



Virtual Desktop ADOPTION PLAN

Adoption Plan

AVD Business Adoption Plan

Client-XYZ Corporation

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Document Control

The following table describes each version release of this document and references any changes made to the document in the specific release.

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Understanding the version numbers

- Releases prior to version 1.0 of the document are internal drafts.
- Version 1.0 is the first client release, ready for cubesys internal review.
- Version 2.0 is the first client release of the document ready for distribution.
- Each review completed shall increase the version number by 0.1

Each acceptance / rejection of changes made by the author following a review increases the version number by 0.1.

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The current version of this document has been distributed to the following recipients

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SAMPLE

1. Introduction

The following *sample documentation* has been compiled by combining several real-world situations and data to create a fictitious client called XYZ Corporation. Although completely fictitious, the following sample is very real from a situational and data perspective, the costs, savings and architecture are all real; in the sense this adoption plan could be achieved.

1.1.Purpose

The purpose of this document is to provide an economic impact assessment for migration of XYZ workloads hosted on Citrix to AVD, considering migration to an Azure native, Citrix Cloud, or a hybrid managed implementation. The assessment will consider existing applications, environment and usage information provided. The assessment will include ongoing consumption and implementation cost estimates and a high-level implementation plan illustrating the main phases required to adopt AVD services. An architectural blueprint illustrating a likely end-state for AVD will also be provided. This information will provide XYZ with the information required to progress AVD development plans and modernize their current VDI solution stack.

1.2.Target Audience

The intended audience for this document includes:

XYZ technical and managerial staff responsible for the applications and supporting infrastructure that is the focus of the assessment.

2. Executive Summary

2.1. Overview

Microsoft engaged cubesys to provide an economic assessment for XYZ focused on integrating Azure Virtual Desktop (AVD) to publish a suite of existing applications currently published via Citrix and hosted on-premises. This engagement included the following objectives:

- Workshops with XYZ to understand the existing environment and business objectives
- Consideration of architectural options and recommendations
- Estimated total cost of ownership
- High-level implementation plan based on the recommended architecture

2.2. Architectural Recommendation

Having analysed the requirements, success criteria and cost base, across (a) Azure native, (b) Azure native + NMW, and Citrix Cloud + Azure AVD, cubesys recommend an Azure native AVD implementation managed by Nerdio Manager for AVD (NMW). This recommendation is based on best ROI balance of capabilities, cost and features required to achieve the desired XYZ business outcome. The main considerations contributing to this recommendation included:

- The complexity and opportunity to reduce cost through automation ruled out (a), a native-only solution stack, due to the complexities of scheduling, usage patterns and workload types. A management tool is needed to achieve the best cost and manageability outcome.
- Both Citrix Cloud and NMW, offer considerable cost savings via optimisation of compute and storage within the Azure platform. These savings are comparable, with negligible difference in the ability to optimise cost consumption.
- The additional capabilities of the Citrix Control plane offered in either the Advanced or Premium editions have not been triggered in the XYZ success criteria.
- The licensing cost of the Citrix Cloud are 2x Advanced and 3x Premium, the cost of Nerdio Manager for AVD.
- Nerdio Manager for AVD licensing is consumption based without a lock-in term. This provides flexibility for XYZ seasonal workers and strategic roadmap. Further enhancing the ROI and lowering the cost base.
- Nerdio Manager for AVD architecture is design to work with the Microsoft AVD solution, rather than replacing it, this simplifies the operational overhead, lowering the management services footprint.
- XYZ have an established Azure environment which is in an optimal ready state for deployment of AVD.

2.3. Total Cost of Ownership Estimates

To provide an appropriate monthly cost estimate aligned to the XYZ business, the estimates have been calculated in 2 parts, one focusing on permanent employees (544 staff), and one focusing on the casual seasonal employees (1000 staff). Based on these two scenarios the monthly costs, including Nerdio Manager for AVD are shown below. Main costs items have been displayed below, for more information and rationale used to calculate these costs, refer to the [AVD Consumption Estimates](#) section.

AVD Total Cost of Ownership Estimates - Items	Permanent Employees	Seasonal Casual Employees
Compute / OS disk	\$3,115.27	\$2,151.06
User Profile Storage	\$2,478.08	\$1,126.40
Network Bandwidth usage	\$1,360.00	\$1000.00
Monitoring / log data	\$169.68	\$96.30
Nerdio Manager for AVD (hosting costs)	\$421.32	N/A
Nerdio Manager for AVD (license costs, assume maximum users*)	\$2,176.00	\$4000.00
Total monthly cost	\$9,720.35	\$8,373.76

* in most use cases maximum utilisation, by 100% of staff is an unlikely scenario.

2.4. Cost Estimate Recommendations Summary

The following points further elaborate on the costs presented in the preceding section:

- cubesys recommend implementing AVD in Azure managed by Nerdio Manager for AVD. This approach can satisfy the desired requirements, provides flexible capabilities, optimal consumption costs and performance.
- The foundational requirements for AVD are already in place which places XYZ in a 'ready' state to adopt AVD service leveraging existing investments. These requirements include hybrid networking between on-premises networks and Azure (Express Route), extending on-premises AD into Azure, appropriate setup of Azure AD, and appropriate licensing.
- Based on the usage and application requirements defined during workshops conducted with XYZ, the most optimal Azure VM SKU to use for AVD session hosts is D4s v3 (4CPUs, 16GB RAM), capable of hosting 16 permanent employees per VM, and 24 casual employees.
- Based on the business hours defined across the time zones provided, VMs can be scaled back and deallocated during non-business hours to minimise compute spend. Cost estimates are based on total users and total business hours.
- Azure hybrid use benefits (AHUB) have been applied which also significantly reduces consumption costs.
- Azure NetApp Files have been recommended for profile storage, which is cheaper than Azure Files (premium tier) and more costly than Azure Files (standard tier). Azure NetApp Files provides the best combination of optimal performance and enterprise capabilities and control.
- cubesys recommend Nerdio Manager for AVD (NMW) to manage the Azure AVD environment. NMW is a cost effective AVD management solution that extends native AVD management capabilities to an enterprise level and provides granular control to minimise Azure consumption spend.
- Additional cost optimisation opportunities will likely be possible with Nerdio Manager for AVD, for example, controlling availability of compute at a more granular level across time zones.

2.5. Cost Avoidance Opportunities

The above recommendations and cost estimate calculations have not addressed the following areas which on-premises solutions commonly need, and which cloud-based solutions address more efficiently. These include opportunities to reduce licensing, avoid lock-in contracts, capacity planning, system maintenance and more. Together these items provide XYZ further commercial benefit by avoiding the associated costs.

- RDS Licensing
- Windows Server Licensing
- Citrix Licensing
- Capital expenditure on compute & storage
- Power, cooling, and Data Centre maintenance

Additionally, total employee numbers have been assumed for Nerdio Manager for AVD, whereas in reality, this number would be lower (and therefore cost less) as Nerdio has a flexible monthly active user (MAU) licensing model. Furthermore, compute hours used for compute consumption calculations have been based on the total business hours across New Zealand to Western Australia time zones. Additional cost optimisation will be possible with regards to autoscaling compute at a more granular level across time zones in a realised AVD/Nerdio deployment.

3. Existing Environment

3.1.1. Citrix

The current Citrix landscape consists of two environments, using legacy on-premises architectures aligned to common Citrix deployment patterns. They are predominantly used for published applications, as shown in the '3.1.3 – Workloads' list below.

3.1.2. Compute

Currently, all of these workloads are hosted on Citrix infrastructure consisting of 18 Windows Server 2016 servers.

CPU	RAM	Sessions per host	Scaling Out
8 x CPUs	24GB RAM	Average 20, but up to 30 is possible.	Additional hosts are provisioned to cater for additional casual workforce during the seasonal period (Sep – Mar)

3.1.3. Workloads

The below table lists details provided by XYZ regarding the apps and desktops that they wish to host in the proposed environment (after a separate internal body of work to rationalise and reduce the workloads hosted on Citrix infrastructure).

Published Workload Type	Application	Users: Avg Concurrent	Users: Total	Seasonal Peak
Desktop	Use Case A - Desktop			No
App	App A - Commodity	6 to 12		No
App	App B	12 to 16		No
App	App C	1 to 10		No
App	App D	12 to 15		No
Desktop	Group Policy Object	IT Support		No
App	SCCM Remote View	IT Support		No
App	Sap Business client	4 to 16	16	No
App	GNC SAP (SAP GUI/SAP login)	180 to 230	435	No
App	Excel Reporting	2 to 3	13	No
App	Chrome	5 to 11	80	Seasonal (Sep-Mar)
App	Edge		100	Seasonal (Sep-Mar)

Published Workload Type	Application	Users: Avg Concurrent	Users: Total	Seasonal Peak
Desktop	Desktop			Seasonal (Sep-Mar)

3.1.4. Application Details

The below point regarding the applications where noted during workshops.

- 2 desktop images are currently used, although XYZ wish to consolidate down to the 1 image.
- With the exception of App A, all other apps have been successfully packaged and tested on Window 10.
- None of the apps have excessive CPU, RAM, or disk requirements.
- Current Antivirus is Symantec, which is son to be replaced by CrowdStrike.
- Employee are licensed with Microsoft 365 E3, and casual Seasonal employees Microsoft F3.
- XYZ have entitlement to Azure Hybrid Use Benefits.

3.1.5. Usage Concurrency and Times

XYZ core business hours are from 6am – 7pm, applicable across New Zealand, Eastern Australia, and Western Australia time zones. Basing the active business hours window on AEDT time zone, this would result in 17 hours, i.e. from 4am – 9pm. The proposed solution should also cater for afterhours usage, but only catering for 5% usage of core business hours.

The are 544 users to consider in total. Estimated user numbers across the above time zones are 75 (NZ), 50 (WA), and the rest in Eastern Australia (419).

XYZ estimate that the maximum concurrent user sessions count is 300. This would usually be within the first 2-3 hours of the core business hours windows (across the relevant time zones), as employees start their day checking their emails and doing administrative tasks, before heading out for the day. Corporate users' usage would be more consistent across the day.

In addition to the above, during the Seasonal, which XYZ defined as from September to March, there could be up to an additional 1000 casual workers using Citrix, with an estimated maximum concurrency of 30% (or 300 users).

3.1.6. Usage Profiles

For the purposes of this engagement, the below usage profiles are defined.

Workload type	Example users	Example apps	Indicative bandwidth/data requirements
Light	Users doing basic data entry tasks	Database entry applications, command-line interfaces	1.5 Mbps
Medium	Consultants and market researchers	Database entry applications, command-line interfaces, Microsoft Word, static web pages	3 Mbps
Heavy	Software engineers, content creators	Database entry applications, command-line interfaces, Microsoft Word, static web pages, Microsoft Outlook, Microsoft PowerPoint, dynamic web pages	5 Mbps

Workload type	Example users	Example apps	Indicative bandwidth/data requirements
Power	Graphic designers, 3D model makers, machine learning researchers	Database entry applications, command-line interfaces, Microsoft Word, static web pages, Microsoft Outlook, Microsoft PowerPoint, dynamic web pages, Adobe Photoshop, Adobe Illustrator, computer-aided design (CAD), computer-aided manufacturing (CAM)	15 Mbps

Considering these usage profiles, XYZ considered their corporate employees (desktop) to be medium profile usage, regional site employees (remote apps) as light-medium usage, and the Seasonal casual workers (remote apps) as light usage.

3.1.7. User Profiles

There are no specific profile requirements, although some user profiles are large, and will need to be catered for in the proposed solution.

3.1.8. Azure

XYZ have established hybrid connectivity between their on-premises environment and Azure (site-to-site VPN/Express Route), and on-premises Active Directory has been extended into Azure. Azure AD Connect is synchronising identities to Azure AD. XYZ also advised that they have a reasonable maturity level with regards to Azure Governance (security, monitoring, policies, etc.).

There is no DR requirement for regional redundancy in Azure.

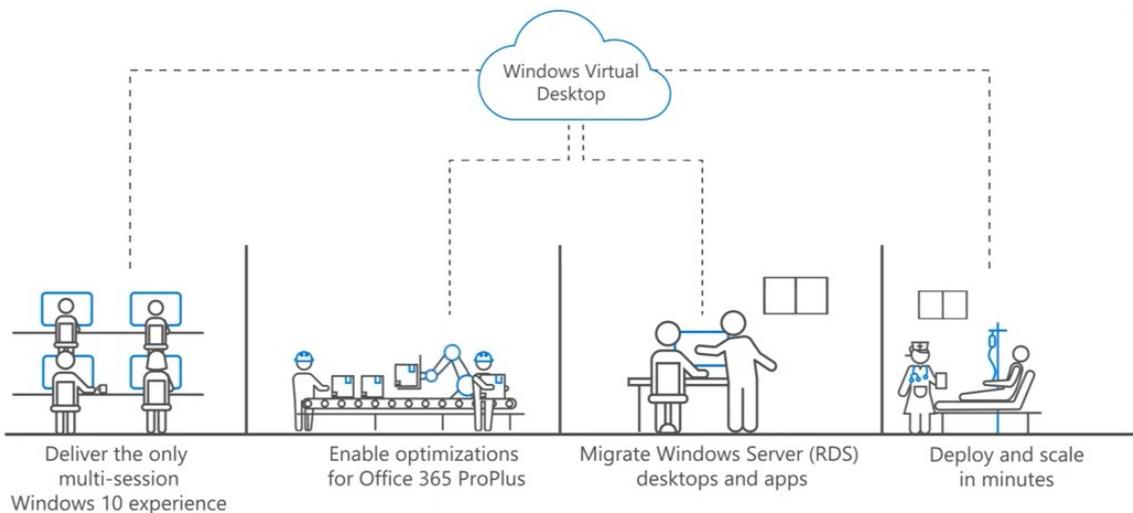
4. Architecture Options for AVD

4.1. Azure Virtual Desktop

Azure Virtual Desktop (AVD) is Microsoft's offering that provides a managed virtual desktop environment running in Azure. Traditional VDI environments are usually quite complex with several components that need to be managed, resources are fixed assets and there are various costs associated with hardware and licensing. AVD reduces this burden by offering all the front-end services completely managed by Microsoft at no cost (PaaS), and AVD sessions hosts (VMs) are required to be deployed (IaaS) to host XYZ applications.

There are a number of compelling reasons to choose Azure Virtual Desktop as the VDI of choice. Most notable is the introduction of Windows 10 multi session, which now for the first time allows organisations to provision full desktop versions of Windows 10 for users. This removes the need for single desktop virtual desktop implementations allowing cost savings from resource utilisation and server licensing. Other benefits include:

- Windows 10 multi-session
- Ability to run Windows 7 or Windows 2008 R2 with Extended Security Updates (through Jan 2023) in Azure.
- Azure's security and knowledge in managing a control plane (leveraging their experience from 180 million monthly active users of Office 365)
- Performance benefits particularly for Office 365 applications
- Cost optimisation capabilities and options for reserved instance pricing Azure hybrid use benefits



Work creatively, collaboratively, and securely

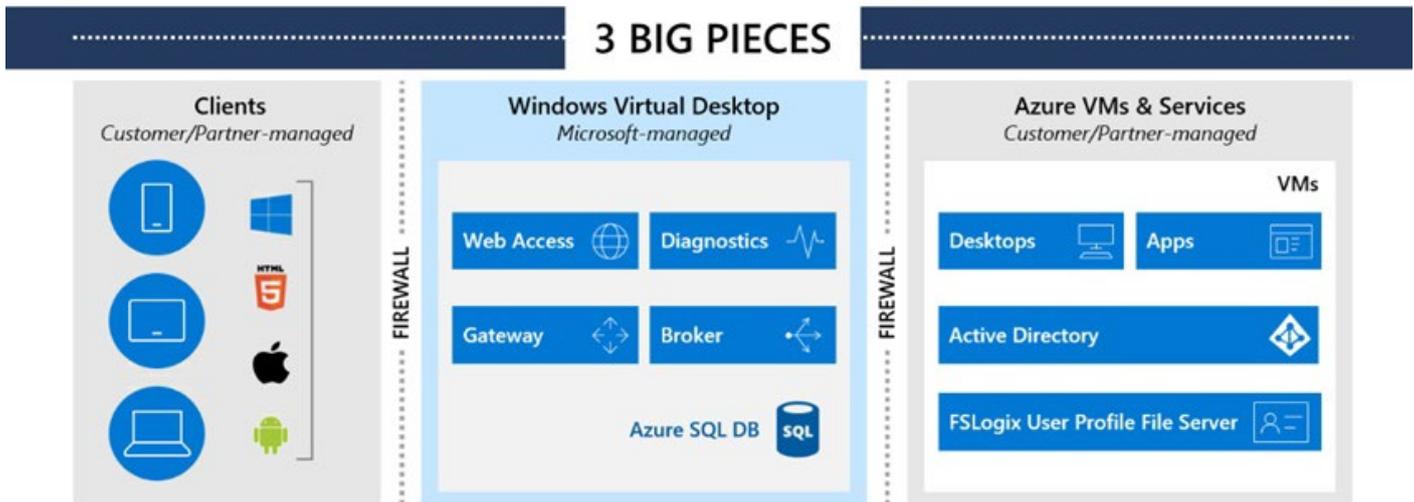


Access to virtual desktops and applications that is easy to manage and provision

4.1.1. AVD Components

Looking at the picture below, AVD is the middle section that is managed and controlled by Microsoft in Azure (PaaS). Clients (Windows, MacOS, HTML5, Android) on the left are managed by your organization. The Azure VMs on the right (IaaS), accessible to users via AVD, are hosted in your Azure subscription along with your user profile/offline caching technology.

WVD Architectural Overview



Elaborating further, below is a list of the core components for consideration when deploying AVD:

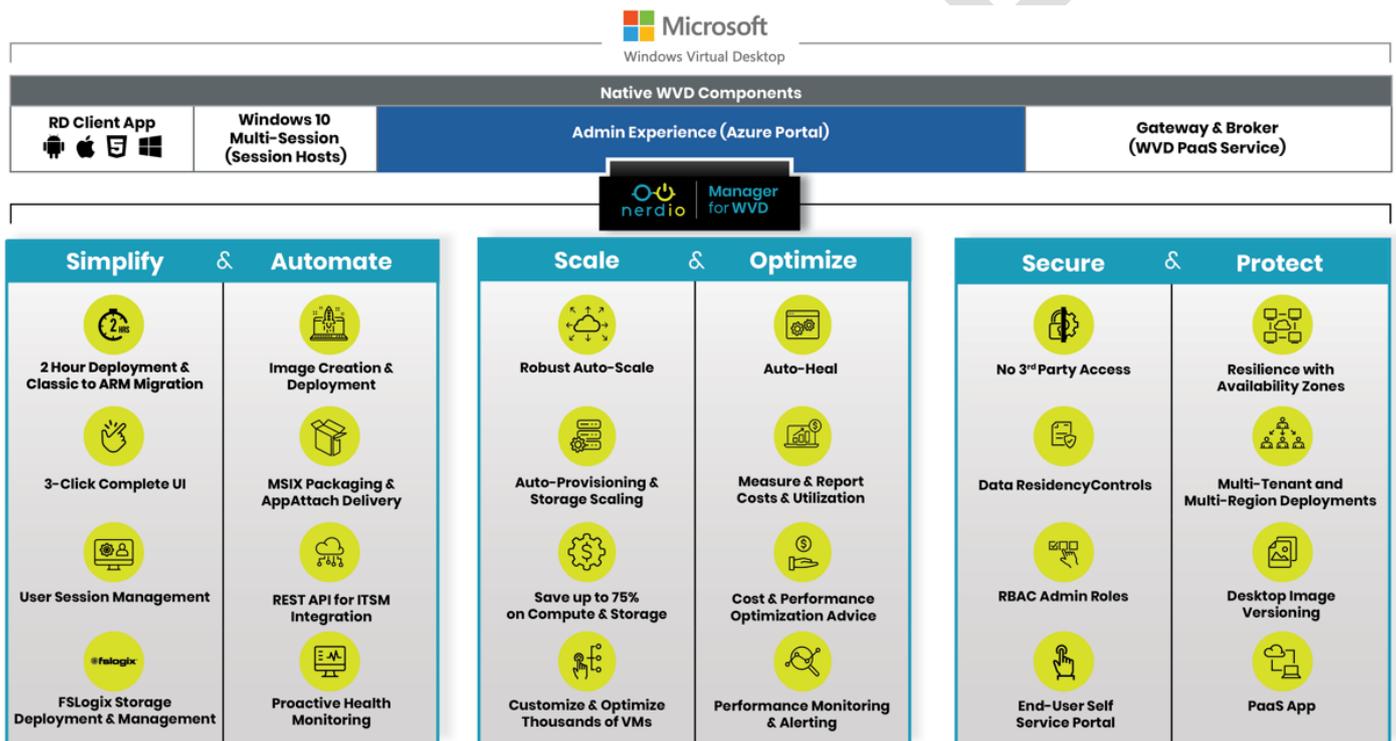
- The AVD services provided by Microsoft are hosted in Azure.
- The AVD components managed by customer, including Session Host pools (Azure VMs), AVD Desktop and Application groups, and RBAC authorisation via AVD roles.
- Azure Active Directory, which is required to authenticate to the AVD/Azure services. Azure AD can also provide additional security benefits such as MFA and Conditional Access.
- An existing instance of Active Directory Domain Services or Azure AD DS services, which is leveraged to host and configure Session Hosts (e.g. via AD Group Policy) and authentication to services hosted on Session Hosts.
- Supporting network connectivity to control access to the AVD environment, including on-premises and Azure networking, e.g. access to AVD Session Hosts and users profile service (e.g. Azure File Shares).
- A user profile location (e.g. Azure File Shares, Azure NetApp Files, File Server), which is roaming profile typically managed by FSLogix.
- A gold image (or images) for the desktops (Session Hosts), including required applications.

4.1.2. Nerdio Manager for AVD

Nerdio Manager for AVD (NMW) is a native, enterprise-grade solution that addresses data residency, compliance, and security. NMW layers on top of Azure AVD to extend and enhance the management capabilities of AVD to suit enterprise scale. The advanced autoscaling provides enhanced availability and reduces Azure consumption spend. The architecture has been specifically designed with the enterprise client in mind. The solution deploys into the client own Azure environment, from the Microsoft marketplace which is a secure deployment method. Once installed the NMW uses PaaS services supplied by XYZ in Azure, it is not a SaaS solution. This means Nerdio has no connection to the solution or environment whatsoever. The only requirement is for a push of licensing data back to Nerdio – this is one way.

cubesys recommends NMW for the anticipated size and scaling complexities. NMW has proved, further numerous client deployments to be a valuable addition to the AVD management plane, allowing for complex automation and reducing overall Azure spend.

The below diagram illustrates where NMW sits in the over AVD environment.



NMW autoscaling is at the core of AVD host pool provisioning and management. NMW provides robust autoscaling and auto-heal features that:

- automatically matches size of infrastructure to real-time user demand with multiple powerful, but easy-to-use auto-scale algorithms. Auto-scaling perform both VM power management and provisions/deletes resources on demand.
- single-user, non-persistent VDI auto-scaling provides each user with their own desktop without permanently assigning a dedicated VM.
- personal, persistent desktops can be powered on when users start their work and powered off automatically when they are done for the day.
- control aggressiveness of auto-scaling to balance cost savings with end-user experience.
- comprehensive auto-scale visualisations to understand and optimise system behaviour. Leverage auto-scale visualisation to understand user behaviour and impact on costs to better match infrastructure size to user demand.

- well-tuned auto-scaling can reduce Azure infrastructure costs up to 75% by shutting down compute or completely removing both compute and storage when not in use.
- Nerdio autoscaling also caters for using 'ephemeral' disks on supported Azure VMs, which are stateless disks. Ephemeral disks are free and high-performance disks (premium SSD), but also have some limitations. For example, instead of powering session host VMs on and off with autoscaling, they have to be provisioned and destroyed, as the OS disk is not persistent. Refer to [Ephemeral OS disks for Azure VMs](#) for more information.
- detect "broken" session hosts and repair them by restarting and/or rebuilding the VM to get it back to a functional state.

NMW monitoring capabilities include:

- collection of data from AVD service and inside of each VM every minute. Data is collected in Azure Log Analytics and can be retained for a configurable amount of time.
- actionable dashboards show users, hosts, and applications utilisation and performance.
- alerting via Azure Monitor can be triggered on any combination of logged events.

NMW can integrate into or control image management and deployment. It provides MSIX packaging and delivery, and a customisable library of scripted actions to facilitate image management and session host deployment.

NMW provides user session management and a user self-service portal. Access is controlled via Azure AD, and overlaid with RBAC defined in NMW.

NMW is licensed based on monthly active users (MAU), allowing for consumption based billing and automatic optimisation of licensing requirements.

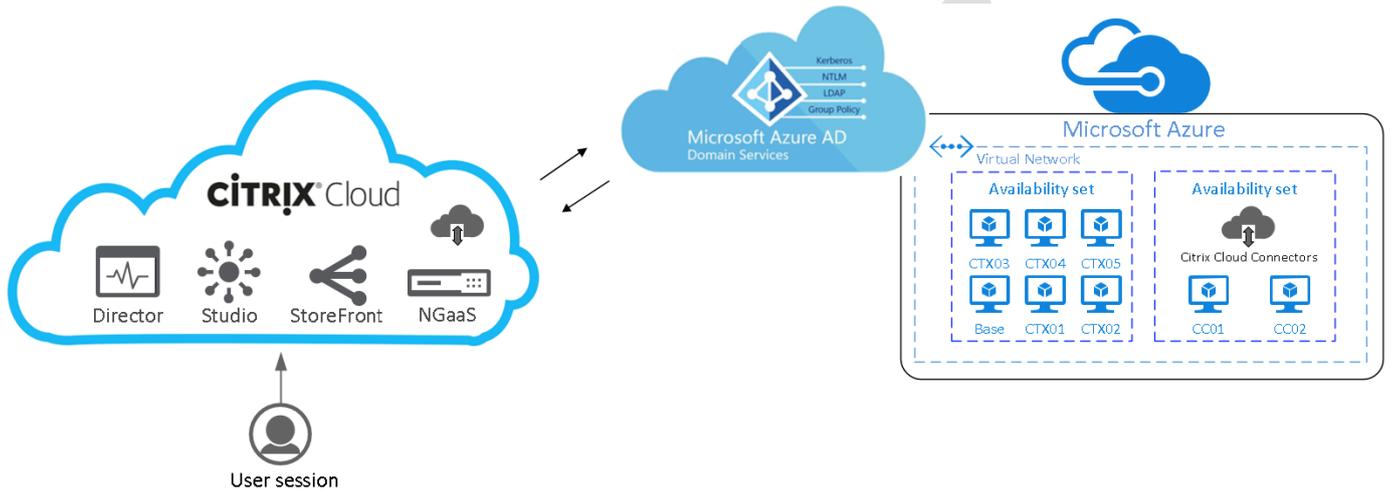
For more information on NMW cost savings, refer to [Appendix B](#).

4.2.Citrix Cloud & AVD

This section provides a high level overview of architecture and deployment model of Citrix Virtual Apps and Desktops services on Microsoft Azure.

The combination of Citrix Cloud and Microsoft Azure makes it possible to spin up new Citrix virtual resources with greater agility and elasticity, adjusting usage as requirements change. Virtual Machines on Azure support all the control and workload components required for a Citrix Virtual Apps and Desktops service deployment. Citrix Cloud and Microsoft Azure have common control plane integrations that establish identity, governance, and security for global operations.

The following diagram provides an architectural overview of Citrix cloud and Azure, AVD.



5. AVD Economic Assessment & Recommendations

This section is organised into the areas of analysis and recommendations listed below that are related to XYZ IT infrastructure, with a focus on AVD and utilising Azure as the foundation for the supporting platform.

This will include:

- Overview of AVD requirements and supporting foundational services.
- AVD Azure consumption estimates

5.1.Solution Recommendation

Recommendation:

Azure native AVD implementation managed by Nerdio Manager for AVD (NMW).

This recommendation is based on best ROI balance of capabilities, cost and features required to achieve the desired XYZ business outcome.

Having analysed the requirements, success criteria and cost base, across (a) Azure native, (b) Azure native + NMW, and Citrix Cloud + Azure AVD, the findings indicate the following:

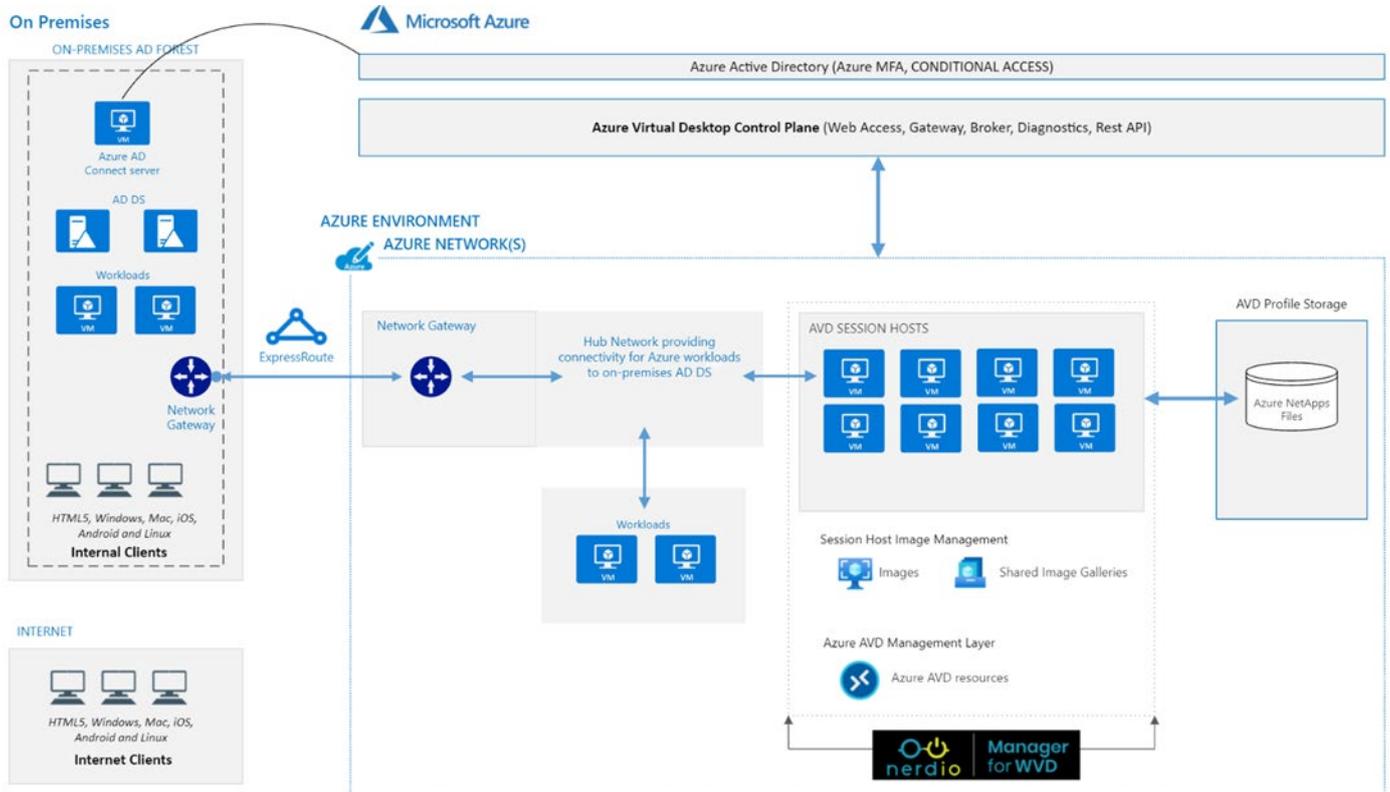
- The complexity and opportunity to reduce cost through automation ruled out (a), a native-only solution stack, due to the complexities of scheduling, usage patterns and workload types. A management tool is needed to achieve the best cost and manageability outcome.
- Both Citrix Cloud and NMW, offer considerable cost savings via optimisation of compute and storage within the Azure platform. These savings are comparable, with negligible difference in the ability to optimise cost consumption.
- The additional capabilities of the Citrix Control plane offered in either the Advanced or Premium editions have not been triggered in the XYZ success criteria.
- The licensing cost of the Citrix Cloud are 2x Advanced and 3x Premium, the cost of Nerdio Manager for AVD.
- Nerdio Manager for AVD licensing is consumption based without a lock-in term. This provides flexibility for XYZ seasonal workers and strategic roadmap. Further enhancing the ROI and lowering the cost base.
- Nerdio Manager for AVD architecture is design to work with the Microsoft AVD solution, rather than replacing it, this simplifies the operational overhead, lowering the management services footprint.

XYZ already have in place all of the main prerequisites required for AVD which would normally require additional planning, effort, and cost to establish. These prerequisites will be discussed in the following sections, but in summary include:

- Hybrid networking has been established between on-premises networks and Azure.
- On-premises Active Directory has been extended to Azure (AD sites containing domain controllers have been implemented in Azure), and AD DS services are available for workloads in Azure.
- Azure network resources are ready to deploy AVD resources into.
- Azure AD Connect is synchronising identities from on-premises AD to Azure AD.
- XYZ have established a mature governance model in Azure.
- Appropriate licensing is already in place for AVD.

5.2.AVD Architecture Blueprint

The below diagram illustrates the main components and traffic flow of the proposed AVD environment.



1. Express Route provides dedicated hybrid connectivity between on-premises and Azure networks.
2. On-premises AD DS has been extended into Azure. Azure VMs and other workloads are able to resolve on-premises AD DS services.
3. Remote clients connect to AVD over the Internet.
4. The public endpoint for AVD provides access to AVD web access, broker and gateway services which are part of the AVD PaaS service.
5. The AVD broker orchestrates a connection (via load-balancing) from the AVD host VM agent to the gateway.
6. The host-pool VMs are able to resolve AD DS services and connect to AD domain resources either located in Azure or on-premises. The host-pool VMs can also connect to the Internet from Azure (rather than routing via on-premises).
7. Nerdio Manager for AVD manages the AVD environment including host pools, images and autoscaling.

5.3.AVD Requirements and Considerations

5.3.1. Active Directory and Azure AD

AVD requires an instance on Active Directory to join the AVD session hosts/desktops to. How Active Directory is integrated into the Azure environment is a major factor contributing to the AVD architecture. The recommended approach is to extend existing on-premises AD to Azure, which XYZ already have in place. This approach provides the best performance and availability of on-premises AD DS services in Azure.

Another requirement is to synchronise on-premises AD identities to Azure AD, which again is already in place. Additionally, Azure AD premium licensing is available via the currently held Microsoft 365 E3 subscriptions, which provides additional security capabilities leveraging Azure MFA and Azure AD Conditional Access. Existing M365 E3 and F3 licensing also satisfies AVD licensing requirements.

AD DS service establishment and Azure AD/AVD licensing, as they are already in place, are not considered in this assessment.

5.3.2. Hybrid Network Connectivity

There are various topologies that can be adopted to achieve this with Azure, however, the most appropriate solution is Azure ExpressRoute. ExpressRoute lets you extend your on-premises networks into the Microsoft Azure cloud over a private connection facilitated by a connectivity provider, offering more reliability, faster speeds, consistent latencies, and higher security than typical connections over the Internet. XYZ already have this in place. Estimated bandwidth usage will be considered in this assessment based on the defined user usage profiles detailed under [Usage Profiles](#).

5.3.3. AVD User Profiles

cubesys recommend using FSLogix managed profile containers for user profiles in a non-persistent AVD environment. FSLogix provides superior performance and tight integration with native apps such as Office and OneDrive.

The underlying storage for user profiles can be deployed via Azure Files, Azure Net Apps Files, Azure Storage, or traditional file shares. Azure Files are generally recommended. Azure Files provide an easily deployed, high performance, scalable solution that integrates with Active Directory (for authentication).

However, especially during the Seasonal period from September to March, when there is increased demand on the AVD environment, and in particular, increased user session concurrency, Azure Net App Files may be a better solution. Azure NetApp Files is a high performance native storage solution in Azure that can provide the necessary IOPS and performance for any storage scenario.

Azure Files and Azure NetApp Files will be considered for user profile storage in this assessment.

During the assessment it was noted that there are some large profiles (50GB and more), these were not common, and the average profile size would be far less. The profile size assumed for storage consumption cost estimates in this assessment is 20GB.

5.3.4. AVD Compute

cubesys will use proprietary tooling, calculators, and their experience to nominate appropriate Azure VM SKU(s) to host AVD multi-session desktops that provide the best performance at optimal cost. This process will also consider existing Citrix compute and sizing gathered during workshops conducted with XYZ.

The cost of running the underlying compute for AVD can also be controlled and reduced by scaling the number of Azure VMs up and down in alignment with daily usage demands. Autoscaling VMs in this sense means shutting down and deallocating the session host VMs (and therefore not incurring Azure consumption costs for compute), and can be actioned in natively managed AVD based on:

- Schedule VMs to start and stop based on peak and off-peak business hours.

- Scale out VMs based on number of sessions per CPU core.
- Scale in VMs during off-peak hours, leaving the minimum number of session host VMs running.

Nerdio Manager for AVD greatly enhances the granularity with which the autoscaling can be controlled, as well as live reporting on predicted consumption costs. This estimate will consider compute costs and how they can be optimised with Nerdio Manager for AVD.

5.3.5. AVD Management

As previously discussed under [Nerdio Manager for AVD](#), NMW greatly extends the management capabilities and control upon Azure Native management capabilities. The assessment will include NMW being used as the management control plane and recommends the monthly active user (MAU) licensing model.

5.4. Azure Pricing Models and Benefits

cubesys will consider the below pricing models in formulating cost consumption estimates. Azure Hybrid Use Benefits will also be applied.

- Pay-As-You-Go (PAYG)
- 1-year reserved instance (1yr RI)
- 3-year reserved instance (3yr RI)

Note:

Reserved Instance pricing can provide a large discount but is calculated based on the Azure VMs being available 24x7, so is generally not used with AVD as autoscaling automation is used to reduce consumption spend.

5.5. Azure Governance

In addition to the Azure foundation services required for AVD, there is also the consideration of establishing proper governance frameworks in Azure. This topic is also referenced as Azure Scaffold. Azure Scaffold is concerned with establishing core foundational elements of Azure, upon which services can be deployed, in an efficiently managed, governed and secure way. This topic is discussed further under [Azure Governance](#).

Note:

Additional effort and costs are required to set up the establishment of Azure governance framework.

5.6.AVD Consumption Estimates

Focusing firstly on the ongoing monthly cost estimate to run a AVD environment in Azure for the XYZ's employees, considering usage profiles and workloads, the main factors that contribute to sizing the environment appropriately (and therefore determining the cost) are:

- The hours of operation. Considering the business hours of 6am-7pm and the time zones involved, from a company-wide perspective, there are 17 business hours/day, or 368 hours/month.
- There are 544 employees across the 3 time zones, with a peak concurrency of 60%.
- During the seasonal (September-March), up to 1000 additional casual employees use the AVD environment, with a peak concurrency of 30%.
- Regardless of the time of year, a peak concurrency of 5% is assumed for non-business hours.

Given the above criteria, the cost estimates will be displayed separately for permanent and casual (Seasonal) employees.

Additionally, with regards to the following estimates, the following should be noted:

- Permanent employee's usage profile was classified as medium and the profile size was assumed to be, on average 20GB. Casual employee usage profile was assumed to be light, and the profile size was assumed to be, on average, 5GB.
- Network bandwidth usage (egress) was estimated to be \$2.50/month for medium usage profiles and \$1.00/month for light usage profiles.

5.6.1. Compute Cost

The below table presents cost estimates focusing on compute to cater for permanent employees and for the additional casual workforce during the seasonal. Because compute will be scaled back after hours by Nerdio Manager for AVD, Reserved Instance pricing models provide no cost benefit in this scenario because of the lower consumption hours (Reserved Instance must use 24x7 consumption hours). Therefore PAYG with autoscaling compute provides the most cost-effective approach. AHUB pricing has also been applied to the costs presented below.

The Dv3 family of Azure VMs have been recommended. This family is the latest generation of general purpose VMs powered by Intel® Xeon® processors and offers an optimal blend of compute and memory. The D4s v3 SKU (4 vCPUs, 16GB RAM) has been recommended. The D8s v3 SKU (8 vCPUs, 32GB RAM) is also an option, but assuming the [usage profiles](#) defined and lack of further benchmarking performance data from the existing Citrix environment, the D4s v3 works out to be more cost effective.

Compute Item	Employees	Casuals (Seasonal)
Azure VM SKU	D4s v3	D4s v3
VM vCPU	4 (4 users per core)	4 (6 users per core)
VM RAM	16	16
Users per VM	16	24
Hours per month / month	368 / 12 months (peak) 360 / 12 months (off-peak)	368 / 6 months (peak) 360 / 12 months (off-peak)
Required off-peak VMs	2	3

Compute Item	Employees	Casuals (Seasonal)
Off-peak VMs cost / month	\$252.63 for 12 months	\$378.95 for 6 months
Required peak VMs	21	13
Peak VMs cost (allowing for 2 Off-Peak VMs)	\$2,652.64 for 12 months	\$1,642.11 for 6 months
Premium SSD OS disk	\$210.00	\$130.00 for 6 months
Total Cost / Month (PAYG /w AHUB)	\$3,115.27 (over 12 months)	\$2,151.06 (over 6 months)

5.6.2. Profile Storage Cost

The below storage costs assume an average profile size of 20GB for permanent employees and 5GB for casual (seasonal) employees.

Storage Item	Employees	Casuals (Seasonal)
Assumed Profile Size	20GB	5GB
Azure NetApp Files (Standard performance tier)	\$2,478.08	\$1,126.40
Azure Files (Standard performance tier)	\$1,111.43	\$554.67
Azure Files (Premium performance tier)	\$3,193.17	\$1,573.51

5.6.3. Network Cost

Network Item	Employees	Casuals (Seasonal)
Estimate usage based on profile	Medium usage profile \$2.50 / user / month	Light usage profile \$1 / user / month
Cost/month	\$1,360.00	\$1000.00

5.6.4. Monitoring Costs

To monitor the AVD environment, logs need to be collected from the Azure VMs and other Azure resources to a Log Analytics workspace. The below cost calculation is based on each VM sending 2GB of data to Log Analytics per month and assuming a retention of data for 31 days (which is the default and free).

Network Item	Costs / month
Logs for permanent VMs (21 VMs)	\$169.68
Logs for casual (Seasonal) VMs (13 VMs)	\$96.30

5.6.5. Total Infrastructure Cost

5.6.5.1. Permanent Employees

The below cost includes user profiles hosted on Azure NetApp Files storage. Given profile sizes, peak user session concurrency and comparative costs with other storage options, cubesys recommend using this option.

Item	Monthly Cost
Compute	
Peak	\$2,652.64
Off-peak	\$252.63
OS Disk	\$210.00
Storage (user profiles)	
Azure NetApp Files (Standard performance tier) Employees	\$2,478.08
Network	
Employee's bandwidth usage	\$1,360.00
Monitoring	
Log Data	\$169.68
Total Monthly Cost	\$7,123.03
Cost per user / month	\$13.09

5.6.5.2. Casual Employees

The below costs would only be incurred during the seasonal from September to March (6 months). The below cost includes user profiles hosted on Azure NetApp Files storage.

Item	Monthly Cost
Compute	
Peak	\$1,642.11
Off-peak	\$378.95
OS Disk	\$130.00
Storage (user profiles)	
Azure NetApp Files (Standard performance tier) Casuals	\$1,126.40
Network	
Casual's bandwidth usage	\$1,000.00
Monitoring	
Log Data	\$96.30
Total Monthly Cost	\$4,373.76
Cost per user / month	\$4.37

5.6.6. Nerdio Manager for AVD Cost

Nerdio Manager for AVD (NMW) is deployed on native Azure PaaS Services. The main Azure resources required for NMW (in terms of consumption cost) are Azure App Service and Azure SQL, the costs for which are illustrated below.

Item	Monthly Cost
Azure App Service (Basic B3 plan)	\$376.86
Azure SQL Database (Standard S1)	\$44.46
Total monthly cost	\$421.32

Nerdio Manager for AVD is charged based on a monthly active users (MAU) model, providing optimal month/month cost control for XYZ.

Item	Monthly Cost
Nerdio Manager for AVD	
MAU license / users	\$4.00
Permanent employees, cost / month (assume 100%)	\$2176.00

Item	Monthly Cost
Casual employees (Seasonal), cost / month (assume 100%)	\$4,000.00

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5.7. Summary Recommendations

Based on the findings and considerations in the preceding section, the recommendations for XYZ's AVD environment are listed below.

- cubesys recommend implementing AVD in Azure managed by Nerdio Manager for AVD. This approach can satisfy the desired requirements, provides flexible capabilities, optimal consumption costs and performance.
- Additionally, the foundational requirements for AVD are already in place which places XYZ in a 'ready' state to adopt AVD service leveraging existing investments. These requirements include hybrid networking between on-premises networks and Azure (Express Route), extending on-premises AD into Azure, appropriate setup of Azure AD, and appropriate licensing.
- Based on the usage and application requirements defined during workshops conducted with XYZ, the most optimal Azure VM SKU to use for AVD session hosts is D4s v3 (4CPUs, 16GB RAM), capable of hosting 16 permanent employees per VM, and 24 casual employees.
- Based on the business hours defined across the time zones provided, VMs can be scaled back and deallocated during non-business hours to minimise compute spend. Cost estimates are based on total users and total business hours.
- Azure hybrid use benefits (AHUB) have been applied which also significantly reduces consumption costs.
- Azure NetApp Files have been recommended for profile storage, which is cheaper than Azure Files (premium tier) and more costly than Azure Files (standard tier). Azure NetApp Files provides the best combination of optimal performance and enterprise capabilities and control.
- cubesys recommend Nerdio Manager for AVD (NMW) to manage the Azure AVD environment. NMW is a cost effective AVD management solution that extends native AVD management capabilities to an enterprise level and provides granular control to minimise Azure consumption spend.
- Additional cost optimisation opportunities will likely be possible with Nerdio Manager for VWD, for example, controlling availability of compute at a more granular level across time zones.
- cubesys recommend establishing Azure governance practices, which are explained in the following section.

Based on the above recommendations, assumptions made, and including AVD Azure infrastructure costs, Nerdio Manager for AVD Azure PaaS and licensing costs, the monthly consumption spend for permanent staff is estimated to be **\$9,720.35 / month, or \$17.86 / user / month.**

Considering the casual employees that are onboarded during the seasonal and including AVD Azure infrastructure costs and Nerdio Manager for AVD licensing costs only, the monthly consumption spend for casual staff is estimated to be **\$8,373.76 / month, or \$8.37 / user / month.**

Item	Monthly Cost
Total Cost Summary	
AVD managed by Nerdio	\$9,720.35
AVD managed by Nerdio (for Seasonal casuals, required for 6 months)	\$8,373.76

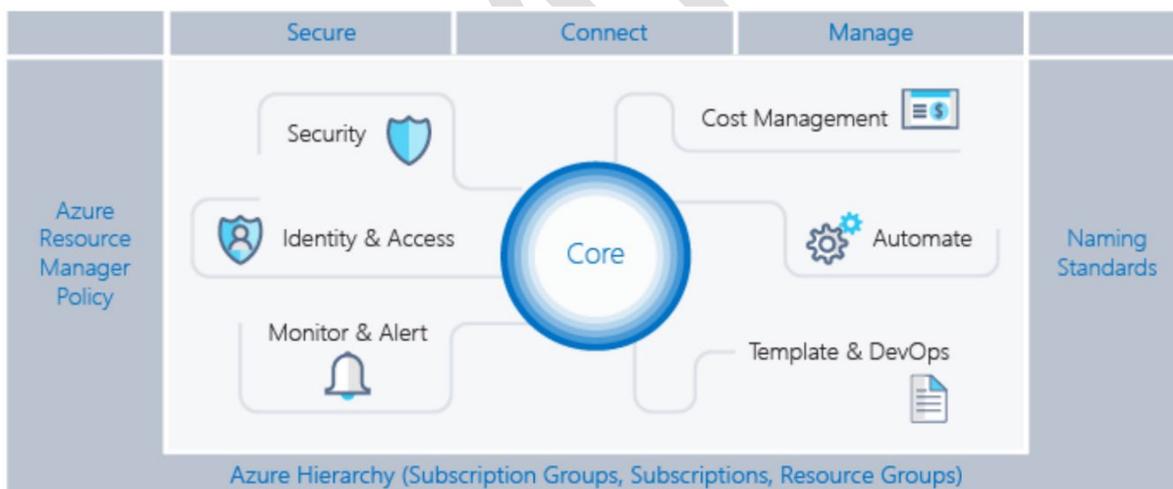
6. Azure Governance

When considering a move to Azure, a best practice approach should address the topic of governance early to ensure the successful use of the cloud within the enterprise. Key to this concept is understanding how an enterprise can effectively use Azure and identify the baseline capabilities that need to be in place to provide a strong governance, security and management foundation whilst also facilitating speed of delivery. Not adopting such an approach can leave an enterprise open to compromise if the Azure resources are not properly managed.

Azure scaffold is defined as a set of flexible controls and Azure capabilities that provide structure to the environment, and anchors for services built on the public cloud. It provides IT and business groups a foundation to create and attach new services keeping speed of delivery in mind. It enables administrators to ensure workloads meet the minimum governance requirements of an organization without preventing business groups and developers from quickly meeting their own goals.

Some of the elements that Azure Scaffold considers overlap with Azure foundational services mentioned already in this report, such as core networking. However, there are other elements more specific to governance which are the focus here. The elements that make up governance in Azure include:

- Subscription hierarchy and resource groups
- Role-based access control (RBAC)
- Naming Standards
- Policies and initiatives
- Resource Tags
- Resource Locks
- Identity and access
- Established Devops practices, i.e. Continuous Integration and Development (CI/CD)

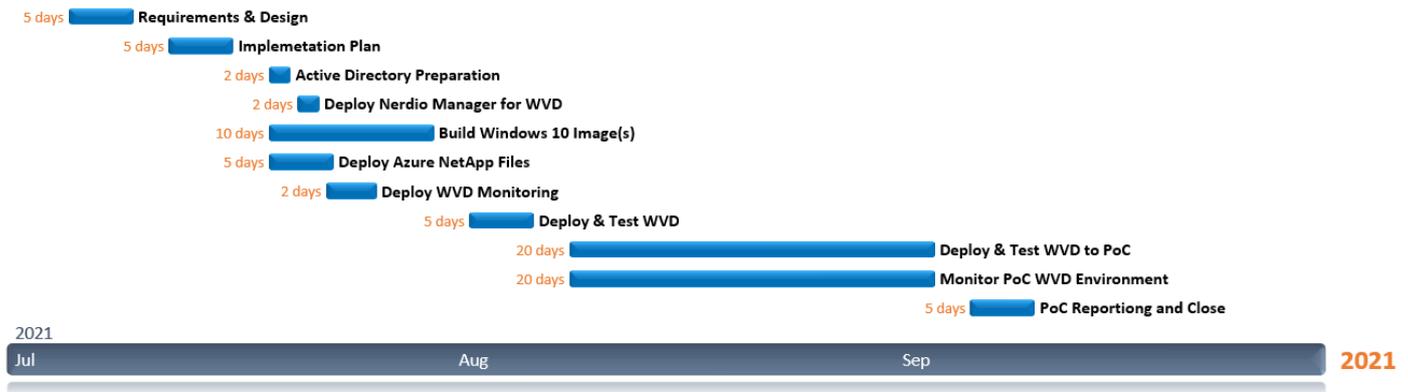


XYZ have an established Azure environment, which during workshops was indicated to have a reasonably mature governance model. For the purposes of this cost estimate, it is assumed that nothing is required here to prepare for the rollout of AVD. However, during the initial phases of the proposed AVD adoption works when requirements and prerequisites are being confirmed, a review of Azure governance is recommended. cubesys provides various services focused on Azure governance areas and Azure Establishment Architecture, which facilitate the appropriate establishment of these scaffold elements in Azure.

7. Adoption Plan

7.1. Implementation of AVD Proof-of-concept

For XYZ to adopt the approach recommendations in this document in an initial proof-of-concept, the below diagram illustrates the main phases and an indicative timeline.



The phases displayed above are explained below.

- **Requirements and Design:** Workshop(s) to confirm scope, AVD design prerequisite requirements, business requirements, as well as review of Azure governance.
- **Implementation plan:** Preparation of Implementation Plan detailing all requirements and design decisions.
- **Prepare AD:** Preparation of on-premises AD environment, including such items as group policy, OU structure, service accounts, AD groups and permissions.
- **Deploy Nerdio Manager for AVD:** Implementation and configuration of Nerdio Manager for AVD (NMW). This would include tailoring NMW autoscaling configuration to minimise Azure consumption costs.
- **Build Windows 10 image(s):** Build of Windows 10 multisession image with required applications and configurations.
- **Deployment of Azure NetApp Files:** Deployment of Azure NetApp Files and configuration of file shares.
- **Deploy monitoring:** Deployment of Azure and Sepago monitoring for the AVD environment.
- **Deploy and test AVD:** Initial deployment of AVD hostpool for limited IT/testing group and cubesys. Testing of the environment will be carried out to defined objectives and to the general [success criteria](#) defined in the next section.
- **Deploy AVD to PoC group:** Increase AVD hostpool capacity as appropriate to accommodate PoC users.
- **Monitor AVD environment:** Monitor AVD usage, performance, and issues. Include further PoC validation by checking against defined [success criteria](#). This phase would include meetings or workshops to address any issues and remediation.
- **PoC Reporting and close:** Produce report confirming successful proof-of-concept, including actual PoC and projected consumption costs, and define next steps to full production deployment.

Note:

The above timeline assumes that all existing identity and networking requirements for AVD are in place. The above timeline is indicative only and used to present a timeline for a high-level understanding of the phases and approximate time involved.

7.2.Success Criteria

During workshops and data provided by XYZ, the following areas of success have been highlighted. Further, the areas have been weighted for importance when considering architecture, deployment, management tools and overall solution design.

Identified Area of Success	Priority
Logon/Access/Functionality	7
MFA/Conditional Access	6
App functionality	2
Performance	4
Cost	1
Support / Monitoring & diagnosis	8
Operational Management	9
Autoscaling working / cost optimisation	5
User Experience	3

Appendices

Appendix A – Questionnaire Data

Current Environment Stats:	No.
Numbers of users:	595
Number of concurrent users (max)	300
Hours of operation	
9-5 core business	This covers NZ/AU time zones. Also 50 users in WA so consider that time zone also. 6am to 7pm
5-10 extended hours	none
Overnight	Scale back to 5-10% overnight and prestage 40% in morning or something similar
Morning Start	6am NZ/AU
Minimum viable footprint out of hours, user count	N/A
Will Teams or other video collaboration tools be used ?	Yes Teams
Users profile type (resource usage) Workload type definitions can be found here.	
Light	Numbers of users we have AUS(700)/NZ(8 sites, Agtech/SAP 75) timezones covered. Core Hours 6am-7am. Jan-Sep 50%, maybe 60% concurrency of total users West Coast WA, 50 users, AgTech and EpiCore SAP 535 concurrent users icensing Logon/active times,
Medium	Desktop and Remote App users
Heavy	[Heavy]
Power	[Power]
Application Type \ volume:	
Legacy	No specific excessive CPU/RAM requirements for Apps that are included
Web	[Web]
Standard SOE	[Standard SOE]
LoB Apps	[LoB Apps]
Desktop usage	
Number images (SOE equivalent\Gold Image)	2 images for version of OS ... PVS used and aim for one image "A" - 4 versions NOT tested in Win10. All of the rest have been packaged and tested on Win10 Want to explore Windows 10 multi sessions
Personal Desktop ?	No
Published Apps requirement	
No. of Apps	See Spreadsheet
Platform Requirements \ Security	
DR\HA Requirement	Unlikely to need another region

MFA & Conditional access	Used for Office workers only, not frontline workers - Microsoft
AV protection used	Currently Symantec, CrowdStrike is planned for deployment soon
Licensing Position	
Current licensing RDS Cals?	Not Known
Current licensing Windows 10	M365E3, Casuals consume F3, F1s not required, E3 and F3 used ... F1 too but not for Citrix users
Other VDI Licensing (Citrix\VMWare)	Citrix cloud 595 users
Current Azure Environment Readiness:	
ExpressRoute	Yes
DC access	Yes, DC's there and sites & services
Landing Zones readiness (Governance)	Yes. Ready to provide cubesys with AVD Resource Group
Any restrictions on the use of Azure	n/a

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Appendix B – Nerdio Cost Savings

Cost Reduction Strategies For  Azure Virtual Desktop						
	AZURE COMPONENT COSTS			Monthly Total	Per-User Cost	% Savings
	Compute (VMs)	OS Disks (Storage)	FSLogix (Storage)			
Unoptimized	\$4,038	\$215	\$737	\$4,991	\$25.99	N/A
#1: VM Power Management	\$1,202	\$215	\$737	\$2,154	\$11.22	57%
#2: Just-in-time Provisioning (50% Burst)	\$1,202	\$140	\$737	\$2,079	\$10.83	58%
#3: 3-year Reserved Instances	\$457	\$140	\$737	\$1,333	\$6.94	73%
#4: OS Disks Auto-scale	\$457	\$89	\$737	\$1,283	\$6.68	74%
#5: OS Disks Shrink to 64 GB	\$457	\$46	\$737	\$1,240	\$6.46	75%
#6: FSLogix Shrink by 50%	\$457	\$46	\$369	\$871	\$4.54	83%
Assumptions <ul style="list-style-type: none"> • Number of users: 192 • User type: Heavy (2 users per vCPU) • Session host VM size: DBs_v4 • OS disk: P10 (128 GB Premium SSD) • FSLogix profile size: 20 GB • FSLogix storage: Azure Files Premium • Hours in work week: 50 • Azure list pricing: South Central US 				TOTAL SAVINGS		83%

6 Cost Reduction Strategies For Azure Virtual Desktop
