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Lab Overview - HOL-1851-03-ADV - Horizon 7.1: App Volumes - Getting Started
Lab Guidance

Note: It will take more than 90 minutes to complete this lab. You should expect to only finish 2-3 of the modules during your time. The modules are independent of each other so you can start at the beginning of any module and proceed from there. You can use the Table of Contents to access any module of your choosing.

The Table of Contents can be accessed in the upper right-hand corner of the Lab Manual.

This lab will provide an overview of VMware App Volumes on Horizon 7. Discover how App Volumes provisions applications to act as part of the Just-In-Time Management Platform (JMP). Attendees will learn how applications are captured, managed and entitled. Explore use cases such as user installed applications and persona management with the App Volumes writable volume. Advanced design topics such as scalability and storage considerations are also covered.

Lab Module List:

- **Module 1 - Introduction to App Volumes** (30 minutes) (Basic) This module will provide an overview and benefits of App Volumes followed by a hands-on walkthrough of the App Volumes console.
- **Module 2 - AppStack Management** (30 minutes) (Beginner) This module demonstrates the management features of an AppStack starting at provisioning stage all the way through to deletion and managing Templates.
- **Module 3 - Entitling Applications via AppStacks** (30 minutes) (Intermediate) This module will show the different entitlements for AppStacks when used with either Desktops or Remote Desktop Servers.
- **Module 4 - Writable Volumes** (45 minutes) (Advanced) In this module, we will look at the correct use case for Writeable Volumes, then move onto more practical concepts around how to create, edit and update writable volumes.
- **Module 5 - Application Isolation with ThinApp** (45 minutes) (Advanced) This module demonstrates Application Isolation with ThinApp when used in merged, WriteCopy or Full mode. The module includes using a single application with two different versions.
- **Module 6 - Advanced Topics - App Volumes** (45 minutes) (Advanced) This module will look at storage policies, scalability and security for App Volumes.

Lab Captains:

- Module 1-6 Lead Captain - Vernon Lihou, Senior TAM PSO, United Kingdom
- Module 1-6 Captain - Michael McDonnell, Senior Systems Engineer, US

This lab manual can be downloaded from the Hands-on Labs Document site found here:
This lab may be available in other languages. To set your language preference and have a localized manual deployed with your lab, you may utilize this document to help guide you through the process:


**Location of the Main Console**

1. The area in the RED box contains the Main Console. The Lab Manual is on the tab to the right of the Main Console.
2. A particular lab may have additional consoles found on separate tabs in the upper left. You will be directed to open another specific console if needed.
3. Your lab starts with 90 minutes on the timer. The lab cannot be saved. All your work must be done during the lab session. But you can click the **EXTEND** to increase your time. If you are at a VMware event, you can extend your lab time twice, for up to 30 minutes. Each click gives you an additional 15 minutes. Outside of VMware events, you can extend your lab time up to 9 hours and 30 minutes. Each click gives you an additional hour.

**Alternate Methods of Keyboard Data Entry**

During this module, you will input text into the Main Console. Besides directly typing it in, there are two very helpful methods of entering data which make it easier to enter complex data.
Click and Drag Lab Manual Content Into Console Active Window

You can also click and drag text and Command Line Interface (CLI) commands directly from the Lab Manual into the active window in the Main Console.

Accessing the Online International Keyboard

You can also use the Online International Keyboard found in the Main Console.

1. Click on the Keyboard Icon found on the Windows Quick Launch Task Bar.
Click once in active console window

In this example, you will use the Online Keyboard to enter the "@" sign used in email addresses. The "@" sign is Shift-2 on US keyboard layouts.

1. Click once in the active console window.
2. Click on the Shift key.

Click on the @ key

1. Click on the "@ key".

Notice the @ sign entered in the active console window.
Activation Prompt or Watermark

When you first start your lab, you may notice a watermark on the desktop indicating that Windows is not activated.

One of the major benefits of virtualization is that virtual machines can be moved and run on any platform. The Hands-on Labs utilizes this benefit and we are able to run the labs out of multiple datacenters. However, these datacenters may not have identical processors, which triggers a Microsoft activation check through the Internet.

Rest assured, VMware and the Hands-on Labs are in full compliance with Microsoft licensing requirements. The lab that you are using is a self-contained pod and does not have full access to the Internet, which is required for Windows to verify the activation. Without full access to the Internet, this automated process fails and you see this watermark.

This cosmetic issue has no effect on your lab.

Look at the lower right portion of the screen
Please check to see that your lab is finished all the startup routines and is ready for you to start. If you see anything other than "Ready", please wait a few minutes. If after 5 minutes your lab has not changed to "Ready", please ask for assistance.
Module 1 - Introduction to App Volumes (30 minutes)
Introduction

In this module we will introduce you to the benefits of using App Volumes in different use cases.

- [Part 1] Introduction to VMware AppVolumes?
- [Part 2] Overview of App Volumes Components
- [Part 3] VMware App Volumes Manager Walk Through
- [Part 4] Conclusion

What is VMware App Volumes?

VMware App Volumes is a real-time application delivery system that IT can use to dynamically deliver and manage applications. You do not need to modify desktops or RDS servers to work with App Volumes because applications act as if they were natively installed. The App Volumes solution can be scaled out easily and cost-effectively, without compromising end-user experience. Applications are centrally managed and delivered to desktops through virtual disks.
How Does App Volumes Work?

In modern desktop environments, the demand for real-time application delivery often puts strain on existing infrastructures. Through App Volumes, VMware addresses this strain by virtualizing applications above the operating system (OS) and by offering an alternative to managing per virtual machine. Applications virtualized above the OS are delivered as if natively installed without modification, in various configurations, to multiple groups of users. Through file and registry virtualization, applications are organized into application management containers. This arrangement uses existing storage and networking services, reduces infrastructure strain and overhead, and simplifies application life-cycle management.

As illustrated in Figure 1 application-management containers are above the desktop OS, which has an App Volumes Agent installed. Applications, data files, middleware, and configurations are in separate, layered containers.

There are two types of App Volumes containers:

- **AppStack** - A read-only container for one-to-many delivery of IT-managed applications
- **Writable volume** - A one-to-one, user-specific, read-and-write container for user-installed applications, data, and files

Administrators use the App Volumes Manager, a Web-based interface integrated with Active Directory (AD) and VMware vSphere, to create AppStacks and assign application entitlements. Application installations recorded in AppStacks are stored in shared...
volumes across virtual disks. These applications require no special packaging formats or snapshot technologies and are easy to provision. During provisioning of AppStacks, App Volumes intelligently records the entire application-installation process, and the changes made by the native application installers are available for delivery to users.

Administrators can easily deliver provisioned AppStacks to an individual system, a user, or a group. Applications delivered by App Volumes look and feel natively installed, and they follow users across sessions and devices, as can data, at the administrators option. Administrators can update or replace applications in real time and remove any assigned application, either immediately, while the user is still logged in, or, in accordance with VMware best practices, at next login or reboot.

With a writable volume, user data, such as user-installed applications, moves across systems with the user. Any settings that the user applies to an application are stored in the writable volume and these can be settings for an application either on an AppStack or on the users writable volume. VMware User Environment Manager complements the App Volumes AppStack feature. User Environment Manager can manage application settings for all users of a particular AppStack at a more granular level, and provide contextual rules to enforce policy, based on different conditions or events. User Environment Manager can also manage application settings for writable volumes assigned to single users.
Real-Time Application Delivery and Management (JMP)

**JMP - Next-Generation Desktop and Application Delivery Platform**

JMP (pronounced jump) represents capabilities in VMware Horizon 7 Enterprise Edition that deliver Just-in-Time Desktops and Apps in a flexible, fast, and personalized manner. JMP is composed of the following VMware technologies:

- **VMware Instant Clone** Technology for fast desktop and RDSH provisioning
- **VMware App Volumes** for real-time application delivery
- **VMware User Environment Manager™** for contextual policy management

JMP allows components of a desktop or RDSH server to be decoupled and managed independently in a centralized manner, yet reconstituted on demand to deliver a personalized user workspace when needed. JMP is supported with both on-premises and cloud-based Horizon 7 deployments, providing a unified and consistent management platform regardless of your deployment topology. The JMP approach provides several
key benefits, including simplified desktop and RDSH image management, faster delivery and maintenance of applications, and elimination of the need to manage “full persistent” desktops.

**Summary of App Volumes Benefits**

With App Volumes, applications become objects that can be moved easily across data centers or to the cloud and shared with thousands of virtual machines. In a virtual desktop environment, App Volumes provides the following benefits:

**Real-time, dynamic application delivery in virtualized environments**

- Delivers and updates applications and data by using a one-to-many shared delivery model.
- Applications delivered through App Volumes behave as natively installed applications.

**Persistent end-user experience in non-persistent environments**

- Supports fully customizable desktops, allowing end users to install their own applications on writable volumes.
- Invisibly attaches applications to virtual machines, undetected by end users.
- Creates a persistent user experience with the cost savings of a non-persistent architecture.

**Application life-cycle management**

- Manages the application life cycle, from provisioning, delivery, and maintenance, to retirement.
- Speeds up application updates or upgrades and supports easy application replacement.

**Reduced VDI infrastructure costs and improved efficiency**

- Can drive down compute, network, and storage costs by leveraging on-demand delivery of applications in a non-persistent desktop architecture.
- Can be implemented in any supported VMware vSphere datastore.
- Works with existing infrastructure for flexible delivery to users, groups, or devices.
- Enables IT to use the most appropriate storage, including fast storage with high-read IOPS, such as VMware vSAN™.
- Allows IT administrators to deliver and manage applications in virtual desktops using less storage capacity than they would with Horizon 7 alone.
Overview of App Volumes Components

A typical VMware App Volumes environment consists of a few key components that interact with each other and an external infrastructure.
## Component Summary

Please have a look at the table below to understand each component with a short description.

<table>
<thead>
<tr>
<th>ICON</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="User Icon" /></td>
<td><strong>App Volumes user</strong> - Active Directory user or organizational unit (OU) account. User account must be assigned local administrator rights if you want users to install their own applications in a writable volume.</td>
</tr>
<tr>
<td><img src="image" alt="Manager Icon" /></td>
<td><strong>App Volumes Manager</strong> - A Windows Server system used as the Web console for administration and configuration of App Volumes, and tracking of assignments for AppStacks and writable volumes.</td>
</tr>
<tr>
<td><img src="image" alt="Database Icon" /></td>
<td><strong>App Volumes Database</strong> - A Microsoft SQL (production) or SQL Express (nonproduction) database that contains configuration information for AppStacks, writable volumes, users, machines, assignments, and VM and user transactions.</td>
</tr>
<tr>
<td><img src="image" alt="Agent Icon" /></td>
<td><strong>App Volumes Agent</strong> - Software installed on all Windows desktops where users receive AppStack and writable volume assignments. The agent runs as a service and uses a filter driver to handle application calls and file-system redirects to AppStack and writable volume virtual machine disks (VMDKs).</td>
</tr>
<tr>
<td><img src="image" alt="Stack Icon" /></td>
<td><strong>AppStack</strong> - A read-only volume containing any number of Windows applications, files, folders, registry settings, and more. Multiple AppStacks can be delivered to an individual system or user. An individual AppStack can also be delivered to more than one system or user.</td>
</tr>
<tr>
<td><img src="image" alt="Volume Icon" /></td>
<td><strong>Writable volume</strong> - A user-specific read-write volume where the user is allowed to preserve application files and user-installed applications, settings, licensing information, and data. A user can have only one writable volume attached at a time to a desktop, but can have multiple writable volumes assigned.</td>
</tr>
<tr>
<td><img src="image" alt="Desktop Icon" /></td>
<td><strong>Provisioning desktop</strong> - A clean desktop virtual machine that includes the OS and necessary updates and service packs, and has core applications installed. This machine acts as a master device that is used to install new applications on the AppStack. The provisioning virtual machine must have the App Volumes Agent installed and configured to connect to the App Volumes Manager.</td>
</tr>
<tr>
<td><img src="image" alt="Server Icon" /></td>
<td><strong>vCenter Server</strong> - VMware vCenter Server® provides centralized management of vSphere virtual infrastructures. App Volumes leverages VMware vCenter Server for inventory information and operational connectivity to host, virtual machine, and storage resources within a deployed vSphere environment. For more information about using vCenter Server, see the vCenter Server and Host Management Guide.</td>
</tr>
</tbody>
</table>
App Volumes Manager Console Walk Through

In this section we will walk through the App Volumes Manager for day-to-day management of the App Volumes infrastructure.

**Note:** Feel free to look around, but please do not commit any changes or you may alter the results of the following lab sections.

**Launch Google Chrome**

1. On the Main Console desktop if not already open, launch the Google Chrome browser
App Volumes Management Console

1. Click on the App Volumes Manager **shortcut**
2. Log in as **Administrator**
3. Password **VMware1!**
4. Ensure domain is **CORP**
5. Click **Login**
Once authenticated, you will be taken to the App Volumes Dashboard.

The dashboard provides the following information:

- **A** - The number of user and server licenses in use
- **B** - User utilization
- **C** - Most recent user logins
- **D** - Computer utilization
- **E** - Most Recent computer logins

### Table Example

<table>
<thead>
<tr>
<th>User License</th>
<th>Utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>User Licenses: 2 of 10</td>
<td>(20% utilization)</td>
</tr>
<tr>
<td>Concurrent User Licenses: 0 of 10</td>
<td>(0% utilization)</td>
</tr>
<tr>
<td>Terminal User Licenses: 2 of 10</td>
<td>(20% utilization)</td>
</tr>
<tr>
<td>Concurrent Terminal User Licenses: 0 of 10</td>
<td>(0% utilization)</td>
</tr>
<tr>
<td>Desktop Licenses: 0 of 10</td>
<td>(0% utilization)</td>
</tr>
<tr>
<td>Concurrent Desktop Licenses: 0 of 10</td>
<td>(0% utilization)</td>
</tr>
<tr>
<td>Server Licenses: 0 of 10</td>
<td>(0% utilization)</td>
</tr>
<tr>
<td>Concurrent Server Licenses: 1 of 10</td>
<td>(10% utilization)</td>
</tr>
</tbody>
</table>

### Diagram Example

- **B** - User Utilization
- **D** - Computer Utilization
- **F** - AppStack Utilization
- **C** - Most Recent User Logins
- **E** - Most Recent Computer Bootups
- **G** - Most Recent AppStack Attachments
1. Moving along the toolbar section, click on the VOLUMES section.

The Volumes tab is used to create and manage AppStacks and writable volumes and for monitoring currently attached volumes.

This will show you 5 tabs:

- **A** - AppStacks - These are the read-only volumes containing applications which may be assigned to Active Directory User Accounts, Active Directory Computer Accounts, Active Directory Groups, or OUs. This is done in order to deliver applications to end users.
- **B** - Writable Volumes - These are volumes which are writable and assigned one per user or computer and come in three different flavors: Profile Only, User Installed Apps Only, or Profile Plus User Installed Apps.
- **C** - Attachments - This tab lets administrators see all actively attached AppStacks and writable volumes.
- **D** - Assignments - This tab allows administrators to see all AppStack and writable volume assignments defined.
- **E** - Applications - Lists all available applications from all AppStacks.
1. Moving to the right one section, click on the **DIRECTORY** section.

The Directory tab displays information about:

- **A - Online** (quick report of which Active Directory entitlements are currently online)
- **B - Users**
- **C - Computers**
- **D - Groups**
- **E - OUs**

These objects have assignments or were logged in to a computer that has the App Volumes agent installed. Active Directory objects are automatically synchronized with the App Volumes database every 4 hours. To force synchronization, use the **Sync** function (found within the Directory tab).
1. Moving to the right one section, click on the **INFRASTRUCTURE** section.

The Infrastructure tab displays information about computers and storage seen by the App Volumes Manager.

Additionally, App Volumes administrators may view and create clones of other VMs, review storage information utilized by App Volumes, and define groups of storage locations so they may collectively function as one.
1. Click on Create Storage Group

NOTE: We need to click create to expose the features, but will not create a storage group at this point!

1. Below the INFRASTRUCTURE section, click on the Storage Groups section.

NOTE: You DO NOT need to create a storage group within the Hands On Lab. When you are done looking at the setup continue to click on the next tab (Activity)
You can use storage groups to automatically replicate AppStacks or distribute writable volumes across many datastores. They are also used to define a group of datastores that should all contain the same AppStacks. Some of the attributes for the group, such as template location and strategy, only apply when using the group for distributing writable volumes.

The (A) Distribution Strategy setting controls how writable volumes are distributed across the group.

- **Spread:** Distribute files evenly across all the storage locations. When a file is created, the storage with the most available space is selected.
- **Round Robin:** Distribute files by sequentially using the storage locations. When a file is created, the storage with the oldest used time is selected.

You can manage the capabilities of storage groups by selecting the required storage and ignoring unwanted or slow-performing storage while mounting volumes. When you mark the storage as Not Attachable, the App Volumes Manager ignores it while mounting volumes.

For example, you can set up two vCenter Server instances. Each server can have a local storage and shared storage capability. You can mark the slower-performing storage as Not Attachable. This storage is ignored by the App Volumes Manager while mounting volumes and can be used solely for replication of AppStacks.

**ACTIVITY - App Volumes Management Console**

1. Moving to the right one section, click on the **ACTIVITY** section.

The Activity tab has sub-tabs that can help with monitoring App Volumes Infrastructure. Administrators have the option of viewing Pending Actions, a history of actions in the Activity Log, and any System Messages.
• **A - Pending Actions**: Displays actions waiting to be performed in the background and will be completed in the order submitted.

• **B - Activity Log**: Displays records of system activity such as user logins, computer power-ups, volume attachments, and so forth.

• **C - System Messages**: Displays messages and errors generated by internal events such as volume attachment, Active Directory access, and so forth.

• **D - Server Log**: This is the Web Server Log which shows entries in reverse order (most recent at the top) and refreshes automatically every 30 seconds. This Server Log shows only the last 100 entries.

2. NOTE: For all entries recorded, browse to **App Volumes Management Server** then **LOG**. You will be asked to authenticate if you are not already authenticated. Entries shown in the "/LOG" page are shown with the most recent at the bottom of the page.

**CONFIGURATION - App Volumes Management Console**

![Configuration page screenshot](image-url)
1. Moving to the right one section, click on the **CONFIGURATION** section.

The last section on the far right of the console is the Configuration tab. Here administrators can install or update their App Volumes license, define Active Directory connectivity settings, view and configure who is an App Volumes administrator, view and configure the underlying hypervisor communication settings such as for vCenter/ vSphere, and configure storage settings and upload prepackaged volumes.

- **A - License:** Contains information on the license and/or update/install a new license as needed. A valid license issued by VMware App Volumes is required to use this management console.
- **B - Active Directory:** Provides information about your Active Directory. App Volumes uses the Active Directory to assign AppStacks to users, computers, and groups. Any credentials provided here are stored in encrypted format. This account only needs READ access to Active Directory, and the account should be configured to not have an expiring password.
- **C - Administrators:** Enables the choice of the Active Directory group responsible for administering the App Volumes Manager. Only users in this group will be able to login to the Manager.
- **D - Machine Managers:** Enables you to define a supported hypervisor and specify the login credentials, such as to the vCenter Server.
- **E - Storage:** Enables you to set the default database where AppStacks and writable volumes are stored. You must use storage that is accessible to all virtual machine host servers and, while local host storage may be used, it should be noted volumes will only be attached for VMs which reside on the same host.
Conclusion

This module covered an Introduction, Overview of App Volumes and a hands on walk through of the App Volumes Manager console.

Congratulations, you've finished Module 1

Congratulations on completing Module 1.

If you are looking for additional information on VMware App Volumes, try one of these:

- Click on this link
- Or go to https://tinyurl.com/yc5cyj59
- Or use your smart device to scan the QRC Code.

Proceed to any module below which interests you most.

- Module 1 - Introduction to App Volumes (30 minutes)
- Module 2 - AppStack Management (30 minutes)
- Module 3 - Entitling Applications via AppStacks (30 minutes)
- Module 4 - Writable Volumes (45 minutes)
- Module 5 - Application Isolation with ThinApp (45 minutes)
- Module 6 - Advanced Topics / App Volumes (45 minutes)
Module 2 - AppStack Management (30 minutes)
Introduction

This module will look at creating, provisioning and assigning an AppStack.

Module 2 contains the following lessons:

- [Part 1] Create an AppStack
- [Part 2] Provision an AppStack
- [Part 3] Assign an AppStack
- [Part 4] Conclusion
Create an AppStack

In this section we will walk through the process of provisioning an AppStack.

Launch Google Chrome

1. On the Main Console desktop if not already open, launch the Google Chrome browser

Login to vCenter

1. Click on **HOL-1851 Admin**
2. Select and click **vCenter HTML5 Client**

   ![Login Screen]

1. Click - **Use Windows session authentication**

   **Note:** Should this step fail then use
   
   User name: **corp\administrator**
   
   Password: **VMware1!**

2. Click **Login**

**Power on Base**

If BASE-W10-X64-01 is already powered-on then continue to the Login step, if not (NO GREEN ARROW) then power-on the base image.

1. Right click on **base-w10-x64-01 (under RegionA01-IC01)**
2. Select **Power**
3. Click **Power On**
Login - Console BASE-W10-X64-01

1. Click on **base-w10-x64-01**
2. Click in the middle of the **Windows Console** Window

*New tab should open at the top.*

1. Select the new **tab name base-w10-x64-01** at the top
2. Click **Send Ctrl+Alt+Delete**

1. Ensure you log in as **CORP\administrator (select other user if needed)**
2. In the Password box type **VMware1!**
3. Click **to continue**

Once the desktop loads successfully then continue to the next step!
App Volumes Management Console

1. Select a **new tab** in chrome

1. Click on the App Volumes Manager **shortcut**
2. Log in as **Administrator**
3. Password **VMware1!**
4. Click **Login**

Once authenticated, you will be taken to the App Volumes Dashboard.
Volumes

1. Click and select **VOLUMES**
2. Click **Create AppStack**

Create AppStack

1. Select the Name: field and type "**Skype**"
2. For Storage / Path / Template use the **defaults**
3. Select Description: field and type "**Skype for all Users**"
4. Click **Create**

![Create AppStack](image)

1. Using the default setting, click **Create**

![AppStacks](image)

1. If the Skype AppStack does not show straight away, then **click refresh**

   (*A - you can also click VOLUMES and then AppStacks to refresh if step 1 fails)*
1. Click the + Symbol next to Skype

*Notice* that the AppStack is now created, but not yet provisioned.

The AppStack automatically reminds the user of the next steps to enable a successful AppStack.
Provision an AppStack

Now that we created an AppStack, we will use this lesson to capture an application into the AppStack and then assign the AppStack containing the application to a user.

Provision

1. Click on **Provision** to start the process

This process should be followed carefully and please note all the different alerts during this process, telling you exactly when to click OK!
1. Type **base** and click **search**
2. Select and click the **radio button** next to CORP\BASE-W10-X64-01$
3. Click **Provision**

*Note - This will trigger the provisioning agent on the Windows Desktop to start "capture mode" and link the Skype AppStack to the VM, ready to installation application.*
1. Click **Start Provisioning**

*Once again the next step is defined by App Volumes for you.*

**Install your Dream Apps**
1. Switch to the **base-w10-x64-01** tab  
2. If you have been logged out then log in using **Send Ctrl+Alt+Delete**  
3. **VMware1!** as the password  
4. Click to login

IF you get this error ignore the message for Flex Config File Path- Feel free to close any pop-ups with this message!

You are now in provisioning mode and this window MUST stay open until the entire install has completed. Make sure you see the VMware App Volumes Provisioning notification banner before you continue!
1. Click on the folder icon

2. Navigate to `\controlcenter\tools`
3. Click `SkypeSetup`

   ![Security Warning Dialog](image)

   - 1. Always ask before opening this file
   - 2. Run

   **Do you want to run this file?**
   - Name: `\controlcenter\tools\SkypeSetup.exe`
   - Publisher: Skype Software Srl
   - Type: Application
   - From: `\controlcenter\tools\SkypeSetup.exe`

   **What's the risk?**
   - While files from the internet can be useful, this file type can potentially harm your computer. Only run software from publishers you trust.
1. Make sure you **un-tick** the Always ask checkbox
2. Click **Run**

1. Click **Next**
1. Click **checkbox** [I accept the terms in the Licensing Agreement]
2. Click **Next**
1. Click **Install**
1. Click **Finish**

![Sign in screen](image)

1. Once completed, close the Sign in screen

**Click OK**

![OK button](image)
1. Click **OK**

![OK button](image)

1. Click **YES**

![Yes button](image)

1. Click **OK**
Your Computer will reboot at this point and will ensure the capture is completed, but you must wait for the desktop reboot, then log back into the VM to complete the process. Do not return to App Volumes Manager before you have **completed this step.**

1. Switch to the **base-w10-x64-01** tab (if you are not still on the same tab)
2. Once the reboot is complete, then log in using **Send Ctrl+Alt+Delete**
3. **VMware1!** as the password
4. **Click** to log in
1. Click **OK**
Switch to App Volumes Manager (Dashboard)

1. Switch to the **App Volumes Manager** tab
2. Notice that the application has been successfully captured and the icon shows that we have Skype installed in the AppStack.
Assign an AppStack

Assigning an App Volumes AppStack

1. Click Assign
We will assign the AppStack to RDSH-01A as Lab1User is already part of the user group that can access this RDSH server. We want to ensure all users that log in to this RDSH server can access this application. You can however assign this to a single user on a Desktop if you wish.

1. In the search Active Directory, type **rdsh**
2. Click **Search**
3. Select the **tick** box next to **CORP\RDSH-01A$**
4. Click **Assign**

![Confirm Assign](image)

1. Click **Attach AppStack immediately**
2. Click **Assign**

![Attach AppStack immediately](image)
1. Click **Edit**

![Edit AppStack](image)

1. Tick the **Windows Server 2012 R2 (x64)** and accept all pop-up warnings

We captured this on a Windows 10 machine and we need to ensure we can assign this to a 2012 R2 Server. Please have a look at the next module "Entitlements" for more information. We will use the Skype AppStack captured on Windows 10 then assign this to a Horizon RDSH server.

2. Click **Save**
Note - We captured the Skype application on Windows 10 and we will test this on a 2012 R2 RDSH server, but this is not how we do things in production! Make sure you capture and assign from the same Operating system version you intend to assign the AppStack to (capture on Server 2012 R2 then assign to Server 2012 R2).

1. Click Save

**Machine assigned**

Because the AppStack is machine assigned for this exercise we need to first reboot the RDSH server.
If you closed the vCenter tab, then open a new tab in Chrome first.

1. Click on **HOL-1851 Admin shortcut**
2. Select and click **vCenter HTML5 Client**

![Login Screen]

1. Click - **Use Windows session authentication**

**Note:** Should this step fail then use

User name: **corp\administrator**

Password: **VMware1!**
2. Click **Login**

1. Right-click on **rdsh-01a (under RegionA01-IC01)**
2. Select **Power**
3. Click **Restart Guest OS**

![Confirmation message](image)
1. Click **OK**

1. Make sure the RDSH server is up and running before proceeding to the next step.

**Test your AppStack**
1. Open a **new tab** at the top while in Chrome
2. Select the **Horizon** shortcut on the bookmarks bar

VMware Horizon

You can connect to your desktop and applications by using the VMware Horizon Client or through the browser.

The VMware Horizon Client offers better performance and features.

- Install VMware Horizon Client
- VMware Horizon HTML Access
1. If you receive the VMware Horizon prompt then click and select the **HTML Access**
2. **If not then continue to login**

   ![VMware Horizon login screen]

   1. Username - **lab1user**
   2. Password - **VMware1!**
   3. Click **Login**

   ![RDS Desktop icon]
1. Click and select **RDS Desktop**

The Skype application should now be on the desktop ready for use - Congratulations, you have successfully assigned your first AppStack.

1. Right-click on the Windows symbol
2. Click **Sign Out**
Conclusion

This module helped you to create your first AppStack, provision an AppStack and then assign it to a user. Continue to the next module to see more about entitling AppStacks.

Congratulations, you've finished Module 2

Congratulations on completing Module 2.

If you are looking for additional information on VMware App Volumes, try one of these:

- Click on this link
- Or go to https://tinyurl.com/yc5cyj59
- Or use your smart device to scan the QRC Code.

Proceed to any module below which interests you most.

- **Module 1** - Introduction to App Volumes (30 minutes)
- **Module 2** - AppStack Management (30 minutes)
- **Module 3** - Entitling Applications via AppStacks (30 minutes)
- **Module 4** - Writable Volumes (45 minutes)
- **Module 5** - Application Isolation with ThinApp (45 minutes)
- **Module 6** - Advanced Topics / App Volumes (45 minutes)

How to End Lab

1. To end your lab click on the **END** button.
Module 3 - Entitling Applications via AppStacks (30 minutes)
Introduction

This module will focus on entitlements for applications used in AppStacks.

This module contains the following lessons:

- [Part 1] Entitle AppStacks
- [Part 2] RDSH Integration Tips
- [Part 3] Storage Groups
- [Part 5] Conclusion
Entitle AppStacks

In this section we will walk through the process of importing and assigning AppStacks.

• [Part 1] Import an AppStack
• [Part 2] Entitle a User AppStack
• [Part 3] Entitle RDSH AppStack

Launch Google Chrome

1. On the Main Console desktop if not already open, launch the Google Chrome browser
Login to vCenter

1. Click on **HOL-1851 Admin**
2. Select and click **vCenter HTML5 Client**

1. Click - **Use Windows session authentication**

**Note:** Should this step fail then use

User name: **corp\administrator**

Password: **VMware1!**
2. Click **Login**

**Power on Base**

If BASE-W10-X64-01 is already powered-on then continue to Login step, if not (**NO GREEN ARROW**) then power-on the base image.

1. Right-click on **base-w10-x64-01 (under RegionA01-IC01)**
2. Select **Power**
3. Click **Power On**

1. Click on **base-w10-x64-01**
2. Click in the middle of the **Windows Console** Window

*New tab should open at the top, leave this tab open and continue to the next step.*
Open a new Chrome tab.

1. Click on the App Volumes Manager shortcut
2. Log in as Administrator
3. Password VMware1!
4. Click Login

Once authenticated, you will be taken to the App Volumes Dashboard.
Import an AppStack

1. Click VOLUMES
2. Click AppStacks
3. Click Import AppStacks

Importing AppStacks to App Volumes is really simple and ensures the reuse of AppStacks (create-once-use-many).

If you have pre-configured AppStacks or have AppStacks from another deployment, you can import them following the simple steps below.

Prerequisites: Using the vCenter Server datastore browser, select a datastore, create a new folder, and then upload the AppStacks into this folder. We have done this step for you.
1. Select Path and clear the current path content first, then type `oo_appstack`
2. Click **Import**

![Confirm import AppStacks](image)

1. Click **Import Volumes Immediately**
2. Click **Import**

![Volumes>AppStacks](image)

1. Select **Volumes>AppStacks** and then **expand** Open Office 4.1.3

Congratulations, you have successfully imported your first AppStack.

*Keep the screen open to start with Assigning the AppStack.*
Assigning an AppStack to a Windows Desktop User

*Note* that an AppStack is now created, but not yet assigned. We can assign an AppStack to Windows Desktops or to RDSH Desktops. In this example, we will look at a Windows assignment.

1. Select the OpenOffice AppStack and **click to select**
2. Click **Assign**

1. In the Search Active Directory bar, type **lab3**
2. Click **Search**
3. Click the select user **check** box
4. Click **Assign**

1. Using the defaults click **Assign**

**Switch to base-w10-x64-01**

1. Switch to the **base-w10-x64-01 tab** in Chrome
1. Select the new **tab name base-w10-x64-01** at the top
2. Click **Send Ctrl+Alt+Delete**

![CORP\administrator](image1)

![Other user](image2)

1. Click **Other user**

![Lab3User](image3)

1. **In the User box, type lab3user**
2. **In the Password box type VMware1!**
3. **Click to continue**

![invalid arguments](image4)
1. Please ignore all "Flex Config Files path" errors if they occur. Close the window and continue to the next step.

1. Click the **OpenOffice** Icon  
2. Click and accept the **defaults > finish**

LAB3USER now has an OpenOffice 4 AppStack assigned, well done!

3. Right-click, then **Sign out** from the desktop and return to the App Volumes tab
Lab3User - Horizon Group

Now that the AppStack has been imported and tested with Lab3user on a Windows 10 desktop, we can also assign the same AppStack to an RDSH server. The next steps will ensure you are comfortable with the entitlement of this AppStack including Active Directory access permissions and App Volumes assignment. If you are comfortable with RDSH AppStacks as demonstrated in Skype Test earlier, then feel free to skip to the next module.

We first need to add Lab3user to the Horizon group to enable access to the RDSH server.

On the main console:

1. Click Windows Start
2. Type dsa.msc
3. Double-click
1. Click **corp.local**
2. Click **Users**
3. Double-click **Lab 3 User**
4. Click **Member Of**
5. Click **Add**
1. Type **horizon**
2. Click **OK**

### Assigning an AppStack to RDSH

1. Click **OK**
2. **Close** any open **Active Directory** screens
1. Click and select the **Horizon** shortcut on the Chrome Bookmarks Bar.
1. Click and select the **Horizon HTML Access**
1. Username: **lab3user**
2. Password: **VMware1!**
3. Click **Login**
1. Click on **RDS Desktop**

You are logged in with user LAB3USER and you cannot see the OpenOffice application. The reason for this is, although we can assign users an AppStack, this excludes RDSH environments. We must assign OpenOffice to the RDSH servers and not the user.

Keep this screen open and we will push the AppStack in real time to the desktop.
If you have been logged out or closed the App Volumes Management screen, then follow the steps to log in:

1. Click on the App Volumes Manager shortcut
2. Log in as Administrator
3. Password VMware1!
4. Click Login
Once authenticated, you will be taken to the App Volumes Dashboard.

1. Click **AppStacks**
2. Click the + symbol to expand Open Office 4.1.3
3. Click **Assign**

   1. In the Search Active Directory type - **rdsh**
   2. Click **Search**

   1. Click **Assign**
3. Select CORP\RDSH-01A$
4. Select checkbox **tick**
5. Click **Assign**

![Confirm Assign](image)

Assign AppStack **Open Office 4.1.3** to the following entity?

- CORP\RDSH-01A$ (RDSH-01A)

- Attach AppStacks on next login or reboot
- Attach AppStacks immediately

⚠️ Users must be logged into a VM to have AppStacks attached immediately.
1. Select **Attach AppStacks immediately**
2. Click **Assign**

1. Switch back to the RDSH Desktop - Click the **VMware Horizon** tab
2. Notice you have the OpenOffice 4 AppStack delivered to the user while logged in. That is pretty cool, congratulations!
3. Open the Setting tab

1. Click - **Log out**
RDSH Integration Tips

App Volumes supports AppStack integration with Microsoft RDSH shared desktops and published applications. RDSH integration is as easy as deploying the App Volumes Agent on the RDSH host. After the agent is deployed, AppStack assignment is handled through the machine assignment process (by computer name) in the App Volumes Manager interface. RDSH servers receive machine assignments of AppStacks rather than user assignments.

AppStacks are attached to the RDSH host. Users are entitled to the RDSH desktops or applications through the View entitlement process.

Microsoft Windows Server 2008 R2 and 2012 R2 are supported for RDSH use cases with App Volumes. For information about using App Volumes in a Citrix XenApp shared-application environment, see Implementation Considerations for VMware App Volumes in a Citrix XenApp Environment.

Writable volumes are not supported with RDSH assignments.
Storage Groups

In this module we will look at storage group considerations, planning and creation of a storage group.

Storage Considerations

Storage that is assigned to App Volumes contains the VMDK files used by AppStacks and writable volumes.

The following are recommendations and considerations for AppStack storage.

- Use dedicated AppStack datastores to optimize storage for read-only traffic during application start and use.
- Disk operations and network traffic are increased as more users concurrently mount AppStacks at login and as the applications are started. Scaling infrastructure resources to meet this demand is recommended.
- When combining multiple applications into a single AppStack, it might be necessary to increase the size of the AppStack template from the default of 20 GB. (For more information, see Module 4, Writable volumes and Templates)

The following are recommendations for writable volume storage.

1. Use RAID 10 to optimize storage for writable volumes.
2. Use flash-based storage arrays for writable volumes, such as:
   - VMware vSAN 6.x
   - EMC XtremIO
   - Pure Storage FlashArray
   - NetApp SolidFire
When planning your storage infrastructure, determine how many copies of an AppStack are required for optimal performance. The number of copies determines the required number of datastores and storage arrays. The Table lists the recommended number of connections per AppStack depending on the storage type.

<table>
<thead>
<tr>
<th>STORAGE TYPE</th>
<th>VMFS</th>
<th>NFS</th>
<th>FLASH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommended maximum connections per AppStack</td>
<td>128</td>
<td>250</td>
<td>1000</td>
</tr>
</tbody>
</table>

You can use the following equation to determine how many AppStack copies are needed.

\[
\text{Number of users} / \text{Maximum connections per storage type} = \text{Number of AppStack copies}
\]

For example, if you assign an AppStack to 500 users in your organization and the storage type on which they are stored is VMFS, the calculation is:

\[
500 \text{ (Users)} / 128 \text{ (Maximum connections)} = 3.9 \text{ (AppStack copies)}
\]

To optimize performance in this scenario, you need four storage arrays and datastores. You place a single copy of the AppStack on a datastore within the storage group, and
the App Volumes Manager replicates it to the other three datastores within the storage group.

Storage Groups - Create

This is a short exercise creating a storage group and looking at the options available to achieve this.

App Volumes Management Console

1. Click on the App Volumes Manager shortcut
2. Log in as Administrator
3. Password VMware1!
4. Click Login

1. Click on the App Volumes Manager shortcut
2. Log in as Administrator
3. Password VMware1!
4. Click Login
Once authenticated, you will be taken to the App Volumes Dashboard.

1. Click **Infrastructure**
2. Click **Storage Groups**
3. Click **Create Storage Group**
Creating a storage group in this HOL is not possible, but we will assume that once the storage group is created then any storage name starting with COMP0 will be added to the group. This storage group will import and replicate AppStacks, as they are attached, using a round-robin strategy.

1. Click inside the Group Name, type **Chrome-DS1**
2. Select Automation and **tick both** options
   - **Automatically Import AppStacks** - After replication, import AppStacks into the App Volumes Manager, ready for assignment from all datastores.
   - **Automatically Replicate AppStacks** - Replicate any AppStack placed on any datastore across all datastores.

3. Click the Distribution Strategy box and select Round-robin
   - Storage groups for writable volumes use the following distribution strategies:
     - **Spread** - Distribute writable volumes evenly across datastores.
     - **Round-robin** - Sequentially distribute writable volumes to the least recently used datastore.

4. Click the Template Storage box and select **[RegionA01] COMP01-ISCSI01**
5. Click the Storage Selection box and select **Automatic**
6. Click the Storage Name Prefix and type **COMP0**

Any Datastore with the name that starts with COMP0 will be added to the group. In this case we only have one store.
7. Click **Create**
8. **Accept and create**

1. Click and expand the + Chrome storage Group.

Always name your storage group something meaningful, as a name like Chrome does not indicate what this storage group is used for!

At this point you have the option to **RESCAN / IMPORT / REPLICATE** or **EDIT** the storage group.

We will not be using this storage group, so feel free to explore and close the App Volumes Management console when you finish.
Best Practices for Provisioning Virtual Machines and Applications

Best Practices for Creating and Provisioning AppStacks

Consider the following best practices when creating and provisioning AppStacks:

- The following characters cannot be used when naming AppStacks: & < >
- Provision AppStacks on a clean master image that resembles as closely as possible the target environment where the AppStack is to be deployed. For example, the provisioning virtual machine and target should be at the same patch and service pack level and, if applications are included in the master image, they should also be in the provisioning virtual machine.
- Caution: Do not use a provisioning machine where you have previously installed and then uninstalled any of the applications that you will capture. Uninstall may not clean up all remnants of previous applications, and the App Volumes application capture will not be complete.
- Perform provisioning on a virtual machine that has no AppStacks previously assigned to it. If any AppStacks have been assigned to the virtual machine, or the virtual machine has been used previously for provisioning, revert that virtual machine to the clean snapshot before provisioning a new AppStack.

Best Practices for Configuring AppStacks

When there is an application conflict, the last AppStack virtualized wins. In the App Volumes Manager, use the Override Precedence option. In the Directory tab, click the Users, Computers, or Groups sub-tab and select one of the objects. The Override Precedence option allows you to define AppStack ordering. It may be necessary to reorder AppStacks in order to remove application conflicts. This option can also be used to ensure that an AppStack with a supporting application loads before an AppStack with an application that requires that supporting application.

Best Practices for Updating AppStacks and Assigning Updated AppStacks

Consider the following best practices when updating and assigning updated AppStacks:

- After updating an AppStack, unassign the original AppStack before assigning the updated AppStack. Failure to unassign the old AppStack before assigning the new one can result in application conflicts because most Windows applications cannot run side by side with older versions of themselves in a Windows OS.
• Unassign AppStacks to take effect on next login rather than immediately. Removing applications while in use could result in user data loss and OS instability.

**Sizing Best Practices for AppStacks**

When sizing AppStacks:

• Limit each virtual desktop to no more than 15 attached AppStacks.
• The size of the default AppStack is 20 GB. The default writable volume template is 10 GB. In some environments, it might make sense to add larger or smaller templates. For information on creating multiple, custom-sized templates, see the VMware Knowledge Base article Creating a New AppVolumes AppStack template VMDK smaller than 20 GB (2116022).
• When deploying user-assigned AppStacks, use fewer AppStacks, rather than more. You can include more than one application per AppStack.

**AppVolumes Manager Storage Policy Best Practices**

When configuring the AppVolumes Manager storage policy, select the Mount on Host option, if possible. This option speeds up AppStack and writable volume mount operations and provides resiliency in a situation where vCenter Server is not online.

*Note:* You may not be able to use the Mount on Host option. This feature requires that the password for the ESXi account used by that AppVolumes Manager be consistent across all ESXi hosts.

**Best Practices for Client Desktops**

When setting up client desktops, consider the following best practices:

• When reverting a desktop virtual machine that is running the AppVolumes Agent to a previous snapshot, make sure that the virtual machine is gracefully shut down, to avoid syncing issues. This is primarily relevant to the provisioning desktop and master VMs for View linked- and instant-clone pools.
• If using a View pool, the AppVolumes Agent should be installed on the master VM for linked- and instant-clone pools, or on the virtual machine template for full-clone pools, for ease of distribution.
• If using a View linked-clone pool, make sure the Delete or Refresh machine on logoff policy in Desktop Pool Settings is set to Refresh Immediately. This policy ensures that the VMs stay consistent across logins.
Conclusion

This module covered Entitling AppStacks including RDSH integration tips, storage groups and Best Practices. Continue to Module 4 to learn more about Writable Volumes.

Congratulations, you've finished Module 3

Congratulations on completing Module 3.

If you are looking for additional information on VMware App Volumes, try one of these:

- Click on this link
- Or go to https://tinyurl.com/yc5cyj59
- Or use your smart device to scan the QR Code.

Proceed to any module below which interests you most.

- Module 1 - Introduction to App Volumes (30 minutes)
- Module 2 - AppStack Management (30 minutes)
- Module 3 - Entitling Applications via AppStacks (30 minutes)
- Module 4 - Writable Volumes (45 minutes)
- Module 5 - Application Isolation with ThinApp (45 minutes)
- Module 6 - Advanced Topics / App Volumes (45 minutes)

How to End Lab

1. To end your lab click on the END button.
Module 4 - Writable Volumes (45 minutes)
Introduction

This module will walk through working with App Volumes writable volumes.

This module contains the following lessons:

- [Part 1] Working with Writable Volumes
- [Part 2] Creating a Writable Volume
- [Part 3] Writable Volume Exclusions
- [Part 4] Using Writable Volumes with User Environment Management Solutions
- [Part 5] Storage Configuration with Writable Volumes
- [Part 6] Conclusion
Working with Writable Volumes

Writable Volumes

The App Volumes writable volumes feature enables the creation of a per-user volume where the following user-centric data can be installed and configured in different ways and move with the user:

- Application settings
- Licensing information
- Configuration files
- User-installed applications

Writable volumes do not provide a complete user environment management solution, but complement a user environment management solution. VMware User Environment Manager is a companion to App Volumes and provides management of user application settings that are applied when the user logs in or when an application launches. VMware User Environment Manager can manage data within writable volumes at a more granular level and provide contextual rules to enforce policies based on different conditions or events.
Note the key differences between AppStacks and writable volumes:

- **AppStack VMDKs** are mounted as read-only and can be shared among all desktop virtual machines (VMs) within the data center.
- **Writable volumes** are dedicated to individual users and are mounted as the user authenticates to the desktop. Writable volumes are user-centric and roam with the user for nonpersistent desktops.

After writable volumes are created and assigned to a user, that user can install and configure applications. For this functionality to work properly, users require account permissions that allow application installation. App Volumes defers to Microsoft Windows security policies to determine user rights assignments.
Create a Writable Volume

In this module we will walk through the creation of a Writable Volume.

Launch Google Chrome

1. On the Main Console desktop if not already open, launch the Google Chrome browser

App Volumes Management Console

1. Click on the App Volumes Manager **shortcut**
2. Log in as **Administrator**
3. Password **VMware1!**
4. Click **Login**

Once authenticated, you will be taken to the App Volumes Dashboard.

**Create Writable Volume**

1. Click and select **VOLUMES**
2. Click **Writables**
3. Click **Create Writable**

Choose entities from Active Directory for which to create a writable volume.

- **Domain:** All
- **Search Active Directory:** lab4-user
- **Contains:**

[Image and diagram of the App Volumes interface with highlighted steps and options]
1. In the Search Active Directory box, type **lab4user**
2. Click **Search**
1. Select CORP\lab4user check box
2. Accept the default
3. Accept the default
4. Drop down the source template section and select /template_uia_only.vmdk (10GB)
5. Select Prevent user login check box
6. Select Limit the attachment check box
7. Only attach when the name of the host computer begins with - type base
8. Click Create
1. Click - **Create volumes immediately**
2. Click **Create**

![Screenshot of Writable Volumes section in VMware App Volumes management interface]

1. **Click** to expand User information

Lab4user now has a writable volume that will follow the user on any VM that has the prefix "base" in its machine name.

We can now edit these choices, disable, expand or delete the writable volume. Continue to the next step to test your newly created writable volume.
Login to vCenter

SKIP the login to vCenter and power steps if base-w10-x64-01 is already powered-on.

1. Click on **HOL-1851 Admin**
2. Select and click **vCenter HTML5 Client**

Note: Should this step fail then use

User name: **corp\administrator**
Password: **VMware1!**

2. Click **Login**

**Power on Base**

If BASE-W10-X64-01 is already powered-on then continue to Login step, if not (NO GREEN ARROW) then power-on the base image.

1. Right-click on **base-w10-x64-01 (under RegionA01-IC01)**
2. Select **Power**
3. Click **Power On**

**Login - Console BASE-W10-X64-01**

Only follow this step if the base-w10-x64-01 Vm is switched off. Click [here to go to the desktop step and skip the power on and login](#)

1. Click on **base-w10-x64-01**
2. Click in the middle of the **Windows Console** Window
1. Select the new **tab** name **base-w10-x64-01** at the top
2. Click **Send Ctrl+Alt+Delete**

1. Click **Other user**

1. In the User box, type **lab4user**
2. In the Password box type **VMware1!**
3. **Click** to continue

*Once the desktop loads successfully, **keep the Chrome tab open** and then continue to the next step!*
1. **Right-click** on the Windows Start Symbol
2. Click **Run**
1. Type `diskmgmt.msc` into the run box
2. Click **OK**

The 10GB writable volume has successfully attached to the base Windows VM for `lab4user`. This user can now make profile changes and even install applications directly into the writable volume. Please see the section on Best Practice for Writable volumes before you decide on a use case for your organization.

Please sign out from Windows.
Writable Volumes Exclusions

You can specify certain locations for writable volumes to exclude them from being persisted across sessions or getting overwritten.

As an administrator, you might want to prevent automatic updates of some applications and prefer to update the AppStacks that contain these applications manually.

When applications are automatically updated, multiple copies of the files might get created since the applications are also stored on the writable volume. The existing applications then either do not behave as desired or stop working completely. To prevent this behavior, you can apply writable volume exclusions to specific locations and registry paths.

You can also specify exclusions to prevent certain folders such as temporary download folders, from accumulating huge, unwanted files.

Important

The writable volumes exclusions feature is for advanced IT administrators or users who are aware of application behavior with App Volumes and want to tweak the way applications are managed or how writable volumes are used along with AppStacks.

Keep the following considerations in mind before you apply writable volume exclusions:

- If the user modifies the locations that are excluded, the changes are lost when the user logs off the machine.
- You must be aware of the application behavior and the data that gets stored in the folders you want to exclude.
- Do not use generic locations such as \REGISTRY\MACHINE\SOFTWARE or \Program Files(x86). Using generic locations can cause all application updates to be erased.

Look at how to change the Snapvol.cfg

The snapvol.cfg configuration file is located in the root folder of each individual writable volume. This file contains information such as what should be captured and not captured on the writable volume for a user-installed application or user data.

The snapvol.cfg file contains not only paths to folders in the users C:drive, but also registry locations to capture (or not to capture), file types in a given path, specific process names, and so on.

This configuration file allows you to customize writable volumes to suit business needs. Let's have a look at writable volume exclusions.
Launch Google Chrome

1. On the Main Console desktop if not already open, launch the Google Chrome browser

App Volumes Management Console

1. Click on the App Volumes Manager shortcut
2. Log in as Administrator
3. Password VMware1!
4. Click Login

Once authenticated, you will be taken to the App Volumes Dashboard.
Create a Writable Volume

1. Click and select **VOLUMES**
2. Click **Create Writable**
1. Type **Administrator** into the Search Active Directory box
2. Click **Search**

![Image of Active Directory search results]

1. Select CORP\Administrator **check** box
2. Use the **drop down** selection (**Source Template**)
3. Select `[appvolumes/writable_templates/template_uia_plus_profile.vmdk (10GB)]`
4. Click **Create**

![Image of Create Writable Volumes confirmation]

- **Check volumes immediately**
- **Create volumes in the background**
- **Create**

*Warning: The UI may issue an error after 10 minutes even if the task is still processing.*
1. Click - **Create volumes immediately**
2. Click **Create**

Administrator now has a writable volume. Continue to the next step to test your newly created writable volume.
Login to vCenter

1. Click on **HOL-1851 Admin**
2. Select and click **vCenter HTML5 Client**

1. Click **Use Windows session authentication**

**Note:** Should this step fail then use

User name: **corp\administrator**

Password: **VMware1!**
2. Click **Login**

**Power on Base**

If BASE-W10-X64-01 is already powered-on then continue to the Login step, if not (NO GREEN ARROW) then power-on the base image.

1. Right click on **base-w10-x64-01 (under RegionA01-IC01)**
2. Select **Power**
3. Click **Power On**

**Login - Console BASE-W10-X64-01**

1. Click on **base-w10-x64-01**
2. Click in the middle of the **Windows Console** Window
1. Select the new **tab name base-w10-x64-01** at the top
2. Click **Send Ctrl+Alt+Delete**

1. In the Password box type **VMware1!**
2. Click **to continue**

*Once the desktop loads successfully, **keep the Chrome tab open** and then continue to the next step!*

1. **Right-click** on the **Windows** Start Symbol
2. **Click Run**
Edit Snapvol.cfg following the Mount Points

1. Type `C:\snapvolumestemp` into the run box
2. Click `OK`
1. Click the **MountPoints** folder
1. **Click** on the volume starting `{8e399...}`
2. **This volume relates to the actual mountpoint**

![Image of file explorer with snapvol.cfg open with VMware App Volumes]

1. Right-click `snapvol.cfg` and **Open with**

   ![Image of file explorer with snapvol.cfg open with Notepad]

   **How do you want to open this file?**

   ![Image of file explorer with options to always use this app to open .cfg files]

   ![Image of file explorer with OK button selected]

   ```text
   Notepad
   Look for an app in the Store
   More apps
   Always use this app to open .cfg files
   OK
   ```
1. Select **Notepad**
2. **Un-check** - Always use this app to open .cfg files
3. Click **OK**

The snapvol.cfg is now ready to be edited.

Make sure you understand the impact of your changes and the support from VMware when altering this file in production environments.

**Example - **DO NOT** commit these changes:** Exclude an Application Location

The following examples exclude the folder and registry location of Notepad++ from being overwritten during an update.

```plaintext
exclude_uwv_file=\Program Files (x86)\Notepad++
exclude_uwv_reg=\REGISTRY\MACHINE\SOFTWARE\Notepad++
```

What to do next
You must test the application after applying any writable volumes exclusions to ensure that the application works as desired.

1. **Right-click** the Windows Start icon and **Sign Out**

Once you have updated your snapvol.cfg file you would:

- Restart the machine used for the user Writable volume
- Then go to the App Volumes Writable section and **Update Writeables** before the .cfg changes will apply.

Close the App Volumes Management console.
Using Writable Volumes with User Environment Management Solutions

VMware User Environment Manager Solutions

This exercise will demonstrate a use case for Outlook OST files to be stored on the users writable volume. We will redirect the OST location for Outlook using VMware User Environment Manager.

1. On the main console desktop log in using the UEM Management Console shortcut.
1. Click **User Environment**
2. Click **ADMX-based Settings**
3. Click **Outlook 2013 Cache**

![Outlook 2013 Cache - ADMX-based Settings](image)

1. Click **Edit Policies**

![Edit Policies](image)
1. Click **Show only Configured Settings**
2. Expand Microsoft Outlook 2013
3. Click **Default location for OST files**

1. Click on the Default location for OST Files, type (this is already done) - `C:\snapvolumestemp\Writable\Outlook`
2. Click OK
3. Close the Edit Policies
4. Click Save

You have successfully ensured that all OST files for Outlook will be written to the App Volumes>Writable Volume for this user. Please refer to our UEM modules for more information on ADMX template use and application redirection. (*Condition sets have not been configured to trigger this policy in UEM).
Storage Configuration with Writable Volumes

Configure the App Volumes Storage

You can select datastores and paths where AppStacks and writable volumes will be stored. You can configure a Hypervisor or VHD In-Guest storage type.

Use a storage location that is accessible to all virtual machine host servers. When using VMDK Direct Attach Operation Mode, the App Volumes Manager requires local or shared storage to be configured on the hypervisor.

You can use local host storage, but volumes will only be attached for virtual machines on the host. The option to add available storage only appears when App Volumes Manager is configured in the VHD In-Guest mode. Otherwise, the list of storage locations and datastores is populated from vCenter.
1. Click on the App Volumes Manager shortcut
2. Log in as Administrator
3. Password VMware1!
4. Click Login

Once authenticated, you will be taken to the App Volumes Dashboard.

**Edit Storage**

1. Click and select **CONFIGURATION**
2. Click **Storage**

Feel free to explore, but do not change the locations or commit/save any updates to the storage.

1. **AppStacks** - can be changed to alter the Storage location and Path including the Templates path
2. **Writable Volumes** - can be changed to alter the Storage location and Path including the Templates path

Once completed please Log out from App Volumes Manager.

**Configure VHD In-Guest Storage (Information Only)**

To use App Volumes with VHD In-Guest Operation mode, the machines where the App Volumes Manager and agents are installed require special permissions on the CIFS file share.

Procedure
1. On a file server, create a new empty folder.
2. Copy the contents of the Hypervisor\In-Guest VHD folder from the App Volumes installation media to the new folder.
3. Share the folder and grant full access permissions on the file share to everyone.
4. Configure NTFS permissions as described below.

An Active Directory domain group might be used to manage permissions for the following roles:

- Managers: App Volumes Manager
- Agents: Machines that receive App Volumes and writable volumes assignments
- Capture Agents: Machines that are used for provisioning new App Volumes agents

NTFS folder permissions required for each role

<table>
<thead>
<tr>
<th>Folder</th>
<th>Managers</th>
<th>Agents</th>
<th>Capture Agents</th>
</tr>
</thead>
<tbody>
<tr>
<td>apps</td>
<td>Full</td>
<td>Read</td>
<td>Write</td>
</tr>
<tr>
<td>apps_templates</td>
<td>Read</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>writable</td>
<td>Full</td>
<td>Note</td>
<td>None</td>
</tr>
<tr>
<td>writable_templates</td>
<td>Read</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Note: Write permissions are required by Agents when Dynamic Permissions are not enabled.
Conclusion

This module walk through creating and using Writable Volumes with tips on exclusions and storage configuration.

Congratulations, you've finished Module 4

Congratulations on completing Module 4.

If you are looking for additional information on VMware App Volumes, try one of these:

- Click on this link
- Or go to https://tinyurl.com/yc5cyj59
- Or use your smart device to scan the QRC Code.

Proceed to any module below which interests you most.

- **Module 1 - Introduction to App Volumes (30 minutes)**
- **Module 2 - AppStack Management (30 minutes)**
- **Module 3 - Entitling Applications via AppStacks (30 minutes)**
- **Module 4 - Writable Volumes (45 minutes)**
- **Module 5 - Application Isolation with ThinApp (45 minutes)**
- **Module 6 - Advanced Topics / App Volumes (45 minutes)**

How to End Lab

1. To end your lab click on the END button.
Module 5 - Application Isolation with ThinApp (45 minutes)
Introduction

In this module we will look at ThinApp integration with App Volumes.

This module contains the following lessons:

- [Part 1] Why ThinApp
- [Part 2] Sandbox
- [Part 3] Isolation Modes
- [Part 4] Summary of Isolation Modes and Data Precedence
- [Part 5] VMware App Volumes and ThinApp
- [Part 6] Conclusion
Why ThinApp?

Network latency is often the limiting factor for scalability and performance when deploying ThinApp packages in streaming mode. Yet, ThinApp provides exceptional application-isolation capabilities. With App Volumes, administrators can present ThinApp packages as dynamically attached applications located on storage instead of moving bits around the data center over the network. This removes the network latency due to Windows OS and environmental conditions. Using App Volumes to deliver ThinApp packages allows for the best of both worlds real-time delivery of isolated and troublesome applications alongside other applications delivered on AppStacks. With App Volumes in a virtual desktop infrastructure, enterprises can take advantage of local deployment mode for ThinApp packages. ThinApp virtual applications can be provisioned inside an AppStack using all the storage options available for use with AppStacks. This architecture permits thousands of virtual desktops to share a common ThinApp package via AppStacks without the need to stream or copy the package locally.
Sandbox

ThinApp Sandbox

In this module we will look at the role "Sandbox" plays within the Windows operating system.

ThinApp is designed to allow an application to run in a self-contained environment without having to install it to a host operating system in a traditional manner. The application is comprised of one or more .exe files and a possible .dat file, all located in a single directory. If it is installed as an .msi or is registered with regedit, shortcuts may be created on the desktop and in the Start Menu and a few registry entries created to
accommodate file and protocol associations. If it is installed as an .msi, further registry entries are created to display the application in Add/Remove Programs or Programs and Features. Aside from these host file system and registry modifications, the installation of the application has no other impact on the host operating system.

If the application is isolated from the host system, any changes, deletions, or additions made by the application to the file system or registry are recorded in the sandbox instead of the host operating system. The sandbox is a directory in which these modifications are recorded. The degree to which these modifications are recorded in the sandbox instead of the host operating system itself is determined by the isolation modes in use. There are three main methods of setting the sandbox location for an application:

- The SandboxPath parameter in package.ini
- A Thinstall folder in the same directory as the ThinApp application's .exe file(s)
- The value of the %THINSTALL_SANDBOX_DIR% environment variable on the host operating system

If none of these methods have been used, the default location of the application sandbox is %appdata%\thinstall\application, where application is replaced by the name of the application as configured in its package.ini.
Isolation Modes

Isolation modes apply to individual directories and subdirectories as well as to registry locations. The three isolation modes are:

- **Merged** - This isolation mode causes all modifications made by the application to be made to the host operating system. (If a file already exists in the virtual OS, changes are made in the sandbox.)
- **WriteCopy** - This isolation mode causes all modifications made by the application to be made to the application's sandbox.
- **Full** - This isolation mode causes all modifications made by the application to be made to the application's sandbox. In addition, when the application is looking for a file or registry value it does not query the host operating system for this data.

Application Data Precedence

When an application is looking for a file or registry value, it queries these locations in this order:

1. The application's sandbox.
2. Any modifications made by the application when either WriteCopy or Full isolation mode was used.
3. The virtual operating system.
4. The set of files and registry entries that were stored in the project source directory on the machine that ran ThinApp's Setup/Capture wizard. This is all contained in its `.exe` or `.dat` file.
5. The native operating system.
6. Any file or registry entry that actually exists on the host operating system.

**Note:** When something is found, ThinApp immediately stops querying for it in any other location.
## Summary of Isolation Modes and Data Precedence

This graphical representation shows the effect of isolation modes and helps you determine from where data is read and to where it is written.

<table>
<thead>
<tr>
<th>Isolation Mode</th>
<th>Data is read from (until found)</th>
<th>Data is written to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Merged</td>
<td>Sandbox Virtual OS Native OS</td>
<td>Native OS (if already existing in the Virtual OS, changes go to the Sandbox)</td>
</tr>
<tr>
<td>Write Copy</td>
<td>Sandbox Virtual OS Native OS</td>
<td>Sandbox</td>
</tr>
<tr>
<td>Full</td>
<td>Sandbox Virtual OS Sandbox</td>
<td>Sandbox</td>
</tr>
</tbody>
</table>

---

---
VMware App Volumes and ThinApp

By combining App Volumes and ThinApp, you can deliver virtual applications to Active Directory users, groups, or computers in real time and to scale. We will test this and create an AppStack with a ThinApp installed application. For this lab we already prepared the ThinApp ZIP file to save time.

Launch Google Chrome

1. On the Main Console desktop If not already open, launch the Google Chrome browser
Login to vCenter

1. Click on **HOL-1851 Admin**
2. Select and click **vCenter HTML5 Client**

1. Click **Use Windows session authentication**

**Note:** Should this step fail then use

User name: `corp\administrator`
Password: **VMware1!**
2. Click Login

### Power on Base

If BASE-W10-X64-01 is already powered-on then continue to Login step, if not (NO GREEN ARROW) then power-on the base image.

1. Right-click on base-w10-x64-01 (under RegionA01-IC01)
2. Select Power
3. Click Power On

### Login - Console BASE-W10-X64-01

1. Click on base-w10-x64-01
2. Click in the middle of the Windows Console Window
*New tab should open at the top, leave this tab open and continue to the next step.*

1. Select the new **tab name base-w10-x64-01** at the top
2. Click **Send Ctrl+Alt+Delete**

1. In the password box type **VMware1!**
2. Click to continue

Once the desktop loads successfully then continue to the next step!
App Volumes Management Console

1. Click on the App Volumes Manager shortcut
2. Log in as Administrator
3. Password VMware1!
4. Click Login

Once authenticated, you will be taken to the App Volumes Dashboard.

**Detach Writable Volume**

If you have done any of the previous modules, you need to first detach the writable volume.
1. Click and select **VOLUMES**
2. Click **Writables**
3. Click **Checkbox**
4. Click **Delete**

Warning: Deleted volumes will be detached from all computers immediately. All data and settings for the user or computer will be permanently deleted. Please ensure the following Writable Volumes are no longer in use.
1. Click **Delete**

2. Click **Create AppStack**

   1. Click and select **VOLUMES**
   2. Click **Create AppStack**

   - **Name:** ThinApp Repository
   - **Storage:** vcsa-01a.corp.local: [RegionA01] COMP01-ISCSI01
   - **Path:** appvolumes/apps
   - **Template:** appvolumes/apps_templates/template.vmdk (20GB)

   3. Click **Create**
1. Select the Name: field and type "ThinApp Repository"
2. Use the Storage / Path / Template defaults
3. Click Create

1. Click - Wait for completion
2. Click Create

*Notice* that the AppStack is now created, but not yet provisioned.
1. Type **base** into the Find Provisioning Computer text box
2. Click **Search**
3. Select CORP\BASE-W10-X64-01$ **check box**
4. Click **Provision**
1. Click **Start Provisioning**

Switch to the **base-w10-x64-01** tab in Chrome

Notice that the Machine is now in provisioning mode - **DO NOT CLICK OK**
1. Right-click the **Windows Start** Icon
2. Click **Run**

![Image of Run dialog box]

1. In the Open box type - `\controlcenter\tools\ThinApps`
2. Click **OK**

![Image of ThinApps folder in File Explorer]

1. Copy **NotePad++ 7.2**
2. Paste into Downloads (drag and drop)
1. Click **Downloads**
2. Double-click **Notepad++ 7.2**

1. Double-click **Build**

1. Double-click **bin**
Double-click **Notepad++ 7.2**

1. Click **Run anyway** (if you get this prompt)
1. Click the App Volumes **Agent Icon**

1. Click **OK**
2. Click **Yes**
3. Click **OK** (automatic reboot at this point)
4. **After reboot, log back in**

1. In the password box type **VMware1!**
2. **Click** to continue

Once the desktop loads successfully then continue to the next step!
1. ThinApp has been captured successfully, click **OK**
2. Now sign out from the Windows 10 desktop
1. Switch to the **App Volumes Manager** tab  
2. Log in as **Administrator**  
3. Password **VMware1!**  
4. Click **Login**

Well done, your ThinApp is now in an AppStack and ready for assignment.
1. Expand **ThinApp Repository**
2. Select the ThinApp Repository **check-box**
3. Click **Assign**

![Assign AppStack: ThinApp Repository](image)

1. Click in the Search Active Directory text box and type **lab1**
2. Click **Search**
3. Click **CORP\lab1user**
4. Click **Assign**

![Confirm Assign](image)

1. Click **Assign**
1. Click Assign

1. In Chrome switch to the **base-w10-64x-01** tab
1. Click Other user
2. Username - **lab1user**
3. Password - **VMware1!**
4. **Click continue**

---

1. The ThinApp **Notepad++** application has successfully been published via an AppStack.

Feel free to use the application and test the functionality.

2. Once completed please **Sign out**
Conclusion

Congratulations, you've finished Module 5

This module started with an overview of ThinApp, explaining sanboxing, isolation modes and precedence. We also covered creating and integrating ThinApp with an AppStack.

Congratulations on completing Module 5.

If you are looking for additional information on VMware App Volumes, try one of these:

- Click on this link
- Or go to https://tinyurl.com/yc5cyj59
- Or use your smart device to scan the QRC Code.

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- Module 6 - Advanced Topics / App Volumes (45 minutes)

How to End Lab

1. To end your lab click on the END button.
Module 6 - Advanced Topics / App Volumes (45 minutes)
Introduction

In this module we will look at some advanced topics for VMware App Volumes.

This module contains the following lessons:

- [Part 1] TLS Connections in App Volumes
- [Part 3] Expandable Writable Volumes
- [Part 4] Conclusion
TLS Connections in App Volumes Manager

You can modify the Nginx configuration file to ensure that App Volumes Manager accepts connections only from specified TLS versions.

App Volumes Manager uses SSL and TLS to communicate securely with servers and App Volumes agents.

Launch Google Chrome

1. Validate you're on the main console desktop
2. If not already open, launch the Google Chrome browser
Login to vCenter

1. Click on **HOL-1851 Admin**
2. Select and click **vCenter HTML5 Client**

1. Click - **Use Windows session autentification**

**Note:** Should this step fail then use

User name: **administrator**

Password: **VMware1!**
Login - Console appvol-01a

1. Click on appvol-01a
2. Click in the middle of the Black Console window

*New tab should open at the top.*
1. Select the new **tab name appvol-01a** at the top
2. Click **Send Ctrl+Alt+Delete**

Once the desktop loads successfully then continue to the next step!

1. In the password box type **VMware1!**
2. **Click** to continue

1. Right click Windows **Start** icon
2. **Click** **File Explorer**
1. Type - C:\Program Files (x86)\CloudVolumes\Manager\nginx\conf
2. Click **continue**

   ![Image of file explorer](image)

   1. Click and **open nginx**

   ![Image of Notepad](image)

   Use the Find function in Notepad (**Ctrl + F**)

   1. Search for **TLS**

   This file can now be edited to accept only TLS connections approved by your organizations security team. For example, if you include TLSv1.1 and TLSv1.2 in the ssl_protocols line, App Volumes Manager will accept connections only from these TLS versions.

   In this example, App Volumes Manager will accept connections only from agents that use TLS v1.2 protocols, as specified in the ssl_protocols entry in the Nginx configuration file.

   ```
   server {
   server_name 192.168.110.10;
   listen 3443;
   ```
listen 443;
listen [::]:443;

ssl on;
ssl_certificate appvol_ca1_vmware.com.crt;
ssl_certificate_key appvol_ca1_vmware.com.key;
ssl_protocols TLSv1.2
ssl_session_cache builtin:1000;
ssl_session_timeout 5m;
root ../public;

1. **Close** Notepad - Do not make or commit any changes
2. **Sign out**
Data Flow in an App Volumes Environment
Figure 1 shows the data flow for App Volumes in a typical View environment. The diagram illustrates a View pod in a single data center with multiple View blocks.
1. The left side of Figure 1 illustrates App Volumes without the direct-to-host connection option (Mount on Host).
2. The right side illustrates App Volumes with the direct-to-host connection option.

The direct-to-host-connection option is recommended for deployment at scale because AppStacks and writable volumes are mounted more quickly when ESXi directly mounts them, rather than waiting for vCenter Server to direct ESXi to mount the volumes.

### Without Direct-To-Host Connection

- **A1** – User connects to virtual desktop.
- **A2** – App Volumes Agent checks with the App Volumes Manager for an assigned writable volume and assigned AppStacks to mount.
- **A3** – Attachment of AppStacks and a writable volume begins during desktop login.
- **A4** – App Volumes Manager directs vCenter to get ESXi to mount assigned writable volume and AppStacks.

### With Direct-To-Host Connection (Mount on Host)

- **B1** – User connects to virtual desktop.
- **B2** – App Volumes Agent checks with the App Volumes Manager for an assigned writable volume and assigned AppStacks to mount.
- **B3** – Attachment of AppStacks and a writable volume begins during desktop login.
- **B4** – With Direct-To-Host Connection (Mount on Host option), App Volumes Manager directs ESXi to mount assigned writable volume and AppStacks, without going through vCenter. This is the best option for large-scale deployments.

Note: The direct-to-host connection requires that all ESXi hosts use the same login and password for App Volumes operations. Root is not required and a custom role can be used to set up this connection.

For both connection options, the user logs in to their View desktop, and the connection is authenticated through the broker, the View Connection Server. The App Volumes Agent on the View desktop connects to the App Volumes Manager via a load balancer. The App Volumes Agent checks with the App Volumes Manager whether the user has a writable volume and AppStacks to mount. The App Volumes Manager retrieves this information from the App Volumes SQL database.

Without the direct-to-host-connection option, the App Volumes Manager requests that vCenter Server mount the user’s assigned volumes. VMware vCenter Server directs ESXi to mount the volumes. This attachment of volumes to the desktop begins during user login to the desktop. By the time the user logs in, their volumes are attached to their desktop. Not using the direct-to-host-connection option is adequate in small-scale deployments. For production deployments, we recommend the direct-to-host option in order to minimize the load on vCenter Server and eliminate potential performance bottlenecks.

With the direct-to-host-connection option, the App Volumes Manager directs ESXi to mount the volumes. This attachment of volumes to the desktop begins during user login to the desktop. While the user logs in, their volumes are attached to their desktop. The benefit of the direct-to-host-connection option is that vCenter Server is not part of the data flow. This is particularly useful in large-scale deployments, where vCenter Server might get overloaded and create a bottleneck.

The dashed blue line in the diagram indicates an ongoing, periodic communication between the App Volumes Manager and vCenter Server. The App Volumes Manager finds out if the host is up, if storage is still available, and if VMs are still online. App Volumes Manager then informs vCenter Server which volumes to attach to the desktop. This
background communication is essential in all deployments, to ensure that the current status of the environment is communicated to the App Volumes Manager. App Volumes Manager periodically checks with vCenter Server to find out what has changed in the environment.

AppStack storage groups are replicated across View blocks via a non-attachable datastore.
Expandable Writable Volumes

If a user’s writable volume has reached or is about to reach full capacity, it can be expanded.

Allowing End Users to See the Size of Their Writable Volumes

You can view space remaining in writable volumes from the App Volumes Manager. You can also allow the end user to see available space on their writable volume, from their system volume.

To do this, create a new registry key during the App Volumes Agent configuration: (This is for information only, please do not apply these changes to your lab)

1. Navigate to HKLM\System\CurrentControlSet\Services\svdriver.
2. Within the Parameters key, create a new key called ReportSystemFreeSpace with a DWORD value of 0 (zero).
This change requires a reboot to take effect. Logging out or logging in does not apply the changes.

After you make the registry modifications, and you reboot the system:

1. C:\ object now reports free space on the user’s writable volume (which is 8.13 GB total in this case).
2. The total space still reflects the combined C:\ value.

**Expanding Writable Volumes**

To expand the writable volume for each user from the App Volumes Manager, locate the user’s writable volume in the Volumes tab under the Writables sub-tab, and expand the information on the specific writable volume. Click the Expand Volume option and enter a larger value in 1-GB increments. The additional size is added to the writable volume after the user logs out and back in.
**Note** - The free-space usage is not reflected in the App Volumes Manager until the user logs out and back in again.

If you still have a writable volume from your previous lab or you would like to challenge yourself, please go ahead and confirm the expand for your Writable Volume.
Conclusion

This advanced module looked at TLS Connections in App Volumes Manager and how to edit connections, data flow within App Volumes and finally expandable writable volumes.

Congratulations, you've finished Module 6

Congratulations on completing Module 6.

If you are looking for additional information on VMware App Volumes, try one of these:

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- Module 6 - Advanced Topics / App Volumes (45 minutes)

How to End Lab

1. To end your lab click on the END button.
Conclusion

Thank you for participating in the VMware Hands-on Labs. Be sure to visit http://hol.vmware.com/ to continue your lab experience online.

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