liquidware™

FlexApp™
Application Layering for Citrix Virtual Apps and Desktops

Whitepaper

Introduction

FlexApp layering from Liquidware can streamline the way your organization builds and deploys CVAD. The solution provides a better methodology for application delivery while allowing you to take advantage of Citrix renowned fast and reliable desktops and application publishing. This paper focuses mainly on the benefits and methodology of FlexApp for Citrix Virtual Apps and Desktops (CVAD).

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Liquidware

3600 Mansell Road
Suite 200
Alpharetta, Georgia 30022
U.S.A.
Phone: 678-397-0450
www.liquidware.com

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Citrix Virtual Apps Server - Windows OS Level Image Management

For the past several years, Citrix has made base-image management very straightforward with MCS (Machine Creation Services) and PVS (Provisioning Services). These two imaging technologies differ in when they should be used, but generally they both enable you to take a Windows-machine base image and rapidly copy and leverage it for disaster recovery or to build another Virtual Apps image for another Virtual App server. Imaging technologies ease the pain of building and maintaining base images, and they are ideal for enabling the use and reuse of one image on multiple machines, quickly rendering them identical. Building an image once and applying it to multiple machines is the primary use-case for PVS and MCS.

Additionally, Citrix PVS and MCS simplify the rigorous task of updating and patching the Windows OS for a Virtual Apps Server. When security or update patch cycles occur, administrators simply modify the base image by installing the patch/update and then replicating the image by means of MCS or PVS.

Using MCS and PVS to manage the Windows OS and patches seems sufficiently uncomplicated — until you add applications to the image-management mix, because multiple images are often needed to deliver unique sets of applications per department, group and user. Also, applications are usually added to images because experience shows that application perform best when they are installed directly into the Windows OS. This direct approach supports applications with drivers and services as well as applications with unique pre-requisites. However, these scenarios produce multiple images and additional management tasks to deliver applications — a consequence known in the industry as "image sprawl."

There are several ways to add applications to Virtual Apps servers; the most common are listed below.

Virtual Apps Installation Methods:
1. **Install applications in the base image**. Considered the most traditional method, installing apps in the base image requires the administrator to identify the appropriate Virtual Apps Server for that particular application's accessibility and installing the application using the software vendor's executable or MSI package. The application is tested and put into production for the specific departmental Virtual Apps server or published application Virtual Apps server.
2. **Software Deployment**. Third-party software distribution solutions and Microsoft SCCM (System Center Configuration Manager) enable administrators to manage the application deployment across an enterprise. Virtual Apps administrators can also leverage this for unattended installation of applications and updates over the network.
3. **Microsoft App-V.** Microsoft App-V was introduced as a way to not only isolate applications, but also to facilitate image management and application delivery. The solution works by packaging an application and then applying a more contained version of it to a Virtual Apps Server. This method has its advantages as well as its drawbacks and, including packaging complications and strained interactivity among isolated application packages or with the OS itself. App-V packaging/sequencing can be time-consuming and requires specialized expertise. It also has a disappointing success rate (60-70%) with

application virtualization. It is important to note that Microsoft has announced that App-V is end-of-life is slated for 2026.

4. MSIX – MSIX is a relatively new format that may replace some use cases for App-V. The big drawback to MSIX is that it is only compatible with about 30-40% of applications.

Image Sprawl

As explained, typical Citrix Virtual Apps deployments can produce dozens of base images that require maintenance such as OS updates and application installations/updates. The technology provides a way to quickly create department-based images for application delivery, but it can also contribute to image sprawl and management nightmares.

The tasks associated with patching, maintaining, updating, installing, and securing applications is cumbersome for any sizeable organization running Virtual Apps. Not only does image sprawl burden the IT staff, it also strains IT budgets. Organizations end up spending more on additional storage, support costs, and software licensing for applications users do not need.

Traditional Citrix Virtual Apps Application Delivery

There are many ways to manage a Citrix Virtual Apps environment; however, to establish a baseline, we'll present common methods.

Any given Virtual Apps environment may have several Windows servers that deliver Microsoft RDS and Citrix Virtual Apps. For this discussion, we'll call these Virtual Apps servers. Obviously, the bigger and more diverse the user environment, the greater number of servers will be required, and each of these servers might require a unique image (with ongoing maintenance tasks) to deliver the Windows OS along with the applications and their requirements/prerequisites, examples of which are provided below.

- **Virtual Apps Server Departmental Published Desktops**. Organizations have various departments (i.e., finance, HR, call centers, medical staff, students, faculty) that require specific applications per workspace. To date, one of the easiest ways to meet this need with Virtual Apps has been to have departmental servers with unique applications per server group. For instance, the finance department may have a dedicated Virtual Apps server for payroll applications, while HR likely has different application needs, and individual users also may have further distinct application requirements, and so on. These Virtual Apps servers may have additional identical servers for failover. It would not be uncommon for a medium to large organization to have as many as 20-30 or more Virtual Apps servers running in this capacity.

- **Virtual Apps Server Published Applications**. Often, dedicated Virtual Apps servers exist for the sole reason of application publishing, which is the process of delivering applications to Windows desktops through Virtual Apps server rather than through the entire Citrix Virtual Apps workspace. Application publishing servers can also be dedicated by department or by specific application. Additionally, these servers may have additional identical failover servers. It would not be uncommon for a medium-to-large organization to have as many as 20 to 30+ Virtual Apps servers running in this capacity. The above practice is also referred to as applications and/or desktops being "siloed."

A mid-sized organization with 5,000 Citrix Virtual Apps users may currently require a substantial number of Virtual Apps Servers to be maintained per the groups above. An example per number of Virtual Apps servers is outlined in Table 1:

Table 1: Servers typically required for a mid-sized organization

	Departmental Virtual Apps Worker Servers	Application Publishing Dedicated Virtual Apps Servers
Mandate for server	Application Delivery – Siloed per department based on unique desktops	Application Delivery – Dedicated Servers per application or group of applications
Groups of users supported	Human Resources, Finance, Manufacturing, Marketing, R&D, Product Management, customer service public-facing, customer service, call center (9 total departments using Virtual Apps)	Specialized applications for sales, HR, finance, customer/patient service, etc.
Users accessing desktops or applications	4,000	1,000
Number of unique Virtual Apps images required due to application delivery	9	5

In the modest example above, <u>14</u> images must be maintained due to application delivery in the organization's Virtual Apps environment. Image management on this scale is a substantial, time-consuming task for administrators that, until recently, was required for Virtual Apps and Microsoft RDS deployments. Fortunately, recent technological advances have brought about increasingly dynamic applications. One such leading technology is Liquidware's FlexApp, which provides flexible application layering.

FlexApp

FlexApp radically streamlines the way organizations manage and deliver applications on Citrix Virtual Apps and other Windows desktops. FlexApp ended the era of modifying Windows OS base images through cumbersome application installation processes. In fact, FlexApp streamlines application delivery so effectively that many FlexApp customers have adopted a "FlexApp First" application strategy. Such a strategy strives to first deliver any given application through FlexApp layering. FlexApp provides Rapid Application Deployment (RAD) and reduces image-management processes. On the rare chance that an organization confronts a unique environmental or layering challenge for an individual application, a traditional delivery method can still be used. The net result is a drastic reduction in base images requiring maintenance. It is not unusual for FlexApp customers to realize a 90 percent reduction in maintained base images.

FlexApp provides just-in-time application layering at user logon or on-demand layering with exclusive Click-to-Layer™ (CTL) technology. This approach enables organizations to keep base images of Windows workspaces to a minimum and layer applications to users instantly and on-

demand – saving both time and money by helping end Windows OS image sprawl. In turn, base-image management is also streamlined as it is finally decoupled from your organization's applications – fewer images are then required, and those that remain can easily be managed by Citrix PVS or MCS.

Here are some of the benefits that FlexApp layering provides in a Citrix Virtual Apps environment:

- Minimization of base Windows OS images by managing base images separately from applications
- Use of PackageOnce™ (most applications) and layering to any platform, any Windows OS, and in any cloud hosted environment
- FastPackaging™ of applications in approximately the same amount of time it takes to install an app
- Reduction of the number of Microsoft RDS/Citrix Virtual Apps servers that your organization runs and maintain
- Significant reduction of DTAP (develop, test, accept, production)– the time it takes to test and accept an application into production
- Speedy delivery of applications at user logon or with Click-to-Layer on-demand technology
- Direct publishing and assignment of app layers from the Virtual Apps management console – Citrix Studio
- Provision of unique and personalized applications to users
- Side-by-side deployment of app layers with application virtualization technologies like App-V or MSIX

Additionally, FlexApp is compatible with any Windows workspace, including virtual and cloud-based desktops (Amazon WorkSpaces, Citrix Desktops and VMware Horizon View) and Microsoft RDS — as well as physical desktops.

FlexApp for Citrix Virtual Apps — Designed for Unique Challenges

Advanced features for Microsoft RDS and Citrix Virtual Apps include the ability to layer applications to individual user sessions with session-based layers and optional on-demand Click-to-Layer technology.

FlexApp Session Layers

Session layers from FlexApp provide the ability to deliver application layers to individual user sessions on Virtual Apps servers. This enables organizations to leverage a single OS image shared by multiple desktop users or application publishing groups. Citrix administrators currently have the ability to attach and assign FlexApp to users by attaching the individual FlexApp layers to the Virtual Apps server instance. Additionally, administrators can assign individual applications to each user's unique Virtual Apps session through FlexApp Session layers. Each user is then given access to the individual applications they need without the extra congestion of the other users' applications on the shared Virtual Apps server.

FlexApp Click-to-Layer

FlexApp provides several deployment options for the enterprise, including at system boot and during the user login process. To further optimize this workflow, Liquidware created an on-demand feature known as Click-to-Layer (CTL). While some applications are required by users when they log into their desktop (e-mail, browsers, etc.), other applications are not immediately. Therefore, FlexApp offers several delivery methods to address non-immediate use cases while keeping user logons fast:

1. At boot or logon – the default action for FlexApp layers. Applications are mounted from VHD/VMDK and are ready for immediate use.
2. Post login- applications appear after login, during the first few seconds of the user session, if desired
3. Trigger – FlexApps appear when a context aware trigger is reached, such as location of login or on the launch of another app
4. FlexApp Click-to-Layer (on-demand)– this method allows administrators to optimize the login experience by making select applications available when users double-click them versus at login. Just-in-time (JIT) application icons, which look identical to application icons, are delivered to the desktop, but with CTL, only the icon has been written to the desktop. If and when the user executes one of the FlexApp CTL icons, the FlexApp layer is attached in the background and the application launches for the user.

FlexApp Click-to-Layer also provides great performance while retaining each application in its own VHDX container for ease of updates by an administrator. With CTL, dozens of application layers are applied to a desktop with virtually no performance degradation. It is also easy to package multiple applications in a single container should it be preferred by the administrator.

Both FlexApp Session Layers and FlexApp Click-to-Layer fully support published applications and desktops across any vendor platform, including CVAD, as shown in Figure 1.
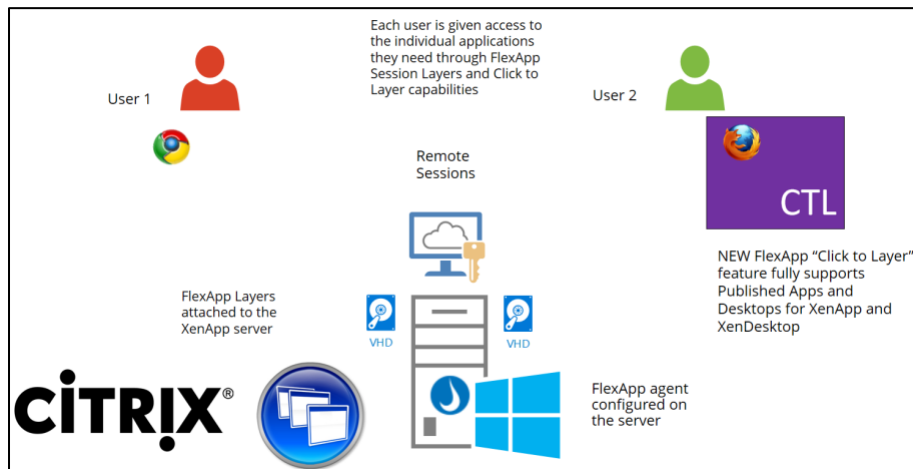

Figure 1 – FlexApp support of published applications and desktops

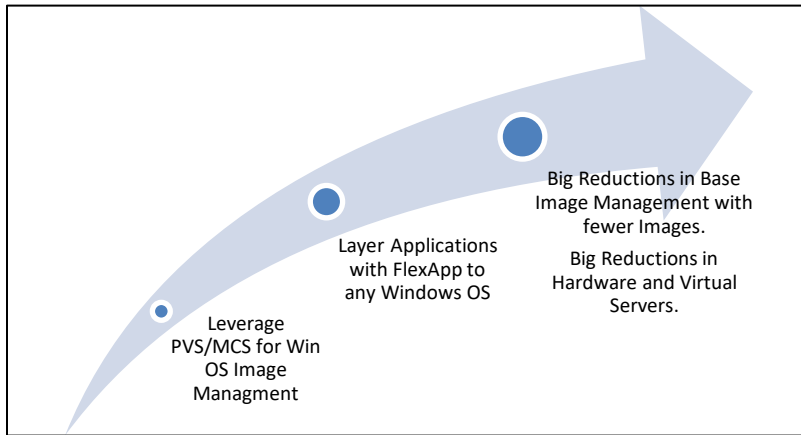**Optimized Image Management Capabilities**

FlexApp has always provided tremendous value to Citrix environments by reducing the number of images required. This is achieved by decoupling the application management components from

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the core image management procedures associated with both CVAD through the use of FlexApp layering.

Many Citrix customers consider PVS and MCS to be the de facto mechanism for delivering/cloning images across environments and managing both Virtual Apps and Desktops. FlexApp continues to provide tremendous value within Citrix environments by streamlining and augmenting existing PVS and MCS workflows for enterprises.

Big Reductions in Base Image Management with fewer Images.

Big Reductions in Hardware and Virtual Servers.

Layer Applications with FlexApp to any Windows OS

Leverage PVS/MCS for Win OS Image Managment

Figure 2 – Application delivery without native installation

Liquidware's FlexApp layering delivers applications to Citrix and any Windows desktop without needing to install the application into the desktop's base image. The solution has advantages over traditionally installed applications because desktop and server base images can remain clean and unfettered by application installations and associated maintenance.

FlexApp seamlessly integrates with any and all Citrix FlexCast models. In addition, FlexApp integrates with smooth roaming. FlexApp layers can be attached to both Virtual Apps and Desktops in ways that are invisible to users while providing increased benefits and flexibility to administrators. FlexApp applications are published to users seamlessly through Citrix Studio. As described in Figure 3, FlexApp layers can seamlessly be presented to the various FlexCast options in the background.
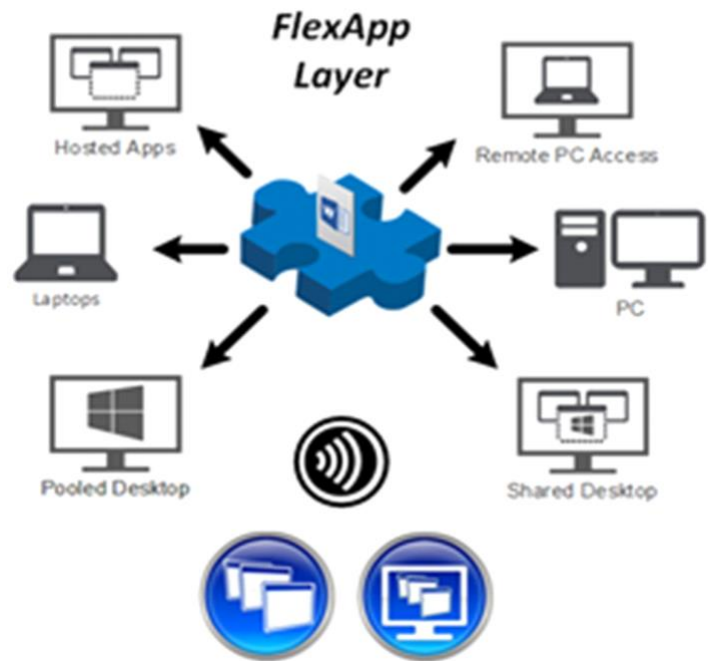

Figure 3 – Presentation of FlexApp Layers to FlexCast Options

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Figure 4 depicts users' access of Microsoft Word through Citrix Receiver while on a laptop. The Microsoft Word FlexApp layer has replaced the need for a natively installed Word application on the Virtual Apps server. As users switch to a tablet and Smooth Roams to the same session through Citrix Receiver, FlexApp is still providing the Word application access.

Figure 4 - FlexApp Provides Non-native Access

FlexApp Layering – A Closer Look

When FlexApp was created, the team at Liquidware filled a market need with a new-generation application solution. FlexApp utilized an approach called application layering, which is highly complementary to techniques like application isolation. The goal was to simplify application delivery for non-persistent VDI. Since then, the solution has evolved to extend application delivery to persistent VDI and physical machines and Virtual Apps/RDS servers. FlexApp provides the highest degree of compatibility with your applications and, consequently, lowers the cost of managing desktops by enabling dynamic assignment and delivery of applications on-the-fly, while allowing administrators to maintain an absolute minimum number of base images that would contain only those applications required by the majority of users. This approach enables many levels of administrators to participate and eliminate the need to edit a CVAD base image.

Creating FlexApp Layers

FlexApp leverages a FlexApp Packaging Console that is connected to the Liquidware ProfileUnity™ console at login. This allows for a more streamlined management approach. During the creation of FlexApp layers, application installs are redirected to virtual disks in the form of VHDK containers. This capture results in the creation of individual FlexApp layers.

FlexApp also features the industries only fully automated packaging architecture. This enables organizations with dozens, hundreds, or thousands of application to fully automate package creation.

To illustrate, we present the Windows OS as a puzzle piece. FlexApp layers are similar to the individual pieces that interlock like a puzzle. The puzzle piece represents the virtual disk container that the corresponding application now resides in. This concept is controlled by and made possible through the Filter Drivers within FlexApp. In Figure 5, the Word application has been redirected
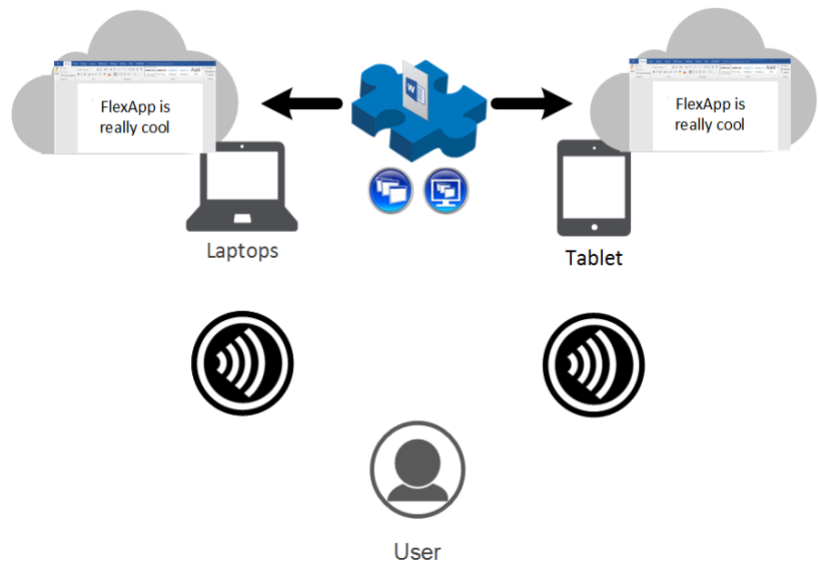

Figure 5 - Application redirection into FlexApp layer

into the new FlexApp layer that is similar to a puzzle piece.

FlexApp Filter Driver and Rules Engine
The process surrounding the attachment of layers to endpoints is controlled by FlexApp's Filter Driver components. These components are distinguished by two distinct features embedded within the technology – the Filter Driver and the Rules Engine.

The Filter Driver is a simple kernel mode service responsible for communication between the host OS and the layers to create virtual keys, files and folders at a basic level within the host OS.

The Rules Engine is an advanced user-mode-based architecture responsible for directing and controlling what the Filter Driver creates within the host OS; essentially it identifies, prepares and aligns all virtual registry, file and folder requirements among the applications within the layers and the host OS.

Considering the role of a traffic cop is helpful here. Traffic cops are responsible for maintaining a steady flow of traffic flow while maintaining order and preventing conflicts, among other tasks. As shown in Figure 6, FlexApp Filter drivers

Figure 6 - FlexApp filter drivers maintain order and prevent conflicts

function like a traffic cop, acting as a communication mechanism between the FlexApp layers and the corresponding host OS.

A feature within FlexApp, known as the Micro Isolation feature, is an integral part of the Rules Engine that addresses interlayer conflicts.

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Figure 7- Micro Isolation provides compatibility and co-existence

Micro Isolation

FlexApp Micro Isolation is a technology that engages automatically to resolve interlayer application conflicts, enabling applications within the FlexApp layers to be perceived as native to the OS and other application layers. To accomplish this, FlexApp redirects layered applications requests for a file, folder or registry key to its own layer, making it possible for two versions of the same file, folder or registry key to coexist, as shown in Figure 7.

Without Micro Isolation, each independent application layer is unaware of other layers and can potentially conflict at the file and

registry levels, causing failures. Previously, the only way to resolve application conflicts was to combine the conflicting applications into one large layer. However, this work-around creates management problems because it prohibits updates to a single application, with admins having to deal with larger layers. In addition, this method reprises an old problem: having everything in the base image, at the application level, which is what everyone is trying avoid.

Reduced Management Overhead

Rather than adhering to the standard approach of installing applications natively, administrators can now create FlexApp layers and simply attach them during the Virtual Apps Server's boot process. The Virtual Apps administrator can then focus on a reduced number of Virtual Apps images, which dramatically reduces overall management overhead. Figure 8 shows the integration of these technologies.

When FlexApp layers are integrated with the Virtual Apps server, organizations can shift their focus to an optimized server-maintenance approach. Essentially the administrator can compartmentalize server maintenance from application updates. Simply shifting or migrating FlexApp layers to additional servers ensures little-to-no downtime during the maintenance window.

Figure 8 - FlexApp layer creation reduces Citrix Virtual App and Desktop images

The task of updating individual applications then shifts over to a FlexApp-managed application lifecycle process workflow. By shifting the application update responsibility from Virtual Apps to FlexApp, a tremendous burden is lifted from the Virtual Apps administrator. This significantly reduces the complexity of maintaining the Virtual Apps server instance without the challenge of application support in the mix. This approach leads to a more self-sufficient application lifecycle in the long run.
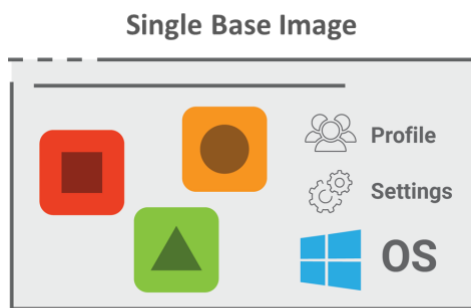
Reducing the Number of Base Images

Streamlining the number of core images within the Virtual Apps environment is always a critical focus. One of the many reasons for image sprawl within environments stems from the very applications natively installed within the Virtual Apps environment. Many of these applications do not play nicely with one another. As a work-around, administrators often stand up another Virtual Apps server. The applications are baked into the individual images, perpetuating the problem of many golden images. (Updating individual applications within the various golden images is challenging considering each image has to be managed separately. The image is opened by an administrator, the application is updated and then the image is resealed.) FlexApp layering can reduce the support challenges across images by providing a more efficient application deployment model. In addition, FlexApp layers can be presented to individual users across numerous Virtual Apps golden images, thus reducing the administrative overhead within the Virtual Apps environment.

VM Images (silos)
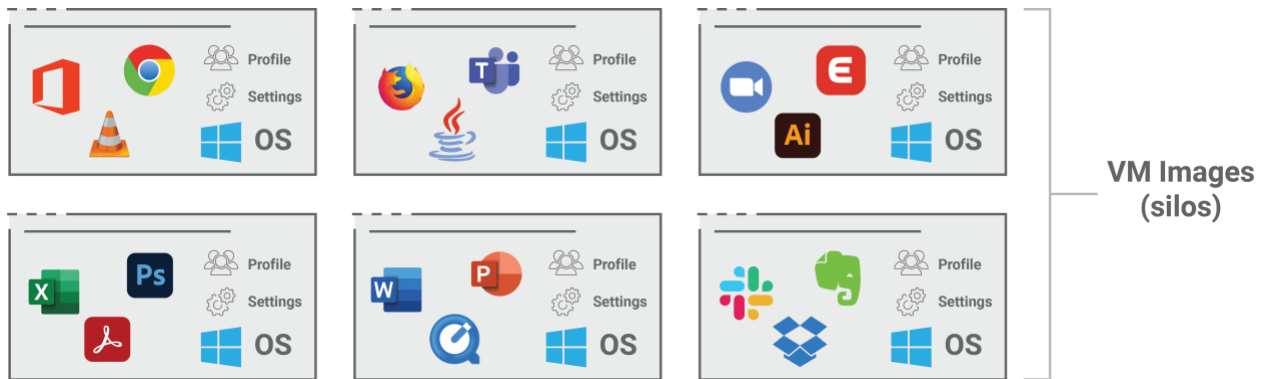
Numerous FlexApp layers can be attached to an individual Citrix Virtual Apps server or provisioned to a Citrix Desktop instance. When users access the Virtual Apps instance or Desktop environment, they are provided with access to all the corresponding applications within the FlexApp layers. The goal of FlexApp layering is to simplify application delivery while streamlining Virtual Apps and Desktop management behind the scenes.

Single Base Image

Apps are Dynamically Assigned

The table referred to in this paper earlier has now been updated below to reflect the number of base images required to deliver applications with FlexApp. As you can see, the number has been reduced from 14 base images to 1. These results are based on FlexApp's ability to layer 100% of an organization's applications. Though results may vary, FlexApp's estimated applications-layering success rate is often greater than 90%. Table 2 demonstrates FlexApp's impact on the number of images that the sample organization discussed in the table on page 6 would be maintaining.

Table 2: Servers typically required for a mid-sized organization

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Mandate for server	Application Delivery – Siloed per department based on unique desktops	Application Delivery – Dedicated Servers per application or group of applications
Groups of users supported	Human Resources, Finance, Manufacturing, Marketing, R&D, Product Management, customer service public-facing, customer service, call center (9 total departments using Virtual Apps)	Specialized applications for sales, HR, finance, customer/patient service, etc.
Users accessing desktops or applications	4,000	1,000
Number of unique Virtual Apps images required due to Application Delivery	9	5
Number of unique Virtual Apps images required as a result of FlexApp Application Delivery	1	The same Virtual Apps Server image (in the left cell) can be leveraged for published applications.

Seamless FlexApp Integration with CVAD

Integrating FlexApp layers with a Virtual Apps environment is designed to be very intuitive. Once the FlexApp layers have been attached to the host Virtual Apps environment, the administrator can simply use Citrix Studio and standard best practices to deliver the corresponding applications to user sessions within the FlexApp layers. The host Virtual Apps environment regards the FlexApp layers as natively installed. In this case, however, the user simply connects to Virtual Apps as usual, but the applications presented are, in fact, FlexApp layers as opposed to natively installed applications.

Similar advantages are realized when FlexApp layers are delivered via Citrix Desktop. Users enjoy an uninterrupted workflow with access to needed applications, while administrators benefit from dramatically reduced environment-maintenance, as shown in Figure 9.

Summary

Managing CVAD is easy by using time-proven solutions such as Citrix PVS and MCS to maintain base images that contain only the Windows OS and certain applications that may apply to all users. This methodology keeps base image management very streamlined and enables as few as one base image to be used across any type of Citrix Virtual Apps or Desktop deployment.

Delivering applications with Liquidware FlexApp empowers administrators by truly separating application management from Windows OS management. Base images need not be modified in order to publish applications, which reduces required base images management and its consequent

Figure 9 - Uninterrupted workflow with access to needed applications

management costs by as much as 90 percent. This approach leads to a more self-sufficient application lifecycle as well as streamlined desktop and server management.

Contact Information and Trial Software

More information about FlexApp is available at www.liquidware.com/products/profileunity.

Liquidware solutions are available for immediate download and trial by visiting www.liquidware.com/download.

ProfileUnity with FlexApp is an integrated solution, it but can be licensed separately, in which case select features are available depending on the license chosen.

Additional technical product documentation and installation guides are available at www.liquidware.com/support.