FS8600 Thin Provisioning Best Practices

Dell Storage Technical Solutions
May 2014
THIS WHITE PAPER IS FOR INFORMATIONAL PURPOSES ONLY, AND MAY CONTAIN TYPOGRAPHICAL ERRORS AND TECHNICAL INACCURACIES. THE CONTENT IS PROVIDED AS IS, WITHOUT EXPRESS OR IMPLIED WARRANTIES OF ANY KIND.

© 2014 Dell Inc. All rights reserved. Reproduction of this material in any manner whatsoever without the express written permission of Dell Inc. is strictly forbidden. For more information, contact Dell.


Performance of network reference architectures discussed in this document may vary with differing deployment conditions, network loads, and the like. Third party products may be included in reference architectures for the convenience of the reader. Inclusion of such third party products does not necessarily constitute Dell's recommendation of those products. Please consult your Dell representative for additional information.

Trademarks used in this text:

Dell™, the Dell logo, Dell Boomi™, Dell Precision™, OptiPlex™, Latitude™, PowerEdge™, PowerVault™, PowerConnect™, OpenManage™, EqualLogic™, Compellent™, KACE™, FlexAddress™, Force10™ and Vostro™ are trademarks of Dell Inc. Other Dell trademarks may be used in this document. Cisco Nexus®, Cisco MDS®, Cisco NX-OS®, and other Cisco Catalyst® are registered trademarks of Cisco System Inc. EMC VNX®, and EMC Unisphere® are registered trademarks of EMC Corporation. Intel®, Pentium®, Xeon®, Core® and Celeron® are registered trademarks of Intel Corporation in the U.S. and other countries. AMD® is a registered trademark and AMD Opteron™, AMD Phenom™ and AMD Sempron™ are trademarks of Advanced Micro Devices, Inc. Microsoft®, Windows®, Windows Server®, Internet Explorer®, MS-DOS®, Windows Vista® and Active Directory® are either trademarks or registered trademarks of Microsoft Corporation in the United States and/or other countries. Red Hat® and Red Hat® Enterprise Linux® are registered trademarks of Red Hat, Inc. in the United States and/or other countries. Novell® and SUSE® are registered trademarks of Novell Inc. in the United States and other countries. Oracle® is a registered trademark of Oracle Corporation and/or its affiliates. Citrix®, Xen®, XenServer® and XenMotion® are either registered trademarks or trademarks of Citrix Systems, Inc. in the United States and/or other countries. VMware®, Virtual SMP®, vMotion®, vCenter® and vSphere® are registered trademarks or trademarks of VMware, Inc. in the United States or other countries. IBM® is a registered trademark of International Business Machines Corporation. Broadcom® and NetXtreme® are registered trademarks of Broadcom Corporation. Qlogic is a registered trademark of QLogic Corporation. Other trademarks and trade names may be used in this document to refer to either the entities claiming the marks and/or names or their products and are the property of their respective owners. Dell disclaims proprietary interest in the marks and names of others.
# Table of contents

Revisions .............................................................................................................................. 2

Introduction .......................................................................................................................... 4

1 Thin provisioning overview ............................................................................................. 5
   1.1 Thin provisioning terminology .................................................................................. 5
   1.2 Use cases for thin provisioning ................................................................................. 6
   1.3 Example of a thin provisioned NAS volume .............................................................. 7

2 Monitoring thin provisioned volumes ............................................................................. 8

3 Modifying thin provisioned volumes ............................................................................. 11

4 Thin provisioning guidelines and best practices ............................................................. 12

5 Conclusion ......................................................................................................................... 13

6 Additional resources ....................................................................................................... 14
Introduction

Thin provisioning can be an important component of a data management strategy because it provides a way to efficiently use the available space in the FluidFS FS8600 Network Attached Storage (NAS) appliance. Thin provisioning operates by allocating disk storage space in a flexible manner among multiple NAS users, based on the minimum space required by each user at any given time.

This paper discusses the thin provisioning capability built into Dell Fluid File System (FluidFS) version 3, including management, monitoring and typical use cases. Thin provisioning is new for version 3 and is part of the volume data management capabilities built into FluidFS. FluidFS underlies Dell Compellent FS Series NAS solutions. It is designed from the ground up to meet customer requirements for data availability, data integrity, high performance, scalability, and data protection. FluidFS also provides an easy-to-use interface for deployment, administration, and general management.
1 Thin provisioning overview

Thin provisioning gives the administrator the ability to provision more advertised space than the actual size of the NAS storage pool. This is useful when providing storage space for many volumes to many users and applications without over-committing NAS Storage pool space. This allows for flexible disk purchasing decisions and flexibility of day-to-day management. Thin provisioning gives the end user or application the flexibility to provision and grow NAS volumes unencumbered by the physical capacity of the NAS pool. Free space is assigned to a volume on demand.

![Thin provisioned capacity vs physical capacity](image)

Figure 1    Thin provisioned capacity versus physical capacity

The ability to thin provision volumes also means that the administrator can dynamically provide free space to volumes by over-committing the physical space within the NAS pool. All free space in the NAS pool is available to all volumes. Figure 1 shows the NAS pool capacity at 100 TB but the total advertised capacity of the thin provisioned volumes is 300 TB.

1.1 Thin provisioning terminology

![Space in a typical NAS volume](image)

Figure 2    Space in a typical NAS volume

**NAS volume available space:** The space that is physically available for a volume within the NAS pool.

**NAS volume overcommit space:** The part of a thin provisioned NAS volume that is not available and not in use by this volume. It is equal to the **NAS volume Size** minus **NAS volume Available Space** minus **NAS volume Used Space**. It allows a server or application to view more storage capacity than has been allocated in the NAS Pool itself. Physical storage capacity on the NAS is only dedicated when data is actually written by the application, not when the storage volume is initially allocated.

**NAS volume reserved space:** The declared space guaranteed for the NAS volume from the NAS pool. Thinly provisioned volumes can have a reserved portion which has been allocated when the NAS volume is initially created. The minimum reserved size is 10% of the NAS volume size.
**NAS volume size**: The maximum size of a thin provisioned volume defined by the user, this is the volume size that the clients connected to the volume will see.

**NAS volume unreserved space**: The part of a NAS volume that is not reserved. This is equal to NAS volume size minus NAS volume reserved space. Reserved space will be used before unreserved space.

**NAS volume used space**: The space occupied by the writes to the NAS volume (includes snapshots).

### 1.2 Use cases for thin provisioning

The table below lists some typical use cases and helps you decide if you should use thin provisioning.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Thin provisioning use case</th>
<th>Is this a good use of thin provisioning?</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Home directories</td>
<td>Yes</td>
<td>Home directory capacity requirements vary greatly across a user community. This is a scenario where thin provisioning makes sense. By thin provisioning the volumes that store home directories, the administrator can easily accommodate the heavy users without having to provision extra disk space on users with modest requirements.</td>
</tr>
<tr>
<td>2</td>
<td>Departmental shares</td>
<td>Yes</td>
<td>Generally speaking, thin provisioned volumes support a pay as you grow strategy where the administrator can advertise the space to users up front and grow the NAS pool physical space as needed. An example of this could be when a department has asked for a 1 TB volume but is not expected to use the space immediately.</td>
</tr>
<tr>
<td>3</td>
<td>Group file sharing</td>
<td>Yes</td>
<td>Group file sharing areas are typically used as areas where users can store files and data common to the group and enable the ability to work collaboratively with those files. Like home directories, file shares like this are usually unstructured and are good candidates for thin provisioning.</td>
</tr>
<tr>
<td>4</td>
<td>Applications that cannot tolerate any down time</td>
<td>No</td>
<td>If the application using the volume is mission critical such that even a brief storage outage cannot be tolerated, thick provisioning should be used.</td>
</tr>
</tbody>
</table>
1.3 Example of a thin provisioned NAS volume

In this scenario, the size of the FluidFS NAS Pool is 100 TB. The administrator creates a thin provisioned volume called **Vol1** and sets the size at 120 TB. There is approximately 38 TB consumed on this volume as used space. The administrator then sets the reserved space at 40 TB.

**Figure 3 Editing volume space settings**

With the NAS pool size set at 100 TB, the administrator has over-committed space on the Vol1 volume by 20 TB.

**Figure 4 Vol1 volume space settings**

Note that the unreserved space is equal to the available space plus the overcommit space. Since the NAS pool is only 100 TB, this 20 TB overcommit space does not actually exist in physical disk. As a best practice, the administrator should consider setting the reserve space for each volume according to the criticality of that volume’s space requirement. In doing so, this guarantees the volume has reserved that amount of space. The system tracks the reserved space against unreserved space.
Monitoring thin provisioned volumes

A critical aspect of thin provisioning is appropriate monitoring of space utilization. Thin provisioning can offer and advantage with NAS volumes to account for future increases in usage. However, the administrator must take care to monitor actual disk usage because it is possible for the storage space used by the NAS volumes to exceed the storage space allocated to the NAS pool. When thresholds are met or exceeded, alerts are generated and can be viewed in Enterprise Manager and forwarded as an email to the appropriate staff for attention.

Since thin provisioned environments can allocate more logical space than they have underlying physical storage, the administrator needs tools that can monitor the storage systems for space utilization and generate appropriate messages and warnings so that the administrator can react in a timely manner to prevent out-of-space conditions.

There are two levels of notification the system can provide when available space is running out:

**System level:**

- System used space is greater than the NAS pool space threshold (%)
- Unused Unreserved Space is less than the NAS used space pool threshold (GB)

NAS Pool Space Thresholds can be set by right-clicking on the FS8600 cluster name in left panel -> Edit Space Settings in Enterprise Manager.

Figure 5  Example of a used space threshold exceeded message in Enterprise Manager

Figure 6  System level view in Enterprise Manager
NAS Volume level:

- NAS Volume Used Space is greater than the NAS volume space threshold (%)
- Alert will be generated when NAS Volume Available Space is less than the NAS volumes used space threshold (GB)

Volume level space thresholds can be set from **NAS Volumes-> Edit Space Settings** in Enterprise Manager.
When planning and configuring thin provisioned volumes, the administrator should ensure that volume use level thresholds are set at the system level and volume level to give the administrator enough time to take action because running out of space could cause an unplanned outage.

The administrator should also ensure that the threshold monitoring and alerting process is fully tested making sure that threshold messages and alerts are being seen and acted upon by appropriate staff.
### Modifying thin provisioned volumes

When an FS8600 NAS volume is created, it is created **thin** by default. The volume can be changed to a **thick** volume at any time assuming there is enough unused space in the NAS storage pool. When you change the setting to thick, the system immediately reserves the entire size of the volume removing it from the NAS pool. This guarantees the full amount of the size specified when the volume was created or modified.

If the volume is set to thin, the reserved space can be modified at any time, but cannot exceed the size of the volume. Note that when the space provisioning is changed to thick, there is no reserved space option because the volume size is reserved completely.

![Figure 10  Changing a thin provisioned volume from thin to thick](image)

Some volumes may not benefit from thin provisioning if the application that is using them grows very little. These volumes would be candidates for thick provisioning since there is no need to provide additional growth space. When these types of volumes are removed from thin provisioning, it makes managing the rest of the thin provisioned volumes less complicated because the space is accounted for in the NAS space pool. FluidFS version 3 also includes the ability for the administrator to apply space quotas on users and groups to help control unpredictable growth.
4 Thin provisioning guidelines and best practices

- Replication of a thin provisioned NAS volume
  Replication of a thin provisioned NAS volume is fully supported; the space provisioning settings/changes on the source and destination are independent of each other.

- Scalability (adding storage to the FS8600)
  The administrator can add physical storage to the system and add space to system unallocated space. This can then be added to grow the NAS pool. There is no disruption in service when doing this. The system will automatically adjust available and unreserved space for thin provisioned volumes.

- Upgrading an FS8600 from version 2 to version 3
  If performing a FluidFS version 2 to version 3 upgrade, the existing thick provisioned NAS volumes will remain thick provisioned after the upgrade. All existing version 2 volumes will remain thick after the version 3 upgrade, but can be converted to thin after the upgrade is complete.

- Cloned volumes compatibility
  When working with clones, note that the base NAS volumes can be either thick provisioned or thin provisioned. A cloned volume is the same size as the base volume. A cloned volume is created as thin provisioned (thin clone) and can be modified to thick.

- De-duplication compatibility
  Thin provisioned NAS volumes fully support De-duplication.

- Best practice
  Set the reserve space higher on critical volumes that have a space requirement.

- Best practice
  Make sure the volume level thresholds are set with enough time to react if disk space needs to be added to the NAS pool.

- Best practice
  Test the threshold and alerting capabilities of both the system level and the volume level to make sure important threshold alerts are being generated and received by the appropriate staff.

- Best practice
  Know your workloads, because some applications can consume space unpredictably while others are generally stable in growth. Keep in mind that snapshots also consume space and are counted as used space.

- Best practice
  Consider using quotas in addition to thin provisioning to help with space management.
5 Conclusion

Thin provisioning can be an important component of a data management strategy because it provides a way to optimize existing storage space and help prevent under-utilization of these expensive resources. Thin provisioning is one way to get more return on the investment for the FS8600 NAS. Following the guidelines and best practices in this document will ensure that the FS8600 NAS administrator has more ways to provide cost-effective NAS services.
6 Additional resources

Dell online support resources:

Dell technical support site: http://support.dell.com

Dell Tech Center is an online IT community where IT professionals connect with Dell customers and employees to share knowledge, best practices, and other information about Dell products and installations: http://DellTechCenter.com

Dell Fluid File System resources:

