



Application Virtualization Smackdown

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DOCUMENT OVERVIEW

HISTORY

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1. INTRODUCTION

"Modern application virtualization technologies are elemental in the modern workspace. Fast and flexible windows application delivery require smart and state-of-the art solutions, layering and modern application virtualization is the standard in the modern workspace."

Ruben Spruijt, CTO Atlantis Computing | MVP, CTP, vExpert

"In the modern workspace there's products which can help you with your image management, virtual machine management, patching etc. For years, the great difficulty in traditional OS migration projects and indeed, Virtualization projects has been the applications. You've got hundreds or thousands of applications to deal with and it's rare that any two applications have been 'packaged' by the vendor in the same way. It's quite the challenge. Layering, containerization and modern application virtualization are becoming an essential weapon in fighting the apps battle in the modern workspace. These solutions simplify the application packaging process for most applications and provide a dynamic delivery. If you're not looking at these solutions right now, you will be in the very near future."

Rory Monaghan, CTO Algiz Technology | MVP, vExpert, CTA

"Users' expectation of IT systems is higher than ever before and users demand greater flexibility in where, and how they work. Choosing the right way you deploy and manage applications with their data is a crucial element in user experience."

Jurjen van Leeuwen, Freelance consultant @Leodesk_IT | MVP

Are you looking for an independent overview of Application virtualization solutions and are curious about different strategies and key questions? Are you interested in the use-cases and benefits of delivering applications via Application virtualization? Do you want detailed information about the features and functions each virtualization vendor is offering? If so this is the whitepaper you definitely must read!

In the current market there is an increasing demand for unbiased information about application virtualization solutions. This white paper is focused on solutions that are anticipated to have an important role in the modern workspace. An overview of available features of the various solutions has been created to provide a better understanding of capabilities and to assist you in understanding important differences between these technologies.

1.1 OBJECTIVES

The goals of this whitepaper are to:

- Provide an application and desktop delivery solutions overview
- Explain the pros and cons of application virtualization
- Highlight why application virtualization and VDI are a perfect fit
- Describe the different application virtualization vendors and solutions
- Compare the features of the various application virtualization solutions

1.2 INTENDED AUDIENCE

This document is intended for IT Managers, architects, analysts, system administrators and IT-Pros in general who are responsible for and/or interested in designing, implementing and maintaining application virtualization infrastructures.

1.3 VENDOR INVOLVEMENT

All major vendors whose products are covered in the whitepaper, such as Cameyo, Citrix, Numecent, FSLogix, Microsoft, Turbo, Symantec and VMware have been approached in advance to create awareness of this whitepaper and discuss their solutions functionality and features.

1.4 FEEDBACK

We try to provide accurate, clear, complete and usable information. We appreciate your feedback. If you have any comments, corrections or suggestions for improvements of this document we want to hear from you. Please send an e-mail to Ruben Spruijt (ruben@rspruijt.com) Include the product name, version number and the title of the document in your message.

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2. TOMORROW'S WORKSPACE

Introduction

Flexible work styles, device proliferation, bring your own, collaboration, workspace management, mobility, AnyDevice, AnyApp, AnyCloud, containers, application and desktop delivery are the main trends in the 'Modern Workspace'.

Application virtualization is part of the application and desktop delivery solutions stack in the

modern workspace. Virtualization is incorporated in several of these trends. Virtualization is nothing more than the decoupling of IT resources. The forms of virtualization that are most frequently applied include network, storage, server, application and desktop virtualization.

Application and desktop delivery is a process which has the goal of offering applications independent of location and device, so the business consumers can work onsite, online, off site, offline, anywhere, with any (own) device and at any time. The dynamic delivery of applications is an essential functionality and part of a broader strategy of the modern workspace.

Application and Desktop Delivery

One of the fundamental questions in application and desktop delivery is the following: "What is the execution platform for the applications and where is my data stored?" Within the execution platform, system resources such as the CPU, GPU, memory, storage and network are used in order to execute the windows/Linux, web-architected, rich mobile and mobile web-applications. The most frequently used execution platforms include the following: tablet, smartphone, desktop, laptop and desktop virtualization with both Virtual Desktop Infrastructure (VDI) and Session Virtualization (Server Based Computing).

The choice of an execution platform is the most fundamental decision and it defines the application and desktop delivery strategy. Applications are either executed on a local device or centrally in a private or public datacenter. Each execution platform has its own characteristics. The theories: "Less is more", "Cut out the exceptions" and "Manage diversity" should always be in mind. An execution platform is great; but if there are no applications available on the platform, the platform is of no real value to the business consumer, the end-user. The other questions which needs to be answered is: "How will the (Windows) applications get onto the execution platform?!" A number of solutions exist for making Windows, web-architected (SaaS) and mobile applications available on the platform. The most commonly options used for Windows applications include installation, application virtualization, and more recently, layering.



Other key questions in the application and desktop delivery strategy are:

- Do you need to manage the environment and/or devices?
- In a Bring Your Own Device (BYOD) scenario where does managing the environment start and where does it end?
- How is the desktop composed from a user perspective?
- What are the different access scenarios?

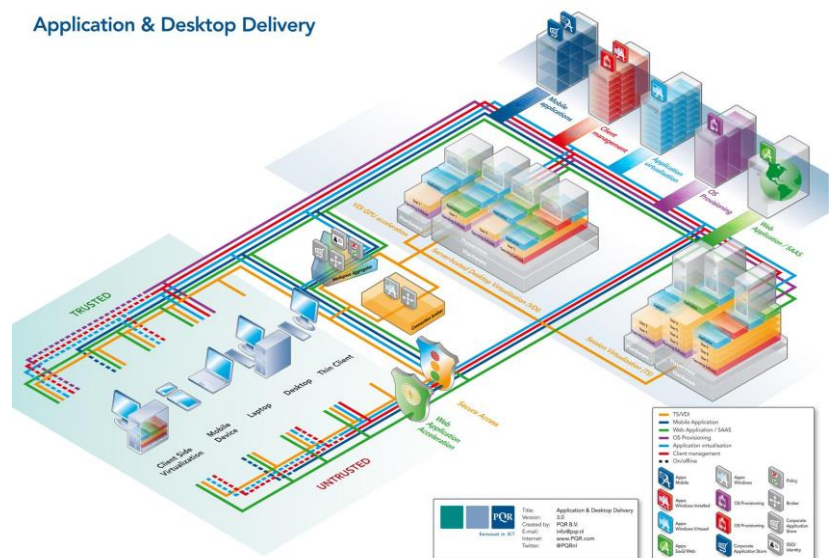
These and more questions fit in this third question:

- How do we control, maintain and support the workspace as a concept and as an endpoint device from an IT Pro and end-user perspective? BTW: Do we need control? Control what, Device, Application or Data? 'Enterprise Mobile Management', 'Workspace Aggregation', 'Client Device Management' and 'User Environment Management' solutions fit in this category.

It's great to see more and more scenarios where application virtualization within Desktop as a Service (DaaS), Application Remoting, desktop virtualization (VDI/SBC) and classic rich-clients are being used. The goal of this document is to explain the use-cases, business benefits, various solutions and differences between the solution.

2.1 OVERVIEW OF APPLICATION AND DESKTOP DELIVERY

Before doing a 'deep dive' into application virtualization, we think it's important to have an overview of all the 'Application and Desktop Delivery' solutions before you proceed with application virtualization. PQR created the "Application & Desktop Delivery Solutions Overview" to provide an at-a-glance outline of the various application and desktop delivery solutions. Reading this chapter will give you a complete outline of the diagram and all the application and desktop solutions that are included within it. This paragraph does not aim to describe all application scenarios or their technical advantages and disadvantages, but to give a general idea of the state of the union in the application and desktop delivery segment, independent of vendors.



Secure Access

Secure Access solutions provide (untrusted) devices secure access to corporate IT resources. A Secure Access solution could be a full (SSL) VPN solution or a Gateway Services which is targeted for Server Hosted Desktops. Solutions that can be used to realize secure access scenarios include Cisco ISE, Citrix NetScaler Gateway, Juniper SSL VPN, Microsoft Remote Desktop Services Gateway, Microsoft UAG and VMware Access Point Security appliance..



Mobile Application Delivery

Rich Mobile applications running natively on Apple iOS, Google Android or Windows Phone are delivered by the Mobile Application delivery solution. In enterprise customer scenarios this function is incorporated in most of the Enterprise Mobility Management or Unified Device Management solutions but it can be a more consumer focused application store as well. The application store is the interface for application access, rich mobile application delivery, self-service and usage reporting functionality



Web application acceleration

Web Application Acceleration appliances or application delivery controllers accelerate and secure web-architected applications. All of us are encountering these solutions every day. Large public facing internet applications, such as Amazon and eBay, all make use of these devices. Web Application Acceleration solutions are not just useful for large public organizations; you can also use them for your own web applications. Solutions that facilitate web application acceleration and security include products such as Citrix NetScaler and F5 BigIP. Functions of Web Application acceleration are:



- Secure access to SaaS and Web resources, represented by the shield symbol
- Fast and optimized access to web applications, presented by the accelerator symbol

Connection Broker

A connection broker determines which hosted remote applications and desktop will be available to a user. When using a hosted virtual desktop infrastructure for this, it is possible to either designate dedicated desktops or a pool of remote desktops. The desktop broker can automatically create, remove or pause remote desktops.



Application virtualization

Application virtualization can make applications available to desktops, laptops, server-hosted VDI and Remote Desktop Session Host (TS-Terminal Server) platforms. The applications are executed and often isolated on the target platform, without needing to make any persistent modifications to the platform. The advantages of application virtualization include: installation, upgrade, roll-back, delivery speed and the ease of application support and management. The physical installation of applications is no longer necessary, eliminating the possibility of conflicts. The result is a dynamic application delivery infrastructure.



Application layering

Application layering has recently emerged as an alternative way to package and deliver applications separate from the operating system, without having to reinstall them on every desktop. Applications can be layered by running a standard setup procedure. The changes in files, directories, and Registry keys made by the installation procedure are captured as a "layer." When the layer is assigned to one or more desktops, its files and Registry keys are overlaid (layered) with the Windows operating system layer and all other application layers. Layered applications appear in Windows Add/Remove programs, and look as if they are natively installed to Windows and all other applications. The advantages of application layering include: simple installation, upgrade, and roll-back; ease and speed of application packaging; support for Boot 0 applications, device drivers, and other complex applications that cannot be virtualized with traditional application virtualization; and interoperability with all other applications and Windows itself. A key advantage of software layering versus application virtualization is typically a higher rate of application compatibility. The isolation introduced by Application virtualization is both a blessing (for the apps that need it) and a curse (for those that don't).

OS Provisioning

OS Provisioning, or Machine Based Imaging, allows workstations to boot up and run from a central image. A single image can be used simultaneously by multiple workstations. The advantage of this is that complete operating systems, including applications and agents, can be made available quickly and securely. It is possible to make a single image available to multiple VDIs, RDSH, Client Side Virtualization and physical desktop environments without causing conflicts. As a result, it is possible to upgrade or roll-back an OS quickly, simply, and without significant risks. When virtual desktops use OS streaming, (valuable) storage is saved, storage performance is offloaded and the management of virtual desktops becomes relatively simple. This means that virtual or physical machines using OS Provisioning can become stateless devices.



Server-Hosted Desktop Virtualization (VDI)

VDI with GPU acceleration, 3D graphics for Virtual Desktops

3D graphics for virtual desktops can be a server-hosted VDI solution. It provides each (virtual) machine with (GPU) graphic performance to run multimedia, 2D/3D, office, browsers, design and engineering applications. The GPU can be shared, dedicated or virtualized for the Virtual Machine or Terminal Server environment. Display data is presented to the client device via an optimized remote display protocol. To ensure that the end-users experience the best possible performance, the bandwidth, latency, or local (software/hardware) components have to meet extra requirements.

Session Virtualization (RDSH)

Session Virtualization, also known as Terminal Services or Remote Desktop Session Host (RDSH), is a solution for the remote access to desktops and applications that are run on a terminal server in a data center. With this virtualization variant, every user has his or her unique (terminal server) session, but not his or her own virtual machine. Access to the desktop or application is not tied to a location or end-user machine, and programs are executed centrally on the terminal server. The data appears on the client screen through a remote display protocol such as Microsoft RDP/RemoteFX, Citrix ICA/HDX, VMware PCoIP/Blast.

Remote Desktop Services consists of various infrastructure components for management, load balancing, session control and support. It has the advantage that applications are made available quickly and securely, the TCO is low, and applications can be accessed irrespective of location or work place.

While this document is not the proper place for a discussion of the pros and cons of RDSH vs VDI, it is important to note that RDSH does have a greater chance of limitations around application compatibility due to being based on a server operating system, whereas VDI is most often delivered via a client operating system.

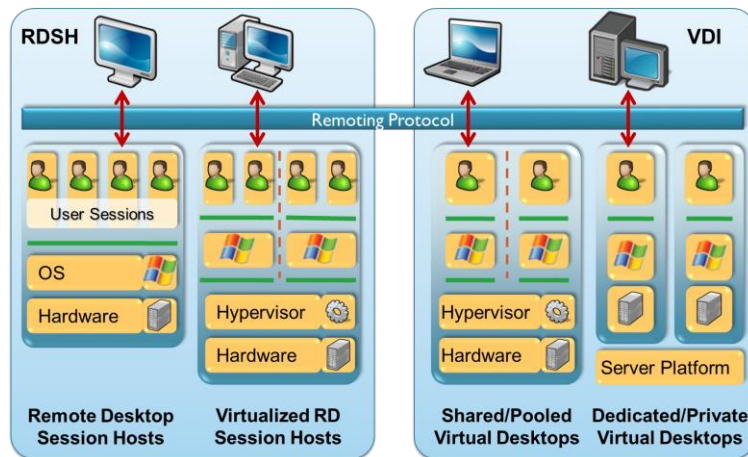


Figure 1, SBC and VDI overview. source: TeamRGE

Client-Side Desktop Virtualization

Client-side desktop (CSV) virtualization is a solution where the virtual machines run locally on the client endpoint device. The client hypervisor ensures that each virtual machine is hardware-independent, and makes it possible to simultaneously use a number of virtual machines at the same workstation. The hypervisor plays an essential part in client-side VDI solutions while the management portion handles synchronization, policy, enforcement and management insights.

The two types of Client-side Desktop Virtualization solution are:

- Client hosted hypervisor is installed and runs as an application on the operating system (be that Windows, Mac OS X or Linux) of the end device. This offers great flexibility of endpoint hardware and operating system compatibility at the expense of less performance.
- 'Bare-metal' client hypervisor acts as the device's base operating system and mostly must be installed before other operating systems. In case of Hyper-V in Microsoft Windows Client the solution is already part of the Operating system. Bare-metal client hypervisors offers great performance at the expense of more limited hardware and operating system compatibility. Since a bare metal solution requires quite often a low level installation on the target device, latest versions of Windows Client and more advanced hardware requirements it is rarely an acceptable solution for the modern BYO (Bring Your Own) model of compute.

The most important differences between the two types of client-side desktop virtualization solutions are around usage in BYO scenarios, hardware support, performance, manageability and end-user experience.

Workspace Aggregation

The term Workspace Aggregator is used to describe software that unifies the delivery of multiple application or desktop types such as:

- Native mobile applications
- Software as a Service (SaaS) web applications
- Windows applications delivered through application virtualization or direct installation
- Local desktops, server-hosted virtual desktops (VDI) or published desktops in RDSH/Terminal Services



A workspace aggregator ideally evaluates the user's device to determine which applications are available for this user on this particular device and at this particular time (context-aware access). In addition to application delivery, workspace aggregators provide secure file system (data) access from a broad range of devices. A workspace aggregator simplifies the deployment and life cycle management of applications. As the single point of access, (de)provisioning, auditing and monitoring is easily accomplished through security rules and policy enforcement. Workspace aggregators that are available at the market today also Identity Management, Self Service and provide Single Sign-On (SSO) capabilities to applications.

Client management

The majority of professional IT organization use a client management solution, as it is needed to facilitate things such as OS deployment, patch management, application and client deployment, asset management, service desk integration, and remote control.

Functions of Client Management (in the context of Application and Desktop Delivery) are:

- Deliver and manage Windows/Linux applications
- Deliver and manage Operating systems, e.g. Linux, Windows Client, Windows Server



2.2 VENDOR MATRIX, WHO DELIVERS WHAT

In this whitepaper various vendors are mentioned. A vendor overview is provided in this matrix. Some of the vendors/products aren't available anymore because of an acquisition or discontinued product.

Vendor	Product	Solution
Citrix	XenDesktop	VDI
Dell	vWorkspace	VDI
Ericom	PowerTerm WebConnect	VDI
Microsoft	VDI with RemoteFX	VDI
NICE	DCV	VDI
RedHat	Enterprise Desktop Virtualization	VDI
NimBoxx	VERDE	VDI
VMware	Horizon (formely Horizon View)	VDI
Citrix	ICA/HDX	Remote Display Protocol
Dell	EOP/RDP	Remote Display Protocol
Ericom	RDP/Blaze	Remote Display Protocol
HP	Remote Graphics Solution (RGS)	Remote Display Protocol
NComputing	Proprietary transport protocol – UXP	Remote Display Protocol
Microsoft	RemoteFX/RDP	Remote Display Protocol
NVIDIA	GRID	Remote Display Protocol
Oracle	ALP	Remote Display Protocol
RealVNC	RFB	Remote Display Protocol
Nimboxx	SPICE	Remote Display Protocol
VMware	PCoIP/Blast	Remote Display Protocol
Teradici	PCoIP	Remote Display Protocol
Citrix	XenDesktop HDX3D Pro	Server Hosted- Physical Desktops
Ericom	PowerTerm WebConnect	Server Hosted - Physical Desktops
HP	Remote Graphics Software (RGS)	Server Hosted - Physical Desktops
VMware	Horizon View	Server Hosted - Physical Desktops
Teradici	PCoIP	Server Hosted - Physical Desktops
Citrix	XenClient (EOL)	Client Side Virtualization, bare metal - centrally managed
Microsoft	Windows 10/10 Client Hyper-V	Client Side Virtualization , bare metal - not managed
Nimboxx	LEAF	Client Side Virtualization , bare metal - centrally managed
Bromium	vSentry	CSV, Security
Citrix	DesktopPlayer for Mac/Windows	CSV, Type-2 hypervisor - centrally managed
Intel	DeepSafe	CSV, Security
VMware	Player/Fusion/Workstation/Flex	CSV, Type-2 Hypervisor – Flex centrally managed, the rest not managed.
Citrix	Provisioning Services / MCS	OS Provisioning

solutions overview and feature comparison matrix

Vendor	Product	Solution
Citrix	Personal vDisk / AppDisk	OS Provisioning++
Double Take	Flex	OS Provisioning
Dell	Streaming Manager (WSM)	OS Provisioning
Dell	HyperDeploy	OS Provisioning
VMware	Horizon View Composer	OS Provisioning
VMware	Horizon Mirage	OS Provisioning++
Unidesk	Unidesk	OS Provisioning++
Nimboxx	Dynamic Gold Imaging	OS Provisioning
NComputing	vSpace Server Software	Session Virtualization
Microsoft	Windows Server 2008R2/2012/2012R2	Session Virtualization
Microsoft	Azure RemoteApp	Session Virtualization -aaS
Citrix	XenApp	Session Virtualization++
Dell/Quest	vWorkspace	Session Virtualization++
VMware	Horizon View	Session Virtualization++
Cisco	ISE	Secure Access
Citrix	NetScaler Gateway	Secure Access
Ericom	Ericom Secure Gateway	Secure Access
Juniper	SA / MAG	Secure Access
Microsoft	Unified Access Gateway / RDG	Secure Access
VMware	View Security Server, Access Point	Secure Access
Cameyo		Application virtualization
Numecent	Cloudpaging for Enterprise	Application virtualization
Microsoft	App-V	Application virtualization
Symantec	Workspace Virtualization	Application virtualization
Turbo	Turbo	Application virtualization
VMware	ThinApp	Application virtualization
Citrix	AppDisk/Personal vDisk	Application layering
FSLogix	Apps	Image Masking, App and Profile Layering
LiquidwareLabs	FlexApp	Application layering
VMware	Mirage	Image and Application management
VMware	AppVolumes	Application layering
Unidesk	Unidesk	OS delivery and application layering
IBM	BigFix	Client Management
LANDesk	Client Management Suite	Client Management
Microsoft	System Center Config Manager	Client Management
Novell	ZenWorks Configuration Mgr	Client Management
RES	Automation Manager	RunBook Automation
Symantec	Client Management Suite	Client Management
Citrix	Storefront	Workspace Aggregator
Centrix	Workspace Universal	Workspace Aggregator
VMware	Horizon Workspace / IDM	Workspace Aggregator

Vendor	Product	Solution
AMD	FirePro	GPU enabling technology for 3D Graphics DV
Intel	Intel Graphics Virtualization Technology (Intel GVT) / IrisPro	GPU enabling technology for 3D Graphics DV
Intel	Intel VT for Directed I/O (Intel VT-d)	Enabling technology for direct assignment of virtual machines for virtual functions
HP	Remote Graphics Software	Enabling technology for 3D Graphics DV
NVIDIA	GRID, Quadro and Tesla	GPU enabling technology for 3D Graphics DV
Teradici	PCoIP	Enabling technology for 3D Graphics DV
Amazon	AWS (G2 instances)	Enabling technology for 3D Graphics DV - DaaS
Microsoft	Azure (N-Series)	Enabling technology for 3D Graphics DV - DaaS
Fra.me		3D Graphics DaaS
Citrix	(Workspace) Cloud	3D Graphics DaaS (basic 3D graphics)
OTOY	Cloud Workstation	3D Graphics DaaS
VMware	Horizon Air	3D Graphics DaaS (basic 3D graphics)

Table 2, Application and Desktop Delivery overview of solution area, products and vendors.

3. APPLICATION VIRTUALIZATION

The previous chapter gave an overview of 'Application and Desktop Delivery' solutions. This chapter describes application virtualization in more detail.

3.1 VIRTUALIZATION

Virtualization is the act of isolating or unbinding one computing resource from others. Or – to put it in another way - the process of decoupling layers of IT functions so that configurations of the layers become more independent of each other. As a result, virtualization masks the specific nature of IT resources from users. A user sees the function, not the resource that delivers the function.

Application virtualization is an essential and critical component for all desktop delivery solutions. The term 'Application Streaming and Virtualization' is often used by customers and IT-Pro's, although it's rarely fully understood. To understand the true meaning it's best to break down into constituent parts:

Application: These are the end-user focused Windows and web programs, executed on a Windows Operating System Platform.

Streaming: is the process of transporting the application specific data/content as quickly as possible to the end-point. The application is quick-up-and-running where ultimately the required resources to run and use the application is being delivered to the user while the remaining data is transferred in the background.

Virtualization: is a software layer that improves portability, manageability and compatibility of applications by encapsulating them from the underlying operating system on which they are executed. A virtualized application is not "installed" in the traditional sense, although it's still executed and behaves as if it were. Virtualization isn't emulation.

3.2 WHY APPLICATION VIRTUALIZATION?

In conversations with customers during workshop sessions we regularly receive the questions: Why do we need application virtualization, what are the benefits and downsides of application virtualization and what is the difference between application deployment and virtualization?

The primary reasons for implementing application virtualization are:

- Applications are quickly and easy delivered.
- It is simple and easy to upgrade applications.
- The rollback to prior application versions is simple.
- There is no need to "install" applications anymore.
- Elimination of application conflicts.
- Reduce regression testing time.
- Allow multiple versions of the same application to be run simultaneously on multiple versions of Windows Operating System, greatly reducing the number of server silos.

- Allow non-multiuser versions to run simultaneously in a session virtualization environment.
- There is no need for application load managed groups, or so called 'silos' allowing consolidation of remote desktop services session hosts.
- It reduces packaging complexity.
- It stabilizes (Windows) user profiles.
- Application virtualization is an essential part in 'layering' of OS | Applications | user configuration.
- It's an important component in the complete application and desktop delivery stack.
- Application virtualization creates dynamic user environments in a static pooled server hosted VDI and SBC environments.
- Improves end-user mobility – access personalized applications from any machine and a per-user application entitlement model.

The attention points, or challenges, of implementing application virtualization are:

- Not all (Windows) applications can be virtualized.
- Integration between (Windows) applications and the operating system can be challenging.
- Performance penalty of application virtualization solution.
- Different way of application packaging which can have impact on packaging tools and knowledge of packagers.
- Vendors that won't support apps that have been virtualized, sequenced, repackaged.
- Troubleshooting is different to deployed applications and can be challenging.

With application deployment, the applications are installed on the execution platform. The execution platform could be a local desktop or laptop, a server hosted virtual desktop (VDI) or a remote desktop server session host (SBC). When speaking of application delivery in the context of application virtualization, the applications are no longer installed, but they are made almost instantly available and executed on the execution platform. The execution platform is not altered. Application virtualization enables fast application delivery in a central and local environment.

3.3 APPLICATION VIRTUALIZATION STRATEGY

The transition to a dynamic and optimized desktop is causing many IT organizations to reevaluate traditional IT operations, deployment, delivery, packaging, support, and management methods. "Static desktops becoming a thing of the past."

Application virtualization is a key component in the optimized desktop. It's important to have a vision and strategy around application and desktop delivery. Designing, building, managing and maintaining the application virtualization infrastructure using the right Technologies, corresponding vendors and products is an important step.

We see a lot organizations primarily focusing on products and vendors and lacking a clear and profound vision and strategy. This approach is fine for a point solutions but a proper vision and strategy is crucial for "tomorrows workspace".

How can the vision and strategy be successful? **success = vision x execution x adoption!**
The business consumer controls IT, adoption of the solution by the business consumers is the key factor for success.

The following *discussions* and corresponding *topics* should be part of the application virtualization and optimized desktop strategy:

- What do you want to achieve, a business enabler, overall cost of ownership (TCO) and cost reducer?
- What are the use-cases? And does the use-case require application virtualization?
- What is the business-case?
- Are you investigating a tactical (point) or strategic solution? What do you want to solve?
- What's your Desktop delivery and migration strategy for Windows 7/Windows 10?
- What endpoints do you support and facilitate and what is the role of these devices in the optimized desktop?
- Are the endpoints managed?
- What is the strategy around Unified Device Management, Client Management, PC Life Cycle Management solution and how does application virtualization fit?
- Is a Bring Your Own Device (BYOD) concept one of the key access scenarios?
- What is your application delivery model? Is delivery of applications focused on SaaS, Enterprise, SMB or the Consumer space?
- Are billing, license-management, reporting and/or charge-back of the delivered applications needed?
- Is a client or agentless application virtualization solution required?
- Do you need to integrate and/or isolate your applications from each other or from the OS? Do you need both functionalities and how do you manage the application integration?
- What is the expected packaging success ratio of virtualizing applications? How do you handle the 'exception' applications which can't be virtualized?
- Is the strategy 'package once runs everywhere' important? What are your expectations?
- Is there a substantial performance impact adding the Application virtualization solution? Maybe www.projectvrc.team can help?!
- How do you design and build the user's profile and his 'workspace'? Does Application virtualization fit into this strategy? Maybe the 'User Environment Management' Smackdown can be helpful.
- Licensing of the application virtualization solution. Stand-alone, part of a license stack? Is Microsoft Software Assurance or other subscription form needed, when needed is it available?
- What is the (business) application's vendor support policy for virtualized applications?
- Is the IT department able to adopt the technology with the right knowledge and skills?
- Does the IT department understand application virtualization and the impact on troubleshooting and the corresponding tools?

- What is the virtual application integration strategy? Applications part of base image, basic application load set or virtual environment integration?
- How do you handle internet explorer plugins; URL redirection and File Type Handlers?
- How do you handle application compatibility issues such as IE6 and Java components while migrating to Windows 7/ Windows 10?
- What is your application readiness assessment strategy? Are Windows 7, Windows 10, VDI, application virtualization and x64 included?
- What is your average package turnaround time (incl. testing)? Where do you spend most of the time?
- How often are your applications updated? How quickly do you need to push them out? How big are the updates?
- Is application conversion to virtual application packages important?
- Is an open, standardized and extendable application package format key?
- Does the application virtualization solution need to be proven and mature? What is your definition of proven?
- Do you need to convert current application packages to the new virtual application package?
- What's your overall desktop delivery strategy model with solutions such as Laptop (Offline), Desktop (Online), VDI and SBC. How can application virtualization enhance these solutions?
- Does the application virtualization solution offer shared-cache or cache-less functionality? What is the use-case?
- How does the Application virtualization solution fit into existing deployment and management tools?.

Bottom Line: What's your current Application and Desktop Delivery strategy?!

3.4 WHAT'S IN A NAME?

In the haze of messaging and marketing around application virtualization, different names can blur the application virtualization arena; therefore it's good to have definitions of streaming, virtualization, isolation, integration and redirection. The name 'client' or 'end-point' can be a desktop, laptop, virtual desktop or terminal server. Managing expectations is always hard; a good starting point is to make sure everyone speaks the same (IT) language. It is important to note that not all vendor implementations support all aspects of the definitions provided below.

3.4.1 Streaming

The delivery process of transporting the application specific data/resources to the end-point at the time the application is executed is called streaming. The application is quick-up-and-running and only the minimum amount of data (usually between 10-30% of the total application) is delivered to a client before the application is launched. Not only does this result in a quicker first time application launch for the user, it also results in significantly reduced load on the network (compared with full application distribution pre-caching) and makes it possible to keep end-user images "stateless". Additional features of an application are delivered on demand, or 'in the background' without user intervention. Application packages are stored on a (centralized)

server, which can be a dedicated or shared infrastructure component. The streaming protocol transports the data over the network in an optimized, efficient and secure way.

Streaming can operate at a file-level (whole files are copied when they are needed) or block-level (file chunks are copied when they are needed) and can cache resources locally on the endpoint for offline execution or faster subsequent startups. Streaming is particularly effective in well-connected environments where applications should be executed on-demand from a network resource and end-user images should be kept stateless – e.g. VDI and SBC.

3.4.2 Application virtualization

The process where applications are encapsulated or isolated from other applications and the underlying Windows Operating System on which they are executed is called Virtualization. This improves portability, manageability and compatibility and reduce conflicts of windows 'end-user' applications. Virtualized applications run in their own discrete, or virtual, environments.

Application virtualization requires a virtualization layer that replaces part of the runtime environment normally provided by the operating system. The layer intercepts all function calls to the Windows Operating System such as File, Registry and objects such as COM and DCOM. The application is executed inside the Virtual Environment, (sometimes called bubble or sandbox) and behaves as if it is running alone in the Operating System. So the underlying Operating System is protected, since the application virtualization prevents changes to system components. Applications can use the hardware and software components that are installed and available inside the Operating System. While most application virtualization technologies today provide an adequate level of isolation between applications, thus preventing app-to-app conflicts, very few provide full OS isolation and are able to prevent app-to-OS conflicts. A quick summary of what application virtualization must provide:

1. All resources required by the virtual application are included in the package
2. The virtual application is completely separated (virtualized/isolated) from the operating system and other applications
3. The virtual application cannot write to the OS file system or registry, or modify the native OS in any way. The application virtualization solution is of course able to write to specific locations to save documents etc.
4. The virtual application must operate the same way as a natively installed application and provide full OS shell integration, inter-process communications, etc.

3.4.3 Application Installation

Application installation is the process where Windows Applications are installed on the Windows Operating System. Installed applications are fully integrated with the system and are able to communicate with other installed applications and the Operating System itself.

The Windows Installer (MSI) is the standard used for the installation, maintenance, and removal of applications. The installation information, and often the files themselves, are packaged in installation packages known as "MSI files". Applications that are installed and integrated don't run in a sandbox environment.

3.4.4 Agent-less

Client-less, or agent-less, application virtualization involves the use of an embedded virtual OS that is deployed as part of the virtualized application. While creating the virtual application package, the application and client components are compiled and stored in one single container, mostly a single executable. These virtualized applications are fully encapsulated and able to run as a standalone executable from multiple locations such as a network drive, local drive, or USB removable storage device. Every virtualized application contains a 'built-in' agent. So no agent, or client-component, is installed in the Operating System but every application has an agent which is used at runtime. VMware ThinApp and Turbo are examples of agent-less application virtualization solutions.

3.4.5 Agent-based

Client-based, or agent-based, application virtualization involves the use of a locally installed agent or client on the endpoint. This agent or virtualization engine, contains functionality to setup and maintain the Virtual Environment for each application. The agent takes care of management tasks such as Shortcut creation, File Type Association (FTA) registration and is a key component in the streaming behavior. This behavior is a key functionality for agent-based application virtualization solutions such as Microsoft App-V.

3.4.6 Kernel and user mode

Windows runs all code, application and services, in one of two modes, user-mode and kernel-mode. The two modes reflect two different security models. Code running in kernel-mode has full Operating System access. Kernel-mode code typically comes from device drivers and the Windows kernel itself. A kernel-mode driver or service is part of a locally installed agent on the endpoint.. Problems when executing code in kernel mode can quickly lead to complete system halts (Blue Screen Of Death). Kernel mode drivers require admin privileges to be initially installed. User-mode agents don't. Code running in user-mode does not have full Operating System access and there is no direct interaction with the kernel of the endpoint's Operating System.

3.4.7 Portable apps

Portable applications are software programs that are able to run independently without the need to install files to the system they are run upon and irrespective of the version of Windows installed on the system. They are commonly used on a removable storage device such as a DVD, USB flash drive, or flash card. Agent-less application virtualization may convert even complex application into portable apps.

3.4.8 U3

U3 is a proprietary method of launching windows applications from U3 compatible USB drives. Applications that comply with U3 specifications are allowed to write files or registry information to the host computer, but they must remove this information when the USB flash drive is ejected. Customizations and settings are redirected and stored with the application on the flash drive. This isn't a virtualization technology, but has its use-cases though.

3.5 WHAT IS THE BEST APPLICATION VIRTUALIZATION SOLUTION?

What is the best application virtualization solution? Is this solution, agent-less running in user-mode, agent-based running in kernel-mode or a more integrated virtualization solution?! Can the solution balance between the fully isolated or virtualized world and more open 'integrated' world? Good questions! 😊

There isn't a single best answer about which solution is the best solution. Use-cases, delivery mechanism, client-management, security, application integration are just some important topics in this discussion. The Application virtualization strategy written in paragraph 3.3 is the key to the question: 'What is the best application virtualization solution?'

4. APPLICATION COMPATIBILITY AND READINESS

4.1 MIGRATION

The use of Application virtualization, Windows 7, Windows 10 and Virtual Desktop Infrastructure (VDI) brings much new functionality and drives upcoming use-cases such as Bring Your Own Device (BYOD). Today, users expect greater flexibility, freedom and functionality on their end-point devices, whereas the IT organization is focused on cost reductions, manageability and compliancy. The migration of applications to a new Operating System platform, such as Windows 7 or Windows 10, has a huge impact on the planning, design build and migration to the optimized desktop especially when x64 Operating System and application virtualization is involved. The main questions in such a migration are:

- Can I run my set of applications on Windows 7 or Windows 10?
- Are the applications suitable to virtualize, which are not and why not?
- Do I run into trouble using Internet Explorer 8/9/10/11 with my stack of web-architected applications?
- Can I move to 64-bit Windows?
- Can I use these applications in VDI and SBC scenarios, what is their resource impact?

There are various solutions on the market designed to address these questions. Some are free and limited but in some cases useful; others are more expensive and valuable. Solutions like Microsoft Application Compatibility Tool Kit (ACT), Dell Changebase and Citrix AppDNA play an important role in application compatibility, readiness and remediation. Solutions such as Changebase and AppDNA examines application compatibility and gives insights to remediation which results in a simpler, less risky and more controlled migration to a new or updated platform.

The decision flow chart for application compatibility projects is useful to determine the steps and solutions to solve application compatibility issues. Technologies used in alternate provisioning strategies are VDI, Remote Desktop Servers Session Host, SBC or client-side Desktop Virtualization.

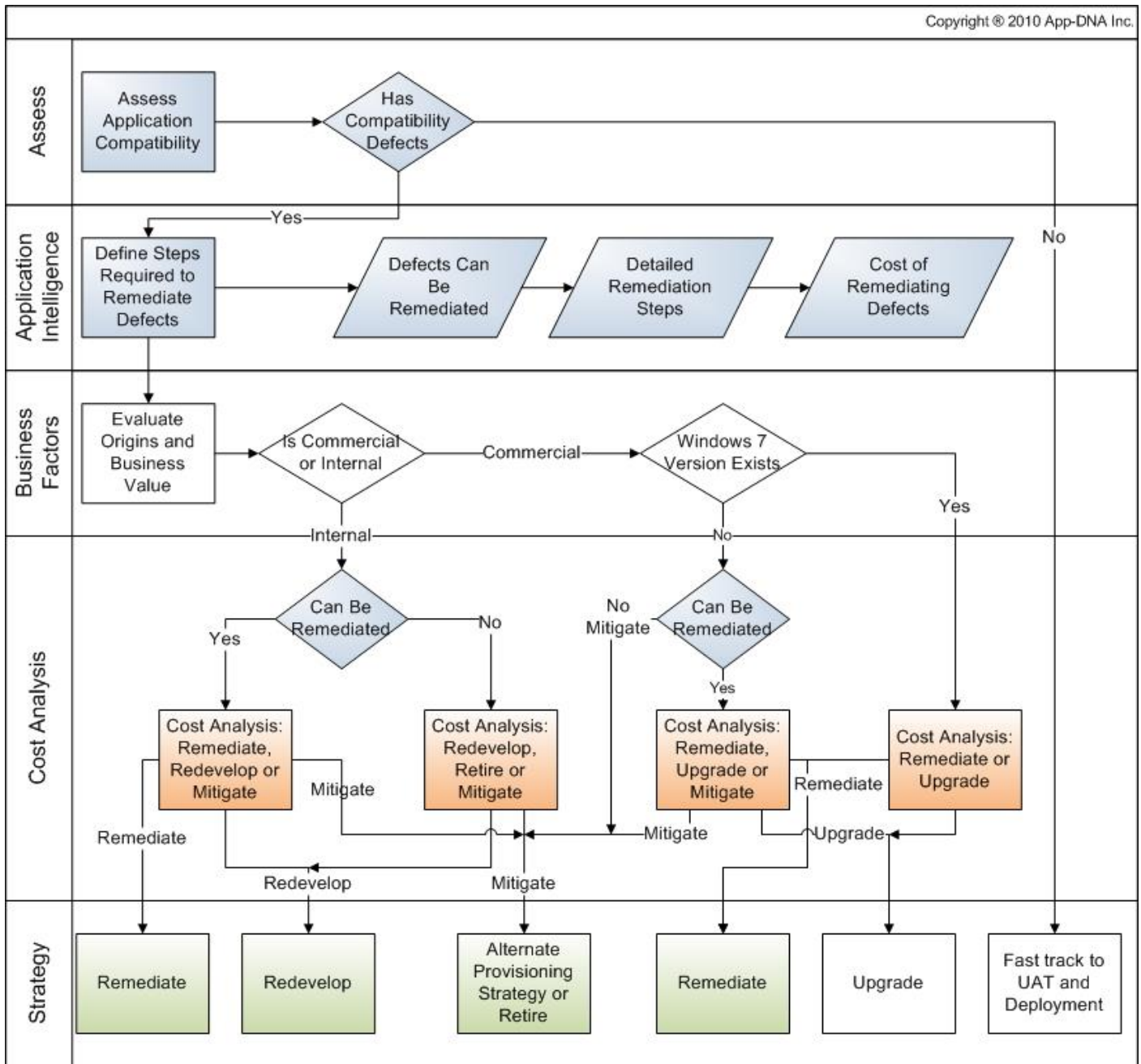


Figure 2, Application Readiness Flowchart

5. APPLICATION VIRTUALIZATION AND VDI

Application virtualization is an essential component required for a successful VDI implementation. In general, there are two types of virtual desktops in a server-hosted VDI environment: pooled or personal. In this chapter both types are explained and why it's beneficial to use application virtualization to deliver applications to users in a server-hosted VDI environment. When deploying sever-hosted VDI, you may be required to host hundreds of applications on the same server. In which case the isolation capabilities of application virtualization may be very important to you.

If deploying personal virtual desktops, installing applications locally on these desktops creates a management headache, as traditional installs are not as dynamic in nature as virtual applications and thus SaaS is not realistic. You may deploy applications using traditional distribution tools in a per user install mode but this produces a poor end user experience, you would also require to carefully plan storage requirements and likely deploy persistent desktops, not non-persistent.

Application virtualization solutions such as the majority of those listed in this document enable you to dynamically deploy applications as SaaS. Many can also run from a file share, never committing any writes to the desktop e.g. Shared Content Store in App-V. Ensuring you can safely deploy virtual applications to non-persistent desktops.

5.1 OVERHEAD AND STORAGE IMPACT

In an infrastructure where users have a dedicated physical desktop to work on, the overhead (CPU/memory/disk) of application virtualization isn't a big concern. But in a shared environment like hosted VDI or Remote Desktop Services Session Host, the overhead of application virtualization is something to take into account. Application virtualization might have effect on:

- **CPU/Memory**

The virtualized applications might use more CPU cycles and/or memory than locally installed applications. This might affect other users on the same server in a Remote Desktop Services Session Host, or SBC, environment or users on the same host in a hosted VDI environment.

- **Network**

Virtualized applications are often streamed to the user's desktop or session. Depending on the size of the virtualized application and the distribution method the application virtualization solution is using, this might have an impact on the network.

- **Storage**

Firstly - the size of the virtualized applications can be important for the disk sizing of the physical desktop or laptops or Virtual Machines. The application virtualization solution can use a caching method where the virtualized application is cached on disk. When hosting a large number of virtual desktops, the caching of the virtualized applications takes place in

these entirely virtualized desktops - this can take up a lot of disk space. Whenever possible, a shared caching method should be considered or one should use application virtualization solutions which don't use a local cache at all.

Secondly, impact on IO's on the storage cannot be taken lightly. On a physical desktop the number of IOPS is the last thing to worry about, but with shared storage this is one of the biggest challenges in a VDI project. *"User experience is king, blazing fast solid state storage is the standard for a modern workspace."*

Example tools to inventory and analyze the behavior of applications are [Liquidware Labs "Stratusphere FIT"](#) and [Lakeside Software "SysTrack"](#). These collect metrics to help determine suitability for application virtualization.

5.2 APPLICATION VIRTUALIZATION IMPACT ON VDI

Depending on the use case scenario, [Project VRC](#) discovered that this impact can be significant. Test results show that application virtualization has impact on the VDI user density, which can be decreased by up to 45%. The impact depends of the configuration, for instance if Microsoft Office is virtualized. This should be considered as a worst case scenario. When only a couple of specific (business) applications are virtualized, the session density decreases by only 3% to 12%. Do you want to know more about the performance impact and best practices of Microsoft App-V 5.0 in a VDI scenario? more information at www.projectvrc.team

In practice the application virtualization overhead will be highly dependent on how often virtualized applications are started, and how much file IO and registry access these virtualized applications generate: specifically the creation of the virtualization 'bubble'/environment for the application can have a significant overhead.

Both Microsoft App-V and VMware ThinApp are very close in overall performance overhead, resulting in very similar VSImax scores. However, Citrix Application Streaming overhead was considerably higher: the overhead is currently more than App-V and ThinApp. The highest VSImax score was achieved with ThinApp 4.6, where the ThinApp packages were locally stored in the VM image. From a disk I/O perspective VMware ThinApp showed the least overhead throughout the test.

Interestingly, the response time of the file-open dialogue is much higher with Citrix Streaming, this clearly impacts VSImax results. Also, it is interesting to see how application virtualization is maturing, for instance ThinApp 4.6 clearly outperforms ThinApp 4.5 in our tests.

The storage impact on read and write IO was also investigated and the general conclusion is that streaming applications will decrease the read IOs by 20% to 44% and increase the write IOs by 20% to 44%. From a management point of view, choosing on demand application streaming as the delivery method brings considerable management benefits and will offload read IO's. However, the impact on write I/O's should not be neglected.

Project VRC highly recommends validating the data in the VRC whitepaper carefully. Project VRC realizes that there are always valid reasons not to use specific settings as mentioned in the VRC whitepaper. Real world VDI environments will always be different from the test-setup in the [Project VRC](#) labs. More importantly, Project VRC must emphasize that it is crucial to test and validate these optimizations in your own environment.

6. VENDORS AND THEIR VIRTUALIZATION SOLUTIONS

6.1 INTRODUCTION

To get an overview of the major players in the application virtualization space, a number of solutions are explained in this chapter (sorted alphabetically by vendor). The goal of this chapter is to enable a better understanding of the options in this space from a vendor perspective.

Note: The vendor solution descriptions are mainly provided by the vendors. However, we have attempted to remove the marketing fluff wherever possible.

6.2 CAMEYO

For years, [Cameyo's](#) virtualization technology focused entirely on bringing entire application environments into one single executable that can run anywhere, and whose usage will not affect or modify your system. Recently, Cameyo released a version of their product which provides the ability to host applications and allow the apps to be run embedded within the browser using RDP & HTML5. As this uses HTML5, there's no requirement to install an agent or plugin. This also enables the use of your favorite Windows applications from any device with a browser. Further to this, Cameyo recently released a free app in the Google Play store to access and run your Windows applications.

Cameyo's purpose is to bring the benefits of application virtualization to everyone, with 4 fundamentals: Cloud, Simplicity, Light weight and performance. The idea of Cameyo was born by thinking about how Windows applications should be like in today's era of Internet and mobility. Since its first release, the product has been through an average of 1 new major version each year, and 2-3 minor versions yearly. Each major version brings considerable improvements. Cameyo has been the first app virtualization product to offer a collaborative cloud-based apps library. They have also invented online virtual app packaging and editing. They plan to continue and innovate in this field.

Cameyo has hundreds of thousands of users worldwide and exists in 10 languages. There are three different versions of the solution available. Free, Enterprise and Developer. Differences between the various versions can be found [here](#).

6.3 CITRIX APPLICATION STREAMING

Note: Since early 2013 Citrix stopped developing Citrix Application Streaming and recommends customers to use Microsoft App-V when customers are migrating to newer platforms such as Windows Server 2012R2 and Windows 8.x or newer.

Client-side application virtualization technology in Citrix XenApp is comprised of two main functionalities: *application streaming* and *application isolation*. The application streaming feature enables applications to be delivered to client devices and run in a protected, virtual

environment. Applications are managed in a centralized application Hub, but are streamed to the client device and run in an isolation environment. Applications become an on-demand service that is always available and up-to-date.

THE CHALLENGE

The reality today is that many companies are hitting a wall of complexity when it comes to managing their ever-growing number of desktop applications and diverse access scenarios. This complexity translates into a huge amount of time and money spent providing what amounts to a patchwork solution.

APPLICATION STREAMING OVERVIEW

Client-side application virtualization reduces the cost of testing, installing and supporting applications. Using isolation and application streaming technologies, client-side application virtualization enables local virtualized applications. Rather than installing applications on each user's PC, applications are streamed to a protected isolation environment on their client device. The isolation environment controls how applications interact on the user device, which prevents application conflicts.

Streaming applications into the isolation environment greatly accelerates their delivery by reducing regression testing and simplifies management with streamlined maintenance, upgrades and de-provisioning. In fact, using streaming for de-provisioning an application is the most efficient method of removing all traces of an application. Caching technology makes applications available even when users are not connected to the network.

With server-side application virtualization, the server acts as the client. Applications are streamed to a protected isolation environment on the server as opposed to the local device. This has many of the same benefits of client-side application virtualization and also helps reduce application silos and greatly improves management of Citrix XenApp farms.

KEY BENEFITS

As a key component of both client-side and server-side application virtualization, Application streaming enables IT to:

- Eliminate application conflicts and OS instability resulting from desktop application installation
- Reduce the costs associated with regression testing, deployment, maintenance, updates, and de-provisioning for applications running locally on users' machines
- Offer applications as an on-demand service
- Lower support costs by automatically updating and repairing applications every time they are used
- Speed regulatory compliance by eliminating the need for extensive testing to certify applications
- Enhance security by giving IT administrators complete control over applications delivered to desktops, even those of unmanaged partners and users

Citrix Application Streaming landing [page](#).

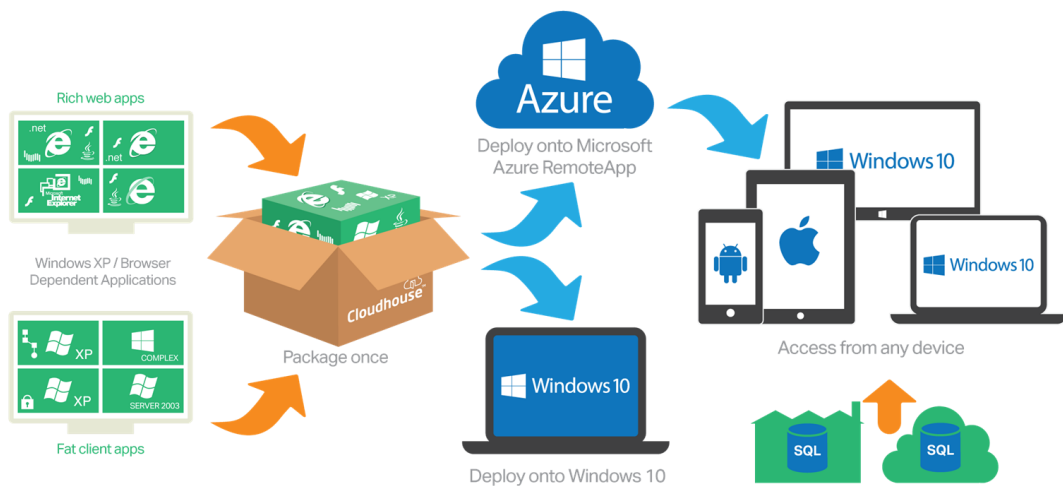
6.4 CLOUDHOUSE

Cloudhouse is an infrastructure software vendor that liberates existing client/server applications to run on modern operating systems and remote deployment environments such as the Azure RemoteApp. The solutions resolve application conflicts, which can occur during operating system upgrades and desktop refresh or transformation projects, and delivers applications in a secure, controlled and managed environment. Cloudhouse’s suite of products can be utilized to complement existing Virtual Desktop Infrastructure / Remote Desktop (VDI/RDS) infrastructure or to address a specific application deployment issue. Users benefit from a simple “click and run” experience and IT can protect investment in existing software whilst decreasing costs and improving performance and having the freedom to choose whether to benefit from modern deployment platforms and data storage options

Cloudhouse has two products: Application Anywhere and Data Anywhere

Applications Anywhere: Applications Anywhere is a 2nd generation application virtualization product that, with minimal time and effort, automatically packages any Windows application to remove platform dependencies. Once packaged, Applications Anywhere enables centralized software distribution, configuration management, access, user licensing and entitlement, thus reducing on-going management costs.

Data Anywhere: Data Anywhere is a distributed WAN Accelerator for database traffic, delivered as an infrastructure software product. It provides a secure, reliable and accelerated connection between any Windows application and its database, regardless of database location. This means that any client/server application may be distributed to run over a WAN, either to enable remote access to on-premises systems without the need for server-based computing, or to migrate application and/or database servers into consolidated data centers or the Cloud



Application virtualization decouples applications from underlying infrastructure by creating a virtual file system and virtual registry to provide the file and registry resources to the application at runtime. The 1st application virtualization generation approach was to create a virtual full replica of the Windows file system and registry and all the APIs that applications use to interface with them. However, this caused two major issues. Firstly, local applications had no way to access the virtual file system and registry so many application integrations are unable to work. Secondly, it meant that all of the APIs that applications use to communicate with the file system and registry had to be re-implemented in the Application Virtualization technology. This means that many applications are unable to be virtualized as it is impossible to correctly re-implement the more than 14,500 APIs, many of which are undocumented.

By comparison, Applications Anywhere takes a completely new approach, Cloudhouse uses the term Lightweight Application Virtualization. It works by automatically deploying application binaries and registry to locations controlled by Applications Anywhere on the local system. This means that instead of fully re-implementing the file system and registry in a virtual layer, only the initial API calls need redirection into the Applications Anywhere locations. Thereafter, any remaining API calls are carried out natively using local file system and registry resources from the Applications Anywhere locations. This occurs in a completely transparent manner to the application and means that all applications may now be virtualized no matter what complex APIs it uses, and integrations just work automatically. In order to virtualize existing Windows applications, Applications Anywhere provides an Auto Packager that automates the entire process.

Applications Anywhere adds additional management capabilities to enable centralized software distribution, configuration management, access and entitlement, thus reducing on-going application management costs. It includes an advanced deployment engine to deploy, configure and centrally manage the application from any remote server or Cloud location. Licenses can be controlled by user, machine or by concurrent licensing allocated to users or groups within a company. Also offline usage is supported for applications that are stand-alone or can work offline, with a defined offline grace period to limit how long users can go offline without communicating with the management serve.

Applications Anywhere also manages application configuration to tailor application behavior for any given set of end users. Packaging decisions can be made dynamically based on environmental information, like deploying 64 bit files to a 64 bit OS and 32 bit files to a 32 bit OS, or the DLLs in the correct language for the end user. Custom fields in the management portal to allow any configuration values to be passed to the application. These values can then be used to change the contents of files, like .ini or .xml configuration files, or change the registry values.

Finally, if required, Applications Anywhere can optionally deliver a self-service catalog capability for end-users to see which applications they are licensed to run and to self-deliver those applications with Cloudhouse's "Click & Run" technology

What does Cloudhouse solve:

- Web applications that are tied to IE 6/7/8/9/10

Applications which are tied to older browsers can be packaged within a Cloudhouse container and deployed onto Windows 10 or Azure RemoteApp without any change to source code. Furthermore, the browser can be locked down and delivered with the runtimes and configuration required by the web application. Restricting the user to approved URLs used by the corporate application means that browser vulnerabilities are no longer exposed through user browsing of external web pages. The container can also prevent, if desired, the opening of multiple records from within the app ensuring clinical data compliance.

- Apps that only run on 32 bit versions of Windows /XP applications that can't work on Windows 10 devices (desktops, tablets)
Windows 10 device upgrades can be blocked due to incompatibilities with apps that only run on 32 bit versions of Windows, or mobile applications written to run on non-Microsoft platforms. Cloudhouse containers allow older applications to run unchanged on Windows 10 devices and, when coupled with Azure RemoteApp, they can be deployed from there onto any mobile device.
- Applications requiring remote deployment from their SQL databases across a WAN
Applications can still move to Azure, even when privacy and regulatory compliance demand that their SQL database remains on-premises. With Cloudhouse Azure SQL Accelerator, customers are free to locate applications and their SQL databases where they need them, with performance and security assured. It provides secure, reliable and accelerated database communications across a WAN or between regions in Azure. Azure SQL Accelerator supports ExpressRoute for customers who demand the highest level of application performance.

6.5 EVALAZE

Note: Since 2013 not real updates on product and organization.

German software vendor Dögel GmbH offers an application virtualization product called [Evalaze](#) of which version 1.0 shipped March 2011. Evalaze is an application virtualization solution that converts Windows applications to single executables. Because it is a user mode solution where there are a lot of similarities with the other user mode solutions on the market, such as VMware Thinapp. For example Evalaze doesn't require a client, driver or admin rights on the target systems. Evalazed applications can be run from USB storage devices as well.

In contrast to a lot of the competition, Evalaze also offers a free version of its product to create .exe files. Another difference with the current market is that the vendor offers a virtualization service for customers. When dealing with many or complex applications, the customer can upload their software and download a virtualized version later. Another interesting feature is the possibility to reimport already Evalazed applications so they can be updated without needing the project folders used for creating the virtualized application.

Evalaze is the application virtualization technology used by Applaya from CloudXperts.net to allow users to access their applications and other services from a single console called the

AppIaya Hub. Applications can then be streamed or published using other technologies, like RDS, from a private or public datacenter. See www.evalaze.de for more information.

6.6 INSTALLFREE / WATCHDOX

“[WatchDox](#) acquired InstallFree to provide secure document viewing, editing on Any platform”. InstallFree was an application and virtualization solution and now has been removed from this whitepaper because their focus isn’t application virtualization anymore.

6.7 FSLOGIX

FSLogix Apps is a solution designed to enable IT Administrators to manage the emerging enterprise workspace, reducing the amount of hardware, time and labor required to support physical, virtual, and cloud desktops. FSLogix has developed a couple of solutions such to solve changes around Office365, Onedrive and running multiple Java versions on the same environment. One of the other solutions is called application / image masking to create a single Unified Base Image that hides everything a logged in user shouldn’t see, providing predictable and real-time access to applications and other workspace components like fonts, browser plugins, application add-ons, etc. This approach targets significant reduction in the number of gold images required in an enterprise, license cost optimization, infrastructure consolidation, and performance and density improvements.

Image masking functions identically across a wide range of Windows-based platforms, simplifying the path from traditional to virtual environments, with a single, unified approach to image management, profile access, and application delivery. Installed as a software agent, FSLogix Apps seamlessly integrates with Windows centric desktop virtualization solutions from Microsoft, Citrix, VMware, and other industry leaders. FSLogix has targeted the following three solution areas to address with its FSLogix Apps solution:

1. **Gold image consolidation:** With FSLogix’s Unified Base Image technology, enterprises can combine all applications, plus browser and app plugins, onto a single gold image, or greatly reduce their current number of images. Based on the image masking technique, users see only the applications, plugins and other components that they are licensed and authorized to see, simplifying application delivery across physical and virtualized Windows infrastructures. Every application, extension, font, etc., installed in the Unified Base Image is available in real time to users authorized to access them
2. **User environment virtualization:** Profile Containers are local or remote volumes, which eliminate the need for folder redirection or Roaming Profile optimization, allowing users to have a consistent, familiar, workspace experience with no limitations on the size of the profile or the size of any individual files. This approach solves the problem of large files, and OST.’s in VDI and RDSH. Users and businesses increase productivity by having access to their unique work environment on any device. Unlike other products, FSLogix provides this solution without the overhead of remote servers and additional configuration databases. Slow logon and application launch times are one of the top complaints in virtual desktops. Profile Containers are a new architectural approach to

address this problem. Instead of placing all of the user's files on a network share like in the redirected files approach, FSLogix encapsulates the entire profile –including the registry– in an in-guest container. This advanced filtering approach removes the maximum amount of resource utilization from processing user profile data and eliminates the need for legacy profile products and folder redirection. User profile performance is indistinguishable to local, yet administrators receive the benefits of centralized profiles, including easy off loading for data retention and compliance, with little or no ongoing administration.

3. **Just-in-Time application delivery:** FSLogix supports an unlimited number of Application Containers for situations where combining all applications into a single image is not practical, for licensing or technical reasons. Application Containers may be either local or remote volume libraries. Combining Application Containers with Unified Base Image technology provides the flexibility to IT to use the optimal design approach for their unique requirements.

When using Apps it is not necessary to sequence or package applications. All applications are installed natively using the application's .msi install. From there, FSLogix Apps takes advantage of Active Directory to control the visibility of when any application is visible to individual users or groups.

Installed as a software agent, Apps has key advantages over traditional application virtualization solutions:

- Native application performance. Since applications run natively, performance is not impacted.
- Supports all Windows applications. Platforms can be traditional or virtual desktops.
- No need to sequence or package applications. Since applications run natively, there is no need to sequence or package. Consequently, all applications, including applications with device drivers, are supported (e.g. iTunes, Adobe Acrobat, Citrix and View clients).
- Compatible with existing application virtualization solutions. Complements existing solutions especially for applications that cannot be virtualized.
- Citrix XenApp/RDSH silo consolidation. A single image can contain all virtualized and remote applications for all users, eliminating the need for silos.
- Multiple application versions in the same image. Application versions reside in the image and are assigned to individual users.
- Time-to-deploy significantly reduced. Since no packaging is required, FSLogix Apps can be installed onto existing servers and systems for quick deployment.
- Simplified image management. A single image can contain all versions of all applications for all users.
- Easy license management. Applications can be revealed or removed in accordance with license requirements.
- Compatible with application management systems. Can be used with solutions from a variety of vendors, including Altiris Client Management Suite or Microsoft System Center.

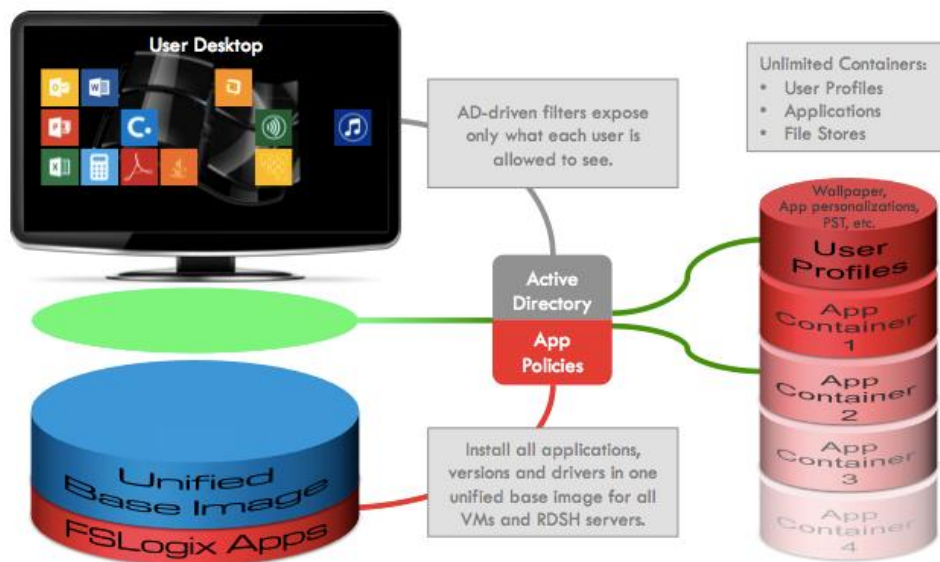


Figure 3, FSLogix Apps overview

The solution areas addressed by FSLogix Apps are sold as a single product, used for:

- Real-time profile access, Java conflict resolution
- Simplified version control, Instant application roll-back
- Silo elimination, License compliance & optimization
- Management of printer visibility, Ability to hide critical data files

6.8 NUMECENT CLOUDPAGING FOR ENTERPRISE

[Numecent](#) (previous known as Endeavours) Cloudpaging for Enterprise is an application virtualization solution designed to deliver any Windows application to any PC, anytime, from anywhere, without the need for downloads or installs. Cloudpaging is an out of the box technology solution for instantly delivering existing Windows software across the enterprise. Cloudpaging Studio creates streamable and virtualized application sets from an original installer. Cloudpaging Server controls and delivers those application sets to the clients. Cloudpaging Player runs on the client machine creating a virtual environment to run the application. Instead of using traditional push technology such as Microsoft Systems Management (SMS), or client-server based solutions to install or run entire applications, Cloudpaging responds to user requests for applications and immediately pulls the application to a user's desktop. It does this via a streaming technology called 'Cloudpaging'. The application is broken down into a number of individual segments (pages) and the initial delivery and launch of the application is achieved with a delivery of around 5-10% of the total app. The rest is paged from the cloud on-demand, or provisioned silently in the background (depending on the license type chosen for the app). This allows extremely fast launching of the app, even faster the second time around when the app has been cached – indistinguishable from the launch speed of a native app.

The new features of Cloudpaging are :

CONFIGURABLE VIRTUALIZATION

Applications held in Cloudpaging can be fully integrated with the end user client environment, fully isolated or any combination in between. This unique functionality gives the administrator complete control on how applications are delivered and interact with client devices. A simple example being, an application that is shipped with fonts only licensed for use with that application. The application could be streamed as a fully integrated application, interacting with local system resources and other locally installed software. The fonts, however, could be streamed in an isolated virtual environment, hidden from the resident OS and installed applications, and therefore only available by the licensed application. The four layers of virtualization are

- Layer 1 – Installed Permanent – this copies the file to the specified location on the user's system when the application is first virtualized and the file is left behind even once the application is removed. This is generally used for the data files that might come with an application, like an .mdb file or personalization registry settings. It is also used for things that you would want to be persistent should the application be virtualized again in future as the files are not overwritten if already present.
- Layer 2 – Installed Temporary – this copies the file to specified location on the users system when the application is first virtualized but the file is then deleted when the application is removed from the player. This might be used for files that you want to have on the machine but put outside of the control of Jukebox, but then remove them when the app is removed in order to leave a clean state.
- Layer 3 – Virtual Integrated – this is a virtualized file or key that can be seen by the rest of the system and is visible in the file system and registry, as if locally installed but its use is restricted by Cloudpaging

- Layer 4 – Virtual Isolated – this is a virtualized file or key that is isolated (sandboxed) and is only visible from within the virtualized application

An important thing to understand is that applications do not have to be either all isolated or all integrated; the level of virtualization can be set for each file and registry key. For example alternatively you might have a fully isolated application but have the files and registry keys for a PDF printer plug-in as integrated. Or you can have all of the application integrated or isolated as a whole if you want to.

MIXED MEDIA STREAMING

Cloudpaging makes it possible to stream applications from different media sources; CD, USB stick or network delivery. This gives the Enterprise increased flexibility in deploying applications. For instance, if a user is in a remote location with limited network access, they can receive a preloaded application on a CD containing only the necessary data to launch the application and then stream any additional data blocks as needed, on-demand from the network.

MULTISTAGE PROGRESSIVE STREAMING

Applications can have additional blocks of data streamed using macros once the activation and prefetching have taken place. An Enterprise can publish an application with some of the data prefetched allowing users to start working more quickly, while in the background additional data is being streamed.

INCREMENTAL PATCHING

When bug fixes and minor point versions of applications are released, Enterprises need to get the updates to their users in a timely manner; Cloudpaging makes it possible to quickly and easily patch the application and stream only the differential, not the whole application, saving time and effort.

ANYTIME – ANYWHERE

Application streaming and virtualization gives users on-demand access to desktop applications anytime, from anywhere. Cloudpaging dramatically reduces the cost and complexity of delivering applications to desktop and laptop computers across the enterprise.

REDUCED TOTAL COST OF OWNERSHIP

Most organizations deploy and manage their business applications using methodologies that were introduced over a decade ago prior to the 'digital age' and the internet phenomenon as we know it today. The exponential growth of our dependence on the PC, and the increase in remote workers, has led to a spiraling application and hardware Total Cost of Ownership (TCO).

Cloudpaging allows organizations to rapidly deliver desktop applications, upgrades and patches. It gives users access to software as they need it, when they need it and where they need it on a "pull-based" application delivery model. Maximizing existing infrastructure organizations can serve many more users per server, dramatically reducing TCO.

AVOID COMPATIBILITY AND STABILITY ISSUES

Cloudpaging avoids application compatibility issues by isolating the streamed application from other application's configuration/run-time environment and dramatically reduces the cost and complexity of delivering applications. Software delivery becomes an on-demand service – one where the latest release of the application is always accessible, where application maintenance releases are automatically detected and instantly made available. Central administration eliminates the need to recall or visit the client computer. By isolating the streamed applications, the enterprise can guarantee software stability with an immediate roll out of new builds to their users. This reduces the need for complex and lengthy regression testing procedures and the need for an intricate testing infrastructure.

6.9 MICRO FOCUS DESKTOP CONTAINERS

Micro Focus Desktop Containers, previously Novell ZENworks Application virtualization, is an easy-to-use solution for deploying your Windows, .NET and Java-based applications in compact, preconfigured virtual executables that run in your existing IT environment. Distribute via a web portal, USB device or from your existing desktop management infrastructure. There are no additional agents or device drivers to support, and no additional infrastructure to set up or manage. Micro Focus Desktop Containers also offer application compression and the ability to distribute patches for a virtual application independently of the application itself. Of course, if you prefer to build MSIs and deploy them using MSI distribution tools, Micro Focus Desktop Containers is capable of doing that, too. Using this approach to application deployment, you can dramatically reduce deployment and maintenance costs associated with traditional application setup and distribution while ensuring a high-quality end-user experience.

Micro Focus Desktop Containers offer three ways to create and configure virtualized applications. The best method in a given situation depends on the nature of the application.

Micro Focus Desktop Containers include a number of auto-configuration wizards for popular applications, which can be built and customized using a guided, step-by-step process. This simple method is recommended for first-time users.

- Snapshot an application installation. The snapshot captures a system's state before and after an application is installed and automatically configures virtual application settings based on observed system changes. This method is ideal for virtualizing off-the-shelf applications.
- Manually configure an application. This method is most often used by developers who are virtualizing internally developed applications. While manual configuration requires a high degree of technical knowledge about the application's inner workings, this does allow extremely fine-grained control over virtual application settings. Because of the tremendous number of variables involved, users should refer to product documentation for additional help and insight.

- Convert ZENworks AXT-based applications. Micro Focus Desktop Containers makes it easy to convert your legacy ZENworks applications to virtual applications and make them a fully integrated component of your virtual application environment.

Each of these configuration methods allows additional configuration and customization to be performed once the initial virtual application configuration has been constructed.

Once you have built a virtualized application, you can distribute it with all the control and automation of Micro Focus ZENworks, or from the Internet or intranets. You can even choose to optimize the virtual applications to run directly from DVDs, USB thumb drives or other portable media all of which can still be controlled by ZENworks policies to insure efficiency and security. This integration with ZENworks Configuration Management makes it possible to create a single unified lifecycle management solution for managing all your physical and virtual applications.

Using the add-on feature for Turbo Containers you can utilize your Turbo.net hub subscription to serve thousands of prebuilt containerized apps.

Bottom-line: Micro Focus is OEM-ing the Application virtualization engine from Turbo and has added specific functionality to have deep integration with ZENwork Configuration Manager.

See the Turbo vendor description and feature matrix for more information.

6.10 MICROSOFT APP-V

Microsoft Application virtualization (App-V) transforms applications into centrally-managed virtual services that are never installed and don't conflict with other applications. App-V streams applications on-demand to desktops, servers and laptops. It changes application management from a series of tedious, manual tasks into an automated, streamlined process. App-V dramatically accelerates application deployment, upgrades, patching and terminations by eliminating time-consuming processes and simplifying the application management lifecycle.

All applications are instantly available on any licensed device. App-V even allows controlled application use when users are completely disconnected. Because App-V centralizes management of applications, users can only get the applications they have the rights to. Centralized control also enables IT to patch or upgrade once to the server and the next time the users access the network, their applications are updated without impacting their productivity. App-V provides various delivery mechanisms including HTTP and file streaming, SBC integration, and standalone mode which provides application caching on the local client for offline usage.

Microsoft Application virtualization fully integrates with Microsoft System Center Management products, providing both users and administrators a seamless experience for running and managing applications in the enterprise.

Microsoft App-V decouples applications from the operating system and enables them to run as network services. Application virtualization can be layered on top of other virtualization technologies—network, storage, machine—to create a fully virtual IT environment where computing resources can be dynamically allocated in real-time based on real-time needs. App-V's patented application virtualization, dynamic streaming delivery, and centralized

management technologies make everything from deployments and upgrades to migrations and business continuity initiatives easier and faster with better agility:

Application virtualization: Enable applications to run without the need to visit a desktop, laptop, or terminal server. Applications are no longer installed on the client—and there is minimal impact on the host operating system or other applications. The most extensive virtualization technology on the market, App-V virtualizes per user, per application instance, as well as key application components. As a result, application conflicts and the need for regression testing are dramatically reduced.

Dynamic streaming delivery: Applications are rapidly delivered, when needed, to laptops, desktops, and terminal servers. In most cases only a small percentage of the application is needed to launch the application. Additional components are delivered when transparently requested by the application. This results in faster delivery of the application when needed.

Centralized, policy-based management: Virtual Application deployments, patches, updates, and terminations are more easily managed via policies, and administered through the App-V console or via your ESD system. Use Microsoft App-V Application virtualization to help reduce the complexities inherent in enterprise application management. With App-V you can reduce challenges and transform your computing environment into a dynamic, services-oriented infrastructure.

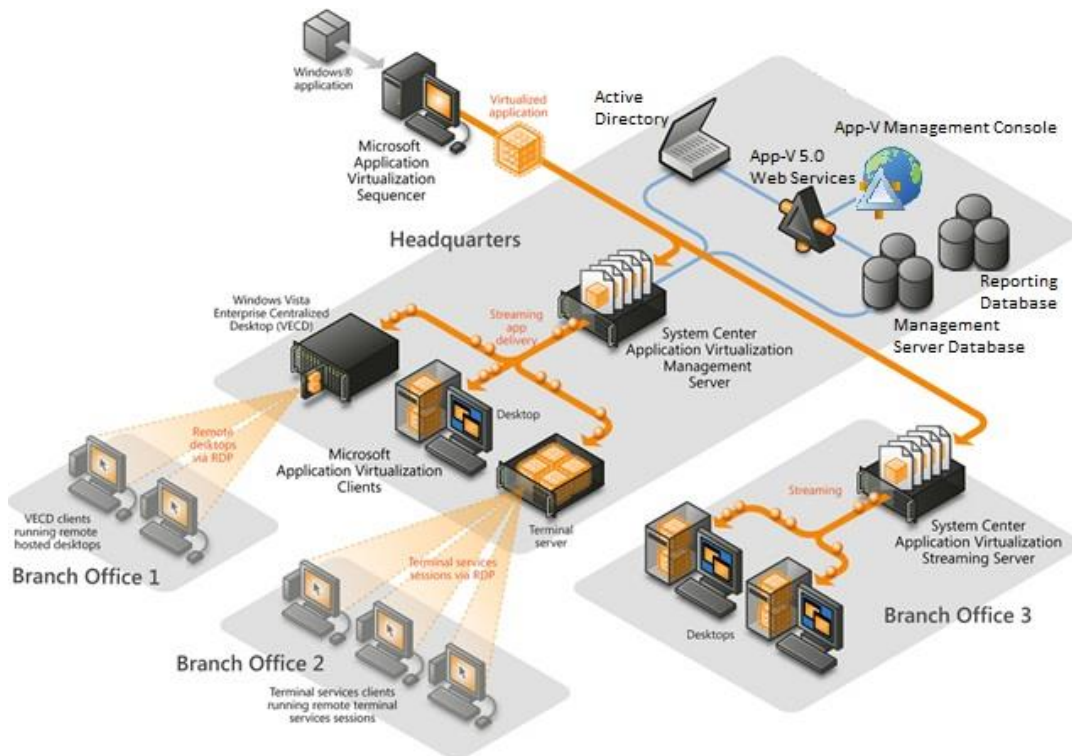


Figure 4, Microsoft App-V components

Microsoft App-V 5.0 – What’s new?

With previous versions of App-V there was a very rigid isolation of sequenced applications, with version 5.0 this isolation is less rigid allowing applications which could not work in 4.6 due to the isolation, to work in this new version. With the possibility to now sequence applications with protocol handlers, certain shell extension features as well as other types of applications, App-V 5.0 will enable you to deploy more virtual applications than you ever have before.

The architecture has changed quite a bit. There's now a Reporting Database as well as a Management Database, there's now three web services required for Management, Publishing and Reporting. There's no longer so many streaming protocols to choose from, It's now standardized to HTTP/HTTPS/SMB. An exciting introduction is the heavy use of PowerShell. The App-V 5.0 client is completely PowerShell driven, Microsoft have provided a conversion tool to convert your applications from 4.6 to 5.0, which is a PowerShell CmdLet. The Sequencer itself can also be PowerShell driven.

The process for sequencing manually has also changed. This change is for the better. Microsoft have standardized on HTTP/HTTPS which eliminates a need to select the protocol and port during sequencing. You also no longer need to provide a path for your application. Security Descriptors are enforced and the new .appv file format is in essence a compressed file format and so there's no option to compress and also an App-V generated MSI is automatically generated.

App-V 5.0 no longer requires a dedicated drive (e.g. Q:\) to be available on the client devices or available on sequencing machines. As stated earlier App-V 5.0 is less rigid with isolation and rather than making the file system completely invisible to the end user, the file system is now mounted in the hidden ProgramData folder. Users could navigate to this directory and launch the application if they are clever enough. By making this change, we all get the reduced limitation when it comes to application virtualization, thank to less rigid isolation.

A really big win for App-V 5.0 is its optimization for VDI environments. Microsoft have worked on the Read Only Cache concept which many have used with 4.x in VDI environments and provided a more intuitive solution. You can now also set whether or not the application should fully cache on a per application basis during sequencing. The background loading is now much more staggered and slow, which is great for a VDI environment as it ensures resources are not being drained needlessly and priority is only given to stream applications quickly, when they have been launched.

SystemCenter Config Manager 2012 SP1+ offers a much more comparable experience to the App-V Management Server than was experienced when using earlier version of App-V with SCCM 2012 and SCCM 2007 R2. This new version of App-V is the first major overhaul of the product since Microsoft purchased it and it's an exciting move forward.

6.11 TURBO

Turbo provides technology to virtualize, stream and deploy applications efficiently over the web to any Windows desktop. The company started in 2003 as Xenocode, rebranded to Spoon in May of 2010 and in 2016 released their newest offering, Turbo containers.

For years Turbo has provided a public web portal to stream Windows applications over the web directly to end-users. Turbo's technology enables one-click access to applications via internal and external websites and the desktop. This makes Turbo the ideal choice for software publishers to simplify the deployment of their software to end-users. A good example is Autodesk deploying Inventor Beta software packaged with Turbo Studio.

Recently, Turbo introduced support for Windows Server applications, putting them into a new category of virtualization referred to as containerization and made popular in the Linux world by Docker.

Windows based containers

Though Microsoft has introduced container support in the latest version of Windows Server, it is limited to only a limited set of server applications and is not backward compatible to previous versions of Windows. Turbo provides container support for legacy versions of Windows and covers a wide scope of server and desktop applications.

Unlike the Linux kernel that provides an interface for containerization that is used by Docker, the Windows kernel prior to the latest Server release was not developed to support containerization. Turbo have designed their own lightweight Turbo Virtual Machine which runs on top of the Windows Kernel, allowing Turbo containers to run on various Windows operating systems.

Application virtualization and adaptive streaming

The core of the company's virtualization technology is the Turbo virtual machine (VM) kernel. The Turbo VM Kernel is a user-mode virtualization solution able to run applications without client installations or administrative privileges requirements for the user. The kernel is a compact implementation of Windows operating system APIs, including the file system, registry, process, and threading subsystems, completely implemented within the user mode space.

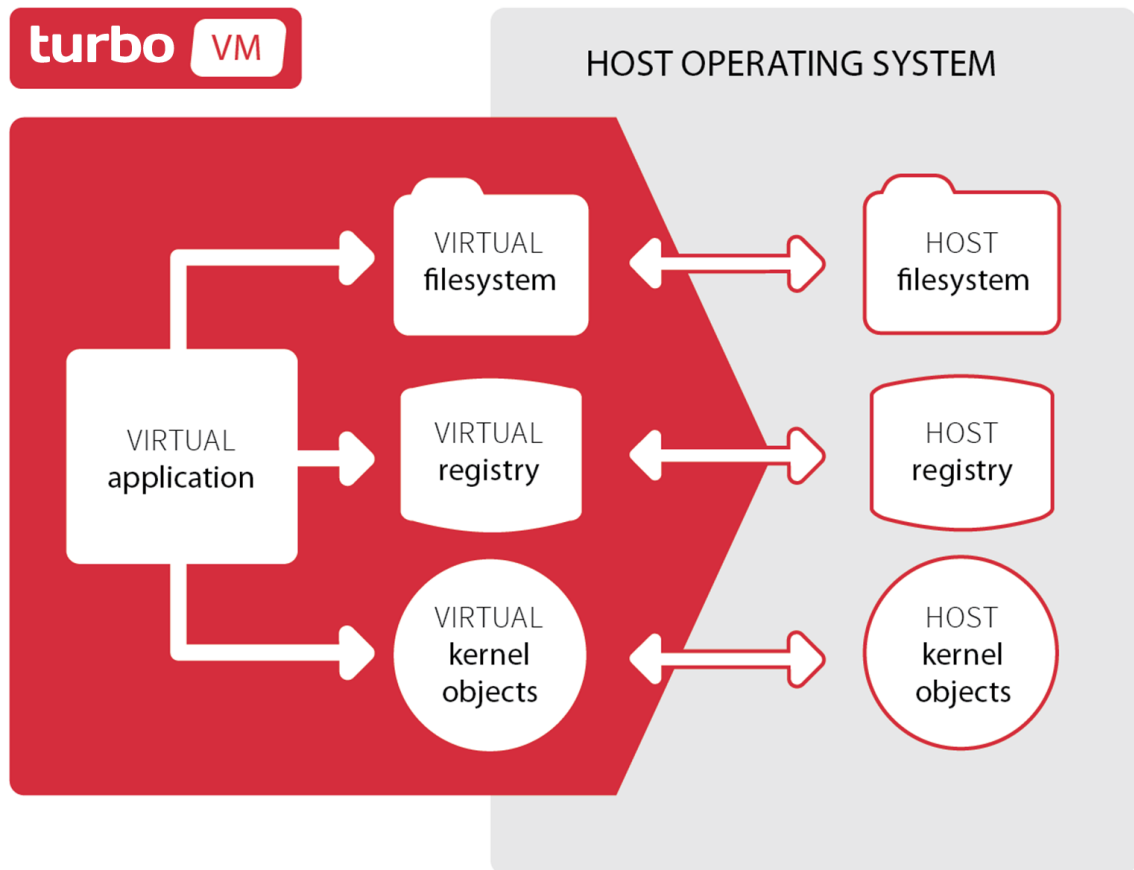


Figure 5, Turbo application container

Based on the behavior of the user, Turbo’s streaming technology transfers application components in the background. Turbo streaming works over HTTP and works with web-servers, Content Distribution Networks (CDNs) and desktop management solutions.

Turbo Studio

Turbo Studio provides a nice User Interface driven tool. The Studio allows for creating virtual applications as standalone executables, MSIs or as Turbo Virtual Machines which can be optimized for streaming using the Turbo Server. The Studio offers multiple methods of creating virtual applications, including a long list of application templates and a scan feature to import already installed applications from the desktop.

Turbo Virtual Machines can also be created using the command window or Turbo’s PowerShell module. Using either of these methods ensures you have no need to run a capture utility on a designated ‘clean’ virtual machine. You can create your Turbo VM’s on any machine in minutes.

Turbo Server

Turbo application streaming is powered by the Turbo Server which streams the virtual application to the end user via HTTP(S). The Turbo Server offers its own application portal or can be used in combination with existing web portals like Microsoft SharePoint, IBM WebSphere

or just by adding HTML code a custom webpage. Besides, managing applications, users, groups and their rights, Turbo Server allows for detailed analytics, all from a single web interface.

Turbo Browser Plugin

Turbo web delivery uses a browser plugin that integrates Turbo streaming and virtualization functionality directly into the user's web browser. The plugin takes only a few seconds to configure, does not require any browser restart, and can be installed without administrative privileges on the desktop.

Turbo Console

Used in combination with the Turbo Server, the Console offers users access to their virtual applications and data including documents that are synchronized to the Turbo Server. The Console runs as an icon in the system tray and synchronized documents are easily accessible through a shell folder.

Turbo Hub

The Turbo hub is a free repository containing popular applications and components. Using the commands found at <https://turbo.net/docs/reference> a developer or packager can easily and quickly leverage the library of pre-packaged images to layer into their own Turbo VM.

The Hub can be used by Developers for sharing their work with colleagues, allowing them to run tests without installing the application or reverting a machine to a clean state. Vendors can also host their own private repository to provide customers with a trial of their product and the ability to manage updates quickly and easily.

Turbo Browsers

Turbo hosts all of the most popular browsers on the market today. The browsers can be launched and used by running them from their site, which can be found here: <https://turbo.net/browsers>

Turbo also have a browser redirect feature, which an enterprise organization can use to re-direct web applications which require a legacy version of Internet Explorer to that legacy browser running as a Turbo browser. The re-direction works by using a policy to set which sites require re-direction. The version of the browser required can be delivered to the end users machines as a single executable. When an end user attempts to navigate to a site listed in the policy, their session will quickly be re-directed to the correct version of IE to allow that web application to work as expected.

Additionally, Turbo also has an IP routing feature which can be implemented to ensure users can only access approved sites in their Turbo browser. This is particularly useful when you want to deploy a legacy browser but want to prevent users from accessing the web from that browser or if you would like to deploy a legacy java with a browser and ensure users cannot browse to any site other than the site with the dependency.

Turbo and Micro Focus Desktop Containers

Turbo has licensed their virtualization technology to Micro Focus which uses it in its ZENworks Application virtualization software. See the corresponding chapter to learn more about ZENworks Application virtualization.

Turbo and LANDesk Application virtualization

LANDesk announced in February 2013 that they will use Turbo technology to integrate application virtualization technology in its Client Management solution. LANDesk Application virtualization was previously powered by VMware.

Turbo and XenApp Integration

In 2016, Turbo released integration of Turbo Containers with XenApp. This feature provides pre-containerized applications directly from the Turbo.net Hub for use in a XenApp environment with no additional infrastructure or packaging effort required.

6.12 SYMANTEC WORKSPACE VIRTUALIZATION

Symantec offers a virtualization product, Symantec Workspace Virtualization (SWV), and a streaming product, Symantec Workspace Streaming (SWS). They may be used together or independently, providing great flexibility for customers. If only virtualization is desired, any delivery mechanism may be used, from a USB stick to a full blown system management suite from any vendor. The streaming product may be used to stream virtualized applications (from Symantec and others), or even existing MSI packages.

The Kernel Driver Advantage

One of the greatest strengths of SWV is the use of kernel level drivers, allowing applications to behave completely normally, regardless of their complexity or dependence on other applications. In fact, the operating system and all management and security tools will interact with Symantec virtualized and streamed applications exactly as if they were installed physically. Services and device drivers are also fully supported. Unless otherwise specified, applications will behave and interact with the operating system and other applications as designed with no effort required to "link" or "un-bubble" them (even for different versions of the same application). For the occasional situation where applications must be isolated or hidden from the OS or other apps in order to work properly, various levels of isolation may be set or changed at any time without needing to re-package to change the application behavior. And packaging is usually as simple as installing the application making it possible for almost anyone to get started with little or no training.

Symantec Workspace Virtualization

Along with the benefits of a kernel driver, SWV packages (often referred to as layers) use two sub-layers, a read-only layer that maintains the known good base installation, and a re-writable layer that contains the changes and user customizations for that application. This makes it very simple to reset the layer instantly and at any time if there is ever a problem or a need to start over. It also makes it easy to separate and manage the user-specific portion independently if desired. Note also that the read-only layer may be mapped to many desktop instances without

the need to copy it into every session, if configured to do so. Although SWV applications are completely transparent and appear to be installed normally, several levels of isolation are available at any time. This is especially valuable for middleware like JVMs where a specific version is required for only a single or handful of applications.

Virtualizing Internet Explorer

Virtualizing IE6 for use on Windows 7 is one of the most popular use cases for SWV because it provides the simplest and most natural way to run multiple browser versions without deploying and managing a separate XP kernel or forcing the IE6-dependent apps. It has also been popular to virtualize IE7, IE8 and IE9 as well due to IE 10 not compatible with numerous web sites and intranet sites like pages with active X controls. SWV allows complete sharing of plug-ins, both previously and subsequently installed, without any re-packaging. Specific versions of certain plugins may be designated if necessary. Also available is a simple whitelist plug-in that enables automatic switching of browsers when necessary. For example, on Windows 7, most browser usage will be through the more secure and native IE9 or higher. Only when a designated application or URL is specified, a separate IE6 window will appear to run that application. If a link, app, or other website is selected from the less secure IE6 session, it automatically reverts to IE8, maintaining maximum functionality and security, without confusing the user or requiring special training.

Symantec Workspace Streaming

As IT organizations today face the reality of managing an increasingly complex mix of desktops, laptops, and mobile devices, more efficient ways to deliver and provision essential applications have become critical to ensuring cost-effective management. SWS is designed specifically for this purpose, and actually enhances users' ability to be productive, while supporting the trend toward increased flexibility and mobility. SWS utilizes your existing infrastructure and software investment to deliver applications to all devices – laptops, desktops, VDI, Terminal Services, and Citrix – on-demand, anywhere, at any time. SWS simplifies application usability, reduces application license costs, and improves IT management efficiency with a cost-effective centralized management system. Some additional benefits include:

- On-demand Application Distribution — Simplify OS image management by reducing the number and size of images. Dynamic configuration of workspaces based on the role of the user, providing instant access to applications without IT intervention while minimizing network bandwidth.
- User-Based Provisioning — New applications, which provisioned users can access from any Windows desktop, are instantly available without IT intervention. "Chargebacks" can be automatically assessed to each department based on application usage.
- Dynamic License Management — Ensure license compliance, simplify software deployment, optimize software costs, and avoid over-deployment by only delivering what is needed and re-harvesting licenses when they expire or after an idle period. The solution offers policy-driven controlled access to any Windows application from any location.

- Un-managed Computers — Extend application management beyond your enterprise boundaries. Deliver applications securely to un-managed computers via the public internet.
- Physical and Virtual — Utilize a single set of application packages and a single process across traditional desktops & laptops as well as server hosted computing environments like virtual desktops and Terminal Services.
- Easy Integration — Streaming can be easily integrated with enterprise workflows and other systems, such as CMDB, Asset and Helpdesk, with an open, standards-based webservice API.
- SWS also allows applications to be virtualized, enabling organizations to:
 - Ease Windows 7 migration
 - Eliminate application incompatibilities
 - Reduce helpdesk calls
 - Reset broken applications instantly

License Management

Symantec Workspace Streaming provides businesses improved control of their application costs, with a web-based, centralized view of application usage data across their extended network, including up-to-date statistics on the number and location of application licenses installed and usage statistics, such as time and frequency of use. License allocation management and compliance features include:

- Manage all popular license types - user, node, and concurrent.
- Automatically re-harvest licenses based on idle time.
- Identify frequently-utilized and under-utilized applications.
- Provide an aggregated, global view of usage levels across the enterprise.
- Track application usage and licenses on a per-user and per-machine basis, including applications with conventional licenses.
- View comprehensive and clear reporting tools that provide text-based views, graphical views, and predefined reports.
- Allow administrators to pre-deploy, de-provision, and re-provision applications as desired; flexible delivery options are supported.
- Remove an idle application package from a client cache after a pre-defined period of non-use.
- Monitor and enforce license compliance for offline applications.
- Automatic notification to the administrator upon reaching a predefined threshold of license utilization.

6.13 VMWARE THINAPP

VMware ThinApp has been bundled with all of the VMware EUC products as part of the introduction of the Horizon Suite, although VMware did recently announce that ThinApp will continue to remain available as a standalone offering as well and has extended the support to three years. The release of [ThinApp 5.0](#) introduced support for 64bit applications, integration with AppSense, and optimized architecture among other things. The recent acquisition of

CloudVolumes and subsequent release of AppVolumes has put ThinApp in a whole new light and possibly provided somewhat of an edge over some of the competition.

HORIZON WORKSPACE WITH VMWARE THINAPP

VMware is focusing ThinApp on legacy applications and browser virtualization, while Horizon Workspace brings centralized management, entitlement, and deployment of ThinApp packages. Horizon Workspace allows administrators to dynamically change entitlements via a web-based interface and provide a user facing portal allowing for self-service delivery of ThinApps. Administrators can provide for streaming or delivery of ThinApp packages and provide updates as well. There is a Horizon Agent for Windows that must be installed to support the additional management capabilities that also can enforce limits to an offline use case. As this solution evolves, customers have the flexibility of leveraging Horizon Workspace as the management infrastructure or utilizing an existing infrastructure tool such as MS SCCM.

Run any version of virtually any application on a single operating system without conflicts. You can even run multiple versions of the same application. Plug VMware ThinApp, formerly known as Thinstall, into your existing management infrastructure and streamline application management and deployment. Deliver and deploy applications more efficiently, more securely, and more cost-effectively with agentless application virtualization.

AppVolumes with VMware ThinApp

Layering provides a very efficient and streamlined method for deploying applications to virtual desktops, as described earlier in this document. The feature comparison matrix shows the strengths of ThinApp, as well as the weaknesses. All application virtualization solutions which output rigidly isolated applications have application compatibility issues and limitations.

Any VMware ThinApp customer who may have attempted to standardize on packaging all of their applications with ThinApp, likely came up short. If you have an application which does not work when isolated with ThinApp, you will need to package and deliver the app in a different format. This is a bad experience in the Enterprise as you have to support applications in different formats and possibly using different deployment tools or methods e.g. Applications installed onto the image vs ThinApp applications delivered using Horizon.

With AppVolumes ability to create an application layer for your ThinApp applications, as well as any application which cannot be packaged using ThinApp. You can standardize on a single delivery method and manage all applications using a single console. Applications which don't work when isolated can simply be captured and delivered as an 'AppVolumes AppStack'. Applications which may cause conflicts can be isolated and then captured as an AppStack and delivered along with all other applications in the organization using the AppVolumes console.

ELIMINATE INSTALLATION CONFLICTS WITH APPLICATION VIRTUALIZATION

Application virtualization encapsulates the applications from the OS and each other; eliminating costly regression testing and conflicts from badly behaving applications. Just plug in a ThinApp package as an .MSI or .EXE file to deploy a virtual system environment, including registry keys, DLLs, third-party libraries, and frameworks without requiring any installation of agents or applications on the underlying operating system.

PACKAGE ONCE, DEPLOY EVERYWHERE (NETWORK, USB, PHYSICAL OR VIRTUAL DESKTOPS)

Deploy virtualized applications in user mode, without administrative rights. No device drivers are installed and no registry changes are made because the entire application and its virtual OS are delivered as a single EXE file. Transparently stream large applications from a shared network drive with no server or client software to install. This provides an efficient mechanism for application deployment for persistent or non-persistent VDI use cases as well as physical devices with LAN connectivity to fileshares. Upgrade or roll-back applications while they're running. The new version will execute the next time the user starts the application and there is no 'residue' of the application left behind because bytes are delivered at runtime into memory.

CATER TO YOUR MOBILE WORKFORCE

Let your users run applications on virtually any computer they have access to, including kiosk and hotel PCs. They won't need to install software or device drivers and won't need admin rights. Applications run directly from portable storage devices, including Flash drives.

IMPROVE YOUR SOFTWARE DISTRIBUTION PROCESS

Deliver software that protects the local OS from modifications that might cause instability or breach security using your existing configuration management tools. Even restricted user accounts can safely run virtualized applications without requiring a local installation, making it much more appetizing for IT staff concerned about security.

EASE OS AND APPLICATION MIGRATIONS

ThinApp agentless application virtualization eases OS migrations by enabling applications to run side by side on the same operating system. Users can continue with business as usual without disruption from problematic applications. Furthermore, if an application needs to be removed from the endpoint—it is a simple file-remove with no mess left to clean up in the system registry.

7. APPLICATION VIRTUALIZATION COMPARISON

It's important to understand that comparing features is the last step in the decision tree. Vision, Strategy and Technology are the preceding steps. Each Application virtualization product has its own functionality and feature set. This chapter describes the features in a very detailed way. We did our best to be truthful and accurate in investigating and writing-down the different features. When you see improvements please let us know.

7.1 PRODUCT VERSION

This detailed feature compare matrix is developed with the following products and versions:

Product	Version
Cameyo	3.0
Citrix Application Streaming, XenApp	6.7; Streaming Profiler and offline plugin 6.7
Numecent Cloudpaging for Enterprise	9.0
Microsoft App-V	4.6 Service Pack 3
Microsoft App-V	5.1.107
Turbo	Turbo Studio 16.0.647 Turbo Server Portal 3.5.232 Turbo Client 3.33.1221.0
Symantec Workspace Virtualization	7.6
VMware ThinApp	5.2.1

Table 1, product versions

7.2 SCOPE

The scope of the feature compare matrix is to have focus on the application virtualization solution. Integration with Microsoft SCCM or other Client Management Solutions or integration with workspace aggregators such as VMware Horizon or VDI solutions such as VMware View which will add valuable functionality to the solution in general is out the scope of this whitepaper. From a Symantec perspective the focus of the feature compare matrix is to use both Symantec Workspace Streaming (SWS) and Symantec Workspace Virtualization. It's out of scope for this whitepaper to explain the 'It depends' remarks.

7.3 FEATURE COMPARE MATRIX

Application virtualization solutions and features	
Goal:	Detailed description of virtualization features
Requirements:	Hands-on-experience, vendor involvement
Result:	Whitepaper
Method of Execution:	Hands-on experience, read articles, communicate with vendors and discuss with colleagues

Table 2, feature compare matrix

Legenda:

✓ = Featured; ✗ = Not featured; ~ = It depends; # = under development by PQR;

- = Not applicable

A green ✓ or red ✗ has nothing to do with advantage or disadvantage of a solution. It just present the availability of the functionality.

Category	Functionality	Cameyo	Citrix App Streaming	Numecent	Microsoft App-V v4	Microsoft App-V v5	Turbo	Symantec	VMware ThinApp	Remarks
Virtualization Characteristics										
	The Solution is capable to fully virtualize/isolate Applications	✓	✓	✓	✓	✓	✓	✓	✓	
	The Solution is capable to fully integrate Applications seamlessly with local Operating System (non-isolated)	✗	✗	✓	✗	✗	✗	✗	✗	
	Applications will operate with minimal chance of conflicts	✓	~	✓	✓	✓	✓	~	✓	Isolation mode = ✓
Manageability										
	Central management platform for application delivery	✗	✓	✓	✓	✓	✓	✓	✗	
	The solution is usable in SaaS scenario. SPLA licensing is available; applications are on-demand streamed and delivered as a service, pay per-use.	✗	✓	✓	✓	✓	✓	✓	✗	
	Application is delivered in a very efficient way, quick up-and running. Stream only data which is needed to start application.	✓	✓	✓	✓	✓	✓	✓	✓	
	Virtual application license metering	✗	✗	✓	✓	✗	✓	✓	✗	
	Virtual application usage tracking	✗	✓	✓	~	✓	✓	✓	✗	
	Role based administration	✓	✓	✗	✗	✗	✗	✓	✗	
	Application 'rollback'	✓	✓	✓	✓	✓	✓	✓	✓	
	Application has to be shut down for upgrade	✓	✓	✓	✓	✓	✓	✓	✓	
	Application upgrade, centrally managed	✓	✓	✓	✓	✓	✓	✓	✓	
	Application upgrade while in use	✓	✓	✓	✓	✓	✓	✓	✓	
	Application upgrade using deltas	✗	✓	✓	✓	✓	✓	✓	✓	

Application Virtualization Smackdown
solutions overview and feature comparison matrix

Category	Functionality	Cameyo	Citrix App Streaming	Numecent	Microsoft App-V v4	Microsoft App-V v5	Turbo	Symantec	VMware ThinApp	Remarks
	The Communication between server and client can be secured without additional solutions	X	✓	✓	✓	✓	✓	✓	~	
	Native integration with Client Management solutions; No difference in manageability, support, deployment scenarios and inventory between installed and virtualized applications.	X	X	X	✓	✓	✓	✓	✓	
	Pre-launch and post-exit scripting	✓	✓	✓	✓	✓	✓	✓	✓	
	Pre-launch and post-exit scripting, centrally managed via GUI	✓	✓	✓	X	X	X	✓	X	
	Determine virtual application pre-requirements	X	✓	✓	✓	✓	✓	✓	✓	
	Determine virtual application pre-requirements, centrally managed	X	✓	✓	✓	✓	X	✓	X	
	Determine virtual application pre-requirements, centrally managed via GUI	X	✓	✓	X	X	X	✓	X	
	Limit application usage based on AD security groups, Controlled from AV solution	✓	✓	✓	✓	✓	✓	✓	✓	
	Limit application usage based on AD computer objects, Controlled from AV solution	X	X	✓	X	✓	X	X	✓	
	Limit application usage based on AD OU's, Controlled from AV solution	✓	X	✓	X	X	✓	X	X	
	Machine targeting, centrally managed	X	✓	✓	~	✓	X	~	~	SCCM, LanDesk, CMS, Horizon
	Machine targeting, application runs dependent of target OS, centrally managed	X	✓	✓	✓	✓	X	✓	~	
	Machine targeting, application runs dependent of target OS/language/service pack, centrally managed	X	✓	X	X	X	X	X	~	
	Application streaming source can be based on client IP-subnet	X	✓	X	~	X	X	✓	X	Group Policy Preferences + ASR
	Application streaming source can be centrally managed	X	✓	✓	✓	✓	✓	✓	X	
	Offline application usage can be time limited	✓	✓	✓	✓	X	✓	✓	✓	

Category	Functionality	Cameyo	Citrix App Streaming	Numecent	Microsoft App-V v4	Microsoft App-V v5	Turbo	Symantec	VMware ThinApp	Remarks
	File Type Association (FTA) centrally and standalone managed	X	✓	✓	✓	✓	✓	✓	X	
	File Type Association (FTA) locally managed	✓	~	X	✓	✓	✓	✓	✓	Only with Citrix Receiver
	Support for the protocol handler MAILTO://	✓	X	✓	X	✓	✓	✓	✓	
	Support for the protocol handlers MAILTO://, FTP://, FILE://	✓	X	✓	X	✓	✓	✓	✓	
	Manageable by scripting; command-line	✓	✓	✓	✓	✓	✓	✓	✓	
	Manageable by API/ WMI	✓	✓	✓	X	✓	✓	✓	✓	
	Manageable by PowerShell - Client	X	X	X	X	✓	✓	X	✓	
	Manageable by PowerShell - Server	X	X	X	X	✓	X	X	X	
	Software development kit(SDK) available	✓	✓	✓	X	X	✓	✓	✓	App-V 3 rd party only
	Integration with Add or Remove programs (generation with MSI needed)	X	X	✓	✓	✓	✓	✓	✓	
	Group policies can never, from a security point of view, be omitted	✓	✓	✓	X	X	✓	✓	✓	App-V 5: client configurable
	Interoperate with roaming user profiles;	✓	✓	✓	✓	✓	✓	✓	✓	
	Event logging on client	X	✓	✓	✓	✓	X	✓	✓	
	Event logging on management server	X	X	✓	✓	✓	X	✓	X	
	Application advanced debugging option part of the solution	✓	X	X	✓	✓	✓	X	✓	
	Window class isolation	X	X	X	X	X	✓	X	✓	
	Pre-packaging diagnostics to check if packaging machine is configured correctly	X	X	X	✓	✓	X	X	X	
	Post-packaging diagnostics to check for issues and/or unsupported technology	X	#	#	✓	✓	X	#	#	
	Support for application templates for a higher packaging success ratio	X	X	✓	✓	✓	✓	✓	X	

Category	Functionality	Cameyo	Citrix App Streaming	Numecent	Microsoft App-V v4	Microsoft App-V v5	Turbo	Symantec	VMware ThinApp	Remarks
	Compatible with software protection and/or 3 rd party DRM solutions	X	X	X	X	X	✓	X	✓	
Usability										
	Desktop and/or Laptop Online	✓	✓	✓	✓	✓	✓	✓	✓	
	Desktop and/or Laptop Offline	✓	✓	✓	✓	✓	✓	✓	✓	
	Microsoft RDSH (Remote Desktop Services) supported	✓	✓	✓	✓	✓	✓	✓	✓	
	Applications can run anonymous, without authentication with a directory service	✓	✓	✓	✓	✓	✓	✓	✓	
	Usable and supported in a Novell NDS environment	✓	✓	✓	✓	X	✓	✓	✓	
	Usable and supported in a Novell eDirectory environment	✓	✓	✓	✓	X	✓	✓	✓	
	Application can run from removable storage without installing a client/agent component	✓	X	X	X	X	✓	X	✓	
	Application <u>and</u> user preferences can run from removable storage without installing a client/agent component	✓	X	X	X	X	✓	X	✓	
	Application package is portable and can be stored on and imported from removable storage	✓	~	✓	✓	✓	✓	✓	✓	
	Official Support for EN localized Windows client operating systems	✓	✓	✓	✓	✓	✓	✓	✓	
	Official Support for EN/DE/FR/ES localized Windows client operating systems	✓	✓	✓	✓	✓	✓	✓	✓	
	Official Support for JP/Simple Chinese localized Windows client operating systems	X	✓	✓	✓	✓	✓	✓	✓	
	URL redirection to Virtualized Internet Explorer(s); locally configured	X	X	X	X	X	✓	✓	✓	
	URL redirection to Virtualized Internet Explorer(s); centrally managed	X	X	X	X	X	✓	✓	✓	ThinApp updated .ADMx Turbo from the Hub
	URL redirection to Virtualized other browsers	X	X	X	X	X	✓	X	✓	Limited to which other browsers

Category	Functionality	Cameyo	Citrix App Streaming	Numecent	Microsoft App-V v4	Microsoft App-V v5	Turbo	Symantec	VMware ThinApp	Remarks
Application Characteristics										
	Compression of virtual application package	✓	✓	✓	✓	✓	✓	✓	✓	
	Dynamic path relocation	#	#	#	#	#	#	#	#	
	Possible to package and deliver application with built-in kernel mode drivers	X	X	✓	X	X	X	X	X	Numecent: Isolation not required
	Virtualization of applications with user mode services	✓	✓	✓	✓	✓	✓	✓	✓	
	Virtualization of applications with boot time services	X	✓	✓	X	X	X	✓	✓	
	Virtualization of services that require privilege	✓	✓	✓	✓	✓	✓	✓	✓	
	Application package can be digitally signed with a certificate	X	✓	X	X	X	~	X	~	Consider performance impact
	Files and Registry virtualization	✓	✓	✓	✓	✓	✓	✓	✓	
	COM virtualization	✓	✓	✓	✓	✓	✓	✓	✓	
	COM+ virtualization	X	X	X	X	X	X	X	X	
	DCOM virtualization	#	#	#	#	#	#	#	#	
	Named Pipes isolation	X	✓	✓	✓	✓	✓	X	✓	
	Network stack isolation	X	X	X	X	X	✓	X	X	
	Side by Side(SxS) support for virtualized applications	✓	X	✓	✓	✓	✓	~	✓	
	Virtualization of fonts on desktops	✓	✓	✓	✓	✓	✓	✓	✓	
	Virtualization of fonts on terminal server	✓	✓	✓	✓	✓	✓	✓	✓	
	Communication between different application virtualization environments	~	✓	✓	✓	✓	✓	✓	✓	

Application Virtualization Smackdown
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Category	Functionality	Cameyo	Citrix App Streaming	Numecent	Microsoft App-V v4	Microsoft App-V v5	Turbo	Symantec	VMware ThinApp	Remarks
	Run application with elevated privileges(RunAs)	✓	✓	✓	✓	✓	✓	✓	✓	
	Compatible with Windows User Account Control	✓	✓	✓	✓	✓	✓	✓	✓	
	Windows long filename support	✓	✓	✓	✓	✓	✓	✓	✓	
	Microsoft .NET framework virtualization	✗	✗	✓	~	✓	✓	~	✓	Not all .NET versions
	(Virtual) reboot during packaging supported	✓	✓	✓	✓	✓	✓	✓	✓	
	Terminal Server drive remapping supported	✓	~	✓	✓	✓	✓	✗	✓	
	Windows Dynamic disks support	✓	✓	✓	✓	✓	✓	✓	✓	
	No maximum application package file size limitation	✓	✓	✓	✗	✓	✓	✓	✓	4GB
	DOS applications support on x32 platform	✓	✓	✗	✗	✗	✗	✓	✓	
	Win16 application support on x32 platform	✓	✗	✓	✓	✓	✓	✓	✓	
	Win16 application support on x64 platform (Windows limitation)	✗	✗	✗	✗	✗	✗	✗	✗	
	Win32 application support on x64 platform	✓	✓	✓	✓	✓	✓	✓	✓	
	Win64 application support on x64 platform	✓	✓	✓	✓	✓	✓	✓	✓	
	Unattended application packaging (install snapshot\monitor)	✓	✗	✓	✗	✓	✓	✓	✓	Most offer command line or PowerShell options. Turbo, Cameyo and VMware offer UI driven methods.

Category	Functionality	Cameyo	Citrix App Streaming	Numecent	Microsoft App-V v4	Microsoft App-V v5	Turbo	Symantec	VMware ThinApp	Remarks
	MSI to virtual application package conversion build-in	✓	✗	✗	✗	✗	~	✗	~	Cameyo Online Packager Turbo simple MSI apps ThinApp Factory
	Support for virtual drive letters	✗	✗	✗	✗	✗	✓	✗	✓	
	Support for virtual Printer drivers	✗	✗	✗	✗	✗	✗	✗	✗	
	Support for virtualized internationalization and code pages	✓	✗	✗	✗	✓	✓	✓	✓	
	Support for virtual drive serial numbers	✗	✗	✗	✗	✗	✗	✗	✓	
	Different versions of Internet Explorer can run simultaneous on the same client	✗	✗	✓	✗	✗	✓	✓	✓	
	Internet Explorer 6-10 can be virtualized and run on Win7	✗	✗	~	✗	✗	✓	✓	✓	ClougPaging does not support IE10 or IE11
	Internet Explorer 11 can be virtualized and run on Win7	✗	✗	✗	✗	~	✓	✗	✗	Microsoft provided an App-V sequenced IE11 for dev use only
	Internet Explorer 6-10 can be virtualized and run on Win7 with local IE 11	✗	✗	~	✗	✗	✓	✓	✓	ClougPaging does not support IE10 or IE11
	Internet Explorer 6-10 can be virtualized and run on Win10	✗	✗	~	✗	✗	✓	✓	✓	ClougPaging does not support IE10 or IE11
	Internet Explorer 11 can be virtualized and run on Win10	✗	✗	✗	✗	✗	✓	✗	✓	
	Internet Explorer 6-10 can be virtualized and run on Win10 with local IE 11	✗	✗	~	✗	✗	✓	✓	✓	ClougPaging does not support IE10 or IE11

Category	Functionality	Cameyo	Citrix App Streaming	Numecent	Microsoft App-V v4	Microsoft App-V v5	Turbo	Symantec	VMware ThinApp	Remarks
	Run application in Windows compatibility mode. (eg. using shims)	✓	✓	✓	✓	✓	✓	✓	✓	
	Apps are packaged and virtualized by user on-demand on the client, User Installed Apps	✓	✗	✗	✗	✗	✓	✗	✗	online.cameyo.com/add And: http://www.cameyo.com/doc/index.html?packager_commands_lines.htm ("GhostCapture" section)
	Microsoft Office 2010/2013/2016 deployment without physically installed requirements	✓	✗	✗	✓	✓	✗	✗	✓	E.g. Microsoft Office Deployment Kit for App-V or Visual C++ for EVS
	Support for import of other vendors virtual application format	✗	✗	✗	✗	✗	✓	✗	✗	
	Redirection of hostnames (virtual DNS entries)	✗	✗	✗	✗	✗	✓	✗	✗	
	Virtual application debugging with build-in tools	✓	✗	✗	✗	✗	✓	✗	✓	
	Scan and virtualize already installed applications	✗	✗	✗	✗	✗	✓	✗	✗	
Architecture										
	Management platform is included	✗	✓	✓	✓	✓	✓	✓	✗	
	Application delivery using (streaming) HTTP/S protocol	✓	✓	✓	✓	✓	✓	✓	✗	
	Application updates delivered using (streaming) HTTP/S protocol	✓	✓	✓	✓	✓	✓	✓	✓	
	Application delivery using proprietary protocol (RTSP/s)	✗	✗	✗	✓	✗	✗	✗	✗	

Category	Functionality	Cameyo	Citrix App Streaming	Numecent	Microsoft App-V v4	Microsoft App-V v5	Turbo	Symantec	VMware ThinApp	Remarks
	Application delivery using SMB / fileshare	✓	✓	✓	✓	✓	✓	✓	✓	
	No need for client/agent installation	✓	✗	✗	✗	✗	~	✗	✓	Plugin req. central mgmt
	Virtualization with client-code in user-mode	✓	✗	✓	✗	✓	✓	✗	✓	
	Virtualization with client code in kernel-mode	✗	✓	✓	✓	✓	✗	✓	✗	
	Original Microsoft Windows APIs are used by application	✓	✓	✓	✓	✓	~	✓	~	
	Multiple concurrent client or agent versions on the same platform	✓	✗	✗	✗	✓	✓	✗	✓	
	Memory sharing in multi-user environment	✗	✗	✗	✗	✓	✗	✗	✓	
	No need for a license service	✓	✗	✗	✓	✓	✓	✓	✓	
	No need for a file share	✓	✓	✓	✓	✓	✓	✓	✓	Only needed for console
	No need for dedicated server	✓	✓	✓	~	✓	✓	~	✓	
	MSI wrapper to deploy virtualized applications with ESD	✗	✗	✗	✓	✓	✓	✓	✓	Virtual Apps only; not streaming
	No need for ESD infrastructure for enterprise wide deployment	✓	✓	✓	✓	✓	✓	✓	~	
	Data store can be on: Microsoft SQL Express Edition	✗	✓	✓	✓	✗	-	✗	✗	
	Data store can be on: Microsoft SQL 2012	✗	✓	✓	✓	✓	-	✓	✗	
	Data store can be on: Oracle	✗	✗	✗	✗	✗	-	✓	✗	
	Data store can be on: IBM DB2	✗	✗	✗	✗	✗	-	✗	✗	
	Data store can be on: MySQL	✗	✗	✓	✗	✗	-	✗	✗	
	Data store is XML based	✗	✗	✗	✗	✗	✗	✗	✗	
	The Application package format is open and documented	✗	✓	✗	✓	✓	✗	✓	✗	

Category	Functionality	Cameyo	Citrix App Streaming	Numecent	Microsoft App-V v4	Microsoft App-V v5	Turbo	Symantec	VMware ThinApp	Remarks
	The Application package format can be encrypted; native tools available	✓	✗	✓	✗	✗	✓	✓	✓	
	Client-side persistent cache,	✓	✓	✓	✓	✓	✓	✓	✗	
	Centralized shared cache	✗	✗	✗	✓	✓	✗	✗	✗	
	Support for application white listing (Applocker Windows 7)	✗	✓	✗	✓	✓	✓	✗	✓	ThinApp: child processes automatically
	Block Caching by network WAN acceleration devices	✗	✓	✓	✓	✗	✗	✓	✓	
	Solution can integrated with Content Delivery Networks such as Akamai	✗	✗	✓	✗	✗	✓	✓	✗	
End user experience										
	Full Windows Explorer context menu integration	✓	✗	✓	✗	✓	~	✓	✗	Turbo: When delivered via Hub
	User driven application repair; repair via normal UI/GUI	✗	✗	✗	✓	✓	✗	✓	✗	
	User settings are preserved between application launches	✓	✓	✓	✓	✓	✓	✓	✓	
	User settings can be redirected and stored on the network	✓	✓	✓	✓	✓	✓	✓	✓	
	User settings can be streamed between user and server	✗	✗	✗	✗	✗	✓	✗	✗	
	Localized client interface available, 4+ languages (EN/DE/FR/ES)	✗	✓	✓	✓	✓	✗	✓	✓	
	User Self Provisioning web portal	✗	✗	✓	✗	✗	✗	✓	✓	ThinApp Factory
	Allow EULA/Message to be displayed at virtual application startup	✓	✗	✓	✗	✗	✓	✓	✓	
	Allow user to easily terminate virtual environment (incl. running child processes)	✓	✗	✓	✓	✓	✗	✓	✗	
	User can run application embedded within a browser	✓	✗	✗	✗	✗	✗	✗	✗	
Supported Client Platforms										

Category	Functionality	Cameyo	Citrix App Streaming	Numecent	Microsoft App-V v4	Microsoft App-V v5	Turbo	Symantec	VMware ThinApp	Remarks
	Windows 2000 - Pro	X	X	X	X	X	✓	X	✓	
	Windows XP - Pro (SP2 and up)	✓	✓	X	✓	X	✓	✓	✓	
	Windows XP - Embedded	✓	X	X	X	X	✓	✓	✓	
	Windows 2000 - Server	✓	X	X	X	X	✓	X	✓	
	Windows 2000 - RDSH	✓	X	X	X	X	✓	X	✓	
	Windows 2003 - Server	✓	✓	✓	✓	X	✓	✓	✓	
	Windows 2003 - RDSH	✓	✓	✓	✓	X	✓	✓	✓	
	Windows Vista	✓	✓	✓	✓	X	✓	✓	✓	
	Windows Server 2008 - Server	✓	✓	✓	✓	X	✓	✓	✓	
	Windows Server 2008 - RDSH / Remote Desktop Session Host	✓	✓	✓	✓	X	✓	✓	✓	
	Windows Server 2008R2 - RDSH / Remote Desktop Session Host	✓	✓	✓	✓	✓	✓	✓	✓	
	Windows Server 2012 - RDSH / Remote Desktop Session Host	✓	X	✓	✓	✓	✓	✓	✓	
	Windows Server 2012R2 - RDSH / Remote Desktop Session Host	✓	X	✓	✓	✓	✓	✓	✓	
	Windows Server 2016 – RDSH / Remote Desktop Session Host	✓	X	#	X	✓	✓	X	✓	
	Windows 7	✓	✓	✓	✓	✓	✓	✓	✓	
	Windows 7 x64	✓	✓	✓	✓	✓	✓	✓	✓	
	Windows 8 RT	X	X	X	X	X	X	X	X	
	Windows 8.0 x86	✓	X	✓	✓	✓	✓	✓	✓	
	Windows 8.0 x64	✓	X	✓	✓	✓	✓	✓	✓	

Category	Functionality	Cameyo	Citrix App Streaming	Numecent	Microsoft App-V v4	Microsoft App-V v5	Turbo	Symantec	VMware ThinApp	Remarks
	Windows 8.1 x86	✓	✗	✓	✓	✓	✓	✓	✓	
	Windows 8.1 x64	✓	✗	✓	✓	✓	✓	✓	✓	
	Windows 10 x86	✓	✗	✓	~	✓	✓	✓	✓	App-V 4: Out of Mainstream support Turbo: CY15 Q4
	Windows 10 x64	✓	✗	✓	~	✓	✓	✓	✓	App-V 4: Out of Mainstream support Turbo: CY15 Q4
	MacOS, deliver and execute Win32 applications on MacOS	✗	✗	✗	✗	✗	✗	✗	~	Wine (limited)
	Linux, deliver and execute Win32 applications on Linux	~	✗	✗	✗	✗	✗	✗	~	ThinApp - CrossOver (limited) Cameyo – Wine (limited)
Public Cloud services support										
	Azure RemoteApp (EOL)	#	#	#	#	#	#	#	#	
	Citrix XenApp Express on Azure	#	#	#	#	#	#	#	#	
	Amazon Workspaces	#	#	#	#	#	#	#	#	
Licensing Model of Solution										
	Concurrent	~	✓	✓	✗	✗	✓	✓	✓	~ Yes for Education only
	Device	✓	✓	✓	✓	✓	✓	✓	✓	
	Unlimited	✗	✗	✓	✓	✓	✓	✓	✓	

Category	Functionality	Cameyo	Citrix App Streaming	Numecent	Microsoft App-V v4	Microsoft App-V v5	Turbo	Symantec	VMware ThinApp	Remarks
	Per named user	X	✓	✓	✓	✓	✓	~	✓	
	Free for personal usage (FFPU)	✓	X	X	X	X	✓	X	X	Cameyo – limited free features Turbo – limited free features
	SPLA	X	X	✓	✓	✓	✓	X	X	View VSPP SKU
Solution in general										
	Proven technology, the solution is being used for 2+ years in enterprise production environments. Packaged 1000+ different apps, various deployment scenarios	X	✓	✓	✓	✓	✓	✓	✓	
	Variety (10+) of <u>public</u> available enterprise references in Europe	X	✓	✓	✓	✓	✓	✓	✓	
	Variety (10+) of <u>public</u> available enterprise references in US	X	✓	X	✓	✓	✓	✓	✓	
	Packager can capture only installer process	✓	X	✓	X	X	✓	X	X	
	Packager can capture all processes	✓	✓	✓	✓	✓	✓	✓	✓	
	Possibility of creating a High Available platform; additional services needed	X	✓	✓	✓	✓	✓	✓	✓	
	Load Balancing is part of the solution	X	X	✓	X	X	X	X	X	
	Official application virtualization training classes available	X	✓	✓	✓	✓	✓	✓	✓	
	Official Certification program, VUE or Prometric	X	✓	X	✓	X	X	X	X	
	Company website for delivering (demo) 25+ applications to community	✓	X	✓	X	X	✓	✓	✓	
	Company website for delivering (demo) 50+ applications to community	✓	X	X	X	X	✓	X	✓	
	Large community resource, share recipes, FAQ, discussion	X	✓	✓	✓	✓	X	✓	✓	

8. CONCLUSION

Which Application virtualization Solution is THE best?!

Without a better understanding of the requirements in general it is impossible to give an accurate and profound answer on THE question. Key areas for your Application virtualization strategy are:

- What do you want to **achieve**?, lowering **TCO**?, **business enabler**, overall cost of ownership and **cost reducer**?
- What are the **use-cases**? and does the use-case require Application virtualization?
- Are you investigating a **tactical** (point) or **strategic solution**? What do you want to solve?
- What is the strategy around **Client Management**, PC life Cycle Management, solution and how does Application virtualization fit?
- Is a Bring Your Own Computer (**BYOC**) concept one of the key **Access Scenarios**?
- What is your application delivery model? Is delivery of applications focused on **SaaS, Enterprise, SMB** or the **Consumer** space?
- Is a client or **agentless** Application virtualization solution required?
- Do you need to **integrate** and/or **isolate** your **applications** from each other? Do you need both functionality and how do you **manage** the application integration?
- What's your **overall Application and Desktop Delivery strategy** model with solutions such as Laptop (Offline), Desktop (Online), VDI and SBC? How can Application virtualization enhance these solutions?
- What's your overall **Enterprise Mobility strategy** with Application, MDM/MAM, Secure Access, Data Access, Networking, Security and BYO. **Enterprise Mobility is an architectural challenge.**
- Does the Application virtualization solution offer **shared-cache** or **cache-less** functionality? What is the use-case?
- **Bottom Line: What's your current Application and Desktop Delivery strategy?!**

It's important to have a **Vision** and **Strategy** around Application and Desktop Delivery. Designing, building, managing and maintaining the Optimized Desktop infrastructure using the right **Technologies**, corresponding vendors and products is an important step.

"This whitepaper is a useful resource in this journey!"

Keep in mind:

"Application virtualization is a solution, providing access to applications and data across devices is the goal".

9. ABOUT

9.1 ABOUT PQR

PQR, trusted advisor and integrator for modern datacenter, workspace and cloud solutions, focuses on availability of data, applications and work spaces in a secure and manageable way. Along with a suite of IT services PQR guarantees a stable environment, to ensure ICT is always within your reach.

PQR customers are active in all sectors of society and can be classified as medium to large organizations where ICT is essential to the business. PQR has profound knowledge of the education, government, profit and healthcare markets.

In addition to many traceable references PQR absorbs a wide range of knowledge areas, according to high status levels and preferable certifications. PQR is Cisco Premier Partner, Citrix Platinum Solution Advisor, Hitachi Data Systems Platinum Partner, HP Platinum Partner, Microsoft Gold Partner, NetApp Star Partner, RES Platinum Partner and VMware Premier Partner.

PQR, founded in 1990, is established in De Meern and counts over 100 employees.
www.PQR.com

9.2 TEAM MEMBERS

Ruben Spruijt is CTO at Atlantis Computing, responsible for driving vision, technology evangelism and thought leadership with Atlantis customers, partners and communities. Ruben is a well-regarded author, speaker, geek, market analyst, and all-around technologist. An established industry leader and luminary, he is one of only a few individuals in the world to hold three prestigious virtualization awards: [Microsoft Most Valuable Professional](#) (MVP), [Citrix Technology Professional](#) (CTP) NVIDIA GRID Community Advisor (NGCA) and [VMware vExpert](#).

Ruben has presented more than 150 sessions at national and international events such as BriForum, Citrix iForum Japan, Citrix Synergy, Gartner Catalyst, Microsoft Ignite, Microsoft TechEd, NVIDIA GTC, and VMworld. Ruben co-founded several independent industry analysis bodies including [ProjectVRC.team](#), Team Remote Graphics Experts ([TeamRGE](#)), [AppVirtGURU](#), [WhatMatrix](#). He has created and co-authored multiple disruptive 'Smackdown' research whitepapers. To contact Ruben directly send an email to ruben@rspruijt.com or follow Ruben on Twitter: [@rspruijt](#).

Jurjen van Leeuwen: With a solid base as an infrastructure consultant in the Netherlands, Jurjen van Leeuwen moved to Norway and started as a freelance consultant. With his company Leodesk.com, Jurjen continues to practice his enthusiasm for products in the application and desktop delivery area with a strong focus on Application virtualization solutions from multiple vendors. Besides his work on the Application virtualization Feature Overview and Compare Matrix, Jurjen also is active in the community as a moderator on AppVirtGuru.com and is a Microsoft MVP on App-V. Contact Jurjen by email at Jurjen@leodesk.no

Rory Monaghan is originally from Galway in Ireland but currently resides in Phoenix, Arizona. Rory has been working with App-V for many years. He gained his experience working with clients in multiple different Industries of varying sizes. Rory is a Microsoft Windows IT Pro MVP and he contributes to the online App-V community which is ever growing and made up of some sharp minds and very helpful people and he enjoys learning about new tech and sharing knowledge via the website www.rorymon.com. Contact Rory by email at Rory@rorymon.com



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