DFS’s business unit’s interactions with customers are increasingly real time or near real time
  • SMS, Mobile App, Social Media, Website, Phone, Mail
• Faster, more intelligent responses, requires more data in OLTP systems
• Data Warehousing, BI/Analytics still important but nightly batch runs increasingly are not enough
Offering card holders useful promotions requires analytics

Presenting the offer requires infrastructure and web development to execute seamlessly

Meaningful Promotions
DFS Enterprise IT Environment

Challenges and Opportunities
Familiar Balancing Act?

Less and Less

Increasing

Budget

Time / Resources

Regulations

Security

Availability

Data Growth

PCI DSS v3

SOX

Big Data

Internet of Things

Audit

99.999%

Flash

Cloud
Traditional Enterprise IT Response

- **Standardize**
  - Unix Configuration
  - x86 Configuration
  - Tier 1 SAN
  - Tier 2 SAN
  - Switches

- **Virtualize**
  - Abstraction of Resources
  - Higher Utilization Rates of Physical Assets

- **Consolidate**
  - Less Servers
  - Less Storage Arrays
  - Less Cables
  - Less SW Licenses

- Lower Capital and Operating Costs
- Staffing Efficiencies
- Faster Incident Resolution
Legacy OLTP Database Environment

- Mix of Unix and Linux clusters
- FC attached Tier 1 SAN for data
- NAS attached Tier 2 for backup / restore

Challenges

- Deployments limited to standard offerings for Server and Storage
- High administration cost during troubleshooting
- Databases routinely I/O bound
- Backup / restore not scaling with data growth
Data Growth

• 2011 capacity planning predicted that 2014 would have:
  – **23.3TB** of OLTP database production data (not counting indexes, archives, redo logs, overhead, etc.)
  – **319TB** of OLTP database disaster recover, backups, and non-production data

• 2014 so far:
  – **75+TB** of OLTP database production data
  – **1PB+** of OLTP database disaster recover, backups, and non-production data

• Growth plan only off by **3.2X**
Technical Design

Purpose Built OLTP Database Environment
High Level OLTP Database Hosting Design

- 10GbE to database servers
- 40GbE Infiniband from database servers to x86 storage servers
- 40GbE Infiniband connectivity to external NAS array for backup / restore
Zoomed in High Level Design

- Database Server
  - x86 processors, DRAM
- Storage Server
  - x86 processors, flash, DRAM, commodity disk
- NAS
  - x86 processors, flash, DRAM in the controller
  - Commodity disk in drive shelves

40Gb/s InfiniBand
Buy vs. Build

• DFS choose commercially available vendor solution leveraging commodity hardware
• Capital depreciation, software licensing, and support costs lower than legacy storage solution
• DFS has not evaluated opensource custom built / self supported solutions for OLTP database backups but will in the future
Metrics
Consolidation, Throughput, and Data Protection Strategies
**Database Consolidation**

**Consolidation Strategy**

Databases consolidated by:
- Criticality
- Security requirements
- Change windows
- LOB channel isolation

**Consolidation # of Databases**
- 40% project delivery
- 89x Admin Efficiency
- Efficiency: 280 (9X)
- 2,600

**Consolidation # of Database Hosts**
- 55% hosting reduction
- Efficiency: 119 (2X)
- 215
Backup / Restore Throughput

- Limiting factor is database backup / recovery script tuning
  - Online database backups can not impact production
  - Compression and encryption takes time/CPU and reduces I/O throughput
- Currently do not have enough database servers on a single Infiniband fabric to saturate
- Testing showed similar throughput with 10GbE attached NAS but higher risk of saturation
Data Protection Strategy

Backups
- Database flashback features first line of defense
- Disk based backup primary site
- Compression level dependent on classification of application
- Mission Critical lower compression ratio = faster restore but more storage consumption
- Standby (DR) database
- Disk based backup at standby site

Restores
- Database flashback features first
- Out of place restore environment for tablespace / object level recovery
- In place recovery for issue impacting entire database
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