

# Dell EMC Ready Architectures for VDI

## Designs for Citrix Virtual Apps and Desktops on XC Family

July 2019

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### Design Guide

#### Abstract

This design guide describes technical considerations and best practices for integrating Citrix Virtual Apps and Desktops brokering software with Dell EMC XC Family devices to create virtual applications and desktops in a VMware vSphere environment.

Dell EMC Solutions

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# Executive summary

## Business challenge

In the past, moving from traditional PCs to a virtual desktop infrastructure (VDI) solution was challenging. A classic VDI implementation of 100 applications and 1,000 users could take 250 days or more, and the final cost was often unpredictable. Organizations today require end-to-end desktop and application virtualization infrastructure solutions that are flexible, reliable, scalable, and easy to deploy.

Desktop virtualization helps improve service delivery and competitiveness by simplifying how IT works on systems, dramatically reducing the complexity of the system and making it more flexible. The IT team can then move from being a largely reactive technical group to playing a proactive role in the strategic organization. Dell EMC can assist IT teams in this journey while improving user experience with the Dell EMC Ready Architectures for VDI.

Some challenges that organizations face today include:

- **Workforce empowerment**— Personal technology is driving newer and higher expectations. People want the same benefits at work as they have on their personal devices. They want faster, easier-to-use devices and applications that fit their specific needs. Technology itself has become a way to attract and retain the best talent. It has become a differentiator and a job perk.
- **Optimized IT resources**—Organizations that manage a large number of traditional PCs find that the task is becoming increasingly complex. With desktop virtualization, you move applications, data, and the OS (the desktop) to the data center. IT can centrally manage the virtual desktop from the data center and save time and money by troubleshooting PCs remotely instead of physically visiting each PC.
- **Improved security**—Organizations require the ability to control data, recover from disasters, apply policies, comply with regulations, and monitor risk. Maintaining data and application security, as well as compliance, are the leading IT concerns in organizations of all sizes. Mobile office trends and bring-your-own device initiatives mean that more devices and sensitive data are out of direct IT control, increasing the risk for data theft, viruses, malware, and ransomware attacks. In addition, traditional antivirus solutions cannot keep up with the amount of new malware that is created daily. Non-security IT specialists also tend to find security and compliance complex.
- **Cost management**—Organizations must monitor and optimize the total cost of ownership (TCO), achieve greater utilization from infrastructure assets, and reduce energy use.

## Technology solution

Dell EMC Ready Architectures for VDI on XC Family devices provide a quick and easy way to simplify and extend your VDI environment. Since Ready Architectures for VDI combine compute, storage, virtualization, and management, these solutions are ideal for VDI.

The Ready Architectures for VDI are built on industry-leading Dell EMC XC Family devices. These true hyper-converged infrastructure (HCI) platforms provide performance, flexibility, and scale for VDI environments.

Dell EMC recommends XC Family devices for customers who require a Citrix broker with a Nutanix-based hyper-converged infrastructure (HCI) solution. In this case, the Dell EMC XC Family devices provides a complete VDI solution. Citrix Virtual Apps and Desktops VDI technology is enhanced with a HCI environment that is built on 14th Generation Dell EMC PowerEdge servers. The solution is further optimized by Dell EMC software and services in the areas of deployment, recovery, management, and automation.

The XC Family includes the following choices. The hardware and software are the same. The difference is in the licensing and service providers.

- **Dell EMC XC Core systems**—Purchase Nutanix licenses through the Nutanix partner ecosystem. Nutanix provides support for Nutanix software.
- **Dell EMC XC Series appliances**—Purchase Nutanix licenses as part of the appliance purchase from Dell EMC or the Dell EMC partner ecosystem. Dell EMC is the initial support contact point for Dell EMC XC Series appliances.

Installing Citrix Virtual Apps and Desktops with its VDI components on XC Family devices enables organizations to quickly deliver Microsoft Windows virtual desktops or server-based hosted shared sessions on a wide variety of endpoint devices.

## Key benefits

Dell EMC offers comprehensive, flexible, and efficient VDI solutions that are designed and optimized for your organization's needs. These VDI solutions are easy to plan, easy to deploy, and easy to run.

- **XC Family lifecycle management (LCM)**—Automates software and firmware updates for XC Family clusters, providing inventory and cluster-aware update capability.
- **Simplified Dell EMC networking solutions**—Reference architectures, deployment guides, and best practices ensure that the networking component on an XC Family solution can support an accelerated time-to-value.
- **ProDeploy**—Provides on-site implementation, including planning, installation, and configuration.
- **Support Flexibility**—Choose Dell EMC XC Series appliances with a single point-of-contact for hardware and HCI software or select XC Core systems for hardware support from Dell EMC and software support for HCI from Nutanix.

## Document purpose

This document introduces the architecture, components, design options, best practices, and configuration details for successful VDI deployments for XC Family devices with Citrix Virtual Apps and Desktops.

## Audience

This guide is for decision makers, managers, architects, developers, and technical administrators of IT environments who want an in-depth understanding of the value of the Ready Architectures for VDI that deliver Microsoft Windows virtual desktops to users using Citrix Virtual Apps and Desktops VDI components on XC Family devices.

## We value your feedback

Dell EMC and the authors of this document welcome your feedback on the solution and the solution documentation. Contact the Dell EMC Solutions team by [email](#) or provide your comments by completing our [documentation survey](#).

**Authors:** Dell EMC Ready Architectures for VDI team.

 **Note:** The following page on the Dell EMC Communities website provides links to additional documentation for VDI Ready Solutions: [VDI Info Hub for Ready Solutions](#).

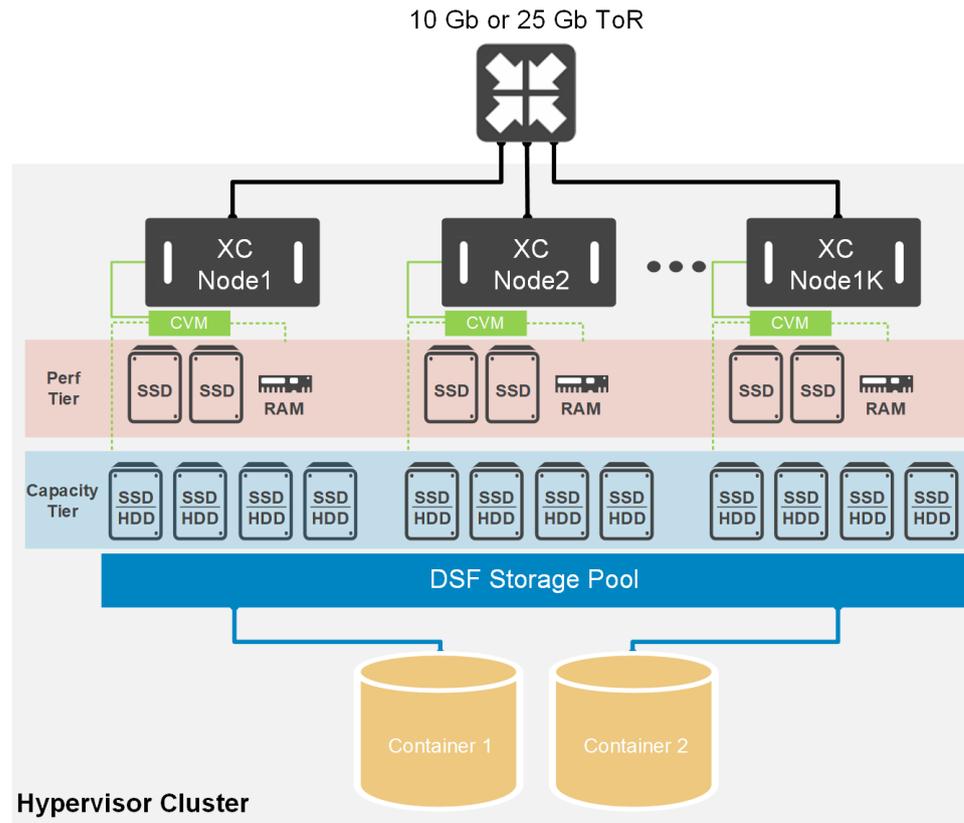
# Solution architecture

This section provides an architecture overview and guidance on managing and scaling a Citrix Virtual Apps and Desktops environment on Dell EMC XC Family devices.

## Architecture overview

The following figure depicts the architecture of the validated solution, including the network, compute, management, and storage layers.

**Figure 1** XC Family devices with Citrix Virtual Apps and Desktops



The deployment option for this Dell EMC Ready System for VDI uses Citrix Machine Creation Services (MCS) with a random or non-persistent desktop—that is, virtual desktops are assigned randomly as users connect. When users log off, changes they made are discarded. The desktop is reset to its original state and is available for another user to log in and use.

## Scaling the solution

Solutions that are based on XC Family devices provide flexibility as you scale, reducing the initial and future cost of ownership. Scale-up flexibility is provided through server hardware upgrade capabilities (for example, addition of storage capacity), while scale-out is enabled through the easy addition of additional XC devices to the XC environment. For XC-based VDI environments, Dell EMC recommends XC640 or XC740xd devices.

## Distributed Storage Fabric

The Distributed Storage Fabric (DSF) delivers enterprise data storage as an on-demand service by employing a highly distributed software architecture. Nutanix eliminates the need for traditional SAN and NAS solutions, while delivering a rich set of VM-centric software-defined services. Specifically, the DSF handles the data path of such features as snapshots, clones, high availability, disaster recovery, deduplication, compression, and erasure coding.

The DSF operates via an interconnected network of controller VMs (CVMs) that form a Nutanix cluster. Every node in the cluster has access to data from shared SSD, HDD, and cloud resources. The hypervisors and the DSF communicate using the industry-standard NFS, iSCSI, or SMB3 protocols, depending on the hypervisor in use.

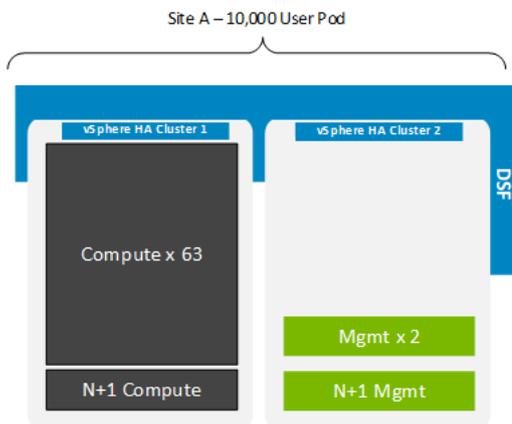
## Scaling out

**Note:** The following example uses a VMware ESXi hypervisor environment. For environments based on other hypervisors (for example, Microsoft Hyper-V, Citrix XenServer, or Nutanix AHV), ensure that you scale pods according to the limits of the hypervisor clusters. Consult your vendor documentation to obtain the cluster-limit information.

Each component of the solution architecture scales independently depending on the required number of supported users. You can add XC devices at any time to expand the Nutanix software defined storage (SDS) pool in a modular fashion.

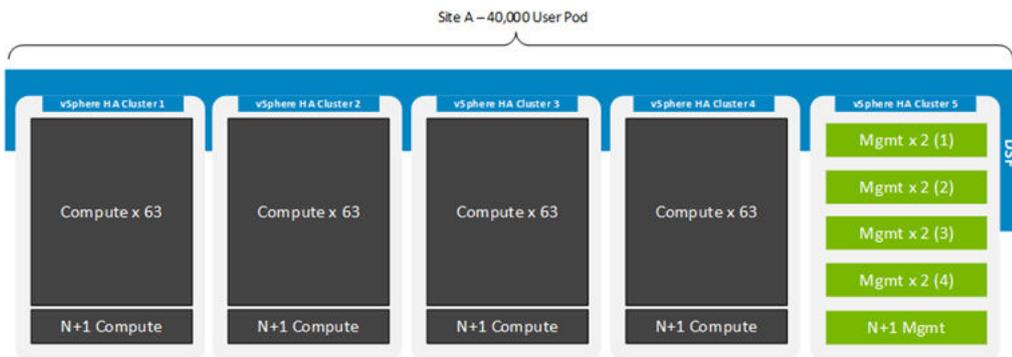
While there is no scaling limit for the Nutanix architecture itself, VMware recommends that pods be scaled based on the limit of an ESXi cluster, which is 64 nodes.

**Figure 2** Single 10,000-user pod



Another option is to design a large single contiguous NDFS namespace with multiple hypervisor clusters within to provide single-pane management. For example, The following figure shows a large-scale user environment segmented by vSphere HA cluster and broker farm. Each farm compute instance is segmented into an HA cluster with a hot standby node providing N+1. A dedicated pair of management nodes per compute cluster in a separate management HA cluster provides multiple broker farms with separated HA protection while maintaining a single NDFS cluster across all nodes.

**Figure 3** Scaleout for 40,000 users



### Scaling up

Dell EMC recommends a validated disk configuration for general purpose VDI. These configurations leave drive slots available for future vertical expansion and ensure that you protect your investment as new technology transforms your organization.

**Note:** These configurations can accept additional or faster processors or memory than the guidance provided here.

[Citrix VDI Handbook and Best Practices](#) provides more information about Citrix best practices and scaling.

## Management and multi-site considerations

Dell EMC recommends that the VDI management infrastructure nodes be separated from the compute resources. Because our test environment was small, both management and compute are in the same vSphere HA cluster. Optionally, the management node can also be used for VDI VMs with an expected reduction of 30 percent of host resources for these nodes only. The 30 percent accounts for management VM resource reservations and should be factored in when sizing.

Compute hosts can be used interchangeably for Virtual Apps and Desktops published apps and desktops.

This design guide describes a single-site or single data center design. For multi-site or disaster recovery (DR) configurations, refer to the following [Citrix resource](#).

## Key components

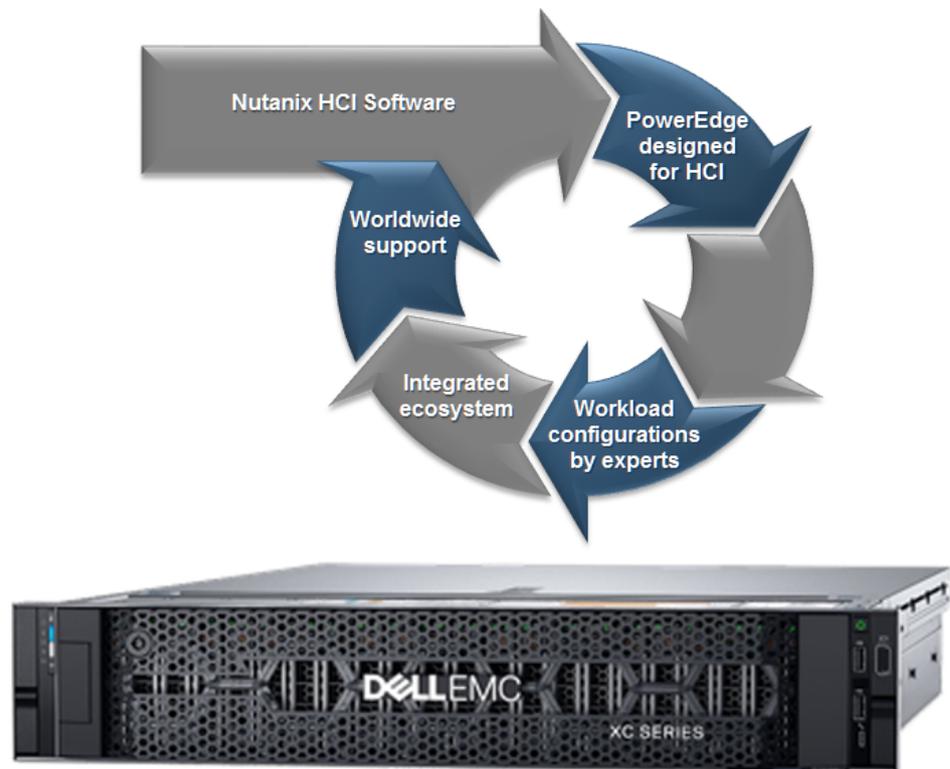
This section describes the key hardware and software components of the solution.

### XC Family

The Dell EMC XC Family is a powerful hyper-converged infrastructure (HCI) environment that is available in 1U or 2U environments. The XC Family is built on Nutanix software and the proven Dell EMC PowerEdge 14th generation server platform. These devices incorporate many of the advanced software technologies that power leading web-scale and cloud infrastructures.

The following figure shows the components and benefits of XC Family devices.

**Figure 4** Dell EMC XC Family device overview



For VDI-optimized configurations, you can deploy a cluster with as few as three nodes, providing an ideal environment for small deployments. To achieve full XC high availability, the recommended starting cluster size is four nodes. The XC Family can support storage-heavy workloads with storage-dense nodes, graphics-heavy VDI workloads with GPU hardware, and entry-level nodes for remote and branch office environments.

The following XC Family devices are recommended for VDI:

- **Dell EMC XC640**—A 10-disk 1U platform with a broad range of configuration options. Each appliance comes equipped with dual CPUs, 10 to 28 cores, and up to 1.5 TB of high-performance RAM. For the hybrid disk configuration, a minimum of six disks is required in each host: two SSDs for the performance tier (Tier1) and four HDDs for the capacity tier

(Tier2), which can be expanded up to eight HDDs as required. For the all-flash disk configuration, the chassis must be populated with a minimum of four SSDs.

The M.2-based BOSS module boots the hypervisor and Nutanix Controller VM, while the PERC HBA330 connects the CVM to the SSDs and HDDs. 64 GB is consumed on each of the first two SSDs for the Nutanix home directory.

All HDD/SSD disks are presented to the Nutanix CVM running locally on each host, which contributes to the clustered DSF storage pool. Each platform can be outfitted with SFP+ or BaseT NICs.

- **Dell EMC XC740xd**—A 2U platform that can be configured with 24 x 2.5" disks or 12 x 3.5" disks to serve a broad range of capacity requirements. Each appliance comes equipped with dual CPUs, 10 to 28 cores, and up to 1.5 TB of high-performance RAM.

A minimum of 12 disks is required in each host: four SSDs for the performance tier (Tier1) and eight HDDs for the capacity tier (Tier2), which can be expanded as required up to 45 TB per node raw. The M.2-based BOSS module boots the hypervisor and Nutanix Controller VM, while the PERC HBA330 connects the CVM to the SSDs and HDDs. 64 GB is consumed on each of the first two SSDs for Nutanix Home.

All HDD and SSD disks are presented to the Nutanix CVM running locally on each host, which contributes to the clustered DSF pool. Each platform can be outfitted with SFP+ or BaseT NICs. The 24-disk XC740xd can support up to three NVIDIA P40 or two M10 GPU cards. Higher wattage power supplies (up to 2,000 W per PSU) are required when GPUs are in use.

The following table shows the full range of configurations that are available for XC640 and XC740xd devices. More specific recommendations are presented in the next section.

**Table 1** Available Dell EMC XC Family 640 and 740xd configurations

XC640-4 & -4i	XC640-10	XC740xd-24	XC740xd-12	XC740xd-12C	XC740xd-12R
<ul style="list-style-type: none"> <li>• 4x 3.5" Drives</li> <li>• 64GB - 1.5 TB</li> <li>• Hybrid, all flash</li> <li>• XC640-4: 3+ node mission critical</li> <li>• XC640-4i: 1 or 2 node non-mission critical</li> </ul>	<ul style="list-style-type: none"> <li>• 10x 2.5" Drives</li> <li>• 4x 3.5" Drives</li> <li>• Hybrid, all flash, NVME +SSD</li> <li>• NVME</li> <li>• 128 GB - 1.5 TB memory</li> </ul>	<ul style="list-style-type: none"> <li>• 24x 2.5" Drives</li> <li>• 64 GB - 1.5 TB memory</li> <li>• Hybrid, all flash, NVME +SSD</li> <li>• Nvidia M10 and P40 GPUs</li> </ul>	<ul style="list-style-type: none"> <li>• 12x 3.5" Drives</li> <li>• 128 GB - 1.5 TB memory</li> <li>• Hybrid, all flash</li> </ul>	<ul style="list-style-type: none"> <li>• 12x 3.5" Drives</li> <li>• 64 GB - 768 GB memory</li> <li>• Hybrid, all flash</li> </ul>	<ul style="list-style-type: none"> <li>• 12x 3.5" Drives</li> <li>• 64 GB - 768 GB memory</li> <li>• Hybrid, all flash</li> </ul>

## Dell EMC Ready Architectures VDI-optimized configurations

The Ready Architectures for VDI team recommends the VDI-optimized 2U XC740xd devices that support GPU hardware for graphics-intensive desktop deployments.

The XC740xd can be configured with or without GPUs. Dell EMC also offers similar configurations in a 1U XC640 device, although graphics configurations are not available on these platforms.

For convenience, we have designated common configurations as *A3*, *B5*, and *C7*. These designations are referenced throughout the document.

Configuration	CPU	RAM	Disk	GPU (optional)	Description
A3	2 x 10-core	192 GB (12x 16 GB @ 2,400 MHz)	4 TB + (Capacity)	Up to 3 x full length, dual width (FLDW)	For small-scale, proof of concept (POC), or low-density, cost-conscious environments
B5	2 x 14-core	384 GB (12x 32 GB @ 2,400 MHz)	6 TB + (Capacity)	Up to 3 x FLDW	Geared toward larger-scale general-purpose workloads; balances performance and cost-effectiveness
C7	2 x 20-core	768 GB (24 x 32 GB @ 2,667 MHz)	8 TB + (Capacity)	Up to 3 x FLDW	Offers an abundance of high-performance features and tiered capacity that maximizes user density

## NVIDIA GPU

NVIDIA GPU accelerators provide high performance for demanding enterprise data center workloads.

In applications ranging from energy exploration to deep learning, scientists can now process petabytes of data up to ten times faster than with CPUs. NVIDIA accelerators deliver the horsepower required to run large simulations faster than ever before. For enterprises deploying VDI, NVIDIA accelerators are perfect for accelerating virtual desktops. GPUs can be used in configurations that are based on XC740xd devices.

## Physical network components

Ready Architectures for VDI for appliances enable flexibility in networking selections. VDI validations have been successfully performed with the following hardware, although several other choices are available.

- **Dell EMC Networking S3048 (1 GbE ToR switch)**—The S3048 switch accelerates applications in high-performance environments with a low-latency top-of-rack (ToR) switch that features 48 x 1 GbE and 4 x 10 GbE ports, a dense 1U design, and up to 260 Gbps performance. The S3048-ON also supports Open Network Installation Environment (ONIE) for zero-touch installation of alternate network operating systems.
- **Dell EMC Networking S4048 (10 GbE ToR switch)**—The S4048 switch optimizes your network for virtualization with a high-density, ultra-low-latency ToR switch that features 48 x 10 GbE SFP+ and 6 x 40 GbE ports (or 72 x 10 GbE ports in breakout mode) and up to 720 Gbps performance. The S4048-ON also supports ONIE for zero-touch installation of alternate network operating systems.
- **Dell EMC Networking S5248F (25 GbE ToR switch)**—The S5248F switch provides optimum flexibility and cost-effectiveness for demanding compute and storage traffic environments. This ToR switch features 48 x 25 GbE SFP28 ports, 4 x 100 GbE QSFP28 ports and 2 x 100 GbE QFSP28-DD ports. The S5248F-ON also supports Open Network Install Environment (ONIE) for zero-touch installation of network operating systems.

[Dell EMC Networking S-Series 10GbE switches](#) and [Dell EMC Networking S-Series 25GbE switches](#) on the Dell EMC website provides more information about these switches.

 **Note:** Ensure that you follow the deployment and best practices provided in the [Dell EMC XC Series Networking Deployment and Best Practices Guide](#).

## Networking

Designed for true linear scaling, XC Family devices use a leaf-spine network architecture, which consists of two network tiers: an L2 Leaf and an L3 Spine that is based on 40 GbE and non-blocking switches. This architecture maintains consistent performance without any throughput reduction.

## VMware vSphere

VMware vSphere provides a powerful, flexible, and secure foundation for business agility that accelerates the digital transformation to cloud computing and promotes success in the digital economy.

vSphere provides the following benefits for VDI applications:

- **Improved Appliance Management**—The vCenter Server Appliance Management interface provides CPU and memory statistics, network and database statistics, disk space usage, and health data. These features reduce reliance on a command-line interface for simple monitoring and operational tasks.
- **VMware vCenter Server native high availability**—This solution for vCenter Server Appliance consists of active, passive, and witness nodes that are cloned from the existing vCenter Server instance. The vCenter HA cluster can be enabled, disabled, or destroyed at any time. Maintenance mode prevents planned maintenance from causing an unwanted failover. The vCenter Server database uses Native PostgreSQL synchronous replication, while key data outside the database uses a separate asynchronous file system replication.
- **Backup and Restore**—Native backup and restore for the vCenter Server Appliance enables users to back up vCenter Server and Platform Services Controller appliances directly from the VAMI or API. The backup consists of a set of files that is streamed to a selected storage device using SCP, HTTP(S), or FTP(S) protocols. This backup fully supports VCSA instances with both embedded and external Platform Services Controller instances.
- **VMware vSphere HA Support for NVIDIA GRID vGPU-configured VMs**—vSphere HA protects VMs with the NVIDIA GRID vGPU shared pass-through device. In the event of a failure, vSphere HA tries to restart the VMs on another host that has an identical NVIDIA GRID vGPU profile. If no available healthy host meets this criterion, the VM fails to power on.
- **VMware Log Insight**—Provides log management, actionable dashboards, and refined analytics, which enable deep operational visibility and faster troubleshooting.

 **Note:** vSphere Enterprise Edition (or vSphere Desktop) is required to support NVIDIA graphics cards.

## Microsoft Windows Hyper-V Server 2012 R2 and 2016

Windows Hyper-V Server 2012 R2 and 2016 is a powerful virtualization technology that enables businesses to take advantage of the benefits of virtualization. Hyper-V reduces costs, increases hardware utilization, optimizes business infrastructure, and improves server availability. Hyper-V works with virtualization-aware hardware to tightly control the resources available to each virtual machine. The latest generation of Dell EMC servers includes virtualization-aware processors and network adapters.

From a network management standpoint, virtual machines are much easier to manage than physical computers. To this end, Hyper-V includes many management features designed to make managing virtual machines simple and familiar, while enabling easy access to powerful VM-specific management functions. The primary management platform within a Hyper-V-based Citrix virtualization environment is Microsoft Systems Center Virtual Machine Manager (SCVMM).

SCVMM provides centralized and powerful management, monitoring, and self-service provisioning for virtual machines. SCVMM host groups enable you to apply policies and check for problems across several VMs at once. Groups are organized by owner, operating system, or by custom names such as "Development" or "Production." The interface also incorporates Remote Desktop Protocol (RDP). VM consoles are live and accessible from the management console by double-clicking the VM.

## Citrix XenServer 7

**Note:** A full list of the XC Family devices that have been qualified for XenServer is available at <http://hcl.xensource.com>. Support for XenServer on these devices comes directly from Citrix. Dell EMC does not provide support for XenServer.

XenServer is a comprehensive server virtualization platform with built in enterprise-class features to easily handle different workload types, mixed operating systems, and storage or networking configurations. For the most demanding application and desktop virtualization use cases, its industry-leading scalability and performance can support the largest Virtual Apps and Desktops deployments.

XenServer is managed by XenCenter to provide VM monitoring, management, and general administration functions through a single, intuitive interface.

XenServer combined with Dell EMC XC Core system provides simple one-click cloud integration for deploying the Citrix Workspace Appliance to eliminate complexity and provide built-in automation and orchestration.

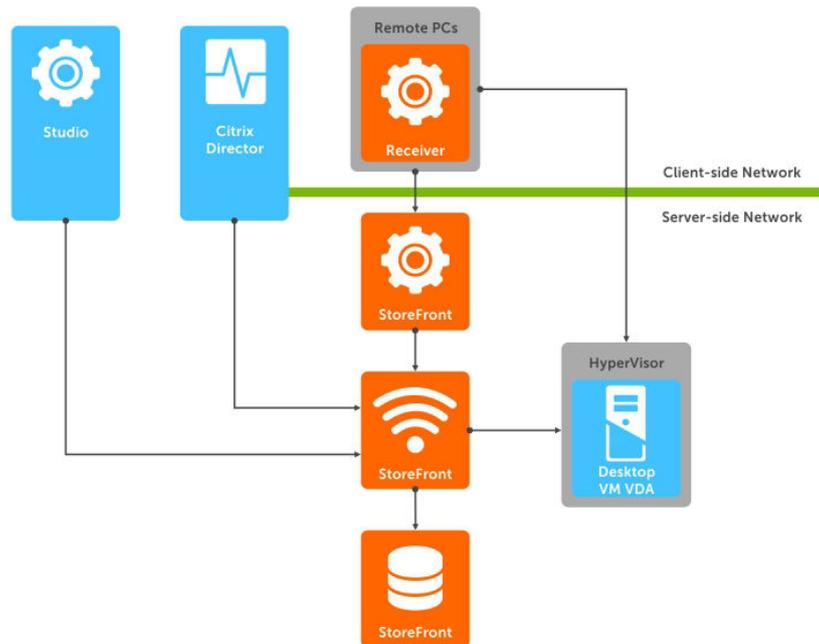
To take advantage of this virtualization platform, order Dell EMC XC Core systems with the XC Core licensing model.

## Citrix Virtual Apps and Desktops

The architecture that this guide describes is based on Citrix Virtual Apps and Desktops, which provides a complete end-to-end solution delivering Microsoft Windows virtual desktops to users on a wide variety of endpoint devices. Virtual desktops are dynamically assembled on demand, providing users with pristine, yet personalized, desktops each time they log in.

Citrix Virtual Apps and Desktops provides a complete virtual desktop delivery system by integrating several distributed components with advanced configuration tools that simplify the creation and real-time management of the virtual desktop infrastructure.

**Figure 5** Citrix Virtual Apps and Desktops architecture



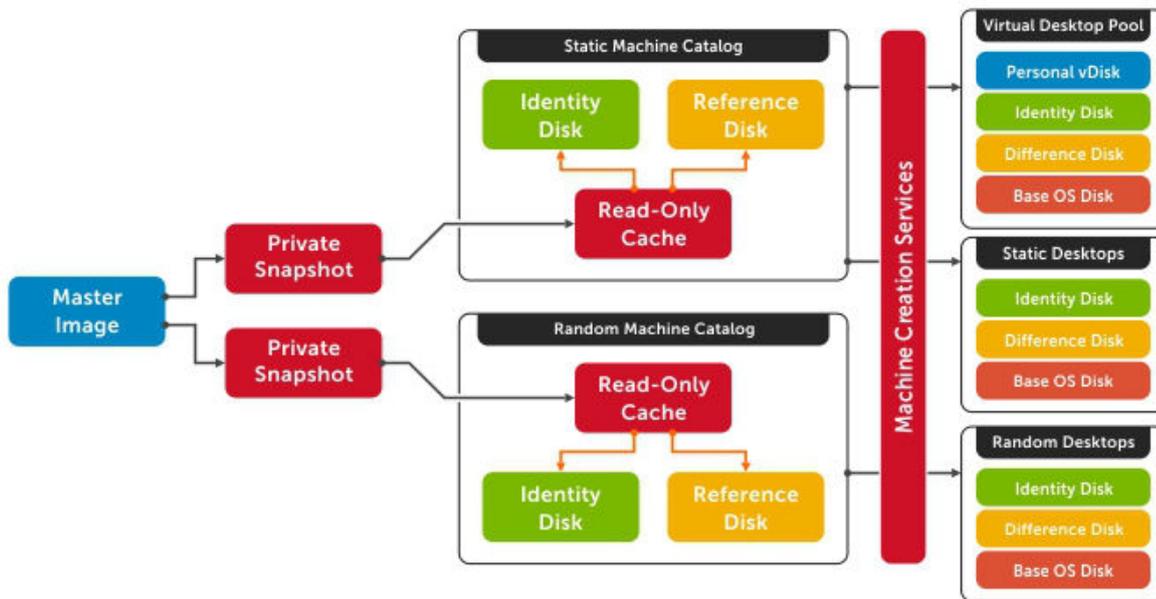
The core Citrix Virtual Apps and Desktops components include:

- **Studio**—Studio is the management console that enables you to configure and manage your deployment, eliminating the need for separate management consoles for managing delivery of applications and desktops. Studio provides various wizards to guide you through the process of setting up your environment, creating your workloads to host applications and desktops, and assigning applications and desktops to users.
- **Delivery Controller (DC)**—Installed on servers in the data center, the controller authenticates users, manages the assembly of users' virtual desktop environments, and brokers connections between users and their virtual desktops. DC also manages the state of desktops, starting and stopping them based on demand and administrative configuration.
- **Database**—At least one Microsoft SQL Server database is required for every virtual application or desktop Site to store configuration and session information. DC must have a persistent connection to the database as it stores data that is collected and managed by the Controller services.
- **Director**—Director is a web-based tool that enables IT support teams to monitor an environment, troubleshoot issues before they become system-critical, and perform support tasks for end users. You can also view and interact with a user's sessions using Microsoft Remote Assistance. Starting in version 7.12, Director now includes detailed descriptions for connection and computer failures, one-month historical data (Enterprise edition), custom reporting, and notifications via SNMP traps.
- **Receiver**—Installed on user devices, Citrix Receiver provides users with quick, secure, self-service access to documents, applications, and desktops from any of the user's devices including smart phones, tablets, and PCs. Receiver provides on-demand access to Windows, web, and Software as a Service (SaaS) applications.

For devices that cannot install the Receiver software, Citrix Receiver for HTML5 provides connectivity through a HTML5-compatible web browser.

- **StoreFront**—StoreFront authenticates users to sites hosting resources and manages stores of desktops and applications that users access. StoreFront version 3.8 (released with XenDesktop 7.12) and above includes the ability to create and use multiple IIS websites each having its own domain name.
- **License Server**—The Citrix License Server is an essential component of any Citrix-based solution. Every Citrix product environment must have at least one shared or dedicated license server. License servers are computers that are either partly or completely dedicated to storing and managing licenses. Citrix products request licenses from a license server when users try to connect.
- **Machine Creation Services (MCS)**—A collection of services that work together to create virtual servers and desktops on demand from a master image, optimizing storage utilization, and providing a pristine virtual machine to users every time they log in. Machine Creation Services is fully integrated and administered in Citrix Studio.

**Figure 6** Machine Creation Services architecture



- **Virtual Delivery Agent (VDA)**—A transparent plugin that is installed on every virtual desktop or application host (RDSH). VDA enables the direct connection between the virtual desktop and users' endpoint devices. Windows and Linux VDAs are available.

## Client components

End users can use a variety of client components to access the virtual desktops.

The following table lists the client components that Dell EMC recommends.

**Table 2** Recommended clients

<b>Component</b>	<b>Description</b>	<b>Recommended use</b>	<b>More information</b>
Dell Wyse 3040 thin client	Dell's lightest, smallest, and most power-efficient thin client	Task and basic productivity	<a href="http://www.dell.com/us/business/p/wyse-3040-thin-client/pd">http://www.dell.com/us/business/p/wyse-3040-thin-client/pd</a>
Dell Wyse 5070 thin client	A single thin client platform that meets every need, the Dell Wyse 5070 has multiple OS and connectivity options and can be monitored, maintained, and serviced remotely.	Knowledge workers who need powerful virtual desktop performance and support for unified communications solutions like Skype for Business	<a href="https://thinclientbenefits.com/products/wyse-5070">https://thinclientbenefits.com/products/wyse-5070</a>
Dell Wyse 5070 Extended thin client	Offers an on-board graphics card for offloading and supporting up to four 4K monitors plus two 2K monitors (total of 6)	Knowledge workers who need powerful virtual desktop performance and support for several monitors	<a href="https://thinclientbenefits.com/products/wyse-5070">https://thinclientbenefits.com/products/wyse-5070</a>

# Design sizing and guidelines

This section provides recommendations and guidelines for designing your VDI environment.

## Platform configurations

With several options to choose from, consider these basic differences:

- Select the base B5 configuration when designing smaller deployments to meet minimum node requirements. B5 configurations scale well and can also effectively serve the maximum number of VMs for a pod.
- C7 configurations are denser configurations that are intended for a higher scale and to reduce the number of nodes to maintain.

 **Note:** In the event of a node outage, the C7 configurations impact more users.

## CPU

User density and graphics considerations:

- Dell EMC Ready Architectures for VDI validation test results suggest that you can use CPU oversubscription to effectively size VDI user density. To use a CPU configuration other than those that have been validated, consider the following guidance to achieve comparable results in a VMware ESXi environment:
  - **Task workers**—4.75 users per core. For example, 76 knowledge users with dual eight-core processors.
  - **Knowledge workers**—4 users per core. For example, 64 knowledge users with dual eight-core processors.
  - **Power workers**—3.25 users per core. For example, 52 power users with dual eight-core processors.
- For graphics configurations consider the following:
  - For high-end graphics configurations with NVIDIA GRID Quadro Virtual Data Center Workstation graphics enabled, consider choosing higher clock speeds over higher core counts. Many applications that benefit from high-end graphics are engineered with single-threaded CPU components. Higher clock speeds benefit users more in these workloads.
  - For NVIDIA Virtual PC configurations, consider higher core counts over faster clock speeds to reduce oversubscription.
  - Most graphics configurations do not experience high CPU oversubscription, because vGPU resources are likely to be the resource constraint in the appliance.

## Memory

Best practices for memory allocation and configuration:

- Do not overcommit memory when sizing, because memory is often not the constraining resource. Overcommitting memory increases the possibility of performance degradation if contention for memory resources occurs (for example,

swapping and ballooning of memory). Overcommitted memory can also impact storage performance when swap-files are created.

- Memory must be populated in units of six per CPU to yield highest performance. Dell EMC PowerEdge servers using Intel Xeon scalable Cascade Lake processors have six memory channels per CPU, which are controlled by two internal memory controllers, each handling three memory channels. To ensure that your environment has the optimal memory configuration, use a balanced configuration, where each CPU supports a maximum of 12 DIMMs (or 24 DIMMs for a dual-CPU server). The most effective configuration is 12 DIMMs (6 DIMMs per CPU) or 24 DIMMs (12 DIMMs per CPU).

## GPU

Consider these options when choosing GPU cards:

- Dell EMC strongly recommends NVIDIA M10 graphics options only for Virtual PC workloads. Quadro Virtual Data Center Workstation licenses do support the M10 card, but the card performance is less aligned with the features available in that license.
- For graphically intense workloads like CAD or for desktops running mixed workloads (including both graphics and significant computation), a P40 card is the optimal choice.
- NVIDIA's Turing architecture is available in the T4 GPU, which is considered the universal GPU for data center workflows. Add up to six GPU cards into your XC740xd device to enable up to 96 GB of video buffer. For modernized data centers, use this card in off-peak hours to perform your inferencing workloads.

## Sizing considerations

This section provides various general best practices for sizing your deployment.

- **User density**—If concurrency is a concern, be sure to calculate how many users will be using the environment at the peak of utilization. For example, if only 80 percent are using the environment at any time, the environment must support only that number of users (plus a failure capacity).
- **Disaster recovery**—When planning for DR, Dell EMC recommends implementing a dual/multi-site solution. The goal is to keep the customer's environment online and, in case of an outage, to perform an environment recovery with minimum disruption to the business.
- **Management and compute clusters**—We recommend that you separate the management and compute layers. When creating a management cluster, consider using the XC640 platform to reduce the data center footprint.
- **Network isolation**—The network configuration for Dell EMC XC devices uses either a 10 Gb or a 25 Gb converged infrastructure model. All required VLANs traverse either two 10 Gb NICs or two 25 Gb NICs configured in an Active/Active team.

## Density recommendations

We tested all configurations with Microsoft Windows 10 and Microsoft Office 2016. Test results provide recommended user densities, as shown in the following table.

**Note:** Care should be taken when comparing the density numbers shown below with density numbers for other brokers and HCI environments, because the level of processor vulnerability mitigation implemented in test environments has a significant impact on density numbers.

**Table 3** User density recommendations for VMware vSphere ESXi 6.5 U1 with Citrix Virtual Apps and Desktops.

Server configuration	Workload	User density
B5 + 3 x P40	Multimedia (Virtual PC: P40-2B)	36
C7	Task worker	190
C7	Knowledge worker	160
C7	Power worker	130
C7 + 3 x P40	Multimedia (Virtual PC: P40-1B)	72

## Design assessment

Before deployment, be sure to perform an assessment of your environment to validate design considerations and ensure that you are designing your architecture to meet or exceed the performance of your current environment. Dell EMC Professional Services offers an assessment service for all VDI needs.

# Design enhancements

## Data protection guidance

As the adoption of VDI has grown, this has resulted in an elevation of the strategic importance of organizational VDI environments: users who are critical to business success are increasingly using VDI for their day-to-day productivity tasks. Consequently, the importance of protecting the VDI environment and the business value of its data has also grown as customers seek to ensure that their VDI environments meet corporate availability, recovery time objective (RTO) and recovery point objective (RPO) requirements.

Dell EMC provides a number of data protection solutions for different data protection requirements.

### [Dell EMC Avamar Virtual Edition](#)

Dell EMC Avamar Virtual Edition (AVE) is a data protection solution that delivers software-only data protection for virtualized environments and is therefore ideal for the VDI use case. AVE is a fully-featured data protection solution that is deployed as a virtual appliance and supports advanced functionality such as backup in the cloud (including VMware Cloud on AWS), change block tracking (for fast backup and recovery) and integration with multiple VMware interfaces, such as the vRealize Automation Data Protection Extension. Further information on AVE is available at the [Dell EMC Avamar Virtual Edition](#) web page.

### [Data Domain Virtual Edition](#)

Dell EMC Data Protection Virtual Edition (DDVE) is a data protection storage solution that runs as a virtual appliance on a customer's choice of hardware or any of multiple public cloud options (including VMware Cloud on AWS). For on-premises deployments, DDVE is deployed as a virtual appliance on the relevant hardware platform, in this case the Dell EMC XC Family. DDVE has a single point of management with Dell EMC Data Domain Management Center and scales up to 96 TB per instance. One of the key features of the DD storage protection solution is DD Boost, which provides advanced integration with data protection applications such as AVE to enable client-side deduplication, thus accelerating backup. Further information on DDVE is available at the [Dell EMC Data Domain Virtual Edition](#) webpage.

### [Other Dell EMC Data Protection Products](#)

As well as the DDVE and AVE solutions described above, Dell EMC provides a number of other data protection products for specific use cases, including a range of appliances which reduce the complexity of data protection with a scalable, pre-configured solution that combines data protection storage with software, search and analytics. Further information is available at the [Dell EMC Data Protection](#) webpage.

## File workload guidance

The increased growth in the amount of data that is stored in file shares and user home directories across corporate IT environments in recent years has resulted in an increased focus on the need to better manage this unstructured data. As a result, many organizations are choosing to deploy dedicated file workload solutions with capabilities such as cloud file tiering and single file system namespaces across their IT infrastructure, including for file workloads in a VDI environment.

Dell EMC provides a number of file workload solutions for different types of file workloads.

The architectures shown in Figures 7 and 8 below show VDI management and compute environments sharing a vSphere HA cluster. This architecture is universally applicable across SDS environments that require access to dedicated file storage. It is also acceptable to configure these management and compute environments in separate HA clusters (as shown in the 'Architecture Overview' section). In this scenario, each compute cluster and its associated management cluster should share a single file storage system, for example Unity, Isilon.

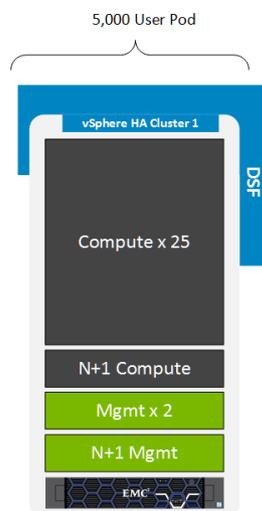
## Dell EMC Unity

Dell EMC Unity storage is simple, unified all-flash and hybrid storage with hybrid cloud capabilities.

Dell EMC Unity is ideal for general purpose NAS/SAN mixed workload consolidation, smaller file workloads (including small to mid-sized VDI environments), and transactional databases.

The following figure shows an example of a 5,000-user VDI deployment using Dell EMC Unity storage for file shares.

**Figure 7** 5,000-user pod on Dell EMC Unity



When deploying Dell EMC Unity in a VDI environment, Dell EMC recommends that you deploy a separate Dell EMC Unity storage system with a vSphere HA cluster or Pod. This structure provides the greatest scalability, resiliency, and flexibility when deploying and maintaining file services for the overall user pod. As unstructured data storage needs grow over time, the capacity of each Dell EMC Unity storage system can be scaled up independently with minimal user impact. You have the choice to deploy alternative architectures to the one suggested here, but you should carefully consider the tradeoffs.

The [Dell EMC Unity All-Flash Unified Storage](#) web page provides guidance about selecting an appropriate Dell EMC Unity storage solution for your file workload requirements.

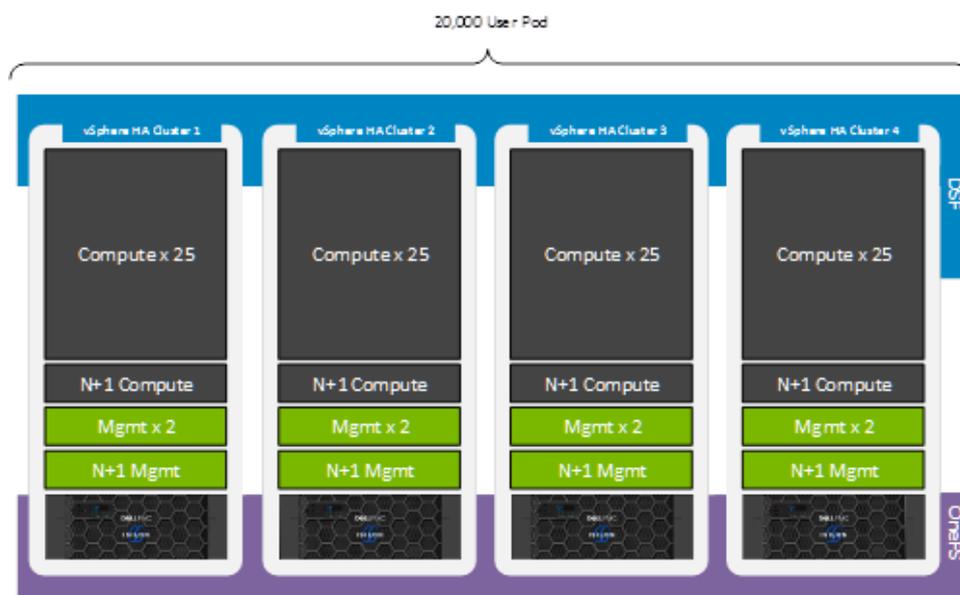
## Dell EMC Isilon file storage

Dell EMC Isilon storage is the industry's number one scale-out NAS solution for any file workload.

Isilon is ideal for a wide range of file workloads (including large-scale enterprise VDI environments requiring a single file system namespace), high performance computing (HPC), archiving, and infrastructure consolidation.

The following figure shows an example of a 20,000-user VDI deployment using Dell EMC Isilon scale-out storage with a single namespace.

**Figure 8** 20,000-user pod on Isilon



When deploying Dell EMC Isilon in a VDI environment, Dell EMC recommends that you deploy a separate Dell EMC Isilon storage system with a vSphere HA cluster or Pod. This structure provides the greatest scalability, resiliency, and flexibility when deploying and maintaining file services for the overall user pod. As unstructured data-storage needs grow over time, the capacity of each Dell EMC Isilon storage system can be scaled up independently with minimal user impact. In addition to scaling up each Isilon chassis, Isilon can also be scaled out using the OneFS operating system. This ability means that additional Isilon systems can be added to provide a single volume and namespace that all user pods in a datacenter can access.

As shown in the previous figure, Isilon OneFS can be scaled out as the VDI environment grows. You can choose to deploy alternative architectures to the one suggested here, but you should carefully consider the tradeoffs.

The [Dell EMC Isilon](#) web page provides guidance about selecting an appropriate Dell EMC Isilon storage solution for your file workload requirements.

## Data center infrastructure

Enterprise equipment requires power to operate, racks to enable streamlined management, and cooling to maintain reliable operations.

Careful selection of the infrastructure solutions that provide these capabilities is vital to ensure uptime, scalability, energy efficiency and ease of management. Dell EMC provides a wide range of Data Center Infrastructure solutions:

- **Dell EMC Netshelter SX racks**—Deploy server, storage, and networking equipment and other IT hardware while optimizing power, cooling, cabling, and systems management.
- **Dell EMC Keyboard Video Mouse (KVM) and Keyboard Monitor Mouse (KMM) solutions**—Manage 8 to 1,024 local and remote servers running various operating systems across the enterprise.
- **Dell EMC Smart-UPS**—Deliver reliable power and protect IT equipment, including servers, storage, networking, point-of-sale, and medical equipment.
- **APC Rack Power Distribution Units (PDUs)**—Reliable power distribution designed to increase manageability and efficiency in your data center

# Conclusion

## Summary

This design guide has described the integration of XC Family devices from Dell EMC and Citrix Virtual Apps and Desktops brokering software to create virtual application and desktop environments. This architecture provides exceptional scalability and an excellent user experience and empowers IT teams to play a proactive strategic role in the organization.

Dell EMC offers comprehensive, flexible, and efficient VDI solutions that are designed and optimized for the organization's needs. These VDI solutions are easy to plan, deploy, and run.

Dell EMC Ready Architectures for VDI offer several key benefits to clients:

- Predictable costs, performance, and scalability to support a growing workforce
- Rapid deployments
- Rapid scaling, ready to serve enterprises of any size
- Dell EMC support

All the Dell EMC Ready architectures for VDI are configured to produce similar results. You can be sure that whichever XC Family devices you choose has been designed and optimized for your organization's needs.

## Next steps

Dell EMC has a configuration to fit the needs of any size organization:

- XC640—Select this device if graphics are not required or where high computer power per unit of rack space is required.
- XC740xd—Select this device if graphics are required or where there are significant storage capacity and I/O requirements.

To explore more about this solution, its design, and testing, see the Validation Guide for this architecture. Your Dell EMC solutions representative can assist with further information and resources.

For additional resources and other VDI designs to help make IT groups a strategic asset, go to [www.dell.com/vdi](http://www.dell.com/vdi).

# References

The documentation in this section provides additional information.

## Dell EMC documentation

The following Dell EMC documentation provides additional and relevant information. Access to these documents depends on your login credentials. If you do not have access to a document, contact your Dell EMC representative. Also see the [Dell EMC VDI Information Hub](#) for a complete list of VDI resources.

- [Dell EMC Virtual Desktop Infrastructure](#)
- [Dell EMC XC Series and XC Core Technical Resource Center](#)

This document is part of the documentation set for this architecture, which includes the following:

- [Dell EMC Ready Architectures for VDI: Designs for Citrix Virtual Apps and Desktops on XC Family Design Guide](#)
- [Dell EMC Ready Architectures for VDI: Designs for Citrix XenDesktop and XenApp on XC Family Deployment Guide](#)
- [Dell EMC Ready Architectures for VDI: Designs for Citrix Virtual Apps and Desktops on XC Family Validation Guide](#)

## VMware documentation

The following VMware resources provide additional and relevant information:

- [VMware vSphere documentation](#)
- [VMware Compatibility Guide](#)

## Citrix resources

The following Citrix resources provide additional and relevant information:

- [XenDesktop and XenApp 7.15 LTSR: System Requirements](#)
- [Citrix VDI Handbook and Best Practices](#)
- [Citrix deployment guides](#)
- [Citrix StoreFront Proof of Concept Implementation Guide](#)
- [Install and Configure](#)

## NVIDIA documentation

The following NVIDIA documentation provides additional and relevant information:

- [NVIDIA Virtual GPU Software Quick Start Guide](#)