Deploying ioMemory in VMware View™ Environments

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Fusion-io: 2855 E. Cottonwood Parkway, Box 100 Salt Lake City, UT 84121 USA

(801) 424-5500
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Introduction

VMware View™ 4.x is VMware’s management software for Virtual Desktop Infrastructure (VDI). VMware View is well-suited for ioMemory (Fusion ioDrives, ioDrive Duos, etc.) deployment, with excellent opportunities for lowering total cost of ownership in a VDI configuration. Using ioMemory is the most cost-effective way to build a high-performance, low-cost VDI solution.

This guide focuses on the key advantages of combining ioMemory and VMware View 4.x in VDI configurations, such as:

- Eliminating the need for an expensive SAN to power a high-IOPS VDI
- Provisioning 100 or more virtual desktop sessions per server, with the ability to scale overall installation nearly linearly by adding more servers

VDI BENEFITS AND REQUIREMENTS

The Virtual Desktop Infrastructure (VDI) provides the following benefits:

- No SAN is required for Virtual Desktop provisioning.
- VMware Linked Clones (pointer-based snapshots) can be used to reduce the storage footprint.
- High availability for desktops is enabled by deploying redundant VMware View Connection Servers.

A highly available CIFS share is required for storage of:

- User profile data
- User file data
- Shared files
ARCHITECTURE OVERVIEW

VMware View 4.x’s tiered storage capability provides a simple, effective architecture. This enables a new era in the evolution of desktop virtualization cost modeling, without sacrificing performance and user experience. In fact, in many cases users experience faster boot times and application load times, now measured in single-digit seconds.

The figure below illustrates the basic VDI architecture.

An example of Virtual Desktop Infrastructure consists of VMware View servers running VMware ESX 4.x or ESXi 4.1, each with the following features or capabilities:

- A 640GB ioDrive Duo
- Provisioning up to 100 user desktops. 120 desktops are actually provisioned, but 20 of them are not booted and are used only in a failure scenario.
- The GMI (Golden Master Image) is replicated twice, once on each ioMemory module. Each replica hosts 50 linked clones. Only one GMI is needed per pool; VMware View Composer automatically creates all the replicas it needs. See also Golden Master Image in the Best Practices and Recommendations section.
• Use of redundant VMware View Connection Servers (Connection Brokers) to direct client connections to VMware View sessions in a highly available way

• `\data\User Profile Data, \data\User Data` and `\Shared Files` are kept on a highly available CIFS filestore.

Folder redirection refers to the automatic re-routing of file I/O to different folders on a network, usually to avoid accumulating local storage. If folder redirection is not possible, such as on Windows XP, then user profiles might begin to accumulate in the linked clones. In that case, profiles that would normally be stored as part of a desktop should be removed on a regular basis, or desktops should be regularly recomposed using VMware View Composer. This helps to keep the overall capacity usage down. For more information on using folder redirection, see Roaming Profiles and Folder Redirection later in the guide.

If a VMware View (ESX) server fails, or when periodic maintenance is required, each client currently hosted on that server is disconnected. As the users’ sessions begin to reconnect, each user is redirected to a different VMware View (ESX) server by the VMware View Connection Server. Profiles and user data are still available from the HA CIFS filestore. Up to 20 additional desktops can be booted on each remaining ESX server to provide more client connections. For example, if three servers provide 100 desktops each, and one of the servers goes down, 20 additional desktops can be gained from the remaining servers, making a total of 240 available desktops. Typically this infrastructure is deployed in an N+1 server configuration.
Installation

INSTALLING IOMEMORY
To install ioMemory in VMware View environments, follow the steps in the Installation section of the Fusion-io VMware ESX User Guide.

MODIFYING THE DATASTORE NAME
When labeling your ioMemory-based datastores, it is best to use a naming convention that enables you to disambiguate the drive based on physical host the drive is installed in. Proper naming of the Datastore will make it easier to identify the Datastore when selecting where to place replica VMs and linked clones in VMware View Administrator’s Pool Creation wizard.

For example, dl785fio160_1 indicates the server type (DL785), the ioMemory device (ioDrive 160GB) and the number of the ioMemory module being used (_1).

Follow these steps to modify the ioMemory datastore name:

1. Select the physical host in Virtual Center.
2. Click the Configuration tab.
3. In the Hardware list, select Storage.

4. Right-click the datastore you want to modify. The Properties dialog appears.
5. Click **Rename** to rename the Datastore.

![Image of Volume Properties window with Rename button highlighted]

**INSTALLING VMWARE VIEW**

To install VMware View, follow the instructions in the VMware View Installation Guide. The minimum requirements for stateless VDI installation include:

- Microsoft Active Directory Server, including DNS and DHCP (if your environment doesn’t support it already)
- VMware vSphere (ESX + vCenter)
- VMware View Connection Server
- VMware View Composer
STORING REPLICA VMs AND LINKED CLONES ON IOMEMORY

You can construct a stateless, floating, linked-clone-based desktop pool, using the VMware View Administrator and VMware View Composer. Follow these steps to enable the replica VMs and linked clones to be populated on ioMemory:

1. Open the VMware View Administrator.
2. In the Dashboard list of VMware View Administrator, select **Pools**.

3. Click **Add** to start the Add Pool Wizard.
4. For a stateless, non-persistent VDI, keep the Type setting as **Automated Pool**.

5. Click **Next**. The User Assignment window appears.

6. Set the User Assignment to **Floating**.

Stateless VDI uses “floating” desktops, because desktop resources are never committed to any given user.
7. Click **Next**. The vCenter Server window appears.

8. Select “View Composer Linked Clones” to dramatically decrease storage requirements.

9. Click **Next**. The Pool Settings window appears.
10. In the Remote Settings list, follow best practices for highly available VDI by selecting the following values:
   - Remote Desktop Power Policy: “Ensure desktops are always powered on”
   - Automatically log off after disconnect: “Immediate”
   - Allow multiple sessions per user: “No”
   - Delete or refresh desktop on logoff: “Delete immediately”

11. Click Next. The Select Datastores window appears.

12. Find and select the Fusion-io based datastore(s) by label for this pool.
13. Click OK to finish the datastore selection.
Best Practices and Recommendations

CUSTOMER CHECKLIST

When you are considering setting up a Fusion-powered VDI with a customer, the following checklist of configuration items should be considered:

1. **Performance Profiles:** Defined? Y / N
   - IOPS / throughput (Rs/sec, Ws/sec, peaks)
   - Profile ratio: ____
   - Pools of dedicated resources for specific performance profiles? Y / N

2. **VMFS Volume:** # of VDI VMs on single VMFS volume ____
   - Standard volume size ______
   - Block size of VMFS volume ______

3. **Storage Configuration:** FC / iSCSI / NFS
   - RAID type ____
   - # of spindles in RAID ____

4. **Golden Master Image (GMI):** Current size _____
   - GMI configuration ____________________________
   - # of GMIs currently used in production ____
   - (Because ioMemory is local storage, GMIs must be deployed on all ESX hosts in a cluster.)

5. **VDI Desktops:** Persistent / Non-persistent
   - Max. # of VDI desktops in a pool ____
   - Desktop pool: automated / individual / terminal services

6. **Replicas and Clones:** Typical desktop replica size _____
   - Linked clone disk configuration: Recompose / Refresh / Rebalance
   - Typical user data within a replica ______

7. **Application Virtualization:** # of applications being used ____
   - Differing versions, if any ______
   - Application performance characteristics ________________________________
   - # of instances of applications typically running _____
SIZING CPU CORES AND DRAM

Follow VMware’s best practices for sizing with respect to CPU cores and DRAM, as stated in the VMware View Optimization Guide for Windows 7. As a rule of thumb, try not to exceed 10 users per modern (Nehalem or later) CPU core. DRAM will be de-duplicated by ESX, so assign a reasonable amount per user, based on the user type. Best practice is to measure and make adjustments as necessary.

SIZING STORAGE

To compute the storage size for the VDI with linked clones, use the following formula:

\[
\text{Total Storage} = (\text{VMs} \times (\text{Delta Footprint} + \text{Log} + \text{User Data Disk}) + \text{Replica} + \text{Master Replica} + \text{Overhead})
\]

where

- Delta Footprint = the base size of each delta disk;
- Log = changes to each delta disk;
- User Data Disk = each user disk (not needed if the user data goes on the CIFS filestore);
- Replica = the per-datasore base image (always an exact duplicate of the GMI);
- Master Replica = Gold Master Image
- Overhead = any additional data not included above

Here are some best practices to follow:

- Use folder redirection and roaming profiles to dramatically reduce the delta footprint (extra profile data) stored. See Roaming Profiles and Folder Redirection for details.
- Place user data on a CIFS filestore, to eliminate that part of the footprint.
- HDDs, USB/CF drives, or PXE are still required for boot. Follow best practice (RAID1, SATA) for booting ESX.

GOLDEN MASTER IMAGE

To set up a golden master image for your VDI, follow the guidelines in the VMware View Optimization Guide for Windows 7. Here are some basic points to keep in mind with your setup:

- It is recommended to use Windows Server 2008 R2 or Windows 7 (64-bit is not essential).
- Do not use file compression or disk defragmentation. CIFS will take care of these issues automatically.

The basic steps to follow are shown in the following diagram.
With current versions of VMware View 4.x, only a single golden Master Image is required. View Composer automatically generates replicas of the Golden Master Image for all datastores in which linked clones will be created.

Additional best practices for creating golden images can be found at:


**ROAMING PROFILES AND FOLDER REDIRECTION**

Follow the best practices given by Microsoft and VMware for efficiently implementing roaming profiles on top of folder redirection (see http://technet.microsoft.com/en-us/library/cc732275.aspx for details). In a stateless, non-persistent desktop environment, these guidelines are the key to isolating the personalization layer. This enables users to maintain the rich, personalized experience they are used to, without bloating the linked clones or risking losing personalization when the clones are refreshed.

Folder redirection for Windows XP clients might not be possible; with XP, folder redirection is only possible for the My Documents folder. Windows 7, on the other hand, can redirect arbitrary folders, including the location of user profiles.
Additional best practices for roaming profiles and folder redirection can be found at:

http://kb.vmware.com/kb/1020967

PARALLELISM IN PROVISIONING AND BOOTING

When provisioning desktops, you can increase parallelism in concurrent operations. This speeds up provisioning and boot time tremendously. To increase parallelism, follow these steps:

1. Open VMware View Administrator to display the Dashboard.
2. Click **View Configuration** in the left pane and select **Servers**. The Servers window appears.

3. Choose your vCenter Server, and then click **Edit**. The Edit vCenter Server dialog appears.
4. Click **Advanced** to view the advanced settings.

![Advanced Settings](image_url)

5. Modify settings to allow 50 concurrent provisioning and 50 concurrent power operations.

**SETTING UP A RESOURCE POOL**

Be sure to use Resource Pools appropriately, especially when using highly accelerated settings. It is possible to provision so rapidly that memory is temporarily exhausted, although transient, ultimately causing out-of-memory conditions for the ioMemory VSL. Therefore, the best practice is to include a hard memory limitation in the resource pool that contains the VDI linked clones, thereby reserving remaining memory for the VSL.

To set up a Resource Pool, follow the steps below.

1. Click the Summary tab in the vSphere client to view the current memory usage and capacity, as well as the datastores that will be set up as the Resource Pool. The example below shows 36.8GB of RAM, with two 160GB ioMemory modules.
2. Click the Configuration tab, and then click **System Resource Allocation** in the Software pane.

The System Resource window appears.
3. Click **Advanced** to display the System Resource Pools.

4. Click **user** to display the settings.

5. Click **Edit Settings**. The Edit user Resource Allocation dialog appears.
6. Clear the **Unlimited** checkbox so you can set a limit for the memory resource allocation.

7. Set the limit to 35,000MB as shown above.
8. Click **OK** to finish Resource Pool Allocation.

A summary window appears, showing the adjusted memory limit for the Resource Pool as 35,000MB (35GB).

| Details |
|------------------|------------------|
| **CPU**           | **Memory**       |
| Reservation: 0 MHz| Reservation: 0 MB|
| Limit: Unlimited  | Limit: 35000 MB  |
| Shares: 9000      | Shares: 9000     |
| Expandable Reservation: Yes | Expandable Reservation: Yes |
Conclusions

IOMEMORY – THE MOST COST-EFFICIENT WAY TO DEPLOY VDI

Traditionally, deploying a VDI has been cost-prohibitive: to get high IOPS, a SAN with many disks or SSDs is typically required. This day-one investment in a large part of the SAN infrastructure is huge, even if disks are added at a later date as needed. Also to be considered are the associated training, management, power usage, and HVAC costs of a typical SAN.

By deploying ioMemory in the VDI solution, the upfront costs are proportionate to number of desktops being deployed. For example, a server with a 640GB ioDrive Duo can provide about 100 user desktops per server. When additional desktops are required, it is simply a matter of provisioning additional servers as needed.

To illustrate the cost savings of deploying a VDI with ioMemory, one customer had planned to roll out 1000 user desktops (10 servers) over time. Using ioMemory as part of the VDI solution has enabled them to buy only the hardware they need, as they need it. They started with 400 desktops on four VMware View servers. As more users are integrated into the system, and more endpoints are deployed, the number of Servers will grow proportionally: CPU, memory, and storage will scale up linearly with no waste.
Appendix: Technology Glossary

VMWARE LINKED CLONES

A linked clone is a copy of a virtual machine that continues to share virtual disks with its parent. The differential—the bits of software that are unique to the linked clone—is stored in a “diff” or “redo” disk. This arrangement allows the linked clone to occupy a smaller virtual disk space than the parent yet still access software installed on the parent. Due to the sharing mechanism, however, a linked clone must always have access to the parent disk; without that, it becomes unusable. Each linked clone can thus act like an independent desktop OS: it has a unique personal identity, including a unique hostname and IP address, yet it requires significantly less storage than a full clone. Hundreds of linked diff disks can be created from one parent image, reducing the total storage space required.

Each linked clone reduces the Windows 7 user desktop to roughly 5GB, as unchanged files are accessed from the gold image. In practice, this diff file is never more than 1 or 2GB per desktop, due to additional management tasks that remove local profile data.

CONNECTION BROKER

All user profiles (roaming) and user data are held on the HA Storage CIFS file share, which is separate from the VMware View infrastructure. Should a VMware View server fail, all VMware View users connected to that server are disconnected. On reconnect, users are directed by the connection broker to a different VMware View server. All profiles and user data are still be available from the HA file store – users should not notice any difference. If required, an additional 20 provisioned desktops can be booted per server to provide additional capacity and availability.