POC (Proof of Concept)

Citrix Virtual Desktop (VDI)
High Level Design Document -DRAFT

Prepared by
Ram Prasad

Table of Contents

1. Introduction 4
   1.1 Authors 4
   1.2 Revision History 4
2. Executive summary 5
   2.1 Purpose of the Document 5
   2.2 Project Goals 5
   2.3 Stakeholders 6
   2.4 Scope /Key Requirements 6
   2.5 Out of Scope 8
3. Solution Design 8
   3.1 Conceptual Architecture 8
   3.2 Logical Architecture 9
      3.2.1 User Layer 10
      3.2.2 Access Layer 11
      3.2.3 Resource Layer 13
      3.2.4 Control Layer 20
      3.2.5 Hardware Layer 25
3.3 Software's & Licensing 36
   3.3.1 Softwares & versions 36
   3.3.2 License 36
   3.3.3 NVIDIA License 35
3.4 Supporting Infrastructure 37
   3.4.1 Active Directory 37
   3.4.2 DHCP 37
   3.4.3 SCCM ..... **Error! Bookmark not defined.**
   3.4.4 Printer ..... **Error! Bookmark not defined.**
3.5 Security Controls 38
3.6 Monitoring & Reporting 39
3.7 Design Decisions 41

3.7.1 HDX Graphics ..... **Error! Bookmark not defined.**
3.7.2 RISKS 44
4.1.1 Limitations 44
4. Appendix 45
4.1. Communication ports 45
4.2. PoC Lessons Learnt 45
4.3. Nutanix Architecture Elements 46
4.4. Glossary 47

List of Tables

Table 1: Authors 4
Table 2: Version History 5
Table 3: Stakeholders 6
Table 4: In scope Requirements 7
Table 5: Authentication Points 12
Table 6: VDI Configuration 16
Table 7: UPM Decision 17
Table 6: Application Delivery 18
Table 7: Application List 18
Table 8: User Type 20
Table 9: Citrix Databases 21
Table 10: Hardware Specifications 26
Table 11: NVIDIA T4 Specifications 27
Table 12: T4 vGPU profiles 34
Table 13: Software's & versions 36
Table 14: Licenses 37
Table 15: Design Decisions 42
Table 18: Assumptions 43
Table 19: Dependencies 44
Table 20: RISKS 44
Table 21: Nutanix Architecture Elements 47
Table 22: Glossary 48

List of Figures

Figure 1: Conceptual Architecture 9
Figure 2: VDI Logical Architecture 10
Figure 3: User Connection Flow 13
Figure 4: User Experience 14
Figure 5: Image Management 19
Figure 6: MCS High Level Architecture 24
Figure 7: Rack Layout 27
Figure 8: TOR Switch port Cabling 28
Figure 9: Nutanix Platform 29
Figure 10: Distributed Storage Fabric 30
Figure 11: vGPU Architecture 33
Figure 12: Director Workflow 40

1. Introduction

About <CUSTOMER NAME>

1.1 Authors

The following authors contributed to the creation of this deliverable.

Author	Role

Table 1: Authors

1.2 Revision History

Version	Date	Details of Change	Updated By

Version	Date	Details of Change	Updated By

Table 2: Version History

2. Executive summary

Desktop Virtualization Service is a part of <Supplier Name>'s solution to build Citrix Virtual Apps & Desktops environment. <Supplier Name> have been engaged by <CUSTOMER NAME> to design and build an on premises-based VDI-as-a-service proof of concept for approximately 30 users.

2.1 Purpose of the Document

This document outlines the POC High-Level Infrastructure Design of the VDI solution, platform and systems to be built for delivering virtual Apps & Desktops for <CUSTOMER NAME> users, by leveraging the technologies Citrix, Nutanix, Microsoft etc.

The solution document will be updated for ongoing design changes and enhancement being done at Citrix level during POC.

2.2 Project Goals

As part of POC Statement of work, <Supplier Name> is expected to fulfill the below deliverables and demonstrate <Supplier Name> VDI capabilities deployed at <CUSTOMER NAME> <Location>

- Procure & Deliver Hardware (3 physical servers) with NVIDIA Graphics cards
- Racking & Stacking of Hardware
- Install Nutanix Hypervisor (AHV) on physical Servers
- Build Citrix Virtual Apps & Desktop Infra on Nutanix platform
- VDI POC is only for Intranet users
- Install & deliver basic applications like Office, Adobe and Intranet apps (Mat Lab etc..) on VDI
- Install & deliver high Graphics intensive applications CAD/CAM.
- Deploy VDI for the total of 30 <CUSTOMER NAME> users

2.3 Stakeholders

The stakeholders are individuals or groups inside the organization who initiate the POC project and are now actively spearheading it:

Name	Company	Role

Table 3: Stakeholders

2.4 Scope /Key Requirements

The overall scope of the VDI POC program that the solution outlines in this document is designed to meet the following details:

In Scope (Key Requirements)	Remarks
Hardware	
Server procurement, Delivery , Racking & Stacking	
Nutanix Acropolis Hypervisor Installation & cluster configuration	
Citrix Infrastructure & VDI Build	
Design and deploy Citrix Virtual Apps & Desktop on Nutanix AHV	
Citrix PoC is only for Intranet applications. (i.e., Citrix Site to be created only in <CUSTOMER NAME>Net (Intranet) network)	
Provision Citrix VDI Management Servers (Windows Server 2019) with minimum and without High Availability.	
Create new Golden images based on the Windows 10 21H2& Windows Server 2019	
Define the required GPO's and Policies for VDI platform that should be implemented by <CUSTOMER NAME> teams	

Implement FSLogix for user profile management	
Provision Windows 10/Windows Server OS VDI workload's (Pooled/HSD)	
VDI's to be provisioned for 100 users	
Applications on VDI Golden Image: Coordinate with <CUSTOMER NAME> teams and install base applications like office, browser and High graphics intensive applications like CAD & CAM	
VDI's should be accessible only for internal users i.e., accessible only from <CUSTOMER NAME> network	
The proposed VDI solution should be accessible from different types of Endpoints, including thin clients, supporting the following OS - Windows, Linux, macOS	
The proposed VDI solution must support multiple monitors spanning functionality	
Integration	
Integrate Citrix storefront with single factor authentication i.e., Active Directory	
Integration with <CUSTOMER NAME> Infra environment – Security tools, AD, messaging & collaboration tools.	
Security	
VDI Infrastructure must be compliant with <CUSTOMER NAME> Security Policies	
VDI URL access must use Digital Certificates for secured connectivity	
The proposed solution must provide Anti Malware protection capability	
Integrate with existing <CUSTOMER NAME> security monitoring solution	
Monitoring	
Integrate the <CUSTOMER NAME> Monitoring tools and Demonstrate the VDI monitoring tools with Director to monitor the VDI platform, (performance, availability, capacity and other health parameters.)	
Testing	
<Supplier Name> to maintain a list of use case and associated test plans.	
Perform System testing and Performance testing of VDI	
Create user acceptance and production environment	
Documents Deliverables	
High Level Design document (with Low level details)	

Table 4: In scope Requirements

2.5 Out of Scope

The following items are out-of-scope for this project:

- Application packaging, sequencing, patching, upgrades, testing and remediation
- Citrix receiver deployment on the end-user desktop
- Endpoints setup & issues
- Networking
- Any task not mentioned in the scope

3. Solution Design

Citrix Virtual Apps and Desktops is an application and desktop virtualization and delivery solution that transforms desktops and applications into secure, on-demand services available to any user, anywhere, on any device.

With Virtual Apps and Desktops, administrators can deliver individual Windows, web, and software-as-a-service (SaaS) applications, or full virtual desktops to PCs, Macs, tablets, smartphones, laptops, and thin clients with a high-definition user experience. Citrix Virtual Apps and Desktops share a unified architecture called FlexCast Management Architecture (FMA).

3.1 Conceptual Architecture

The Citrix architectural design framework is based on a unified and standardized layer model. The conceptual architecture helps define the overarching strategies for the entire solution based on business objectives and organizational structure.

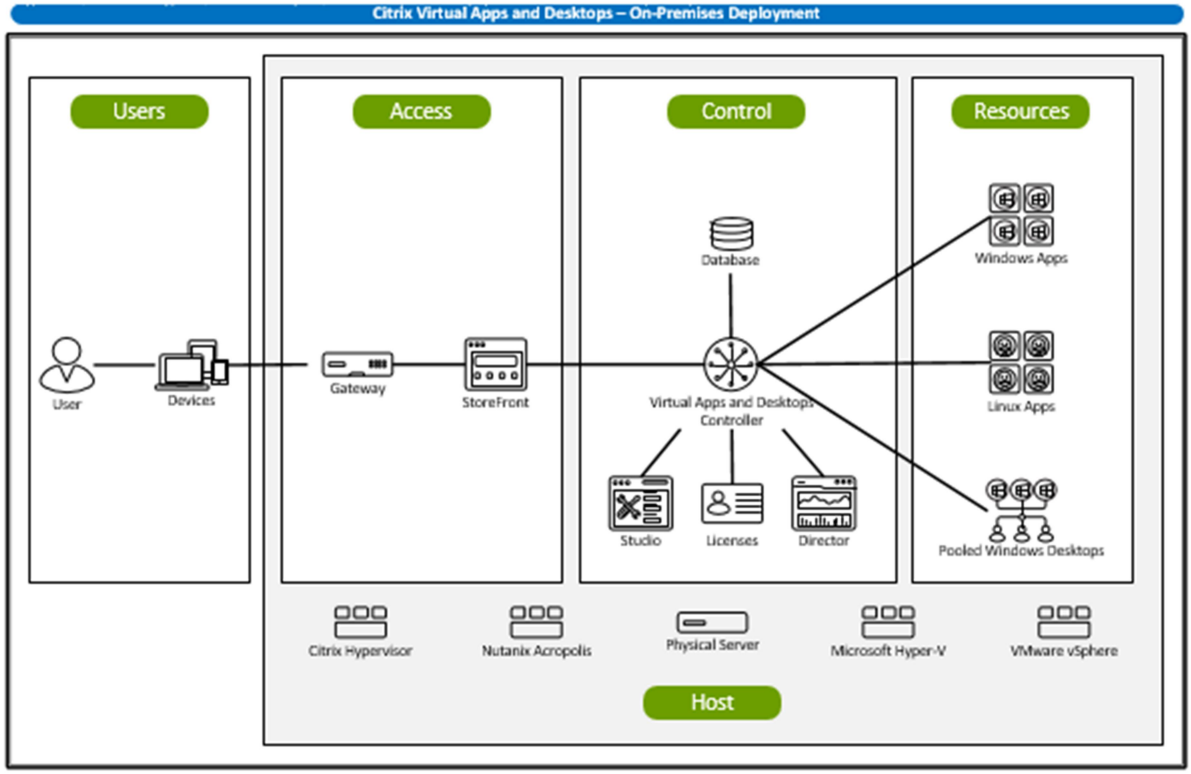

Figure 1: Conceptual Architecture

- **User Layer -** This layer defines the user groups and locations of the Citrix environment.
- **Access layer -** This layer defines how users access the resources.
- **Resource layer -** This layer defines the provisioning of Citrix workloads and how resources are assigned to the given users.
- **Control layer -** This layer defines the components that control the Citrix solution.
- **Hardware (Platform) layer** - This layer defines the physical elements where the hypervisor components and cloud service provider framework run to host the Citrix workloads.

3.2 Logical Architecture

VDI POC is designed for <CUSTOMER NAME> based on the identified key requirements, user segments, application categorization and personalized key design decisions, the following figure provides Citrix VDI high level architecture on Nutanix Hypervisor platform.

Following figure depicts PoC VDI logical architecture at <CUSTOMER NAME>

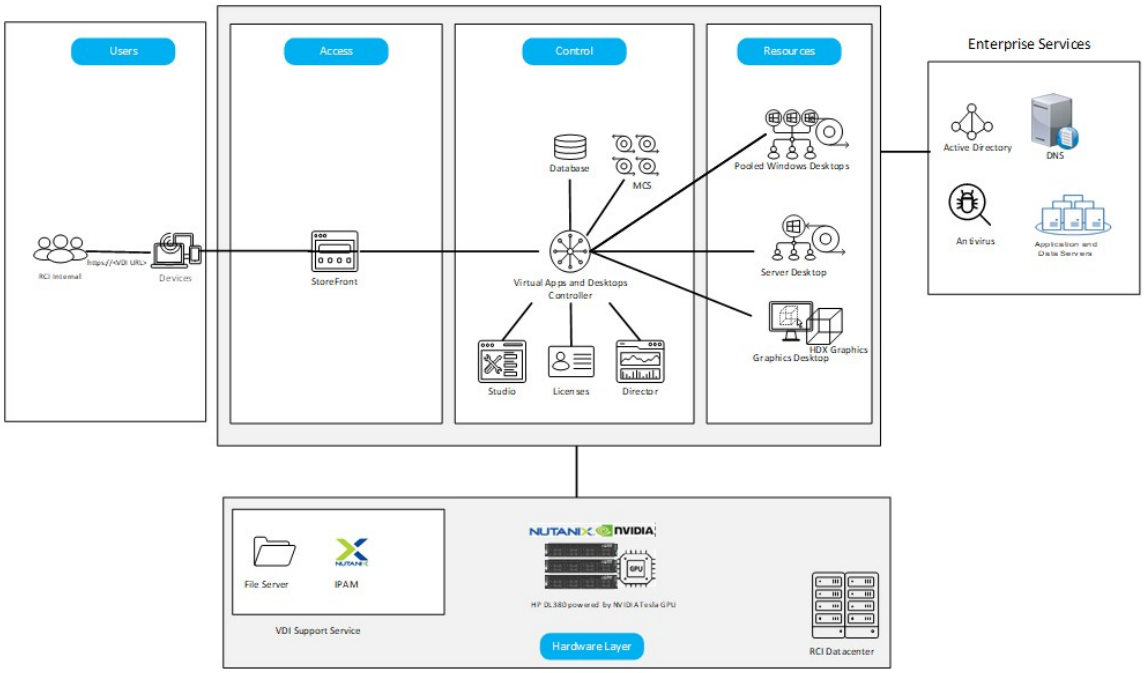

Figure 2: VDI Logical Architecture

3.2.1 User Layer

The User Layer focuses on the unique qualities of each user group. Users are often grouped based on their network connectivity to the datacenter, endpoint devices, data storage needs and any special requirements or concerns (e.g. security, performance, mobility, personalization).

User Topology /Types

The identified use cases include <CUSTOMER NAME> users connecting from office networks. These users access their virtual desktops over Internal Network or VPN.

Note: All Low Level details will be provided post POC completion.

Endpoints

The user's primary endpoint device must align with the overall business drivers as well as each user's role and associated requirements. In many circumstances, multiple endpoints may be suitable, each offering differing capabilities.In order for a user to connect to their VDI, they must use an endpoint and

have the appropriate Receiver/workspace app plugins.

<CUSTOMER NAME> Users use the following Endpoint devices:

- Thin Clients
- Desktops
- Laptops
- Windows/Linux OS Clients

Note: All Low Level details will be provided post POC completion

<CUSTOMER NAME> Endpoint Models:
Make/Model:
OS:

3.2.2 Access Layer

The Access Layer focuses on the method and process users follow in order to establish and maintain a connection to their desktops and applications. User location, connectivity and security requirements play a critical role in defining how users authenticate into their virtual desktop.

Authentication:

Active Directory is the Primary Authntication provider, getting access to resources is based on the user's identity, users required an Active Directory username and password to get access to their XenApp and XenDesktop resources.

Authentication Point

Before a user connects to a virtual resource, they must first authenticate. The place of authentication is often determined by the user group's mobility requirements, which were defined during the user segmentation process.

There are two authentication points available in Citrix Virtual Apps & Desktop(CVAD):

• **StoreFront –** Citrix StoreFront provides authentication and resource delivery services for Citrix Receiver, enabling centralized enterprise stores to deliver desktops, applications and other resources.

• **Citrix Gateway** – NetScaler Gateway is an appliance providing secure application access and granular application-level policy controls to applications and data while allowing users to work from anywhere

Users Group Mobility Requirement	Preferred Authentication Point
Local	Storefront
Roaming Local	Storefront
Remote	Citrix Gateway
Mobile	Citrix Gateway

Table 5: Authentication Points

Note: For VDI POC deployment, Citrix Gateway deployment is excluded as users are Local i.e., Intranet Users

3.2.2.1 Storefront

StoreFront is an integral component of Citrix Virtual App and Desktop design. It offers StoreFront as a portal for end users to access their virtual desktop assets.

Citrix StoreFront authenticates users to Citrix Virtual App and Desktop sites, enumerating and aggregating available desktops and applications in stores. It also keeps track of the users' application subscriptions, shortcut names to ensure users have a consistent experience across multiple devices.

Storefront supports a number of different authentication methods *like "User name and password", "Domain pass-through","Nestcaler Gateway pass-through"," smartcard" & Anonymous"*, although not all are recommended depending on the user access method, security requirements and network location. Note that by default StoreFront authenticates users directly with Active Directory.

Note: All Low Level details will be provided post POC completion

Storefront servers, Store, Authentication etc..

3.2.2.2 User Connection Flow for <CUSTOMER NAME> users

Following figure depicts the <CUSTOMER NAME> user connection workflow to Citrix

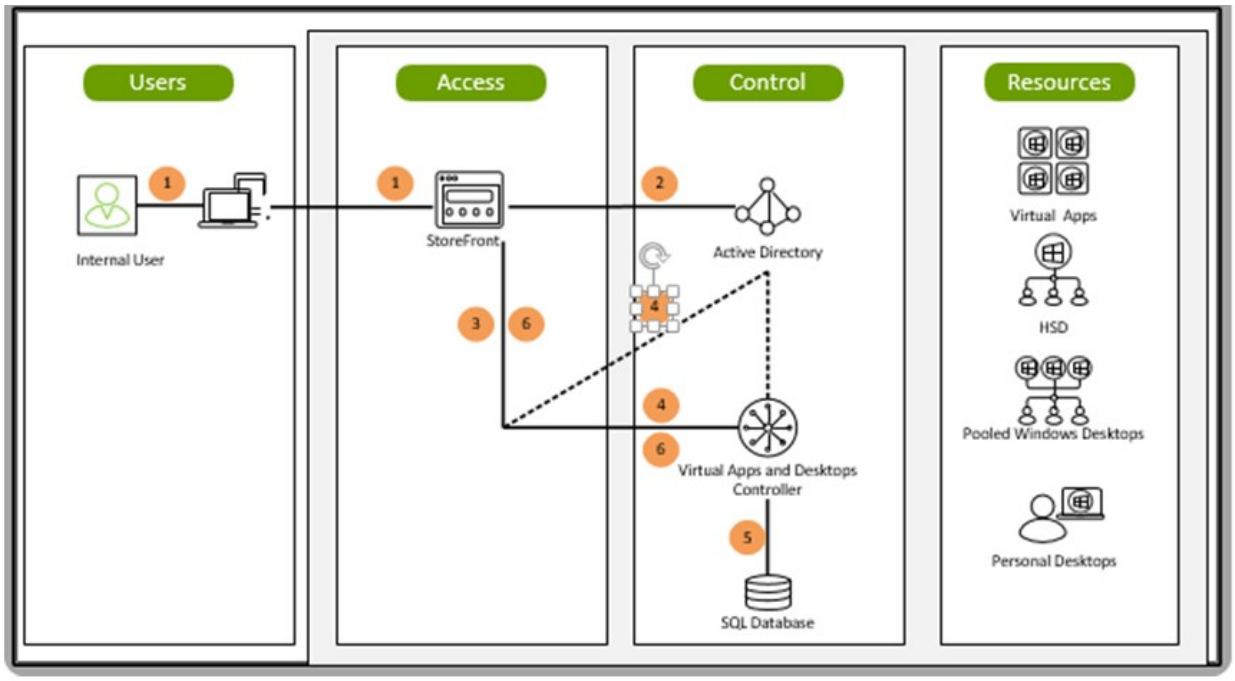

Figure 3: User Connection Flow

1. <CUSTOMER NAME> user initiates a connection to the Storefront URL and provides logon credentials.
2. The credentials are validated against <CUSTOMER NAME> Active Directory.
3. Storefront forwards the user credentials to StoreFront.
4. When StoreFront is in the same domain as the controller, StoreFront validates the user credentials against Active Directory and forwards to the delivery controller.
5. The Virtual Apps & Desktops delivery controller retrieves a list of available resources by querying the SQL Database.
6. The list of available resources is sent to StoreFront, which populates the user's Citrix Virtual Apps & Desktops

3.2.3 Resource Layer

The Resource Layer is where users will interact with desktops and applications and is most visible to the end users. The user requirements obtained during the Assess phase and refined during the User Layer design phase are used as the basis for the VDI design recommendations.

The Resource Layer consists of three sub-layers: *VDI Desktop type, Personalization and Applications*. Within each sub-layer, it specifies information such as the operating system, assigned policies and

profile design, and application requirements

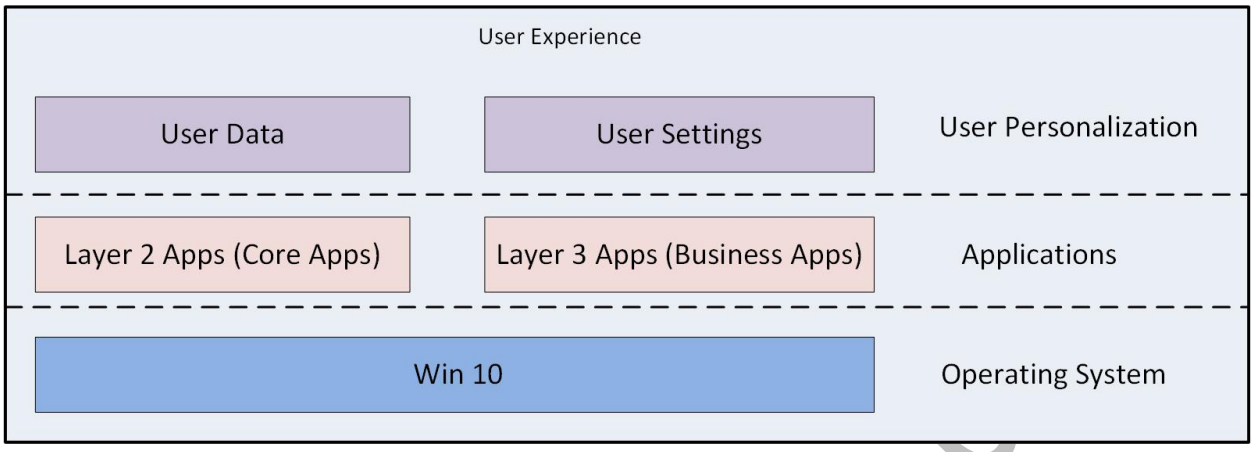

Figure 4: User Experience

3.2.3.1 Client Operating System

Windows 10 based VDIs are delivered to the POC users. <Supplier Name> POC team will create Win 10 21H2 image using <CUSTOMER NAME> build or fresh installation and will install Layer 2 application on this image. Best practices will be applied to optimize image for VDI implementation.

Note: All Low Level details will be provided post POC completion.

3.2.3.1.1 Virtual Apps & Desktop Delivery Types

Citrix Virtual Apps and Desktops offers various delivery methods. A single delivery method will likely not meet all of your requirements.

Virtual Apps

- **Hosted Apps** -The hosted apps model delivers only the application interface to the user
  - **Windows Apps** – The Windows apps model utilizes a server-based Windows operating system,
  - **VM hosted apps** – The VM hosted apps model utilizes a desktop-based Windows operating system, resulting in a single user accessing a single VM model

Virtual Desktops

- **Shared Server Desktop (Multi Session OS)**
  With the shared desktop model, multiple user desktops are hosted from a single, server-based operating system (Windows Server 2012 R2,2016,2019 etc..)

- **VDI Desktop (Single Session OS)**
  - **Pooled Desktop (Random Non-Persistent) -** Each time a user logs on to one of these desktops, that user connects to a desktop selected from a pool of desktops. That pool is based on a single master image. All changes to the desktop are lost when the machine restarts.
  - **Static Non-Persistent Desktop (Personal) -** During the first logon, a user is assigned a desktop from a pool of desktops. (Each machine in the pool is based on a single master image.) After the first use, each time a user logs on to use a desktop, that user connects to the same desktop that was assigned on first use. All changes to the desktop are lost when the machine restarts.
  - **Static Persistent Desktop (Personal)-** Unlike other types of VDI desktops, users can fully personalize these desktops. During the first logon, a user is assigned a desktop from a pool of desktops. Subsequent logons from that user connect to the same desktop that was assigned on first use. Changes to the desktop are retained when the machine restarts.
- **Remote PC Access:** The Remote PC Access desktop model provides a user with secure remote access to their statically assigned, traditional PC.

Classification of Graphics users

Below provides a simplified recommendation to segment the 3D professional graphics users at <CUSTOMER NAME> based on GPU requirements, and define the right solution for each group.

Designers and engineers: The most demanding user group. They create and manipulate large, complex, 3D models and require a dedicated GPU for graphics acceleration.

Operators and contractors (Power users): Users are classified in this segment when they need to view or edit graphics intensive 3D files, or access complex graphics workflows onsite, say on the factory floor or at a construction site; hardware GPU acceleration is recommended.

Knowledge and task workers: The segment of users in the organization that are not engaged in professional graphics design. Hardware accelerated graphics may or may not be required to deliver business graphics, such as the Windows 10 style apps, PowerPoint transitions in Office 2013, or perform light 2D and 3D work.

POC Identified users are Designers & Engineers which falls under Heavy

Note: All Low Level details will be provided post POC completion

For the purpose of the POC <Supplier Name> will utilize the following VM sizing and compute requirements for the POC users.

Desktop Type	Configuration	Usage

Windows 10 Non-Persistent	2 vCPU,4GB RAM,50GB HDD	Standard Users
Windows 10 Graphics (Non- Persistent)	8 vCPU, 16 GB RAM,80GB HDD	Heavy users
Hosted Share Desktop (Windows Server)	8 vCPU, 16 GB RAM,80GB HDD	Applications that require high CPU or GPU
RHEL Linux Workstation	Single Sessions	CAD/CAM

Table 6: VDI Configuration

3.2.3.2 Personalization

Personalization decisions are weighed against user location, data center connectivity and security requirements. With the right combination of technologies, like profiles and policies, a user group receives a desktop where user-level changes range from a complete deletion to complete persistence.

The personalization of the user's sessions is configured in:

- Profile Management
- Policy Management

3.2.3.2.1 Profile Management

Microsoft FSLogix

Each user group, regardless of the required level of personalization, should have a profile. Profile management ensures that the user's personal settings are saved and applied to the user's Published application and Desktop Sessions, regardless of the location and endpoint device.

Microsoft FSLogix is the best recommended solution for VDI profile management profile. FSLogix is designed to roam profiles in remote computing environments, such as Citrix VDI , Microsoft AVD, VMware Horizon etc.It stores a complete user profile in a single container. At sign in, this container is dynamically attached to the computing environment using natively supported Virtual Hard Disk (VHD) and Hyper-V Virtual Hard disk (VHDX). The user profile is immediately available and appears in the system exactly like a native user profile

FSLogix solutions include:

- Profile Container
- Office Container

- Application Masking
- Java Version Control
- Cloud Cache

For POC, Microsoft FSLogix is enabled on all Non-Persistent VDI & HSD users to store profile and data on a central storage so that it can be available across different desktops.

The design decisions for User Profiles are as follows:

Decision	Design Decision	Notes
User Profile Type	Roaming Profiles	FSLogix is the preferred user profile solution.
User Profile Configuration	FSLogix	FSLogix will be configured via Local GP
User Profile Storage	Windows File Server (CS)	A Windows File Server would be created to store users profile and redirected folders.
Profile Size	5 GB	For Profile & office
FSLogix Policies	Enabled through Local Group Policies	

Table 7: UPM Decision

Note: All Low Level details will be provided post POC completion

3.2.3.2.2 Policy Management

Citrix Policies provide the basis to configure and fine-tune the Citrix environment. Policies provide control of connection, security and bandwidth settings based on various combinations of users, devices or connection types. Defining an initial baseline policy and assigning additional policies based on security requirements and specific access scenarios is an important aspect of delivering good user experience.

<Supplier Name> POC team will use Citrix Studio or PowerShell to create policies for POC VDI site. Policies created using Studio are stored in the site database and updates are pushed to the virtual desktop either when that virtual desktop registers with the broker or when a user connects to that virtual desktop.

Note: All Low Level details will be provided post POC completion

Created Base Policy to disable clipboard and Client Drive Mapping

3.2.3.3 Applications

Having an accurate list of applications is important for providing a desktop environment that meets the needs of each user. Each application must be delivered into the solution in the most appropriate way, typically based on a particular application category, defined as follows.

The most important aspect of the resource layer is the applications. Applications will be delivered using following methods:

Note: All Low Level details will be provided post POC completion

Resource Type	Application Delivery
Pooled VDI (Windows 10)	Applications are locally installed on the Server's Golden Image
Hosted Share Desktop (Server Desktop)	Applications are locally installed on the Server's Golden Image

Table 8: Application Delivery

Application List

Department	Master Image	Application Names

Table 9: Application List

3.2.3.4 Images:

Image Management is an approach of creating a Master image that contains the operating systems and all the required applications to deliver that single virtual image to multiple target virtual machines. The key concept behind image management is reusability and simplified management, which allow the Citrix administrator to deliver the necessary operating systems with the required set of applications to appropriate users based on their needs.

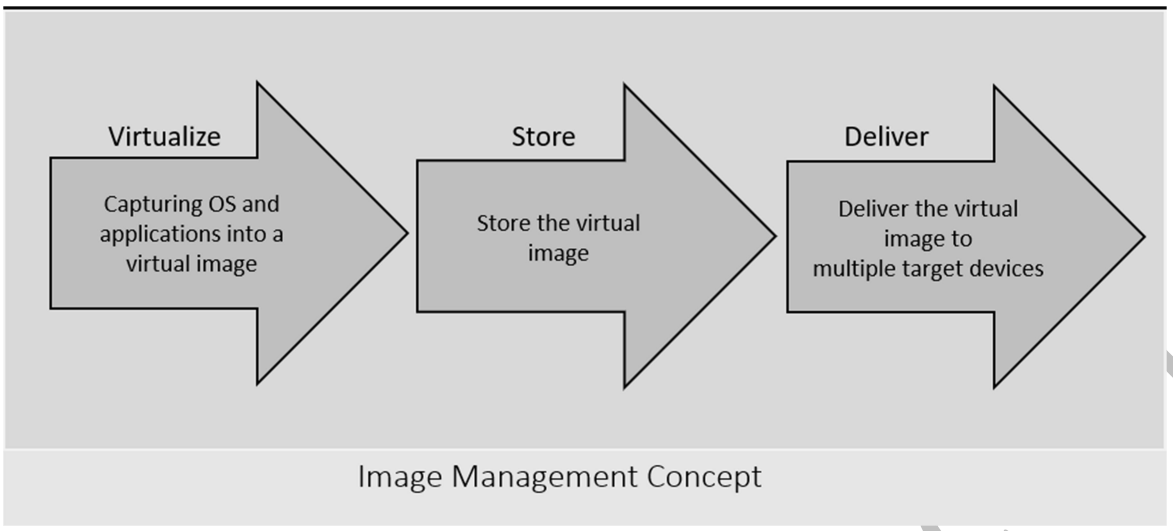

Figure 5: Image Management

Each group of apps and desktop are based on an underlying master image. The master image is defined by an operating system, image size and a set of applications that are installed into the base image. As the number of images increase, the time spent maintaining the images also increase.

Once an image is created, catalogs are used to define the virtual desktop specifications under the service owner governance. This structure allows sharing of the same image to different users requiring different resource allocations.

Based on the requirements captured in the Solution Design section, the following resource layer design decisions go into creating the Virtual Machine base image. We need to create two different master images, one for Windows Server OS and the other with Windows Desktop OS:

Note: All Low Level details will be provided post POC completion

Criteria	Decision for Standard VDI	Decision for Graphics VDI	Decision for HSD
Operating System	Windows 10 21H2	Windows 10 21H2	Windows Server 2016
Delivery	Machine Creation Services	Machine Creation Services	Machine Creation Services
Delivery Type	Pooled	Pooled	Pooled
vCPU	2	8	8
Memory	4	16	16
Disk	50	80	80
Applications			
Graphics Acceleration	NA	vGPU	

User Group			
Number of VM's			

3.2.3.5 Resource Assignment

POC VDIs to be assigned to users based on user requirement categorizations, <Supplier Name> team worked with <CUSTOMER NAME> team to categorize users for POC VDI assignment.

High specification Non-Persistent VDI's are assigned to Designer/Engineers and Standard non-persistent VDI's are assigned to standard users

Example for User Categorizations is shown in below table:

Note: All Low Level details will be provided post POC completion

User Type	Characteristics	VDI Type	Remarks
Standard User	Office productivity apps with light multimedia use.	Stateless	
Developer User	Intense multimedia, data processing or application development.	Stateful	Heavy work load

Table 10: User Type

3.2.4 Control Layer

The Control Layer includes all infrastructure related components supporting the overall solution. This layer deals with designing all the infrastructure components required to deliver the Citrix services in Resource Layer. The Components include delivery controllers, MCS, Database, and Licensing Server. As such this layer is the foundational layer of the Citrix design.

3.2.4.1 Database:

Database is one of the Core component in the Citrix Solution. It plays a key role in deploying the Citrix components like, Delivery Controller and Hypervisor Cluster. It stores the static information such as the Citrix Site information, License Information and Published Desktop details. This also stores the dynamic information such as the Server Load, User sessions and State of the Servers.

The Database is based Microsoft SQL. Multiple database is configured such as:

Database	Details
Site Database	This stores the information about Citrix Site such as Servers deployed and state of the servers, license server information policies applied
Monitor Database	This stores the live and historical data about the User connection, state of the Citrix Farm. As we are deploying XenDesktop Platinum edition, Unlimited historic data can be extracted
Logging Database	This stores all the changes performed by the administrators in the Citrix Environment

Table 11: Citrix Databases

For VDI POC, it is agreed to use SQL express on Delivery Controller for Database.

Note: All Low Level details will be provided post POC completion

3.2.4.2 License Server

The License Server manages Citrix product licenses. It communicates with the Controller to manage licensing for each user's session and with Studio to allocate license files. A site must have at least one license server to store and manage your license files.

The licenses are installed on the License Server. Every time a client or user connects to a session, a license is checked out from the License Server. Citrix License Server does not need to be highly available as clients continue to operate seamlessly for up to 30 days in the event of the License Server being unavailable.

In order to run the Citrix Solution, we need two types Licenses:

- Microsoft RDS CAL Licenses -> Required only for Hosted Shared Desktop (Server Desktops)
- Citrix Licenses

Note: For current POC deployment, Evaluation licensed will be used for both Citrix & Microsoft RDS CAL's

Note: All Low Level details will be provided post POC completion

3.2.4.3 Delivery Controller

Citrix delivery controller is core component of Citrix infrastructure. The Delivery Controllers authenticate users, enumerate resources, direct user launch requests and control desktop startups, shutdowns and registrations. In short, the delivery controller does brokering of user connections efficiently by ensuring all core components are available.

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

Virtual Delivery Agent (VDA)

The VDA is installed on each physical or virtual machine in citrix site that will make available to users. The VDA enables the machine to register with the Controller, which in turn allows the machine and the resources it is hosting to be made available to users. VDAs establish and manage the connection between the machine and the user device. VDAs also verify that a Citrix license is available for the user or session, and apply policies that are configured for the session.

The VDA communicates session information to the Broker Service in the Controller through the broker agent in the VDA. The broker agent hosts multiple plug-ins and collects real-time data. It communicates with the Controller over TCP port 80.

Workspace App

Installed on user devices and other endpoints (such as virtual desktops), Citrix Workspace app provides users with quick, secure, self-service access to documents, applications, and desktops. Citrix Workspace app provides on-demand access to Windows, Web, and Software as a Service (SaaS) applications. For devices that cannot install the device-specific Citrix Workspace app software, Citrix Workspace app for HTML5 provides a connection through an HTML5-compatible web browser.

FlexCast Management Architecture (FMA)

The unified FlexCast Management Architecture lets you deliver virtual desktops and applications tailored to meet the diverse performance, security, and flexibility requirements of every worker in organization through a single solution. Centralized, single-instance management helps you deploy, manage, and secure user desktops more easily and efficiently.

For current POC deployment, one VM will be used to install Delivery Controller, Database & license server.

Note: All Low Level details will be provided post POC completion

3.2.4.4 Machine Creation Services (MCS)

The Citrix Virtual Apps and Desktops solution has two provisioning models for image management: **Citrix Machine Creation Services and Citrix Provisioning.**

The Citrix Virtual Apps and Desktops or Citrix Virtual Apps and Desktops service console, Citrix Studio, lets users deploy all types of desktop and application workloads, whether persistent or non-persistent. The built-in Citrix MCS can derive each of these from gold images and clone them on the spot.

Citrix Machine Creation Services offers a simplified approach for image management without deploying additional infrastructure. It is ideal for persistent and non-persistent workloads. Citrix Machine Creation Services is a component of the Citrix Virtual Apps and Desktops solution that is coupled within the Delivery Controller

Nutanix is particularly well suited to Citrix MCS for several reasons:

- Nutanix distributed storage easily handles increased read I/O through our optimized data path.
- Nutanix provides a single datastore, which dramatically reduces administrative overhead and update time.
- Shadow clones cut network latency and improve user experience.

MCS works as shown in the following figure. Each supported hypervisor has its own specific MCS disk management implementation but the net effect is the same.

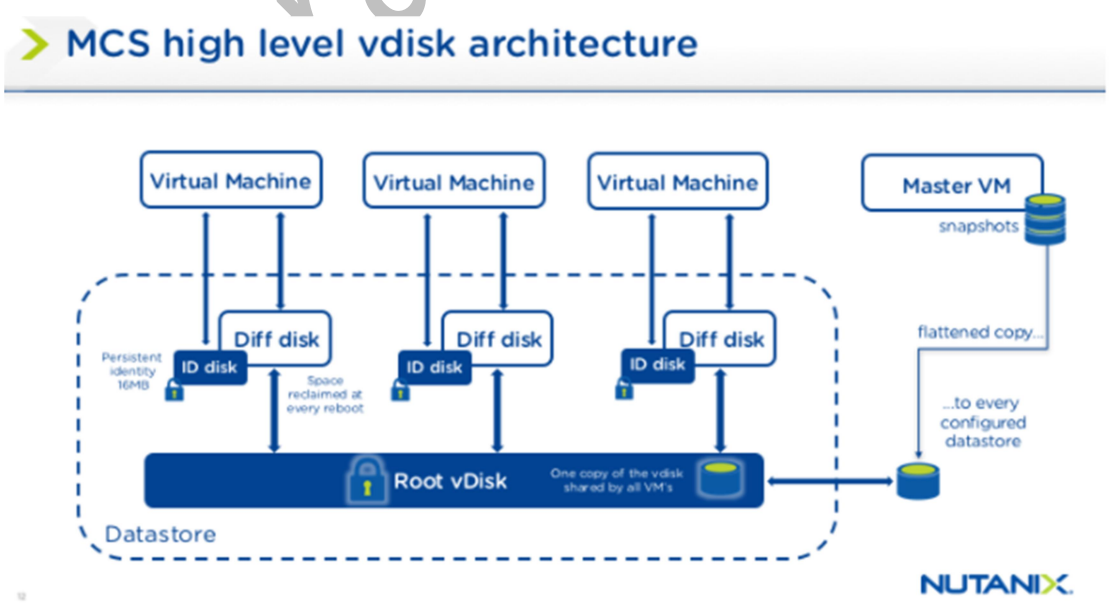

Figure 6: MCS High Level Architecture

To make each VM unique and able to write data, MCS uses two disks in addition to the primary disk.

The **ID disk** is a very small disk (16 MB maximum) that contains identity information; this information provides a unique name for the VM and allows it to join Active Directory. The broker fully manages this process; the administrator only needs to provide Active Directory accounts that the VMs can use. The broker then creates a unique ID disk for every VM.

The **difference disk**, also known as the write cache, separates the writes from the primary disk, while the system still functions as if the write has been committed to the primary disk. . Nutanix AHV uses copy-on-write, which avoids disk-chaining as well as the potential disk corruption and performance issues associated with disk-chaining.

Machine Catalog

Collections of physical or virtual machines are managed as a single entity called a Machine Catalog in Citrix environments. These machines, and the application or virtual desktops on them, are the resources you provide to your users. All the machines in a catalog have the same operating system and the same VDA installed. They also have the same applications or virtual desktops.

Typically, administrators create a master image and use it to create identical VMs in the catalog

Valid machine types are:

- **Multi-session OS:** Virtual or physical machines with a multi-session operating system. Used for delivering Citrix Virtual Apps published apps (also known as server-based hosted applications) and Citrix Virtual Apps published desktops (also known as server-hosted desktops). These machines allow multiple users to connect to them at one time.

- **Single-session OS:** Virtual or physical machines with a single-session operating system. Used for delivering VDI desktops (desktops running single-session OSs that can optionally be personalized), VM hosted apps (applications from single-session OSs), and hosted physical desktops. Only one user at a time can connect to each of these desktops.

- **Remote PC Access:** Enables remote users to access their physical office PCs from any device running Citrix Workspace app.

For VDI POC, Single-Session (Windows 10) & Multi-Session (Windows Server 2016) OS will be created

Note: All Low Level details will be provided post POC completion

Delivery Groups

A delivery group is a collection of machines selected from one or more machine catalogs. The delivery group specifies which users can use those machines, plus the applications and desktops available to those users.

Note: All Low Level details will be provided post POC completion

3.2.5 Hardware Layer

The Hardware layer is responsible for the physical devices required to support the entire solution including servers, processors, memory and storage devices.

For VDI POC at <CUSTOMER NAME>, 3 HP DL 380 Gen10 servers are used to build Nutanix Hyper converged Infrastructure (HCI) and Citrix Virtual Apps & Desktops Infra is built on top of Nutanix Acropolis Hypervisor (AHV) platform.

3.2.5.1 Hardware specifications

Find the below table for detailed server specifications used for VDI POC

Server Items	Serial #	Serial #	Serial #
	Count	Count	Count
HPE DL380 Gen10 Server	1	1	1
Intel Xeon-Gold 6138T processor	2	2	2
HPE 480GB SATA RI M.2 2280 SSD	1	1	1
HPE 32GB 2RX4 PC4-3200AA	10	10	10
HPE 1.92TB SATA MU SFF SC DS SSD	4	4	4
HPE Ethernet 10Gb 2-port 562FLR-T Adapter	1	1	1
HPE Universal SATA HH M.2 Kit	1	1	1
HPE 1600W Flex Slot Platinum Hot Plug Low Halogen Power Supply Kit	2	2	2
HPE Smart Array E208i-a SR Gen10 Controller	1	1	1
Nvidia Tesla T4	1	1	1
HPE iLO Advanced 1-server License with 1yr Support on iLO Licensed Features	1	1	1
Rack Space	2u	2u	2u
Power Supply	800W * 2	800W * 2	800W * 2

	PSU	PSU	PSU

Table 12: Hardware Specifications

Note: All Low Level details will be provided post POC completion

3.2.5.2 NVIDIA Tesla T4

NVIDIA is the best-known manufacturer of GPUs for use with desktop virtualization.

NVIDIA initially launched T4 at GTC Japan in the fall of 2018 as an AI inferencing platform for bare metal servers. The T4 is the most universal graphics processing unit (GPU) to date -- capable of running any workload to drive greater data center efficiency. In a bare metal environment, T4 accelerates diverse workloads including deep learning training and inferencing.

The T4 has a low-profile, single slot form factor, roughly the size of a cell phone, and draws a maximum of 70 W power, so it requires no supplemental power connector. This highly efficient design allows NVIDIA vGPU customers to reduce their operating costs considerably and offers the flexibility to scale their vGPU deployment by installing additional GPUs in a server, because two T4 GPUs can fit into the same space as a single NVIDIA® Tesla® M10 or Tesla M60 GPU, which could consume more than 3X the power.

The flexible design of the T4 makes it well suited for any data center workload - enabling IT to leverage it for multiple use cases and maximize efficiency and utilization. It is perfectly aligned for vGPU implementations - delivering a native-PC experience for virtualized productivity applications, untethering architects, engineers and designers from their desks, and enabling deep learning inferencing workloads from anywhere, on any device

SPECIFICATIONS	
GPU Architecture	NVIDIA Turing
NVIDIA Turing Tensor Cores	320
CUDA® Cores	2,560
RT Cores	40
Memory Size	16GB GDDR6
Memory BW	Up to 320GB/sec
vGPU™ Profiles	1GB, 2GB, 4GB, 8GB, 16GB
Form Factor	PCIe 3.0 single slot (half height & length)
Power 70W	70W
Thermal	Passive

Table 13: NVIDIA T4 Specifications

3.2.5.3 Physical Rack Layout

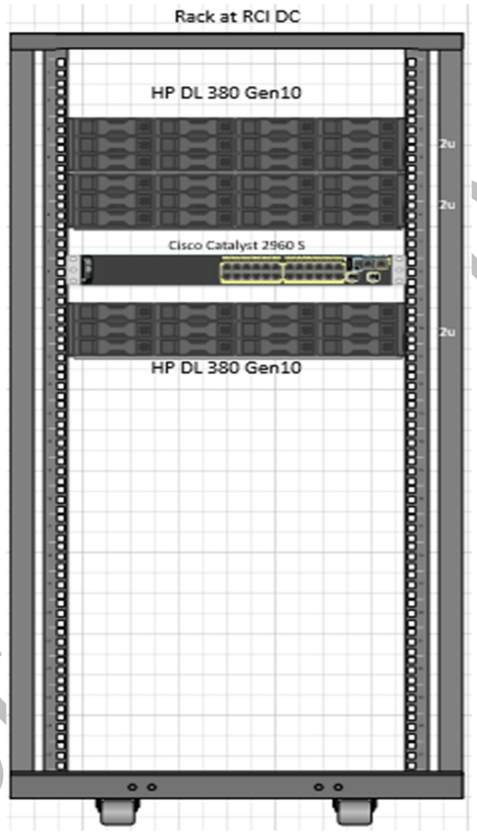

Figure 7: Rack Layout

Servers mounted are at <CUSTOMER NAME> New Datacenter and Rack Space of each HP DL380 Gen10 Rack Space is 2u and Cisco Catalyst Switch is 1u

Note: All Low Level details will be provided post POC completion

3.2.5.4 Network Cabling

Note: All Low Level details will be provided post POC completion

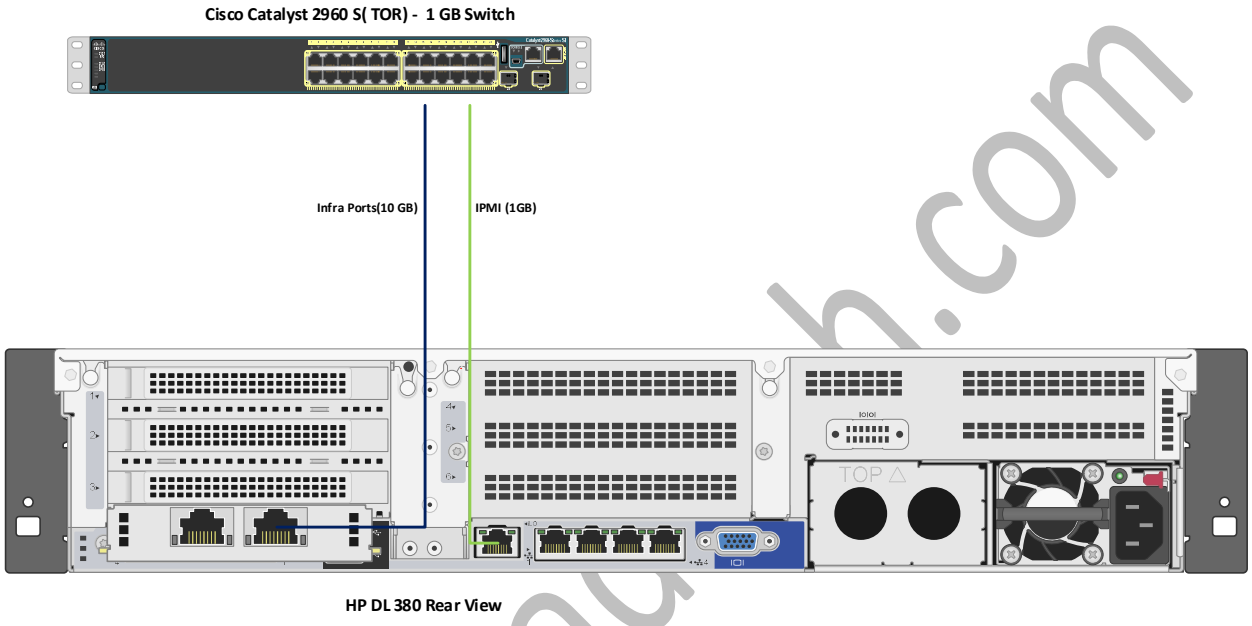

Figure 8: TOR Switch port Cabling

Each HP DL 380 Server has 2 10 GB ports and 4 1G ports, 10 GB Ethernet ports are connected to 1 GB CISCO catalyst switch port due to unavailability of 10 GB Switch.

Note: All Low Level details will be provided post POC completion

3.2.5.5 Nutanix Platform

Nutanix offers a powerful, flexible, and reliable platform for the full spectrum of desktop virtualization requirements, with unbeatable uptime and the freedom to mix and match workloads to fulfill enterprise needs and the objectives of operators, whether they're task workers or power users.

Nutanix includes Acropolis distributed storage, which offers a range of advantages for Citrix Virtual Apps and Desktops deployments:

- Optimized data path that easily handles increased read I/O.
- Data avoidance technologies that you can implement on a fit-for-purpose basis.

- A single data store, which dramatically reduces administrative overhead and update time.
- Storage efficiency techniques, such as deduplication, that can reduce the storage footprint of Virtual Apps and Desktops deployments.
- Nutanix Shadow Clones, which cut network latency and improve user experience.

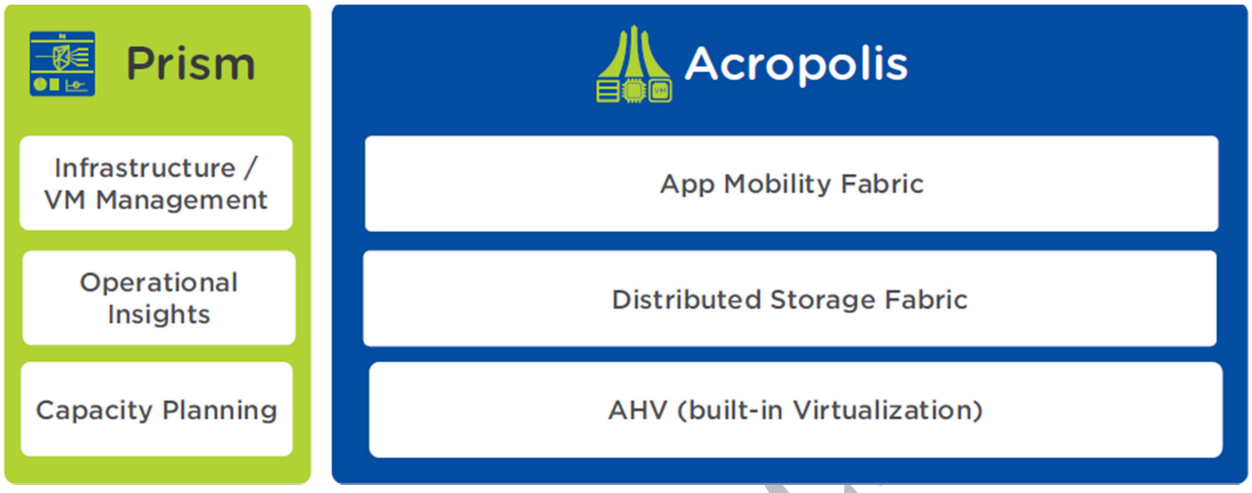

Figure 9: Nutanix Platform

3.2.5.5.1 Distributed Storage Fabric

Nutanix doesn't rely on traditional SAN or network-attached storage (NAS) or expensive storage network interconnects. It combines highly dense storage and server compute (CPU and RAM) into a single platform building block. Each building block delivers a unified, scale-out, shared-nothing architecture with no single points of failure.

Nutanix software provides a hyper-converged platform that uses DSF (Distributed Storage Fabric) to share and present local storage to server nodes within a cluster while creating a clustered volume namespace accessible to all nodes. The figure below shows an overview of the Nutanix architecture including, user VMs, the Nutanix storage CVM, and its local disk devices.

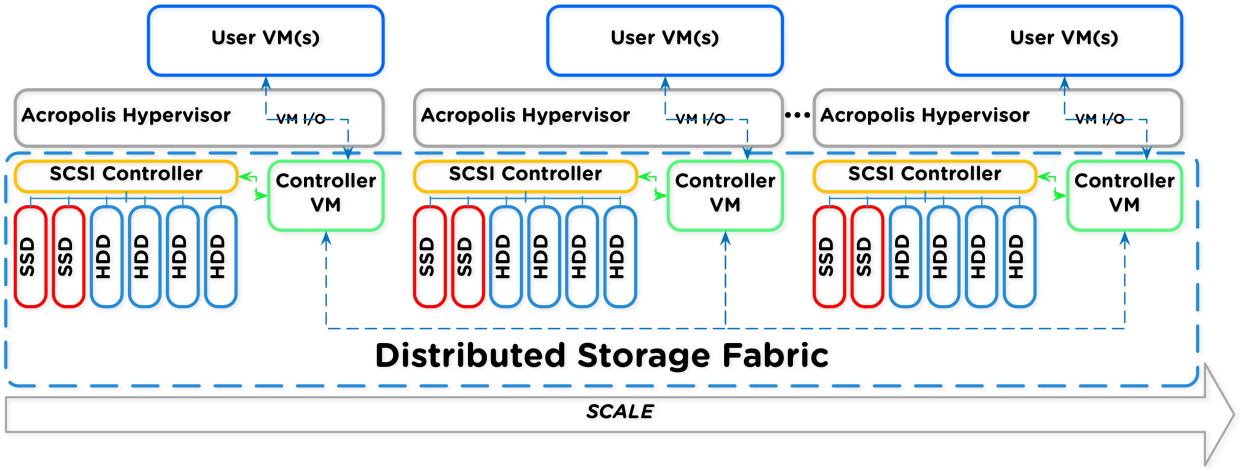

Figure 10: Distributed Storage Fabric

The Distributed Storage Fabric (DSF) appears to the hypervisor like any centralized storage array, however all of the I/Os are handled locally to provide the highest performance

At high level, Nutanix storage is organized with different objects like Storage pool, Storage Container

Storage Pool is a group of physical storage devices including PCIe SSD, SSD, and HDD devices for the cluster. In most configurations, only a single storage pool is leveraged.

Storage Container is a logical segmentation of the Storage Pool and contains a group of VM or files (vDisks).

By default, Nutanix deploys below 3 storage container objects and it is best practice to be untouched as it is referred by Nutanix internally.

- Default-container-UID
- NUtanixManagementShare
- SelfServiceConatiner

Note: All Low Level details will be provided post POC completion

For VDI POC, additional storage containers are created which will be provided in below tables

3.2.5.5.2 Acropolis Operating System (AOS)

The Acropolis Operating System (AOS) is the core software stack that provides the abstraction layer between the hypervisor (running on-premise or in the cloud) and the workloads running. An Acropolis Worker runs on every CVM with an elected Acropolis Leader which is responsible for task scheduling, execution, IPAM, etc.

3.2.5.5.3 Acropolis Hypervisor (AHV)

AHV is the native Nutanix hypervisor and is based on the CentOS KVM foundation. It extends its base functionality to include features like HA, live migration, IP address management, etc. Nutanix AHV is free of cost and bundled in Nutanix Acropolis solution.

Each node runs an industry-standard hypervisor (ESXi, AHV, and Hyper-V) and the Nutanix Controller VM (CVM). The Nutanix CVM is what runs the Nutanix software and serves all of the I/O operations for the hypervisor and all VMs running on that host.

3.2.5.5.4 Controller VM

The Nutanix CVM is responsible for the core Nutanix platform logic and handles services like:

- Storage I/O & transforms (Deduplication, Compression, EC)
- UI / API
- Upgrades
- DR / Replication etc.

3.2.5.5.5 Networking

AHV uses Open vSwitch (OVS) to connect the CVM, the hypervisor, and guest VMs to each other and to the physical network. The OVS service, which starts automatically, runs on each AHV node.

Virtual Local Area Networks (VLANs)
AHV supports the use of VLANs for the CVM, AHV host, and user VMs. Although a virtual network is configured for a specific VLAN, it is possible to configure a virtual NIC in either “access” or “trunked” mode. By default all virtual NICs are created in access mode, which allows a single configured VLAN based on the virtual network.

For POC, only one VLAN created for Nutanix Platform, Citrix Infra and VDI. is used

Note: All Low Level details will be provided post POC completion

Infra VLAN
VDI VLAN

3.2.5.5.6 Cluster

The Nutanix cluster has a distributed architecture, which means that each node in the cluster shares in the management of cluster resources and responsibilities. Within each node, there are software components that perform specific tasks during cluster operation. All components run on multiple nodes in the cluster, and depend on connectivity between their peers that also run the component. Most components also depend on other components for information.

A Nutanix cluster must have at least three nodes. Minimum configuration (three node) clusters provide the same protections as larger clusters, and a three node cluster can continue normally after a node failure.

Nutanix provides the ability to tolerate rack failures for extended data availability, in addition to drive, node, block, and network link failure.

Note: All Low Level details will be provided post POC completion

For VDI POC, as 3 Servers are configured in cluster, Data Resiliency level is configured with "*Replication Factor 2"* which tolerates for "1 block or 1 node or 1 disk failure" and "*Redundancy factor 2*" is configured which means they can tolerate the failure of a single node or drive.

3.2.5.5.7 Prism

Nutanix Prism run as a web service in Nutanix Acropolis cluster to deliver the Nutanix management interface to manage Nutanix infrastructure from single pane of glass.

Prism is categorizes in two components i.e, Prism Element & Prism Central

- ***Prism element*** is the basic version of prism which is built-in with Nutanix Acropolis cluster, when form or create the Nutanix cluster.
- ***Prism central*** is the single pane of glass to manage multi-cluster from single web-console. Prism central can manage multi Nutanix Acropolis clusters to register them on Prism central.

3.2.5.5.8 NVIDIA GPU

AHV supports GPU-accelerated computing for guest VMs. Administrator can configure either GPU pass-through (Dedicated) or a virtual GPU (vGPU) based on user workload

GPU Pass-Through for Guest VMs (Dedicate GPU)

With GPU Pass-through, administrator can create a VM with a dedicated GPU. This configuration provides user experience comparable to using a fat client with a high-end graphics card. However, in a pass-through configuration, only one VM can use a GPU at any given time , limits scalability.

Virtual GPU(vGPU)

AHV supports NVIDIA GRID technology, which enables multiple guest VMs to use the same physical GPU concurrently. Concurrent use is made possible by dividing a physical GPU into discrete virtual GPUs (vGPUs) and allocating those vGPUs to guest VMs. Each vGPU is allocated a fixed range of the physical GPUs framebuffer and uses all the GPU processing cores in a time-sliced manner.

The following figures depict all the components needed for vGPU.

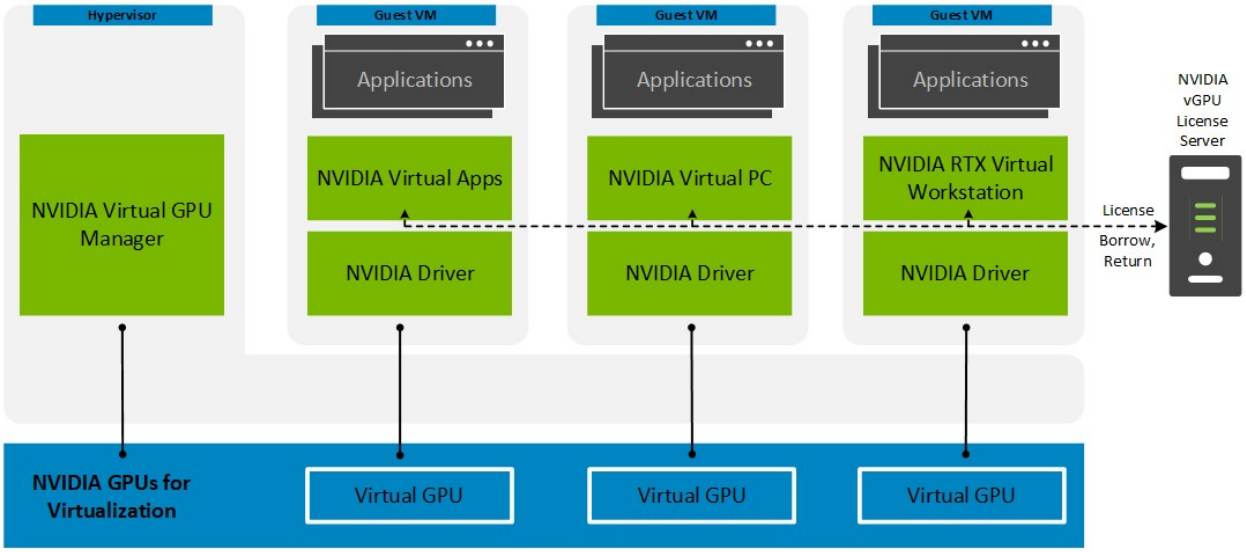

Figure 11: vGPU Architecture

Each NVIDIA vGPU is analogous to a conventional GPU, equipped with a fixed amount of GPU frame buffer and one or more virtual display outputs or “heads”. The vGPU frame buffer is allocated from the physical frame buffer of the physical GPU at the time of creation, and this vGPU retains exclusive access to this frame buffer part until it is destroyed.

All vGPUs residing on a physical GPU can share access to the GPU engines, including graphics (3D), video decoding, and video encoding module

vGPU Profiles

Each physical GPU can support several different types of vGPU Profiles (Virtual GPU Type) simultaneously. Each vGPU profile has fixed hardware key data, such as the frame buffer size, number of supported displays (Virtual Display Heads) and the maximum resolution (per display head). They are divided into different series, each corresponding to different load classes. Each series is identified by the last letter of the vGPU profile name.

- The Q-Series is designed for Designers and Power Users.
- The B-Series is designed for Power Users.
- The A-Series is designed for Users of virtual applications.

Following table depicts the various vGPU profiles

vGPU Profile	Graphics Memory (in MB)	Max Displays per User	Max Resolution per Display	Max Users per Graphics Board	Use Cases
T4-16Q	16,384	4	4096 × 2160	1	Virtual Workstations
T4-8Q	8,192	4	4096 × 2160	2	Virtual Workstations
T4-4Q	4,096	4	4096 × 2160	4	Virtual Workstations
T4-2Q	2,048	4	4096 × 2160	8	Virtual Workstations
T4-1Q	1,024	2	4096 × 2160	16	Virtual Desktops, Virtual Workstations
T4-16C	16,384	1	4096 × 2160	1	Training Workloads
T4-8C	8,192	1	4096 × 2160	2	Training Workloads
T4-4C	4,096	1	4096 × 2160	4	Inference Workloads
T4-2B	2,048	2	4096 × 2160	8	Virtual Desktops
T4-2B4	2,048	4	4096 × 2160	8	Virtual Desktops
T4-1B	1.024	4	2560 × 1600	16	Virtual Desktops
T4-1B4	1,024	1	4096 × 2160	16	Virtual Desktops
T4-16A	16,384	1	1280 × 1024	1	Virtual Applications
T4-8A	8,192	1	1280 × 1024	2	Virtual Applications
T4-4A	4,096	1	1280 × 1024	4	Virtual Applications
T4-2A	2,048	1	1280 × 1024	8	Virtual Applications
T4-1A	1,024	1	1280 × 1024	16	Virtual Applications

Table 14: T4 vGPU profiles

<CUSTOMER NAME> POC identified users are Designers and Engineers hence "T4-4Q" vGPU profile is chosen for evaluation

Limitations for vGPU Support

vGPU support on AHV has the following limitations:

- You cannot hot-add memory to VMs that have a vGPU.
- The Prism web console does not support console access for VMs that are configured with a vGPU. Before you add a vGPU to a VM, set up an alternative means to access the VM. For example, enable remote access over RDP.
- Removing a vGPU from a VM restores console access to the VM through the Prism web console

Note: All Low Level details will be provided post POC completion

3.2.5.5.9 NVIDIA vGPU License Server

vGPU profiles are licensed through an NVIDIA GRID license server. The choice of license depends on the type of vGPU that the applications running on the VM require. Licenses are available in various editions, and the vGPU profile that you want might be supported by more than one license edition.

Install an appropriate license on the licensing server, and configure the VM to use that license and vGPU type. Guest VMs check out a license over the network when starting up and return the license when shutting down. As the VM is powering on, it checks out the license from the licensing server. When a license is checked back in, the vGPU is returned to the vGPU resource pool.

Limitations of unlicensed vGPU

When booting with a supported GPU, a vGPU with reduced capacity will be executed until a license is purchased.

The performance of an unlicensed vGPU is limited as follows:

- If the specified license is not available on the licensing server, the VM starts up and functions normally, but the vGPU runs with reduced capability.
- The frame rate is limited to 3 frames per second.
- The allocation of GPU resources is limited, so some applications cannot run properly.
- For vGPUs that support CUDA, CUDA is disabled.

For POC, NVIDIA vGPU License server is installed to utilize all feature of NVIDIA

Note: All Low Level details will be provided post POC completion

3.3 Software's & Licensing

3.3.1 Software's & versions

Software components versions & licensing are provided in the following table

Item	Description & version
Citrix Delivery Controller	Citrix Virtual Apps & Desktop 2112
Citrix Storefront	Storefront 2112
MS SQL Database	SQL Express
Citrix Director	Director 2112
Citrix License	License 2112
Microsoft FSLogix	
Virtual Delivery Agent	
Nutanix AOS	AOS 5.15.7
Nutanix AHV	AHV 4.XX
Nutanix Virt IO Drivers	
Operating System	Windows Server 2019 & Windows 21H2
NVIDIA Host Drivers (GPU Manager)	
NVIDIA Guest Driver (vGPU Drivers)	
NVIDIA License Server	

Table 15: Software's & versions

3.3.2 Licenses

Below licenses are used to build VDI POC

Item	License Model
Citrix	Evaluation License for 90 days
RDS CAL	Evaluation License for 120 days
Nutanix AHV	Evaluation license for 90 Days
NVIDIA vGPU	Evaluation license for 90 Days

Table 16: Licenses

3.4 Supporting Infrastructure

3.4.1 Active Directory

The Citrix VDI platform is integrated with current <CUSTOMER NAME> Active directory to authenticate and authorize user's login.

Infra & VDI's will be created in a dedicated OU where all <CUSTOMER NAME> Windows 10 virtual client GPO's are linked (as applicable). By having their own OUs, the objects inside will have greater flexibility with their management while allowing Citrix administrators to be granted delegated control.

Citrix Machine Creation Service requires a dedicated OU in <CUSTOMER NAME> active directory with one Service Account having the following permissions:

- Create and Delete Computer objects in OU
- Create and Delete Security group in OU
- Add and remove Users from Security Group
- Domain joining permissions
- Read user attributes

Note: All Low Level details will be provided post POC completion

OU Structure -TBD

3.4.2 DHCP

Nutanix IPAM will be leveraged for VDI IP Auto Assignment (DHCP)

IP Address Management (IPAM)

IPAM enables AHV to assign IP addresses automatically to VMs using the Dynamic Host Configuration Protocol (DHCP). Each virtual network and associated VLAN can be configured with a specific IP subnet, associated domain settings, and group of IP address pools available for assignment. Acropolis uses VXLAN and OpenFlow rules in OVS to intercept DHCP requests from user VMs so that the configured IP address pools and settings are used.

The Acropolis leader assigns an IP address from the address pool when creating a managed VM NIC; the address releases back to the pool when the VM NIC or VM is deleted.

Note: All Low Level details will be provided post POC completion

For VDI POC, IPAM is enabled with below values for VDI IP assignment

3.4.3 Patching

In <CUSTOMER NAME> Intranet, WSUS is used to do patching and for POC, either WSUS or offline patching will be considered

3.4.4 Printers

Printers to be discussed and concluded on the policies to be applied and also to understand if we have any print servers. Needs further discussions if client printer redirection to get started.

3.5 Security Controls

3.5.1.1 Antivirus & Exclusions

Management servers and VDIs would be protected against the viruses and malicious software using the <CUSTOMER NAME> AV Client integrated with the existing <CUSTOMER NAME> Antivirus Server for virus definitions and policies setup for the organization level compliance.

AV Exclusion –

Below antivirus exclusions, typically represent the best trade-off between security and performance. Microsoft and Citrix recommended AV exclusions are provided in the Excel file below.

Attached

User Authentications

Muti Factor Authentication ->Currently, <CUSTOMER NAME> do not have MFA

3.5.1.2 SSL certificate

SSL certificate are required to secure Citrix VDI POC URL. SSL certs are installed on StoreFront and binded with Citrix URL.

3.6 Monitoring & Reporting

Citrix Director

Director is a web-based tool that enables IT support and help desk teams to monitor an environment, troubleshoot issues before they become system-critical, and perform support tasks for end users. Administrator can use one Director Deployment to connect to and monitor multiple Citrix Virtual Apps or Citrix Virtual Desktops sites.

Director displays:

- Real-time session data from the Broker Service in the Controller, which includes data the Broker Service gets from the broker agent in the VDA.
- Historical site data from the Monitor Service in the Controller.

Director uses the ICA performance and heuristics data captured by the Citrix Gateway device to build analytics from the data and then presents it to the administrators.

Administrators can also view and interact with a user's sessions through Director, using Windows Remote Assistance.

Below figures depicts Director Workflow

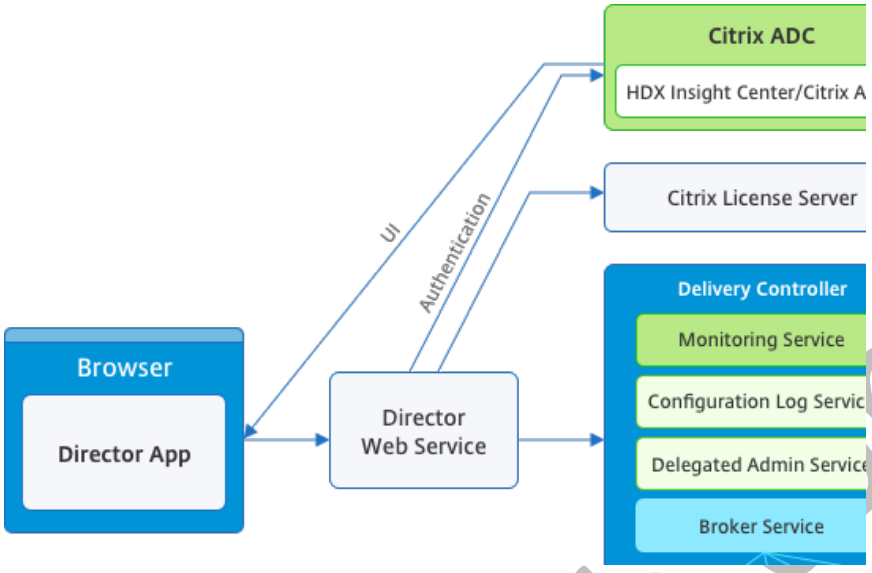

Figure 12: Director Workflow

Monitoring the new environment enables administrators to address issues proactively. By having an in-depth understanding of current and expected behavior of the various services and components, administrators are better equipped to discover issues before it impacts the users. Furthermore, the data tracked during the normal operations can be used for trending and capacity planning.

Monitoring

- Session usage
- Logon performance
- Connection and machine failure
- Load evaluation
- Historical trends
- Infrastructure
- User sessions
- Machines

Reports:

Administrator can export trends data to generate regular usage and capacity management reports. Export supports PDF, Excel, and CSV report formats. Reports in PDF and Excel formats contain trends represented as graphs and tables. CSV format reports contain tabular data that can be processed to generate views or can be archived.

Note: All Low Level details will be provided post POC completion

3.7 Design Decisions

Following section covers the POC design decisions and rationale for Virtual Apps and Desktops deployments on Nutanix.

3.7.1 Design Decisions

Item	Detail	Rationale
General		
Software versions	Citrix Virtual Apps and Desktops 2112	
	AOS 5.15.7 LTS	
Minimum size	3 Nutanix AOS hosts running AHV	Minimum size requirement
Nutanix		
Cluster size		
Datastores	1 AOS distributed storage datastore per pod (Virtual Apps and Desktops server VMs, VM clones, and so on)	Nutanix handles I/O distribution and localization
Storage pools	1 storage pool per cluster	Standard practice
Containers	1 container for VMs	Standard practice
Features and enhancements	Increase CVM memory to 24–32 GB+. Turn on deduplication and compression for persistent desktops. Turn on compression only for nonpersistent desktops. (We set the CVM to 32 GB for the RA.)	Best practice
Citrix Virtual Apps and Desktops		
Citrix Delivery Controllers, License Director& Database	Used one VM to install roles Citrix Delivery Controllers, License Director& Database	As it is PoC and expected users are 30 ,1 VM is sufficent
SQL Express	Installed SQL Express edition in Delivery Controller VM	As it is PoC and expected users is 30 , SQL express choosen

Citrix Storefront	Installed storefront dedicatedly in one VM	
User Profiles	Citrix User Profile Management	
Users per controller	30	
High Availability	High Availability is not configured for all Citrix Managements	As it is PoC ,HA is not considered
Virtual hardware specs (Delivery Controller, License, Director & Database))	vCPU: 4 Memory: 8 GB+ Disk: 50 GB	Standard sizing practice
Virtual hardware specs (Storefront))	vCPU: 2 Memory: 4 GB Disk: 50 GB vDis	Standard sizing practice
Active Directory		
Global catalog and DNS servers	Minimum: 2 (n + 1) per site	HA for global catalog and DNS Microsoft best practice
DHCP		
DHCP servers	Nutanix IPAM	HA for Nutanix IPAM is built in
File Server	1 VM is created for User profile share	
SQL Server		
SQL Servers	SQL Express is installed in Delivery controller VM	Express edition is chooses as it is Poc and user count is 30

Table 17: Design Decisions

3.7.2 Assumptions

<Supplier Name> assumes below items are in place or fulfilled during POC

Assumption	Owner
Rackspace to mount the Servers (#3)	<CUSTOMER NAME>
TOR Switch & Networking will be provided to build Nutanix	<CUSTOMER NAME>
All applications are assumed to be compatible with Windows 10 & Windows Server	<CUSTOMER NAME>

Support for applications binaries/Installaion & Issues to be provided	<CUSTOMER NAME>
Licenses to be provided for Windows Operating Systems & Applications (if applicable)	<CUSTOMER NAME>
Evaluation Licenses to be provided for Nutanix/Citrix & NIVIDIA	<Supplier Name>

Table 18: Assumptions

3.7.3 Dependencies

Following are the Prerequisites & dependencies to fulfill by <CUSTOMER NAME> to build POC

S.No	Pre-requistes/Dependencies - Citrix Setup	Responsbile Team
1	HP Servers Racking and Stacking (6u Space)	<CUSTOMER NAME> Team
2	Cabling to Switches	<CUSTOMER NAME> Team
3	IP & VLAN creation (Nutanix &Citrix) -Need /24 subnet 1 VLAN for Nutanix AHV,ILO & Citrix (as per discussion)	<CUSTOMER NAME> Team
4	DHCP Scope Assignment with /24	<CUSTOMER NAME> Team
5	NTP Server Details for Nutanix cluster build	<CUSTOMER NAME> Team
6	Firewall Communications between VLAN's /Citrix/Applications & Desktop allocated	<CUSTOMER NAME> Team
7	Software Repository (Refer "Softwares & Licensing Section")	<CUSTOMER NAME> Team
8	License (Windows/RDS CAL/SQL)	<CUSTOMER NAME> Team
9	License(Citrix) & NVIDIA Graphics	<Supplier Name>
10	Naming Convention Document (Infra,HSD,Groups etc..)	<CUSTOMER NAME> Team
11	AD Delegated access with create/Modify/Delete for OU,Group Policy,Computer Accounts/Domain Join	<CUSTOMER NAME> Team
12	Service Account Creations for SQL & Citrix	<CUSTOMER NAME> Team

13	Application list with Installers (if applicable)	<CUSTOMER NAME> Team
14	Domain Signed Certificates(Internal) - Will inform during build	<CUSTOMER NAME> Team
15	Antivirus Agents installation & Exclusion configurations	<CUSTOMER NAME> Team
16	Security tools integration like DLP etc..	<CUSTOMER NAME> Team
17	Security Hardening Policy Documents for Windows/Citrix	<CUSTOMER NAME> Team
18	Windows Patching	<CUSTOMER NAME> Team
19	POC users details	<CUSTOMER NAME> Team

Table 19: Dependencies

3.7.4 RISKS

The following risks will be closely monitored during POC execution.

Risk	Impact	Mitigation
External dependencies impacting timeline – Network, AD, Application binaries etc.	Implementation may take long to set up and does not meet <CUSTOMER NAME> objectives.	Establish implementation governance to alert and manage all <CUSTOMER NAME> dependencies.
Hardware /Citrix/Nutanix is available for 3 Months duration	User Acceptance Test and customer Signoff to be secured before expiry	Extend the Contract and Purchase license if Testing is delayed

Table 20: RISKS

3.7.5 Limitations

Limitations for NVIDIA vGPU Support

- vGPU support on AHV has the following limitations:

- Admin cannot hot-add memory to VMs that have a vGPU.
- The Prism web console does not support console access for VMs that are configured with a vGPU. Before admin add a vGPU to a VM, set up an alternative means to access the VM. For example, enable remote access over RDP.
- Removing a vGPU from a VM restores console access to the VM through the Prism web console.

4. Appendix

4.1. Communication ports

Table attached

4.2. POC Lessons Learnt

Issue 1:

VM Network not reachable

Post Nutanix Cluster installation, VM network is not reachable

Observations

- Nutanix CVM/AHV Hosts are network reachable from outside whereas not newly created VM
- VM is not reachable even from CVM/AHV Hosts
- As CISCSO switch is dedicated to POC, <CUSTOMER NAME> made switch configuration as open and switch ports were not made as TRUNK (From Nutanix, TRUNK is recommended configuration)

Resolution

- As Switch ports were not changed to TRUNK and during Nutanix Cluster Installation, CVM/HOSTS VLAN were kept as blank i.e., "untagged",
- To resolve VM network reachable issue, <Supplier Name> team created Virtual Networks with VLAN ID 0 which resolved VM network reachability issue.

Note:

By default, switch port is Access though it is open, however If switch ports were in TRUNK state then no need to create network with VLAN ID 0, it can be created with id 314.

4.3. Nutanix Architecture Elements

Item	Description
HCI	Hyper converged infrastructure (HCI) is a combination of servers and storage into a distributed infrastructure platform with intelligent software to create flexible building blocks that replace legacy infrastructure consisting of separate servers, storage networks, and storage arrays
Nutanix Foundation	The Nutanix Foundation is a tool that allow administrators to completely bootstrap, deploy and configure a bare-metal Nutanix cluster from start-to-end with minimal interaction in matter of minutes.
Nutanix block	The physical chassis that contains between one and four Nutanix nodes.
Nutanix cluster	A logical group of Nutanix nodes providing compute (CPU and RAM) and storage according to availability, capacity, and performance requirements.
Nutanix nodes	Physical servers that run either AHV or ESXi as the hypervisor.
Nutanix storage pool	A group of physical storage devices from the Nutanix nodes in the Nutanix cluster. Can include Optane, NVMe, SSD, and HDD.
Nutanix container	A logical segment of the storage pool that contains one or more VMs or files.
Prism Central	Nutanix cluster administration interface that runs in a separate VM or in multiple VMs and monitors and manages multiple Nutanix clusters through a single web console. Not required but makes Nutanix cluster management easier.
Prism Element	Nutanix cluster administration interface that includes an HTML5-based UI, an API, and a CLI.
Hypervisor	Nutanix AHV or VMware ESXi

AHV	The native Nutanix hypervisor where VMs can run. AHV can be preinstalled on the Nutanix node.
AOS	The Acropolis Operating System (AOS) is the core software stack that provides the abstraction layer between the hypervisor (running on premise or in the cloud) and the workloads running. It provides functionality such as storage services, security, backup and disaster recovery, and much more
IPMI	The Intelligent Platform Management Interface (**IPMI**) is a remote hardware health monitoring and management system
NVIDIA GRID	NVIDIA technology that is a combination of both hardware and software to deliver the ultimate virtualized experience.

Table 21: Nutanix Architecture Elements

4.4. Glossary

Reference	Description
AD	Active Directory
CAL	Client Access License (Microsoft)
CCU	Concurrent Users
CPU	Central Processing Unit
CS	Credit Suisse
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
DR	Disaster Recovery
EUS	End User Services
GPO	Group Policy Object
HA	High Availability
HDX	High Definition Experience (Citrix)
HW	Hardware
HSD	Hosted Server Desktop
IP	Internet Protocol
LAN	Local Area Network

MFA	Multi Factor Authentication
MS	Microsoft
NIC	Network Interface Card
OS	Operating System
OU	Organizational Unit
POC	Proof of Concept
RAM	Random Access Memory
RDS	Remote Desktop Services
SCCM	System Center Configuration Manager
SSL	Secure Sockets Layer
ToR	Top-of-Rack
URL	Uniform Resource Locator
vCPU	Virtual Central Processing Unit
VDA	Virtual Delivery Agent
VDI	Virtual Desktop Infrastructure
VLAN	Virtua Local Area Network
VM	Virtual Machine
vNIC	Virtual Network Interface Card
UPM	Citrix User Profile Management

Table 22: Glossary