Demystifying Thin Provisioning and Thin Reclamation

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Symantec: Data Center Market Leadership

IDC's Worldwide Quarterly Storage Software Tracker, June 2009 (Storage Infrastructure & Filesystems)
Industry leading companies determined by the 2009 Fortune 1000 Industry List

Storage Infrastructure
File Systems
Clustering
Backup
Archiving

99% of the Fortune 500
10 of 10 leading commercial banks
10 of 10 leading IT services companies
10 of 10 leading financial data services companies
10 of 10 leading computer software companies
10 of 10 leading telecommunication companies

Demystifying Thin Provisioning and Thin Reclamation
Storage Management Challenges
Rapid Data Growth and High Storage Inefficiencies Lead To Excessive Storage Spend

“By 2012, users will install 6.5 times the amount of terabytes that they installed in 2008.”

“Cost Optimization, Key Initiatives and I&O Maturity: What Participants Told Us at the 2009 Data Center Conference”, Gartner February 2010

“Gartner storage key metric benchmarking research shows that the average storage utilization rate is 40.8%”

“The Future of Storage Management”, Gartner February 2010

Demystifying Thin Provisioning and Thin Reclamation
Storage Management Challenges in the Data Center

Hard to provision storage

• Provisioning of storage is not automated and can take weeks
• Requires cross team communication & planning

Hard to migrate data

• Migration from any-to-any storage is a challenge
• Traditional migration copy engines do not improve storage utilization

Hard to keep storage utilization high

• Traditional reclamation is disruptive, cumbersome & error-prone
• Periodic reclamation of blocks takes months of effort
# Hard to Provision Storage

## Storage Provisioning Trade-Offs

<table>
<thead>
<tr>
<th>Over Provisioning</th>
<th>Frequent Provisioning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DBA requires 300GB</strong></td>
<td><strong>Provision exactly what DBA needs</strong></td>
</tr>
<tr>
<td>System Admin buffers in 600 GB</td>
<td><strong>Frequent requests from DBAs</strong></td>
</tr>
<tr>
<td>Storage Admin provisions &gt;1TB</td>
<td>– More provisioning work for Storage Admin</td>
</tr>
<tr>
<td></td>
<td>– Provisioning requires weeks of effort</td>
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<tr>
<td></td>
<td><strong>Results in operational efficiency reduction</strong></td>
</tr>
<tr>
<td></td>
<td>– Distractions for Storage Admins</td>
</tr>
<tr>
<td><strong>Storage Admins avoid frequent provisioning</strong></td>
<td><strong>Increases OPEX in organizations</strong></td>
</tr>
<tr>
<td>Buffers are introduced in every request hand-off</td>
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</table>
Thin Provisioning Overview
Adopt Thin Provisioning: Automated & Efficient Storage Provisioning

Demystifying Thin Provisioning and Thin Reclamation

Array Feature
- All vendors have TP

TP Potential Benefits
- CAPEX Benefits
  - Improve Utilization
  - Lower costs
- Performance Benefit
  - Wide Striping
- OPEX Benefits
  - Efficient Provisioning

Storage Pools

500GB Storage Pool

Disks

Host Stack

Storage Array

Application 1

VxFS

VxVM volume 400 GB

Application 2

VxFS

VxVM volume 300 GB

Application 3

VxFS

VxVM volume 300 GB

Thin LUN 1

100GB

Thin LUN 2

500GB

Thin LUN 3

400GB

Disks
Thin Provisioning in Action

TP Volume (Virtual Vol)

TP Pool

Disks

Array Groups/Disk Drives

Actual storage capacity in TP LUN is assigned from the Pool when host writes data to a LUN

Demystifying Thin Provisioning and Thin Reclamation
Why Thin Provisioning?

• TP makes storage provisioning easy
  – Provision large LUNs (it’s free!)
  – Monitor storage pool utilization in the array

• TP optimizes storage admin efforts
  – Don’t micro-manage thousands of LUNs
  – Focus attention on a few storage pools

• A full solution requires smart host stack
  – Host file system has to be thin friendly
  – Make it easy to Get Thin
  – Automate continuous optimization of thin environment

• Storage Foundation is best for thin

Demystifying Thin Provisioning and Thin Reclamation
Thin Provisioning By Itself Is Not Enough

• Thin Provisioning = on-demand allocation
• Real potential to reduce storage waste
• Benefits don’t materialize with OS Native stack

• How Do I Get Thin Without Downtime?
• How Do I Stay Thin Without Working at It?
Optimize Thin Provisioning with Storage Foundation
Thin Provisioning: Migrate from Thick to Thin
Migrating to Thin Storage Eliminate Waste with SmartMove™ in Storage Foundation

**Standard Block Level Migration**

- Migrating online typically involves FULL ‘block level’ copy to Thin Devices
- This applies to ALL block level copy methods (Host, Network, Appliance, Array)

**With Storage Foundation SmartMove™**

- Online reclamation as you migrate to Thin Storage
- Hardware independent and works with ALL thin storage vendors
- Industry’s only solution for online thick to thin conversions

Demystifying Thin Provisioning and Thin Reclamation
SmartMove™ Makes VxVM Smarter

- SmartMove™ requires a mounted file system on the VxVM volume
  - VxFS on Unix/Linux and NTFS on Windows

![Diagram showing SmartMove™ process]

Data Block
Empty Block

SF Host (Unix, Linux, Windows)

VxFS / NTFS
VxVM

Source (legacy)
70% Wasted Storage

Target (thin)
SmartMove™ Makes VxVM Smarter

- SmartMove™ requires a mounted file system on the VxVM volume
- VxVM only copies the blocks that contain user data
- Not writing unused data = No unnecessary allocation on the thin LUN

Demystifying Thin Provisioning and Thin Reclamation
Volume Migration
Automated to reduce cost and complexity

Automated process for Migrating Volumes between Arrays
Migrate and Reclaim Storage Using SmartMove for VVR

- Turbo Charge VVR storage heterogeneity
  - Host based intelligence translates into cost savings
  - Significantly reduce CPU, BW and Storage requirements for initial sync
  - Reclaim Storage while migrating online to thin
  - Industry first and only solution of this kind

- Increase SFHA footprint
Automate Storage Reclamation with SF Thin Reclamation API
Thin Reclamation Challenge: “Write Once, Allocate Forever”

Dynamic Application in Action

TP Volume (Virtual Vol)

TP Pool

Disks

Storage Array

Demystifying Thin Provisioning and Thin Reclamation

VxVM, VxFS

Dynamic Application writes temp files

- VxFS/SFW minimize unnecessary allocations
- BUT unnecessary allocations are caused by applications
- Think of the multiple temp files Word creates on Windows
- Think of an application running-away on a Thin Volume…
Thin Reclamation Challenge: “Write Once, Allocate Forever”

Dynamic Application in Action

- The file system fills up, triggering allocations in the array’s shared TP Pool.
- Deleting the data in the file system does not affect utilization in the TP Pool.

System Admin Recovers and deletes useless data.
Traditional Storage Reclamation: Complex, Disruptive and Highly Inefficient

Demystifying Thin Provisioning and Thin Reclamation

## Reclamation Steps

1. **Shrink application/database ‘empty’ files**  
   Owner: Application/Database Administrator
2. **Shrink file systems and underlying volumes**  
   Owner: System Administrator
3. **Un-map and de-provision LUNs**  
   Owner: Storage Administrator
4. **Verify freed storage in pool and disks**  
   Owner: Storage Administrator

## Challenges

1. **Coordination between multiple teams**  
   => Error prone, time consuming
2. **Application and database downtime**  
   => Impact to business, lost revenue
3. **Inefficient storage reclamation**  
   => Storage isn’t freed, savings not realized
Simplified Storage Reclamation with Storage Foundation

Fully Automated, In Place Reclamation of All Unused Space in Host File Systems

1. All unused space in VxFS is identified

2. Location of unused space is communicated to the array in-band using standards based Thin Reclamation API

3. Storage array reclaims all chunks of physical storage that were wasted supporting file system unused space

- Easy, online, and non-disruptive storage reclamation
- In place, granular, reclamation of all existing free space
  - vxdisk reclaim to reclaim all free space in an enclosure, DG, disk(s)
- Thin reclamation reclaims ALL unused space regardless of actual content
SF Thin Reclamation API
Discovery & Reporting

• Thin Provisioning Device Discovery
  – Each array vendor has different values of TP “attributes”
  – ASL (DMP) discovers TP capabilities of any array
  – LUNS can be thin or thinrclm
  – Enables SmartMove & Allows SCSI Reclamation command

• Thin Reclamation Array Attribute Discovery
  – ASLs (DMP) discovers “Chunk Size” and other array specific TP attributes
  – Optimized handling of different storage vendor TP arrays

• Thin Reclamation Reporting
  – Reported via “vxdisk –o thin list” or via “vxdisk –e list”

<table>
<thead>
<tr>
<th># vxdisk –o thin list</th>
</tr>
</thead>
<tbody>
<tr>
<td>DANAME</td>
</tr>
<tr>
<td>3par0_0</td>
</tr>
<tr>
<td>3par0_1</td>
</tr>
</tbody>
</table>
Only Solution In the Industry Delivering True Thin Storage Optimization in Multi-Vendor SANs

- True thin storage optimization = reclaim ALL unused space
- Supported on Windows, Unix and Linux
  - Storage Foundation for Windows 5.1 SP1
  - Storage Foundation for Unix & Linux 5.0 MP3rp2 and above
- Thin storage leaders support our Thin Reclamation API today

HW Vendor Support of Symantec Thin Reclamation API

Demystifying Thin Provisioning and Thin Reclamation
Customer Use-Cases: Symantec Thin Reclamation

• Any Dynamic Application (DB, NFS, Web Services) that
  – Generates a lot of files and deletes data periodically
  – Ability to “Right Size” the environment should be there periodically

• Periodic Small Projects Cleanups with Thin reclamation
  – Very applicable to any IT department
    • spins off multiple shorter duration projects and then terminates them in 3-6 months
  – 3-6 monthly projects require storage reclamation in the end

• Storage Optimized Flexible Data Sharing
  – Data is shared with partners utilizing snapshots and sometimes full copies
  – For cleanup purposes and to utilize the unused storage again
    • thin reclamation cleans up the environment
ROI Study: “Right Size” Dynamic Application Growth

**ROI for 5-6 servers utilizing 1 thin storage array with multiple FileSystems**

**Before: Customer with Traditional Storage with Any Growing App**
- NFS/DB/Web – Any Dynamic Application
- Host Stack
- EMC Storage Array
- Storage Cost per GB = $5
- Storage Purchased per year = 100TB
- FileSystem Storage Consumption: 70TB
- Data removed but storage allocated = ~30TB
- Wasted Storage Cost = $150,000
- Annual Storage Cost = $500,000

**After: Customer Using SF Thin Reclamation with Thin Storage**
- Host Stack
- EMC Storage Array
- Storage Cost per GB = $5
- FileSystem Storage Consumption: 70TB
- Data removed but storage allocated = ~0TB
- Storage Purchased/year = ~70TB
- Wasted Storage Cost = $0
- Annual Storage Cost = $350,000
- SF License Cost = ~$40,000
- ROI = $110,000 within 6 months

**Traditional Storage Environment**
- Storage Cost per GB = $5
- Storage Purchased per year = 100TB
- FileSystem Storage Consumption: 70TB
- Data removed but storage allocated = 30TB
- Wasted Storage Cost = $150,000
- Annual Storage Cost = $500,000

**Thin Storage with Thin Reclamation**
- Storage Cost per GB = $5
- FileSystem Storage Consumption: 70TB
- Data removed but storage allocated = ~0TB
- Storage Purchased/year = ~70TB
- Wasted Storage Cost = $0
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Thin Provisioning Made Simple with Veritas Operations Manager (VOM)
Deep Storage Visibility with VOM allows better Thin Provisioning Management

- View Thin LUN utilization information: Unallocated Size, Physically Allocated Space
- Get visibility into what LUNS are Thin and Thin Reclaim capable in your enclosure
• Thin Pool Utilization & Exhaustion Information
  – Ability to report “At Risk” storage pools in terms of space exhaustion
  – Ability to create risk signatures that will warn users if running out of space
  – VOM discovers array specific “threshold” Information to warn users
• Alleviate your Over-Provisioning concerns with VOM
Scheduler allows “one time” or periodic automated reclamation

- Reclamation can be triggered at Pool, FS or DiskGroup level
- Ability to create tasks for reclamation for future
- Monitor and Check status of reclamation jobs and “approx space reclaimed”
Optimize Thin Storage with Veritas Storage Foundation

• Thin Provisioning will change how storage is managed

• Optimize Thin Storage on all OS with Storage Foundation
  – Get cross platform thin friendly host based storage management
  – Automatically reclaim space as you migrate online to thin storage
  – Be ready for online thin storage reclamation

• Standardize on SF 5.0 MP3rp2 and SFW 5.1sp1
Storage Foundation Thin Optimization
SmartMove and Online Thin Reclamation

Automatically Reclaim During Online Migration

Continuously Reclaim ALL Unused Storage

One and Only Solution For Non-Disruptive Thin Optimization

- Works with ALL leading storage HW
- Unix, Linux and Windows!
- Optimize Array Thin Pool utilization with VOM

Demystifying Thin Provisioning and Thin Reclamation
Example: Financial Benefits of Thin Provisioning

<table>
<thead>
<tr>
<th></th>
<th>Application Data</th>
<th>Wasted Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional &quot;Thick&quot; Environment</td>
<td>153</td>
<td>510</td>
</tr>
<tr>
<td>Thin Environment</td>
<td>153</td>
<td>306</td>
</tr>
<tr>
<td>Thin with Symantec</td>
<td>153</td>
<td>0</td>
</tr>
</tbody>
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Source: Symantec / Enterprise Strategy Group, 2010

Symantec is the ONLY solution for Optimizing Thin Provisioned Environments

Demystifying Thin Provisioning and Thin Reclamation
Thank you!

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Appendix
Array-based Zero-Page Reclamation

“Allocate Now, Hopefully Reclaim Later”

Sample Pages/Chunks

Post-Migration “Zero-Page” Reclamation

- **Array-based Zero-Page Reclamation**
  - Requires extra storage on destination side during migration
  - Inefficient space reclamation algorithm
    - Applications/FS don’t write back zeros on file deletion